Department of the Interior
Talking Points Concerning Real ID Act Waiver
Invoked by Secretary Michael Chertoff
Department of Homeland Security
Thursday, March 27, 2008

<u>Background</u>

- The Department of the Interior (DOI), through its constituent bureaus, administers a diversity of uniquely beautiful and environmentally sensitive lands along our Nation's Southwest border.
- Over the past several years, the natural and cultural resources located on these lands have been adversely affected by illegal cross-border flow of people
- The safety of both visitors and employees of DOI lands have been significantly compromised by illegal immigration and drug trafficking. A National Park Service ranger, Kris Eggle, was murdered by a Mexican drug dealer in 2002.
- DOI supports the need for DHS to improve the security of our Nation along the border.
- DOI believes that improved border infrastructure will enhance the safety of DOI visitors and employees and will help reverse the adverse environmental and cultural resources effects of illegal cross-border activities.
- DOI has made it a top priority to work cooperatively with DHS in addressing the border security issues.
- It is in DOI's best interests to assist DHS in constructing border security infrastructure in a manner that avoids or minimizes the effects of these facilities upon the natural and cultural resources of the area.

<u>Cooperative Efforts to Date</u>

- Enhanced coordination at field and national levels, i.e. sector leaders and national borderland coordinator.
- Improved process for resolving challenging and difficult issues with DHS.
- Successful resolution of some issues, i.e. Buenos Aires NWR exchange; Columbus, NM cultural resource damage.
- FWS/DHS collaboration on a streamlined consultation process for Endangered Species Act.
- FWS delivery of at least two final biological opinions and expected delivery of several draft biological opinions.
- Productive discussions concerning a comprehensive mitigation approach for addressing impacts occurring from border infrastructure.
- DHS/DOI (FWS) agreement on a mitigation package for impacts to the Sonoran pronghorn on Cabeza Prieta NWR valued at over $800,000.
- DHS/DOI (NPS and FWS) agreement on a mitigation package for impacts to the long-nosed bat and associated habitats on Organ Pipe Cactus National Monument valued at over $960,000.

Challenges Encountered

- The construction of nearly 700 miles of border security infrastructure in a compressed time frame is a significant challenge for all involved, including DHS and DOI employees.
- A project of this magnitude necessitates an array of moving parts and players that are often out of sync with one another, despite best intentions of all.
- Effective communication and coordination within and between DHS and DOI have been and will continue to be very challenging.
- DOI field managers have not always found it easy to communicate, negotiate, and work with DHS on these issues. Given DHS's extremely compressed time frame, their myriad of contractors, and the multitude of issues, it has been challenging for our field managers to represent the interests of their organizations.
- In many cases, the infrastructure was modified to accommodate DOI field manager concerns. In other cases, DHS determined that border security needs were paramount, which prevented them from accepting DOI recommended modifications to the infrastructure.

Benefits of Working Collaboratively

- DHS and DOI at the headquarters level have forged a strong relationship and an equal desire to work through border security and related natural and cultural resources issues in a collaborative fashion.
- DHS accepts their environmental stewardship responsibility and their responsibility for avoiding damage to cultural resource sites.
- Through productive discussions with DOI representative, DHS has committed to funding mitigation projects for threatened and endangered species valued up to $50 million.
- DHS has committed to repairing damage to cultural resource sites that previously occurred and to avoiding damage to other sites as construction continues.
- The need for DHS and DOI to develop productive relationships at all levels will extend far beyond the construction phase of this project.

A New Paradigm – Environmental and Cultural Resource Issues after Waiver

- Following the waivers, DHS and DOI will redefine their processes for addressing the construction of border security infrastructure in a manner that minimizes impacts to both natural and cultural resources.
- DHS will continue to address environmental issues through the use of a newly developed "environmental planning documents" for each border patrol sector. Existing draft NEPA documents will be used for the development of these analyses.
- To enhance coordination and communication, DHS and DOI will jointly develop "site design plans" for each component of the border security infrastructure that overlays DOI interests.

- Among other important components, infrastructure location, design, and construction time table will be identified in the plan. In addition, all measures designed to avoid, minimize, or compensate for the adverse impacts of this infrastructure upon DOI lands and interests will be included in this plan.

Memorandum of Understanding
Among
U. S. Department of Homeland Security
and
U. S. Department of the Interior
and
U. S. Department of Agriculture
Regarding
Cooperative National Security and Counterterrorism Efforts on Federal Lands along the United States' Borders

I. Purpose and Scope

A. This Memorandum of Understanding (MOU) is made and entered into by the Department of Homeland Security (DHS), including and on behalf of its constituent bureau U.S. Customs and Border Protection (CBP) and the CBP Office of Border Patrol (CBP-BP); the Department of the Interior (DOI), including and on behalf of its constituent bureaus, the National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), and the Bureau of Reclamation (BOR); and the Department of Agriculture (USDA), including and on behalf of its constituent agency the U.S. Forest Service (USFS). Throughout this MOU, these three Departments, including their constituent agencies, may be referred to as "the Parties." Any reference to a bureau, agency, or constituent component of a Party shall not be deemed to exclude application to any appropriate bureau or constituent component of that Party. DHS recognizes that the BIA enters into this agreement only on its own behalf and not on behalf of any Indian tribe.

B. The geographic and jurisdictional scope of this MOU is nationwide. The Parties recognize the national security and counterterrorism significance of preventing illegal entry into the United States by cross-border violators (CBVs), including but not limited to the following: drug and human smugglers and smuggling organizations, foreign nationals, and terrorists and terrorist organizations. The Parties further recognize that damage to DOI and USDA-managed lands and natural and cultural resources is often a significant consequence of such illegal entry. The Parties are committed to preventing illegal entry into the United States, protecting Federal lands and natural and cultural resources, and - where possible - preventing adverse impacts associated with illegal entry by CBVs.

C. This MOU is intended to provide consistent goals, principles, and guidance related to border security, such as law enforcement operations; tactical infrastructure installation; utilization of roads; minimization and/or prevention of significant impact on or impairment of natural and cultural resources; implementation of the Wilderness Act, Endangered Species Act, and other related environmental law, regulation, and policy across land management agencies; and provide for coordination and sharing information on threat assessments and other risks, plans for infrastructure and technology improvements on Federal lands, and operational and law enforcement staffing changes. This MOU provides guidance in the development of individual agreements, where appropriate, between CBP and land management agencies to further the provisions contained herein.

D. This MOU is entered into pursuant to the governing statutory authorities of each of the Parties.

E. The Parties acknowledge that CBP operation and construction within the sixty-foot "Roosevelt Reservation" of May 27, 1907 (along the US-Mexico border) and the sixty-foot "Taft Reservation" of May 3, 1912 (along the US-Canada border) is consistent with the purpose of those reservations and that any CBP activity (including, but not limited to, operations and construction) within the sixty-foot reservations is outside the oversight or control of Federal land managers.

F. This MOU supersedes any conflicting provision of any prior MOU or Memorandum of Agreement between the Parties or their subordinate bureaus or components.

II. Background

A. DHS, through its constituent bureaus (including CBP and its CBP-BP), is statutorily mandated to control and guard the Nation's borders and boundaries, including the entirety of the northern and southern land and water borders of the United States.

B. DOI and USDA, through their constituent bureaus, are statutorily charged as managers of Federal lands throughout the United States, including DOI and USDA lands in the vicinity of international borders that are administered as wilderness areas, conservation areas, national forests, wildlife refuges, units/irrigation projects of the Bureau of Reclamation, and/or units of the national park system. Tribal governments have primary management roles over tribal lands; however, the United States, through the BIA, may also have a stewardship or law enforcement responsibility over these lands. Many of these Federal and tribal lands contain natural and cultural resources that are being degraded by activities related to illegal cross-border movements.

C. The volume of CBVs can and has, in certain areas, overwhelmed the law enforcement and administrative resources of Federal land managers. In order to more effectively protect national security, respond to terrorist threats, safeguard human life, and stop the degradation of the natural and cultural resources on those lands, DOI and USDA land managers will work cooperatively with CBP to benefit from the enforcement presence, terrorist and CBV interdiction, and rescue operations of CBP.

III. Common Findings and Affirmation of the Parties

A. The Parties to this MOU recognize that CBP-BP access to Federal lands can facilitate rescue of CBVs on Federal lands, protect those lands from environmental damage, have a role in protecting the wilderness and cultural values and wildlife resources of these lands, and is necessary for the security of the United States. Accordingly, the Parties understand that CBP-BP, consistent with applicable Federal laws and regulations, may access public lands and waterways, including access for purposes of tracking, surveillance, interdiction, establishment of observation points, and installation of remote detection systems.

B. The Parties recognize that DOI and USDA have responsibility for enforcing Federal laws relating to land management, resource protection, and other such functions on Federal lands under their jurisdiction.

IV. Responsibilities and Terms of Agreement

A. The Parties Agree to the Following Common Goals, Policies, and Principles:

1. The Parties enter into this MOU in a cooperative spirit with the goals of securing the borders of the United States, addressing emergencies involving human health and safety, and preventing or minimizing environmental damage arising from CBV illegal entry on public lands;

2. The Parties will strive to both resolve conflicts at and delegate resolution authority to the lowest field operational level possible while applying the principles of this MOU in such manner as will be consistent with the spirit and intent of this MOU;

3. The Parties will develop and consistently utilize an efficient communication protocol respecting the chain of command for each of the Parties that will result in the consistent application of the goals, policies, and principles articulated in this MOU, and provide a mechanism that will, if necessary, facilitate the resolution of any conflicts among the Parties. If resolution of conflict does not occur at the local level, then the issue will be elevated first to the regional/sector office; if not resolved at the regional/sector level, then the issue will be elevated to the headquarters level for resolution;

4. The Parties will cooperate with each other to complete, in an expedited manner, all compliance that is required by applicable Federal laws not otherwise waived in furtherance of this MOU. If such activities are authorized by a local agreement as described in sub-article IV.B below, then the DOI, USDA, and CBP will complete the required compliance before executing the agreement;

5. The Parties will cooperate with each other to identify methods, routes, and locations for CBP-BP operations that will minimize impacts to natural, cultural, and wilderness resources resulting from CBP-BP operations while facilitating needed CBP-BP access;

6. The Parties will, as necessary, plan and conduct joint local law enforcement operations consistent with all Parties' legal authorities;

7. The Parties will establish a framework by which threat assessments and other intelligence information may be exchanged, including intelligence training to be conducted by all parties so that the intelligence requirements of each may be identified and facilitated;

8. The Parties will establish forums and meet as needed at the local, regional, and national levels to facilitate working relationships and communication between all Parties;

9. The Parties will develop and share joint operational strategies at the local, regional, and national levels, including joint requests for infrastructure and other shared areas of responsibility;

10. The Parties will share the cost of environmental and cultural awareness training unless otherwise agreed; and

11. The Parties will, as appropriate, enter into specific reimbursable agreements pursuant to the Economy Act, 31 U.S.C. §1535 when one party is to furnish materials or perform work or provide a service on behalf of another party.

B. Responsibilities and Terms Specific to DOI and USDA. The DOI and the USDA hereby recognize that, pursuant to applicable law, CBP-BP is authorized to access the Federal lands under DOI and USDA administrative jurisdiction, including areas designated by Congress as wilderness, recommended as wilderness, and/or wilderness study areas, and will do so in accordance with the following conditions and existing authorities:

1. CBP-BP agents on foot or on horseback may patrol, or pursue, or apprehend suspected CBVs off-road at any time on any Federal lands administered by the Parties;

2. CBP-BP may operate motor vehicles on existing public and administrative roads and/or trails and in areas previously designated by the land management agency for off-road vehicle use at any time, provided that such use is consistent with presently authorized public or administrative use. At CBP-BP's request, the DOI and the USDA will provide CBP-BP with keys, combinations, or other means necessary to

4. Nothing in this MOU is intended to prevent CBP-BP agents from exercising existing exigent/emergency authorities to access lands, including authority to conduct motorized off-road pursuit of suspected CBVs at any time, including in areas designated or recommended as wilderness, or in wilderness study areas when, in their professional judgment based on articulated facts, there is a specific exigency/emergency involving human life, health, safety of persons within the area, or posing a threat to national security, and they conclude that such motorized off-road pursuit is reasonably expected to result in the apprehension of the suspected CBVs. Articulated facts include, but are not limited to, visual observation; information received from a remote sensor, video camera, scope, or other technological source; fresh "sign" or other physical indication; canine alert; or classified or unclassified intelligence. For each such motorized off-road pursuit, CBP-BP will use the least intrusive or damaging motorized vehicle readily available, without compromising agent or officer safety. In accordance with paragraph IV.C.4, as soon as practicable after each such motorized off-road pursuit, CBP-BP will provide the local Federal land manager with a brief report;

5. If motorized pursuits in wilderness areas, areas recommended for wilderness designation, wilderness study areas, or off-road in an area not designated for such use are causing significant impact on the resources, or if other significant issues warrant consultation, then the Federal land manager and the CBP-BP will immediately meet to resolve the issues subject to paragraphs IV.A.2 and IV.A.3 of this MOU;

6. CBP may request, in writing, that the land management agency authorize installation or construction of tactical infrastructure for detection of CBVs (including, but not limited to, observation points, remote video surveillance systems, motion sensors, vehicle barriers, fences, roads, and detection devices) on land under the local land management agency's administrative jurisdiction. In areas not designated as wilderness, the local Federal land manager will expeditiously authorize CBP to install such infrastructure subject to such terms and conditions that are mutually developed and articulated in the authorization issued by the land management agency. In areas designated or managed as wilderness, the local Federal land manager, in consultation with CBP, will promptly conduct a "minimum requirement," "minimum tool," or other appropriate analysis. If supported by such analysis, the local Federal land manager will expeditiously authorize CBP to install such infrastructure subject to such terms and conditions that are mutually developed and articulated in the authorization issued by the land management agency;

7. The DOI and USDA will provide CBP-BP agents with appropriate environmental and cultural awareness training formatted to meet CBP-BP operational constraints. The DOI and USDA will work with CBP-BP in the development and production of maps for use or reference by CBP-BP agents including, as appropriate, site-specific and resource-specific maps that will identify specific wildlife and environmentally or culturally sensitive areas;

8. The DOI and USDA will, as applicable, provide CBP-BP with all assessments and studies done by or on behalf of DOI or USDA on the effects of CBVs on Federal lands and native species to better analyze the value of preventative enforcement actions;

9. The DOI and USDA will assist CBP-BP in search and rescue operations on lands within the respective land managers' administration when requested;

10. The CBP-BP and land management agencies may cross-deputize or cross-designate their agents as law enforcement officers under each other agency's statutory authority. Such cross-deputation or cross-designation agreements entered into by the local land management agency and the field operations manager for the CBP-BP shall be pursuant to the policies and procedures of each agency; and

11. DOI and USDA will work at the field operations level with affected local CBP-BP stations to establish protocols for notifying CBP-BP agents when DOI or USDA law enforcement personnel are conducting law enforcement operations in an area where CBP-BP and DOI/USDA operations can or will overlap.

C. Responsibilities and Terms Specific to the CBP. DHS hereby agrees as follows:

1. Consistent with the Border Patrol Strategic Plan, CBP-BP will strive to interdict CBVs as close to the United States' international borders as is operationally practical, with the long-term goal of establishing operational control along the immediate borders;

2. If the CBP-BP drag any unpaved roads for the purpose of cutting sign under provision IV.B.2 above, then CBP-BP will maintain or repair such roads to the extent that they are damaged by CBP-BP's use or activities;

3. If CBP-BP agents pursue or apprehend suspected CBVs in wilderness areas or off-road in an area not designated for such use under

paragraph IV.B.5, then the CBP-BP will use the lowest impact mode of travel practicable to accomplish its mission and operate all motorized vehicles in such a manner as will minimize the adverse impacts on threatened or endangered species and on the resources and values of the particular Federal lands, provided officer safety is not compromised by the type of conveyance selected;

4. CBP-BP will notify the local Federal land manager of any motorized emergency pursuit, apprehension, or incursion in a wilderness area or off-road in an area not designated for such use as soon as is practicable. A verbal report is sufficient unless either CBP-BP or the land managing agency determines that significant impacts resulted, in which case a written report will be necessary;

5. If motorized pursuits in wilderness areas, areas recommended for wilderness designation, wilderness study areas, or off-road in an area not designated for such use are causing significant impact on the resources as determined by a land manager, or if other significant issues warrant consultation, then the CBP-BP and Federal land manager will immediately meet to resolve the issues subject to paragraphs IV.A.2 and IV.A.3 of this MOU;

6. CBP will consult with land managers to coordinate the placement and maintenance of tactical infrastructure, permanent and temporary video, seismic and other remote sensing sites in order to limit resource damage while maintaining operational efficiency;

7. CBP-BP will ensure that current and incoming CBP-BP agents attend environmental and cultural awareness training to be provided by the land management agencies;

8. CBP-BP will provide land management agencies with appropriate and relevant releasable statistics of monthly CBV apprehensions, search and rescue actions, casualties, vehicles seized, drug seizures and arrests, weapons seizures and arrests, and other significant statistics regarding occurrences on the lands managed by the land manager;

9. CBP-BP will consult with land managers in the development of CBP-BP's annual Operational-Requirements Based Budgeting Program to ensure affected land managers can provide input and are, in the early stages of planning, made aware what personnel, infrastructure, and technology the CBP-BP would like to deploy along the border within their area of operation; and

10. CBP-BP will work at the field operations manager level with affected local land management agencies to establish protocols for notifying

land management agency law enforcement officers when BP is conducting special operations or non-routine activities in a particular area.

V. Miscellaneous Provisions

A. Nothing in this MOU may be construed to obligate the agencies or the United States to any current or future expenditure of funds in advance of the availability of appropriations, nor does this MOU obligate the agencies or the United States to spend funds for any particular project or purpose, even if funds are available.

B. Nothing in this MOU will be construed as affecting the authority of the Parties in carrying out their statutory responsibilities.

C. This MOU may be modified or amended in writing upon consent of all Parties, and other affected Federal agencies may seek to become a Party to this MOU.

D. The Parties shall retain all applicable legal responsibility for their respective personnel working pursuant to this MOU with respect to, *inter alia*, pay, personnel benefits, injuries, accidents, losses, damages, and civil liability. This MOU is not intended to change in any way the individual employee status or the liability or responsibility of any Party under Federal law.

E. The Parties agree to participate in this MOU until its termination. Any Party wishing to terminate its participation in this MOU shall provide sixty (60) days written notice to all other Parties.

F. This document is an intra-governmental agreement among the Parties and does not create or confer any rights, privileges, or benefits upon any person, party, or entity. This MOU is not and shall not be construed as a rule or regulation.

In witness whereof, the Parties hereto have caused this Memorandum of Understanding to be executed and effective as of the date of the last signature below.

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Date: 3/24/06 __________________________________

Secretary of Homeland Security

Date: 3/31/06 Gale A Norton

Secretary of the Interior

Date: 3/29/06 __________________________________

Secretary of Agriculture

IIB

109TH CONGRESS
1ST SESSION

H. R. 418

IN THE SENATE OF THE UNITED STATES

FEBRUARY 14, 2005

Received

FEBRUARY 17, 2005

Read twice and referred to the Committee on the Judiciary

AN ACT

To establish and rapidly implement regulations for State driver's license and identification document security standards, to prevent terrorists from abusing the asylum laws of the United States, to unify terrorism-related grounds for inadmissibility and removal, and to ensure expeditious construction of the San Diego border fence.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "REAL ID Act of 2005".

TITLE I—AMENDMENTS TO FEDERAL LAWS TO PROTECT AGAINST TERRORIST ENTRY

SEC. 101. PREVENTING TERRORISTS FROM OBTAINING RELIEF FROM REMOVAL.

(a) CONDITIONS FOR GRANTING ASYLUM.—Section 208(b)(1) of the Immigration and Nationality Act (8 U.S.C. 1158(b)(1)) is amended—

(1) by striking "The Attorney General" the first place such term appears and inserting the following:

"(A) ELIGIBILITY.—The Secretary of Homeland Security or the Attorney General";

(2) by striking "the Attorney General" the second and third places such term appears and inserting "the Secretary of Homeland Security or the Attorney General"; and

(3) by adding at the end the following:

"(B) BURDEN OF PROOF.—

"(i) IN GENERAL.—The burden of proof is on the applicant to establish that the applicant is a refugee, within the meaning of section 101(a)(42)(A). To establish that the applicant is a refugee within the meaning of such section, the applicant must establish that race, religion, nationality, membership in a particular social group, or political opinion was or will be a central reason for persecuting the applicant.

"(ii) SUSTAINING BURDEN.—The testimony of the applicant may be sufficient to sustain the applicant's burden without corroboration, but only if the applicant satisfies the trier of fact that the applicant's testimony is credible, is persuasive, and refers to specific facts sufficient to demonstrate that the applicant is a refugee. In determining whether the applicant has met the applicant's burden, the trier of fact may weigh the credible testimony along with other evidence of record. Where the trier of fact determines, in the trier of fact's discretion, that the applicant should provide evidence which corroborates otherwise credible testimony, such evidence must be provided unless the applicant does not have the evidence and cannot reasonably obtain the evidence without departing the United States. The inability to obtain corroborating evidence does not excuse the applicant from meeting the applicant's burden of proof.

"(iii) CREDIBILITY DETERMINATION.—The trier of fact should consider all relevant factors and may, in the trier of fact's discretion, base the trier of fact's credibility determination on any such factor, including the demeanor, candor, or responsiveness of the applicant or witness, the inherent plausibility of the applicant's or witness's account, the consistency between the applicant's or witness's written and oral statements (whenever made and whether or not made under oath), the internal consistency of each such statement, the consistency of such statements with other evidence of record (including the reports of the Department of State on country conditions), and any inaccuracies or falsehoods in such statements, without regard to whether an inconsistency, inaccuracy, or falsehood goes to the heart of the applicant's claim. There is no presumption of credibility.''.

(b) WITHHOLDING OF REMOVAL.—Section 241(b)(3) of the Immigration and Nationality Act (8 U.S.C. 1231(b)(3)) is amended by adding at the end the following:

"(C) SUSTAINING BURDEN OF PROOF; CREDIBILITY DETERMINATIONS.—In determining whether an alien has demonstrated that the alien's life or freedom would be threatened for a reason described in subparagraph (A), the trier of fact shall determine whether the alien has sustained the alien's burden of proof, and shall make credibility determinations, in the manner described in clauses (ii) and (iii) of section 208(b)(1)(B).''.

(c) OTHER REQUESTS FOR RELIEF FROM REMOVAL.—Section 240(c) of the Immigration and Nationality Act (8 U.S.C. 1230(c)) is amended—

(1) by redesignating paragraphs (4), (5), and (6) as paragraphs (5), (6), and (7), respectively; and

(2) by inserting after paragraph (3) the following:

"(4) APPLICATIONS FOR RELIEF FROM REMOVAL.—

"(A) IN GENERAL.—An alien applying for relief or protection from removal has the burden of proof to establish that the alien—

"(i) satisfies the applicable eligibility requirements; and

"(ii) with respect to any form of relief that is granted in the exercise of discretion, that the alien merits a favorable exercise of discretion.

"(B) SUSTAINING BURDEN.—The applicant must comply with the applicable requirements to submit information or documentation in support of the applicant's application for relief or protection as provided by law or by regulation or in the instructions for the application form. In evaluating the testimony of the applicant or other witness in support of the application, the immigration judge will determine whether or not the testimony is credible, is persuasive, and refers to specific facts sufficient to demonstrate that the applicant has satisfied the applicant's burden of proof. In determining whether the applicant has met such burden, the immigration judge shall weigh the credible testimony along with other evidence of record. Where the immigration judge determines in the judge's discretion that the applicant should provide evidence which corroborates otherwise credible testimony, such evidence must be provided unless the applicant demonstrates that the applicant does not have the evidence and cannot reasonably obtain the evidence without departing from the United States. The inability to obtain corroborating evidence does not excuse the applicant from meeting the burden of proof.

"(C) CREDIBILITY DETERMINATION.—The immigration judge should consider all relevant factors and may, in the judge's discretion, base the judge's credibility determination on any such factor, including the demeanor, candor, or responsiveness of the applicant or witness, the inherent plausibility of the applicant's or witness's account, the consistency between the applicant's or witness's written and oral statements (whenever made and whether or not made under oath), the internal consistency of each such statement, the consistency of such statements with other evidence of record (including the reports of the Department of State on country conditions), and any inaccuracies or falsehoods in such statements, without regard to whether an inconsistency, inaccuracy, or falsehood goes to the heart of the applicant's claim. There is no presumption of credibility.''.

(d) STANDARD OF REVIEW FOR ORDERS OF REMOVAL.—Section 242(b)(4) of the Immigration and Nationality Act (8 U.S.C. 1252(b)(4)) is amended by adding at the end, after subparagraph (D), the following: ''No court shall reverse a determination made by a trier of fact with respect to the availability of corroborating evidence, as described in section 208(b)(1)(B), 240(c)(4)(B), or 241(b)(3)(C), unless the court finds that a reasonable trier of fact is compelled to conclude that such corroborating evidence is unavailable.''.

(e) CLARIFICATION OF DISCRETION.—Section 242(a)(2)(B) of the Immigration and Nationality Act (8 U.S.C. 1252(a)(2)(B)) is amended—

(1) by inserting ''or the Secretary of Homeland Security'' after ''Attorney General'' each place such term appears; and

(2) in the matter preceding clause (i), by inserting ‘‘and regardless of whether the judgment, decision, or action is made in removal proceedings,’’ after ‘‘other provision of law,’’.

(f) REMOVAL OF CAPS.—Section 209 of the Immigration and Nationality Act (8 U.S.C. 1159) is amended—

(1) in subsection (a)(1)—

(A) by striking ‘‘Service’’ and inserting ‘‘Department of Homeland Security’’; and

(B) by striking ‘‘Attorney General’’ each place such term appears and inserting ‘‘Secretary of Homeland Security or the Attorney General’’;

(2) in subsection (b)—

(A) by striking ‘‘Not more’’ and all that follows through ‘‘asylum who—’’ and inserting ‘‘The Secretary of Homeland Security or the Attorney General, in the Secretary’s or the Attorney General’s discretion and under such regulations as the Secretary or the Attorney General may prescribe, may adjust to the status of an alien lawfully admitted for permanent residence the status of any alien granted asylum who—’’; and

(B) in the matter following paragraph (5), by striking ''Attorney General'' and inserting ''Secretary of Homeland Security or the Attorney General''; and

(3) in subsection (c), by striking ''Attorney General'' and inserting ''Secretary of Homeland Security or the Attorney General''.

(g) EFFECTIVE DATES.—

(1) The amendments made by paragraphs (1) and (2) of subsection (a) shall take effect as if enacted on March 1, 2003.

(2) The amendments made by subsections (a)(3), (b), and (c) shall take effect on the date of the enactment of this Act and shall apply to applications for asylum, withholding, or other removal made on or after such date.

(3) The amendment made by subsection (d) shall take effect on the date of the enactment of this Act and shall apply to all cases in which the final administrative removal order is or was issued before, on, or after such date.

(4) The amendments made by subsection (e) shall take effect on the date of the enactment of this Act and shall apply to all cases pending before any court on or after such date.

(5) The amendments made by subsection (f) shall take effect on the date of the enactment of this Act.

(h) REPEAL.—Section 5403 of the Intelligence Reform and Terrorism Prevention Act of 2004 (Public Law 108–458) is repealed.

SEC. 102. WAIVER OF LAWS NECESSARY FOR IMPROVEMENT OF BARRIERS AT BORDERS.

Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (8 U.S.C. 1103 note) is amended to read as follows:

''(c) WAIVER.—

''(1) IN GENERAL.—Notwithstanding any other provision of law, the Secretary of Homeland Security shall have the authority to waive, and shall waive, all laws such Secretary, in such Secretary's sole discretion, determines necessary to ensure expeditious construction of the barriers and roads under this section.

''(2) NO JUDICIAL REVIEW.—Notwithstanding any other provision of law (statutory or nonstatutory), no court, administrative agency, or other entity shall have jurisdiction—

''(A) to hear any cause or claim arising from any action undertaken, or any decision made, by the Secretary of Homeland Security pursuant to paragraph (1); or

"(B) to order compensatory, declaratory, injunctive, equitable, or any other relief for damage alleged to arise from any such action or decision.".

SEC. 103. INADMISSIBILITY DUE TO TERRORIST AND TERRORIST-RELATED ACTIVITIES.

(a) IN GENERAL.—So much of section 212(a)(3)(B)(i) of the Immigration and Nationality Act (8 U.S.C. 1182(a)(3)(B)(i)) as precedes the final sentence is amended to read as follows:

"(i) IN GENERAL.—Any alien who—

"(I) has engaged in a terrorist activity;

"(II) a consular officer, the Attorney General, or the Secretary of Homeland Security knows, or has reasonable ground to believe, is engaged in or is likely to engage after entry in any terrorist activity (as defined in clause (iv));

"(III) has, under circumstances indicating an intention to cause death or serious bodily harm, incited terrorist activity;

"(IV) is a representative (as defined in clause (v)) of—

"(aa) a terrorist organization (as defined in clause (vi)); or

"(bb) a political, social, or other group that endorses or espouses terrorist activity;

"(V) is a member of a terrorist organization described in subclause (I) or (II) of clause (vi);

"(VI) is a member of a terrorist organization described in clause (vi)(III), unless the alien can demonstrate by clear and convincing evidence that the alien did not know, and should not reasonably have known, that the organization was a terrorist organization;

"(VII) endorses or espouses terrorist activity or persuades others to endorse or espouse terrorist activity or support a terrorist organization;

"(VIII) has received military-type training (as defined in section 2339D(c)(1) of title 18, United States Code) from or on behalf of any organization that, at the time the training was received, was a terrorist organization (as defined in clause (vi)); or

"(IX) is the spouse or child of an alien who is inadmissible under this subparagraph, if the activity causing the alien to be found inadmissible occurred within the last 5 years,

is inadmissible.".

(b) ENGAGE IN TERRORIST ACTIVITY DEFINED.—Section 212(a)(3)(B)(iv) of the Immigration and Nationality Act (8 U.S.C. 1182(a)(3)(B)(iv)) is amended to read as follows:

"(iv) ENGAGE IN TERRORIST ACTIVITY DEFINED.—As used in this Act, the term 'engage in terrorist activity' means, in an individual capacity or as a member of an organization—

"(I) to commit or to incite to commit, under circumstances indicating an intention to cause death or serious bodily injury, a terrorist activity;

"(II) to prepare or plan a terrorist activity;

"(III) to gather information on potential targets for terrorist activity;

"(IV) to solicit funds or other things of value for—

"(aa) a terrorist activity;

"(bb) a terrorist organization described in clause (vi)(I) or (vi)(II); or

"(cc) a terrorist organization described in clause (vi)(III), unless the solicitor can demonstrate by clear and convincing evidence that he did not know, and should not reasonably have known, that the organization was a terrorist organization;

"(V) to solicit any individual—

"(aa) to engage in conduct otherwise described in this subsection;

''(bb) for membership in a terrorist organization described in clause (vi)(I) or (vi)(II); or

''(cc) for membership in a terrorist organization described in clause (vi)(III) unless the solicitor can demonstrate by clear and convincing evidence that he did not know, and should not reasonably have known, that the organization was a terrorist organization; or

''(VI) to commit an act that the actor knows, or reasonably should know, affords material support, including a safe house, transportation, communications, funds, transfer of funds or other material financial benefit, false documentation or identification, weapons (including chemical, biological, or radiological weapons), explosives, or training—

''(aa) for the commission of a terrorist activity;

"(bb) to any individual who the actor knows, or reasonably should know, has committed or plans to commit a terrorist activity;

"(cc) to a terrorist organization described in subclause (I) or (II) of clause (vi) or to any member of such an organization; or

"(dd) to a terrorist organization described in clause (vi)(III), or to any member of such an organization, unless the actor can demonstrate by clear and convincing evidence that the actor did not know, and should not reasonably have known, that the organization was a terrorist organization.

This clause shall not apply to any material support the alien afforded to an organization or individual that has committed terrorist activity, if the Secretary of State, after consultation with the Attorney General and the Secretary of Homeland Security, or the Attorney General, after consultation with the Secretary of State and the Secretary of Homeland Security, concludes in his sole unreviewable discretion, that this clause should not apply.''.

(c) TERRORIST ORGANIZATION DEFINED.—Section 212(a)(3)(B)(vi) of the Immigration and Nationality Act (8 U.S.C. 1182(a)(3)(B)(vi)) is amended to read as follows:

''(vi) TERRORIST ORGANIZATION DEFINED.—As used in this section, the term 'terrorist organization' means an organization—

''(I) designated under section 219;

''(II) otherwise designated, upon publication in the Federal Register, by the Secretary of State in consultation with or upon the request of the Attorney General or the Secretary of Homeland Security, as a terrorist organization, after finding that the organization engages in the activities described in subclauses (I) through (VI) of clause (iv); or

"(III) that is a group of two or more individuals, whether organized or not, which engages in, or has a subgroup which engages in, the activities described in subclauses (I) through (VI) of clause (iv).".

(d) EFFECTIVE DATE.—The amendments made by this section shall take effect on the date of the enactment of this Act, and these amendments, and section 212(a)(3)(B) of the Immigration and Nationality Act (8 U.S.C. 1182(a)(3)(B)), as amended by this section, shall apply to—

(1) removal proceedings instituted before, on, or after the date of the enactment of this Act; and

(2) acts and conditions constituting a ground for inadmissibility, excludability, deportation, or removal occurring or existing before, on, or after such date.

SEC. 104. REMOVAL OF TERRORISTS.

(a) IN GENERAL.—

(1) IN GENERAL.—Section 237(a)(4)(B) of the Immigration and Nationality Act (8 U.S.C. 1227(a)(4)(B)) is amended to read as follows:

"(B) TERRORIST ACTIVITIES.—Any alien who is described in subparagraph (B) or (F) of section 212(a)(3) is deportable.".

(2) EFFECTIVE DATE.—The amendment made by paragraph (1) shall take effect on the date of the enactment of this Act, and the amendment, and section 237(a)(4)(B) of the Immigration and Nationality Act (8 U.S.C. 1227(a)(4)(B)), as amended by such paragraph, shall apply to—

(A) removal proceedings instituted before, on, or after the date of the enactment of this Act; and

(B) acts and conditions constituting a ground for inadmissibility, excludability, deportation, or removal occurring or existing before, on, or after such date.

(b) REPEAL.—Effective as of the date of the enactment of the Intelligence Reform and Terrorism Prevention Act of 2004 (Public Law 108–458), section 5402 of such Act is repealed, and the Immigration and Nationality Act shall be applied as if such section had not been enacted.

SEC. 105. JUDICIAL REVIEW OF ORDERS OF REMOVAL.

(a) IN GENERAL.—Section 242 of the Immigration and Nationality Act (8 U.S.C. 1252) is amended—

(1) in subsection (a)—

(A) in paragraph (2)—

(i) in subparagraph (A), by inserting "(statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus provision, and sections 1361 and 1651 of such title" after "Notwithstanding any other provision of law";

(ii) in each of subparagraphs (B) and (C), by inserting "(statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus provision, and sections 1361 and 1651 of such title, and except as provided in subparagraph (D)" after "Notwithstanding any other provision of law"; and

(iii) by adding at the end the following:

"(D) JUDICIAL REVIEW OF CERTAIN LEGAL CLAIMS.—Nothing in subparagraph (B) or (C), or in any other provision of this Act which limits or eliminates judicial review, shall be construed as precluding review of constitutional claims or pure questions of law raised upon a petition for review filed with an appropriate court of appeals in accordance with this section.''; and

(B) by adding at the end the following:

''(4) CLAIMS UNDER THE UNITED NATIONS CONVENTION.—Notwithstanding any other provision of law (statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus provision, and sections 1361 and 1651 of such title, a petition for review filed with an appropriate court of appeals in accordance with this section shall be the sole and exclusive means for judicial review of any cause or claim under the United Nations Convention Against Torture and Other Forms of Cruel, Inhuman, or Degrading Treatment or Punishment, except as provided in subsection (e).

''(5) EXCLUSIVE MEANS OF REVIEW.—Notwithstanding any other provision of law (statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus provision, and sections 1361 and 1651 of such title, a petition for review filed with an appropriate court of appeals in accordance with this section shall be the sole and exclusive means for judicial review of an order of removal entered or issued under any provision of this Act, except as provided in subsection (e).

For purposes of this Act, in every provision that limits or eliminates judicial review or jurisdiction to review, the terms ‘judicial review’ and ‘jurisdiction to review’ include habeas corpus review pursuant to section 2241 of title 28, United States Code, or any other habeas corpus provision, sections 1361 and 1651 of such title, and review pursuant to any other provision of law (statutory or nonstatutory).'';

(2) in subsection (b)—

(A) in paragraph (3)(B), by inserting ''pursuant to subsection (f)'' after ''unless''; and

(B) in paragraph (9), by adding at the end the following: ''Except as otherwise provided in this section, no court shall have jurisdiction, by habeas corpus under section 2241 of title 28, United States Code, or any other habeas corpus provision, by section 1361 or 1651 of such title, or by any other provision of law (statutory or nonstatutory), to review such an order or such questions of law or fact.''; and

(3) in subsection (g), by inserting ''(statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus pro-

vision, and sections 1361 and 1651 of such title'' after ''notwithstanding any other provision of law''.

(b) EFFECTIVE DATE.—The amendments made by subsection (a) shall take effect upon the date of the enactment of this Act and shall apply to cases in which the final administrative order of removal, deportation, or exclusion was issued before, on, or after the date of the enactment of this Act.

(c) TRANSFER OF CASES.—If an alien's case, brought under section 2241 of title 28, United States Code, and challenging a final administrative order of removal, deportation, or exclusion, is pending in a district court on the date of the enactment of this Act, then the district court shall transfer the case (or the part of the case that challenges the order of removal, deportation, or exclusion) to the court of appeals for the circuit in which a petition for review could have been properly filed under section 242(b)(2) of the Immigration and Nationality Act (8 U.S.C. 1252), as amended by this section, or under section 309(c)(4)(D) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (8 U.S.C. 1101 note). The court of appeals shall treat the transferred case as if it had been filed pursuant to a petition for review under such section 242, except that subsection (b)(1) of such section shall not apply.

(d) TRANSITIONAL RULE CASES.—A petition for review filed under former section 106(a) of the Immigration and Nationality Act (as in effect before its repeal by section 306(b) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (8 U.S.C. 1252 note)) shall be treated as if it had been filed as a petition for review under section 242 of the Immigration and Nationality Act (8 U.S.C. 1252), as amended by this section. Notwithstanding any other provision of law (statutory or nonstatutory), including section 2241 of title 28, United States Code, or any other habeas corpus provision, and sections 1361 and 1651 of such title, such petition for review shall be the sole and exclusive means for judicial review of an order of deportation or exclusion.

SEC. 106. DELIVERY BONDS.

(a) DEFINITIONS.—For purposes of this section:

(1) DELIVERY BOND.—The term ''delivery bond'' means a written suretyship undertaking for the surrender of an individual against whom the Department of Homeland Security has issued an order to show cause or a notice to appear, the performance of which is guaranteed by an acceptable surety on Federal bonds.

(2) PRINCIPAL.—The term ''principal'' means an individual who is the subject of a bond.

(3) SURETYSHIP UNDERTAKING.—The term ''suretyship undertaking'' means a written agreement, executed by a bonding agent on behalf of a surety, which binds all parties to its certain terms and conditions and which provides obligations for the principal and the surety while under the bond and penalties for forfeiture to ensure the obligations of the principal and the surety under the agreement.

(4) BONDING AGENT.—The term ''bonding agent'' means any individual properly licensed, approved, and appointed by power of attorney to execute or countersign surety bonds in connection with any matter governed by the Immigration and Nationality Act as amended (8 U.S.C. 1101, et seq.), and who receives a premium for executing or countersigning such surety bonds.

(5) SURETY.—The term ''surety'' means an entity, as defined by, and that is in compliance with, sections 9304 through 9308 of title 31, United States Code, that agrees—

(A) to guarantee the performance, where appropriate, of the principal under a bond;

(B) to perform the bond as required; and

(C) to pay the face amount of the bond as a penalty for failure to perform.

(b) VALIDITY, AGENT NOT CO-OBLIGOR, EXPIRATION, RENEWAL, AND CANCELLATION OF BONDS.—

(1) VALIDITY.—Delivery bond undertakings are valid if such bonds—

(A) state the full, correct, and proper name of the alien principal;

(B) state the amount of the bond;

(C) are guaranteed by a surety and countersigned by an agent who is properly appointed;

(D) bond documents are properly executed; and

(E) relevant bond documents are properly filed with the Secretary of Homeland Security.

(2) BONDING AGENT NOT CO-OBLIGOR, PARTY, OR GUARANTOR IN INDIVIDUAL CAPACITY, AND NO REFUSAL IF ACCEPTABLE SURETY.—Section 9304(b) of title 31, United States Code, is amended by adding at the end the following: ‘‘Notwithstanding any other provision of law, no bonding agent of a corporate surety shall be required to execute bonds as a co-obligor, party, or guarantor in an individual capacity on bonds provided by the corporate surety, nor shall a corporate surety bond be refused if the corporate surety appears on the cur-

rent Treasury Department Circular 570 as a company holding a certificate of authority as an acceptable surety on Federal bonds and attached to the bond is a currently valid instrument showing the authority of the bonding agent of the surety company to execute the bond.''.

(3) EXPIRATION.—A delivery bond undertaking shall expire at the earliest of—

(A) 1 year from the date of issue;

(B) at the cancellation of the bond or surrender of the principal; or

(C) immediately upon nonpayment of the renewal premium.

(4) RENEWAL.—Delivery bonds may be renewed annually, with payment of proper premium to the surety, if there has been no breach of conditions, default, claim, or forfeiture of the bond. Notwithstanding any renewal, when the alien is surrendered to the Secretary of Homeland Security for removal, the Secretary shall cause the bond to be canceled.

(5) CANCELLATION.—Delivery bonds shall be canceled and the surety exonerated—

(A) for nonrenewal after the alien has been surrendered to the Department of Homeland Security for removal;

(B) if the surety or bonding agent provides reasonable evidence that there was misrepresentation or fraud in the application for the bond;

(C) upon the death or incarceration of the principal, or the inability of the surety to produce the principal for medical reasons;

(D) if the principal is detained by any law enforcement agency of any State, county, city, or any politial subdivision thereof;

(E) if it can be established that the alien departed the United States of America for any reason without permission of the Secretary of Homeland Security, the surety, or the bonding agent;

(F) if the foreign state of which the principal is a national is designated pursuant to section 244 of the Act (8 U.S.C. 1254a) after the bond is posted; or

(G) if the principal is surrendered to the Department of Homeland Security, removal by the surety or the bonding agent.

(6) SURRENDER OF PRINCIPAL; FORFEITURE OF BOND PREMIUM.—

(A) SURRENDER.—At any time, before a breach of any of the bond conditions, if in the opinion of the surety or bonding agent, the principal becomes a flight risk, the principal may be surrendered to the Department of Homeland Security for removal.

(B) FORFEITURE OF BOND PREMIUM.—A principal may be surrendered without the return of any bond premium if the principal—

(i) changes address without notifying the surety, the bonding agent, and the Secretary of Homeland Security in writing prior to such change;

(ii) hides or is concealed from a surety, a bonding agent, or the Secretary;

(iii) fails to report to the Secretary as required at least annually; or

(iv) violates the contract with the bonding agent or surety, commits any act that may lead to a breach of the bond, or otherwise violates any other obligation or condition of the bond established by the Secretary.

(7) CERTIFIED COPY OF BOND AND ARREST WARRANT TO ACCOMPANY SURRENDER.—

(A) IN GENERAL.—A bonding agent or surety desiring to surrender the principal—

(i) shall have the right to petition the Secretary of Homeland Security or any Federal court, without having to pay any fees or court costs, for an arrest warrant for the arrest of the principal;

(ii) shall forthwith be provided 2 certified copies each of the arrest warrant and the bond undertaking, without having to pay any fees or courts costs; and

(iii) shall have the right to pursue, apprehend, detain, and surrender the principal, together with certified copies of the arrest warrant and the bond undertaking, to any Department of Homeland Security detention official or Department detention facility or any detention facility authorized to hold Federal detainees.

(B) EFFECTS OF DELIVERY.—Upon surrender of a principal under subparagraph (A)(iii)—

(i) the official to whom the principal is surrendered shall detain the principal in custody and issue a written certificate of surrender; and

(ii) the Secretary of Homeland Security shall immediately exonerate the surety from any further liability on the bond.

(8) FORM OF BOND.—Delivery bonds shall in all cases state the following and be secured by a corporate surety that is certified as an acceptable surety on Federal bonds and whose name appears on the current Treasury Department Circular 570:

"(A) BREACH OF BOND; PROCEDURE, FORFEITURE, NOTICE.—

"(i) If a principal violates any conditions of the delivery bond, or the principal is or becomes subject to a final administrative order of deportation or removal, the Secretary of Homeland Security shall—

"(I) immediately issue a warrant for the principal's arrest and enter that arrest warrant into the National Crime Information Center (NCIC) computerized information database;

"(II) order the bonding agent and surety to take the principal into custody and surrender the principal to any one of 10 designated Department of Homeland Security 'turn-in' centers located nationwide in the areas of greatest need, at any time of day during 15 months after mailing the arrest warrant and the order to the bonding agent and the surety as required by subclause (III), and immediately enter that order into the National Crime Information Center (NCIC) computerized information database; and

"(III) mail 2 certified copies each of the arrest warrant issued pursuant to subclause (I) and 2 certified copies each of the order issued pursuant to subclause (II) to only the bonding agent and surety via certified mail return receipt to their last known addresses.

"(ii) Bonding agents and sureties shall immediately notify the Secretary of Homeland Security of their changes of address and/or telephone numbers.

"(iii) The Secretary of Homeland Security shall establish, disseminate to bonding agents and sureties, and maintain on a current basis a secure nationwide toll-free list of telephone numbers of Department of Homeland Security officials, including the names of such officials, that bonding agents, sureties, and their employees may immediately contact at any time to discuss and resolve any issue regarding any principal or bond, to be known as ‘Points of Contact’.

‘‘(iv) A bonding agent or surety shall have full and complete access, free of charge, to any and all information, electronic or otherwise, in the care, custody, and control of the United States Government or any State or local government or any subsidiary or police agency thereof regarding the principal that may be helpful in complying with section 105 of the REAL ID Act of 2005 that the Secretary of Homeland Security, by regulations subject to approval by Congress, determines may be helpful in locating or surrendering the principal. Beyond the principal, a bonding agent or surety shall not be required to disclose any information, including but not limited to the arrest warrant and order, received from any governmental source, any person, firm, corporation, or other entity.

"(v) If the principal is later arrested, detained, or otherwise located outside the United States and the outlying possessions of the United States (as defined in section 101(a) of the Immigration and Nationality Act), the Secretary of Homeland Security shall—

"(I) immediately order that the surety is completely exonerated, and the bond canceled; and

"(II) if the Secretary of Homeland Security has issued an order under clause (i), the surety may request, by written, properly filed motion, reinstatement of the bond. This subclause may not be construed to prevent the Secretary of Homeland Security from revoking or resetting a bond at a higher amount.

"(vi) The bonding agent or surety must—

"(I) during the 15 months after the date the arrest warrant and order were mailed pursuant to clause (i)(III) surrender the principal one time; or

"(II)(aa) provide reasonable evidence that producing the principal was prevented—

"(aaa) by the principal's illness or death;

"(bbb) because the principal is detained in custody in any city, State, country, or any political subdivision thereof;

"(ccc) because the principal has left the United States or its outlying possessions (as defined in section 101(a) of the Immigration and Nationality Act (8 U.S.C. 1101(a)); or

"(ddd) because required notice was not given to the bonding agent or surety; and

"(bb) establish by affidavit that the inability to produce the principal was not with the consent or connivance of the bonding agent or surety.

"(vii) If compliance occurs more than 15 months but no more than 18 months after the mailing of the arrest warrant and order to the bonding agent and the surety required under clause (i)(III), an amount equal to 25 percent of the face amount of the bond shall be assessed as a penalty against the surety.

"(viii) If compliance occurs more than 18 months but no more than 21 months after the mailing of the arrest warrant and order to the bonding agent and the surety required under clause (i)(III), an amount equal to 50 percent of the face amount of the bond shall be assessed as a penalty against the surety.

"(ix) If compliance occurs more than 21 months but no more than 24 months after the mailing of the arrest warrant and order to the bonding agent and the surety required under clause (i)(III), an amount equal to 75 percent of the face amount of the bond shall be assessed as a penalty against the surety.

"(x) If compliance occurs 24 months or more after the mailing of the arrest warrant and order to the bonding agent and the surety required under clause (i)(III), an amount equal to 100 percent of the face amount of the bond shall be assessed as a penalty against the surety.

"(xi) If any surety surrenders any principal to the Secretary of Homeland Security at any time and place after the period for compliance has passed, the Secretary of Homeland Security shall cause to be issued to that surety an amount equal to 50 percent of the face amount of the bond: *Provided, however,* That if that surety owes any penalties on bonds to the United States, the amount that surety would otherwise receive shall be offset by and applied as a credit against the amount of penalties on bonds it owes the United States, and then that surety shall receive the remainder of the amount to which it is entitled under this subparagraph, if any.

''(xii) All penalties assessed against a surety on a bond, if any, shall be paid by the surety no more than 27 months after the mailing of the arrest warrant and order to the bonding agent and the surety required under clause (i)(III).

''(B) The Secretary of Homeland Security may waive penalties or extend the period for payment or both, if—

''(i) a written request is filed with the Secretary of Homeland Security; and

''(ii) the bonding agent or surety provides an affidavit that diligent efforts were made to effect compliance of the principal.

''(C) COMPLIANCE; EXONERATION; LIMITATION OF LIABILITY.—

''(i) COMPLIANCE.—A bonding agent or surety shall have the absolute right to locate, apprehend, arrest, detain, and surrender any principal, wherever he or she may be found, who violates any of the terms and conditions of his or her bond.

''(ii) EXONERATION.—Upon satisfying any of the requirements of the bond, the surety shall be completely exonerated.

"(iii) LIMITATION OF LIABILITY.—Notwithstanding any other provision of law, the total liability on any surety undertaking shall not exceed the face amount of the bond.".

(c) EFFECTIVE DATE.—The provisions of this section shall take effect on the date of the enactment of this Act and shall apply to bonds and surety undertakings executed before, on, or after the date of the enactment of this Act.

SEC. 107. RELEASE OF ALIENS IN REMOVAL PROCEEDINGS.

(a) IN GENERAL.—Section 236(a)(2) of the Immigration and Nationality Act (8 U.S.C. 1226(a)(2)) is amended to read as follows:

"(2) subject to such reasonable regulations as the Secretary of Homeland Security may prescribe, shall permit agents, servants, and employees of corporate sureties to visit in person with individuals detained by the Secretary of and, subject to section 241(a)(8), may release the alien on a delivery bond of at least $10,000, with security approved by the Secretary, and containing conditions and procedures prescribed by section 105 of the REAL ID Act of 2005 and by the Secretary, but the Secretary shall not release the alien on or to his own recognizance unless an order of an immigration judge expressly finds and states in a signed order to release the alien to his own recognizance that the alien is not a flight risk and is not a threat to the United States''.

(b) REPEAL.—Section 286(r) of the Immigration and Nationality Act (8 U.S.C. 1356(r)) is repealed.

(c) EFFECTIVE DATE.—The amendment made by subsection (a) shall take effect on the date of the enactment of this Act.

SEC. 108. DETENTION OF ALIENS DELIVERED BY BONDSMEN.

(a) IN GENERAL.—Section 241(a) of the Immigration and Nationality Act (8 U.S.C. 1231(a)) is amended by adding at the end the following:

''(8) EFFECT OF PRODUCTION OF ALIEN BY BONDSMAN.—Notwithstanding any other provision of law, the Secretary of Homeland Security shall take into custody any alien subject to a final order of removal, and cancel any bond previously posted for the alien, if the alien is produced within the prescribed time limit by the obligor on the bond whether or not the Department of Homeland Security accepts custody of the alien. The obligor on the bond shall be deemed to have substantially performed all conditions imposed by the terms of the bond, and shall be released from liability on the bond, if the alien is produced within such time limit.''.

(b) EFFECTIVE DATE.—The amendment made by subsection (a) shall take effect on the date of the enactment of this Act and shall apply to all immigration bonds posted before, on, or after such date.

TITLE II—IMPROVED SECURITY FOR DRIVERS' LICENSES AND PERSONAL IDENTIFICATION CARDS

SEC. 201. DEFINITIONS.

In this title, the following definitions apply:

(1) DRIVER'S LICENSE.—The term ''driver's license'' means a motor vehicle operator's license, as defined in section 30301 of title 49, United States Code.

(2) IDENTIFICATION CARD.—The term ''identification card'' means a personal identification card, as defined in section 1028(d) of title 18, United States Code, issued by a State.

(3) SECRETARY.—The term ''Secretary'' means the Secretary of Homeland Security.

(4) STATE.—The term ''State'' means a State of the United States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa,

the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and any other territory or possession of the United States.

SEC. 202. MINIMUM DOCUMENT REQUIREMENTS AND ISSUANCE STANDARDS FOR FEDERAL RECOGNITION.

(a) MINIMUM STANDARDS FOR FEDERAL USE.—

(1) IN GENERAL.—Beginning 3 years after the date of the enactment of this Act, a Federal agency may not accept, for any official purpose, a driver's license or identification card issued by a State to any person unless the State is meeting the requirements of this section.

(2) STATE CERTIFICATIONS.—The Secretary shall determine whether a State is meeting the requirements of this section based on certifications made by the State to the Secretary of Transportation. Such certifications shall be made at such times and in such manner as the Secretary of Transportation, in consultation with the Secretary of Homeland Security, may prescribe by regulation.

(b) MINIMUM DOCUMENT REQUIREMENTS.—To meet the requirements of this section, a State shall include, at a minimum, the following information and features on each driver's license and identification card issued to a person by the State:

(1) The person's full legal name.

(2) The person's date of birth.

(3) The person's gender.

(4) The person's driver's license or identification card number.

(5) A digital photograph of the person.

(6) The person's address of principle residence.

(7) The person's signature.

(8) Physical security features designed to prevent tampering, counterfeiting, or duplication of the document for fraudulent purposes.

(9) A common machine-readable technology, with defined minimum data elements.

(c) MINIMUM ISSUANCE STANDARDS.—

(1) IN GENERAL.—To meet the requirements of this section, a State shall require, at a minimum, presentation and verification of the following information before issuing a driver's license or identification card to a person:

(A) A photo identity document, except that a non-photo identity document is acceptable if it includes both the person's full legal name and date of birth.

(B) Documentation showing the person's date of birth.

(C) Proof of the person's social security account number or verification that the person is not eligible for a social security account number.

(D) Documentation showing the person's name and address of principal residence.

(2) SPECIAL REQUIREMENTS.—

(A) IN GENERAL.—To meet the requirements of this section, a State shall comply with the minimum standards of this paragraph.

(B) EVIDENCE OF LAWFUL STATUS.—A State shall require, before issuing a driver's license or identification card to a person, valid documentary evidence that the person—

(i) is a citizen of the United States;

(ii) is an alien lawfully admitted for permanent or temporary residence in the United States;

(iii) has conditional permanent resident status in the United States;

(iv) has an approved application for asylum in the United States or has entered into the United States in refugee status;

(v) has a valid, unexpired nonimmigrant visa or nonimmigrant visa status for entry into the United States;

(vi) has a pending application for asylum in the United States;

(vii) has a pending or approved application for temporary protected status in the United States;

(viii) has approved deferred action status; or

(ix) has a pending application for adjustment of status to that of an alien lawfully admitted for permanent residence in the United States or conditional permanent resident status in the United States.

(C) TEMPORARY DRIVERS' LICENSES AND IDENTIFICATION CARDS.—

(i) IN GENERAL.—If a person presents evidence under any of clauses (v) through (ix) of subparagraph (B), the State may only issue a temporary driver's license or temporary identification card to the person.

(ii) EXPIRATION DATE.—A temporary driver's license or temporary identification card issued pursuant to this subparagraph shall be valid only during the period of time of the applicant's authorized stay in the United States or, if there is no definite end to the period of authorized stay, a period of one year.

(iii) DISPLAY OF EXPIRATION DATE.—A temporary driver's license or temporary identification card issued pursuant to this subparagraph shall clearly indicate that it is temporary and shall state the date on which it expires.

(iv) RENEWAL.—A temporary driver's license or temporary identification card issued pursuant to this subparagraph may be renewed only upon presentation of valid documentary evidence that the status by which the applicant qualified for the temporary driver's license or temporary identification card has been extended by the Secretary of Homeland Security.

(3) VERIFICATION OF DOCUMENTS.—To meet the requirements of this section, a State shall implement the following procedures:

(A) Before issuing a driver's license or identification card to a person, the State shall verify, with the issuing agency, the issuance, validity, and completeness of each document required to be presented by the person under paragraph (1) or (2).

(B) The State shall not accept any foreign document, other than an official passport, to satisfy a requirement of paragraph (1) or (2).

(C) Not later than September 11, 2005, the State shall enter into a memorandum of understanding with the Secretary of Homeland Security to routinely utilize the automated system known as Systematic Alien Verification for Entitlements, as provided for by section 404 of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (110 Stat. 3009–664), to verify the legal presence status of a person, other than a United States citizen, applying for a driver's license or identification card.

(d) OTHER REQUIREMENTS.—To meet the requirements of this section, a State shall adopt the following practices in the issuance of drivers' licenses and identification cards:

(1) Employ technology to capture digital images of identity source documents so that the images can be retained in electronic storage in a transferable format.

(2) Retain paper copies of source documents for a minimum of 7 years or images of source documents presented for a minimum of 10 years.

(3) Subject each person applying for a driver's license or identification card to mandatory facial image capture.

(4) Establish an effective procedure to confirm or verify a renewing applicant's information.

(5) Confirm with the Social Security Administration a social security account number presented by a person using the full social security account number. In the event that a social security account number is already registered to or associated with another person to which any State has issued a driver's license or identification card, the State shall resolve the discrepancy and take appropriate action.

(6) Refuse to issue a driver's license or identification card to a person holding a driver's license issued by another State without confirmation that the person is terminating or has terminated the driver's license.

(7) Ensure the physical security of locations where drivers' licenses and identification cards are produced and the security of document materials and papers from which drivers' licenses and identification cards are produced.

(8) Subject all persons authorized to manufacture or produce drivers' licenses and identification cards to appropriate security clearance requirements.

(9) Establish fraudulent document recognition training programs for appropriate employees engaged in the issuance of drivers' licenses and identification cards.

(10) Limit the period of validity of all driver's licenses and identification cards that are not temporary to a period that does not exceed 8 years.

SEC. 203. LINKING OF DATABASES.

(a) In General.—To be eligible to receive any grant or other type of financial assistance made available under this title, a State shall participate in the interstate compact regarding sharing of driver license data, known as the ''Driver License Agreement'', in order to provide electronic access by a State to information contained in the motor vehicle databases of all other States.

(b) REQUIREMENTS FOR INFORMATION.—A State motor vehicle database shall contain, at a minimum, the following information:

(1) All data fields printed on drivers' licenses and identification cards issued by the State.

(2) Motor vehicle drivers' histories, including motor vehicle violations, suspensions, and points on licenses.

SEC. 204. TRAFFICKING IN AUTHENTICATION FEATURES FOR USE IN FALSE IDENTIFICATION DOCUMENTS.

(a) CRIMINAL PENALTY.—Section 1028(a)(8) of title 18, United States Code, is amended by striking ''false authentication features'' and inserting ''false or actual authentication features''.

(b) USE OF FALSE DRIVER'S LICENSE AT AIRPORTS.—

(1) IN GENERAL.—The Secretary shall enter, into the appropriate aviation security screening database, appropriate information regarding any person convicted of using a false driver's license at an airport (as such term is defined in section 40102 of title 49, United States Code).

(2) FALSE DEFINED.—In this subsection, the term ''false'' has the same meaning such term has

under section 1028(d) of title 18, United States Code.

SEC. 205. GRANTS TO STATES.

(a) IN GENERAL.—The Secretary may make grants to a State to assist the State in conforming to the minimum standards set forth in this title.

(b) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Secretary for each of the fiscal years 2005 through 2009 such sums as may be necessary to carry out this title.

SEC. 206. AUTHORITY.

(a) PARTICIPATION OF SECRETARY OF TRANSPORTATION AND STATES.—All authority to issue regulations, set standards, and issue grants under this title shall be carried out by the Secretary, in consultation with the Secretary of Transportation and the States.

(b) COMPLIANCE WITH STANDARDS.—All authority to certify compliance with standards under this title shall be carried out by the Secretary of Transportation, in consultation with the Secretary of Homeland Security and the States.

(c) EXTENSIONS OF DEADLINES.—The Secretary may grant to a State an extension of time to meet the requirements of section 202(a)(1) if the State provides adequate justification for noncompliance.

SEC. 207. REPEAL.

Section 7212 of the Intelligence Reform and Terrorism Prevention Act of 2004 (Public Law 108–458) is repealed.

SEC. 208. LIMITATION ON STATUTORY CONSTRUCTION.

Nothing in this title shall be construed to affect the authorities or responsibilities of the Secretary of Transportation or the States under chapter 303 of title 49, United States Code.

TITLE III—BORDER INFRASTRUCTURE AND TECHNOLOGY INTEGRATION

SEC. 301. VULNERABILITY AND THREAT ASSESSMENT.

(a) STUDY.—The Under Secretary of Homeland Security for Border and Transportation Security, in consultation with the Under Secretary of Homeland Security for Science and Technology and the Under Secretary of Homeland Security for Information Analysis and Infrastructure Protection, shall study the technology, equipment, and personnel needed to address security vulnerabilities within the United States for each field office of the Bureau of Customs and Border Protection that has responsibility for any portion of the United States borders with Canada and Mexico. The Under Secretary shall conduct follow-up studies at least once every 5 years.

(b) REPORT TO CONGRESS.—The Under Secretary shall submit a report to Congress on the Under Secretary's findings and conclusions from each study conducted under subsection (a) together with legislative recommendations, as appropriate, for addressing any security vulnerabilities found by the study.

(c) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Department of Homeland Security Directorate of Border and Transportation Security such sums as may be necessary for fiscal years 2006 through 2011 to carry out any such recommendations from the first study conducted under subsection (a).

SEC. 302. USE OF GROUND SURVEILLANCE TECHNOLOGIES FOR BORDER SECURITY.

(a) PILOT PROGRAM.—Not later than 180 days after the date of the enactment of this Act, the Under Secretary of Homeland Security for Science and Technology, in consultation with the Under Secretary of Homeland Security for Border and Transportation Security, the Under Secretary of Homeland Security for Information Analysis and Infrastructure Protection, and the Secretary of Defense, shall develop a pilot program to utilize, or increase the utilization of, ground surveillance technologies to enhance the border security of the United States. In developing the program, the Under Secretary shall—

(1) consider various current and proposed ground surveillance technologies that could be utilized to enhance the border security of the United States;

(2) assess the threats to the border security of the United States that could be addressed by the utilization of such technologies; and

(3) assess the feasibility and advisability of utilizing such technologies to address such threats, including an assessment of the technologies considered best suited to address such threats.

(b) ADDITIONAL REQUIREMENTS.—

(1) IN GENERAL.—The pilot program shall include the utilization of a variety of ground surveillance technologies in a variety of topographies and areas (including both populated and unpopulated areas) on both the northern and southern borders of the United States in order to evaluate, for a range of circumstances—

(A) the significance of previous experiences with such technologies in homeland security or critical infrastructure protection for the utilization of such technologies for border security;

(B) the cost, utility, and effectiveness of such technologies for border security; and

(C) liability, safety, and privacy concerns relating to the utilization of such technologies for border security.

(2) TECHNOLOGIES.—The ground surveillance technologies utilized in the pilot program shall include the following:

(A) Video camera technology.

(B) Sensor technology.

(C) Motion detection technology.

(c) IMPLEMENTATION.—The Under Secretary of Homeland Security for Border and Transportation Security shall implement the pilot program developed under this section.

(d) REPORT.—Not later than 1 year after implementing the pilot program under subsection (a), the Under Secretary shall submit a report on the program to the Senate Committee on Commerce, Science, and Transportation, the House of Representatives Committee on Science, the House of Representatives Committee on Homeland Security, and the House of Representatives Committee on the Judiciary. The Under Secretary shall include in the report a description of the program together with such recommendations as the Under Secretary finds appropriate, including recommendations for terminating the program, making the program permanent, or enhancing the program.

SEC. 303. ENHANCEMENT OF COMMUNICATIONS INTEGRATION AND INFORMATION SHARING ON BORDER SECURITY.

(a) IN GENERAL.—Not later than 180 days after the date of the enactment of this Act, the Secretary of Homeland Security, acting through the Under Secretary of Homeland Security for Border and Transportation Security, in consultation with the Under Secretary of Homeland Security for Science and Technology, the Under Secretary of Homeland Security for Information Analysis and Infrastructure Protection, the Assistant Secretary of Commerce for Communications and Information, and other appropriate Federal, State, local, and tribal agencies, shall develop and implement a plan—

(1) to improve the communications systems of the departments and agencies of the Federal Government in order to facilitate the integration of communications among the departments and agencies of the Federal Government and State, local government agencies, and Indian tribal agencies on matters relating to border security; and

(2) to enhance information sharing among the departments and agencies of the Federal Government, State and local government agencies, and Indian tribal agencies on such matters.

(b) REPORT.—Not later than 1 year after implementing the plan under subsection (a), the Secretary shall submit a copy of the plan and a report on the plan, including any recommendations the Secretary finds appropriate, to the Senate Committee on Commerce, Science, and Transportation, the House of Representatives Committee on Science, the House of Representatives Committee on Homeland Security, and the House of Representatives Committee on the Judiciary.

Passed the House of Representatives February 10, 2005.

Attest: JEFF TRANDAHL,

Clerk.

https://www.doi.gov/news/pressreleases/2009_01_15_releaseB

U.S. Department of the Interior

DHS and DOI sign agreement for mitigation of border security impact on the environment

1/15/2009
Last edited 4/25/2016

WASHINGTON, D.C. – The U.S. Department of Homeland Security (DHS) signed a Memorandum of Agreement on Wednesday with the U.S. Department of the Interior regarding environmental stewardship measures related to the construction of border security infrastructure.

The funding will be provided by DHS' U.S. Customs and Border Protection and the work would be carried out according to assessments, plans and priorities developed by Interior in cooperation with DHS and CBP during the past two years, according to the Memorandum of Agreement.

“Increasing the security of our nation's borders has never meant disregarding our environmental responsibilities. CBP's border infrastructure construction projects have involved numerous environmental studies and meetings with stakeholders,” CBP Commissioner W. Ralph Basham said. “No partnership has been more important in our efforts to be good stewards of the environment than our work with the land managers and wildlife experts of the Department of the Interior. Today's signing of this memorandum of agreement demonstrates that our commitment is not only words, but actual resources which have been set aside to allow DOI to mitigate the impact of our border security efforts in environmentally sensitive areas.”

“Interior looks forward to continuing this cooperative stewardship initiative with the Department of Homeland Security and U.S. Customs and Border Protection,” said Secretary of the Interior Dirk Kempthorne. “Securing our borders is a vital national priority and we believe this goal can be accomplished while minimizing and mitigating its impact on our public land resources along the border.”

Interior Deputy Secretary Lynn Scarlett said the agreement will enable Interior agencies to carry out their stewardship responsibilities more effectively. “Interior manages spectacular public lands along over 900 miles of the southwestern border. Our biologists and land managers have examined the expected impacts from these projects and proposed a range of mitigation measures,” Scarlett said. “This Memorandum of Agreement will allow them to implement these actions.”

CBP is building border fences and access roads along 670 miles of the U.S.-Mexico border as mandated by Congress in the Secure Fence Act of 2006. On April 1, 2008, DHS Secretary Michael Chertoff waived certain environmental statutes, as authorized by the Illegal Immigration Reform and Immigrant Responsibility Act, to gain expedited access to Interior-managed lands and other lands for these border security projects. At that time, Secretary Chertoff reiterated his department's firm commitment to environmental stewardship through the use of best management practices and by providing funding for mitigation measures.

Although the waiver removed the legal requirement, DHS and CBP continued to work with DOI to be good environmental stewards. As a result of that commitment, CBP, in coordination with Interior, has prepared Environmental Stewardship Plans and Biological Resource Plans for those projects in which anticipated adverse effects on natural and cultural resources had been identified, to propose measures to mitigate these impacts.

Under the Secure Border Initiative program, CBP obligated approximately $40.5 million for environmental compliance for border infrastructure projects in FY 2007 and FY 2008. An additional $50 million has been set aside for environmental and regulatory mitigation in the FY 2009 Border Security, Fencing, Infrastructure and Technology appropriation, as described below.

In the Memorandum of Agreement, the agencies agreed to the following terms:

- Interior, if provided with appropriate funding, agrees to implement the proposed mitigation measures on behalf of CBP, which agrees to fund up to $50 million in reasonable mitigation measures to address the adverse effects of infrastructure construction and maintenance on Interior-managed natural and cultural resources, as prioritized by Interior.
- As previously agreed to, the cost of mitigation measures identified in the biological opinions for the pedestrian fence projects near Sasabe, Naco, and Douglas, Ariz., and Lukeville, Ariz., will be deducted from this $50 million commitment.
- Interior will provide a prioritized list of mitigation measures to CBP, no later than June 1. These agencies will reconcile any differences on the list before any funding is transferred.
- The Environmental Stewardship Plans, Biological Resources Plans, and segment-specific monitoring reports for the border security projects will serve as the primary planning documentation for the identification of appropriate mitigation

measures. Effects analyses prepared by Interior agencies will be equally considered during identification of appropriate mitigation measures.

- When the necessary funding is received, Interior will implement the reasonable mitigation measures on behalf of CBP in those areas and for those projects identified where the Secretary of Homeland Security has waived the applicability of certain federal laws. Interior will coordinate with CBP as it implements the reasonable mitigation measures on behalf of that agency.

U.S. Customs and Border Protection is the unified border agency within the U.S. Department of Homeland Security charged with the management, control and protection of U.S. borders at and between official ports of entry. CBP is charged with keeping terrorists and terrorist weapons out of the United States while enforcing hundreds of U.S. laws. The U.S. Department of the Interior is the nation's principal conservation agency, whose mission is to protect America's treasures for future generations, provide access to our nation's natural and cultural heritage, offer recreation opportunities, and honor our trust responsibilities to American Indians and Alaska Natives

https://georgewbush-whitehouse.archives.gov/news/releases/2006/10/20061026-1.html
Disclaimer: “This is historical material, “frozen in time.” The web site is no longer updated and links to external web sites and some internal pages will not work.”

For Immediate Release
Office of the Press Secretary
October 26, 2006

Fact Sheet: The Secure Fence Act of 2006

President Bush Signs Secure Fence Act
In Focus: Homeland Security

White House News
En Español

"This bill will help protect the American people. This bill will make our borders more secure. It is an important step toward immigration reform."

- President George W. Bush, 10/26/06

Today, President Bush Signed The Secure Fence Act - An Important Step Forward In Our Nation's Efforts To Control Our Borders And Reform Our Immigration System. Earlier this year, the President laid out a strategy for comprehensive immigration reform. The Secure Fence Act is one part of this reform, and the President will work with Congress to finish the job and pass the remaining elements of this strategy.

The Secure Fence Act Builds On Progress Securing The Border

By Making Wise Use Of Physical Barriers And Deploying 21st Century Technology, We Can Help Our Border Patrol Agents Do Their Job And Make Our Border More Secure. The Secure Fence Act:

- Authorizes the construction of hundreds of miles of additional fencing along our Southern border;
- Authorizes more vehicle barriers, checkpoints, and lighting to help prevent people from entering our country illegally;
- Authorizes the Department of Homeland Security to increase the use of advanced technology like cameras, satellites, and unmanned aerial vehicles to reinforce our infrastructure at the border.

Comprehensive Immigration Reform Begins With Securing The Border. Since President Bush took office, we have:

- More than doubled funding for border security - from $4.6 billion in 2001 to $10.4 billion this year;
- Increased the number of Border Patrol agents from about 9,000 to more than 12,000 - and by the end of 2008, we will have doubled the number of Border Patrol agents since the President took office;
- Deployed thousands of National Guard members to assist the Border Patrol;
- Upgraded technology at our borders and added infrastructure, including new fencing and vehicle barriers;
- Apprehended and sent home more than 6 million people entering America illegally; and
- We are adding thousands of new beds in our detention facilities, so we can continue working to end "catch and release" at our Southern border.

This Act Is One Part Of Our Effort To Reform Our Immigration System, And We Have More Work To Do

Comprehensive Immigration Reform Requires That We Enforce Our Immigration Laws Inside America. It is against the law to knowingly hire illegal workers, so the Administration has stepped up worksite enforcement. Many businesses want to obey the law, but cannot verify the legal status of their employees because of the widespread problem of document fraud, so the President has also called on Congress to create a better system for verifying documents and work eligibility.

Comprehensive Immigration Reform Requires That We Reduce The Pressure On Our Border By Creating A Lawful Path For Foreign Workers To Enter Our Country On A Temporary Basis. A temporary worker program would meet the needs of our economy, reduce the appeal of human smugglers, make it less likely that people would risk their lives to cross the border, and ease the financial burden on State and local governments by replacing illegal workers with lawful taxpayers. Above all, a temporary worker program would add to our security by making certain we know who is in our country and why they are here.

Comprehensive Immigration Reform Requires That We Face The Reality That Millions Of Illegal Immigrants Are Here Already. The President opposes amnesty but believes there is a rational middle ground between granting an automatic path to citizenship for every illegal immigrant and a program of mass deportation. Illegal immigrants who have roots in our country and want to stay should have to pay a meaningful penalty for breaking the law, pay their taxes, learn English, work in a job for a number of years, and wait in line behind those who played by the rules and followed the law.

Comprehensive Immigration Reform Requires That We Honor The Great American Tradition Of The Melting Pot. Americans are bound together by our shared ideals, an appreciation of our history, respect for the flag we fly, and an ability to speak and write the English language. When immigrants assimilate and advance in our society, they realize their dreams, renew our spirit, and add to the unity of America.

# # #

Press Office
U.S. Department of Homeland Security

Press Release

April 1, 2008
Contact: DHS Press Office, (202) 282-8010

DHS EXERCISES WAIVER AUTHORITY TO EXPEDITE ADVANCEMENTS IN BORDER SECURITY

WASHINGTON – The U.S. Department of Homeland Security announced today its intent to issue two waivers of certain laws to expedite security improvements at the southwest border. Congress gave the Secretary of Homeland Security authority to waive all legal requirements necessary to expeditiously install additional physical barriers and roads at the border to deter illegal activity.

"Criminal activity at the border does not stop for endless debate or protracted litigation," said Homeland Security Secretary Michael Chertoff. "Congress and the American public have been adamant that they want and expect border security. We're serious about delivering it, and these waivers will enable important security projects to keep moving forward. At the same time, we value the need for public input on any potential impact of our border infrastructure plans on the environment—and we will continue to solicit it."

One waiver applies to certain environmental and land management laws for various project areas in Calif., Ariz., N.M., and Texas, encompassing roughly 470 total miles. It will facilitate additional pedestrian and vehicle fence construction, towers, sensors, cameras, detection equipment, and roads in the vicinity of the border.

A separate waiver was signed for the levee-border barrier project in Hidalgo County, Texas. This roughly 22-mile project will strengthen flood protection in the area while providing the Border Patrol with important tactical infrastructure. In addition to environmental and land management laws, this waiver addresses other legal and administrative impediments to completing this project by the end of the calendar year.

A substantial portion of the project areas addressed by these waivers have already undergone environmental reviews. In those areas where environmental reviews have not yet occurred, the department will conduct a review before any major construction begins. The department remains deeply committed to environmental responsibility, and will continue to work closely with the Department of Interior and other federal and state resources management agencies to ensure impacts to the environment, wildlife, and cultural and historic artifacts are analyzed and minimized.

The department also places a high priority on interaction with, and feedback from, local officials, landowners and community members about border infrastructure project plans. Since May 2007, more than 600 individual landowners have been contacted and over one hundred meetings with local officials, public open houses and town halls have been held along the southwest border.

The department has used its discretionary waiver authority on three previous occasions. Certain environmental restrictions were waived on Sept. 13, 2005 to complete a roughly 14-mile stretch of fencing, as part of the Border Infrastructure System, near San Diego, California. A second waiver of environmental restrictions was used for additional border infrastructure near the Barry M. Goldwater Range in southern Arizona. on Jan. 12, 2007. A third waiver of environmental restrictions was issued on Oct. 26, 2007, allowing the construction of border infrastructure to move forward near the San Pedro National Riparian Conservation Area in southern Arizona.

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PUBLIC LAW 109–367—OCT. 26, 2006

SECURE FENCE ACT OF 2006

Public Law 109–367
109th Congress

An Act

Oct. 26, 2006
[H.R. 6061]

To establish operational control over the international land and maritime borders of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Secure Fence Act of 2006.
8 USC 1101 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Secure Fence Act of 2006".

8 USC 1701 note.

SEC. 2. ACHIEVING OPERATIONAL CONTROL ON THE BORDER.

Deadline.

(a) IN GENERAL.—Not later than 18 months after the date of the enactment of this Act, the Secretary of Homeland Security shall take all actions the Secretary determines necessary and appropriate to achieve and maintain operational control over the entire international land and maritime borders of the United States, to include the following—

(1) systematic surveillance of the international land and maritime borders of the United States through more effective use of personnel and technology, such as unmanned aerial vehicles, ground-based sensors, satellites, radar coverage, and cameras; and

(2) physical infrastructure enhancements to prevent unlawful entry by aliens into the United States and facilitate access to the international land and maritime borders by United States Customs and Border Protection, such as additional checkpoints, all weather access roads, and vehicle barriers.

(b) OPERATIONAL CONTROL DEFINED.—In this section, the term "operational control" means the prevention of all unlawful entries into the United States, including entries by terrorists, other unlawful aliens, instruments of terrorism, narcotics, and other contraband.

(c) REPORT.—Not later than one year after the date of the enactment of this Act and annually thereafter, the Secretary shall submit to Congress a report on the progress made toward achieving and maintaining operational control over the entire international land and maritime borders of the United States in accordance with this section.

SEC. 3. CONSTRUCTION OF FENCING AND SECURITY IMPROVEMENTS IN BORDER AREA FROM PACIFIC OCEAN TO GULF OF MEXICO.

Section 102(b) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (Public Law 104–208; 8 U.S.C. 1103 note) is amended—

(1) in the subsection heading by striking "NEAR SAN DIEGO, CALIFORNIA"; and

(2) by amending paragraph (1) to read as follows:

"(1) SECURITY FEATURES.—

"(A) REINFORCED FENCING.—In carrying out subsection (a), the Secretary of Homeland Security shall provide for least 2 layers of reinforced fencing, the installation of additional physical barriers, roads, lighting, cameras, and sensors—

"(i) extending from 10 miles west of the Tecate, California, port of entry to 10 miles east of the Tecate, California, port of entry;

"(ii) extending from 10 miles west of the Calexico, California, port of entry to 5 miles east of the Douglas, Arizona, port of entry;

"(iii) extending from 5 miles west of the Columbus, New Mexico, port of entry to 10 miles east of El Paso, Texas;

"(iv) extending from 5 miles northwest of the Del Rio, Texas, port of entry to 5 miles southeast of the Eagle Pass, Texas, port of entry; and

"(v) extending 15 miles northwest of the Laredo, Texas, port of entry to the Brownsville, Texas, port of entry.

"(B) PRIORITY AREAS.—With respect to the border described— Deadlines.

"(i) in subparagraph (A)(ii), the Secretary shall ensure that an interlocking surveillance camera system is installed along such area by May 30, 2007, and that fence construction is completed by May 30, 2008; and

"(ii) in subparagraph (A)(v), the Secretary shall ensure that fence construction from 15 miles northwest of the Laredo, Texas, port of entry to 15 southeast of the Laredo, Texas, port of entry is completed by December 31, 2008.

"(C) EXCEPTION.—If the topography of a specific area has an elevation grade that exceeds 10 percent, the Secretary may use other means to secure such area, including the use of surveillance and barrier tools.".

SEC. 4. NORTHERN BORDER STUDY.

(a) IN GENERAL.—The Secretary of Homeland Security shall conduct a study on the feasibility of a state of-the-art infrastructure security system along the northern international land and maritime border of the United States and shall include in the study—

(1) the necessity of implementing such a system;

(2) the feasibility of implementing such a system; and

(3) the economic impact implementing such a system will have along the northern border.

(b) REPORT.—Not later than one year after the date of the enactment of this Act, the Secretary of Homeland Security shall submit to the Committee on Homeland Security of the House of Representatives and the Committee on Homeland Security and Governmental Affairs of the Senate a report that contains the results of the study conducted under subsection (a).

SEC. 5. EVALUATION AND REPORT RELATING TO CUSTOMS AUTHORITY TO STOP CERTAIN FLEEING VEHICLES.

(a) EVALUATION.—Not later than 30 days after the date of the enactment of this Act, the Secretary of Homeland Security shall—

(1) evaluate the authority of personnel of United States Customs and Border Protection to stop vehicles that enter the United States illegally and refuse to stop when ordered to do so by such personnel, compare such Customs authority with the authority of the Coast Guard to stop vessels under section 637 of title 14, United States Code, and make an assessment as to whether such Customs authority should be expanded;

(2) review the equipment and technology available to United States Customs and Border Protection personnel to stop vehicles described in paragraph (1) and make an assessment as to whether or not better equipment or technology is available or should be developed; and

(3) evaluate the training provided to United States Customs and Border Protection personnel to stop vehicles described in paragraph (1).

(b) REPORT.—Not later than 60 days after the date of the enactment of this Act, the Secretary of Homeland Security shall submit to the Committee on Homeland Security of the House of Representatives and the Committee on Homeland Security and Governmental Affairs of the Senate a report that contains the results of the evaluation conducted under subsection (a).

Approved October 26, 2006.

LEGISLATIVE HISTORY—H.R. 6061:

CONGRESSIONAL RECORD, Vol. 152 (2006):
Sept. 14, considered and passed House.
Sept. 21, 25, 26, 28, 29, considered and passed Senate.
WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 42 (2006):
Oct. 26, Presidential remarks.

Label: "Border Wall"

Created by:aislinn_maestas@fws.gov

Total Messages in label:361 (98 conversations)

Created: 04-12-2018 at 13:00 PM

Conversation Contents

Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act

Attachments:

/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.1 TPs DOI on DHS waiver REAL ID Act2005 27March2008.doc
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.2 2006 MOU DHS.DOI.USDA.pdf
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.3 Secretaries of DHS and DOI memo to P.Bush.9.18.2007.pdf
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.4 BILLS-109hr418rfs RealAct2005.pdf
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.5 Border - DOI DHS Joint NR Mitigation Agreement 15Jan2009.docx
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.6 Border - White House FactSheet The Secure Fence Act 2006 26Oct2006.docx
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.7 DHS waiver press release 2008.doc
/41. Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act/1.8 PLAW-109publ367 Secure Fence Act2006.pdf

"Tincher, Chris" <chris_tincher@fws.gov>

From:	"Tincher, Chris" <chris_tincher@fws.gov>
Sent:	Mon Aug 14 2017 12:35:12 GMT-0600 (MDT)
To:	Aislinn Maestas <aislinn_maestas@fws.gov>
CC:	Keenan Adams <keenan_adams@fws.gov>
Subject:	Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act
Attachments:	TPs DOI on DHS waiver REAL ID Act2005 27March2008.doc 2006 MOU DHS.DOI.USDA.pdf Secretaries of DHS and DOI memo to P.Bush.9.18.2007.pdf BILLS-109hr418rfs RealAct2005.pdf Border - DOI DHS Joint NR Mitigation Agreement 15Jan2009.docx Border - White House FactSheet The Secure Fence Act 2006 26Oct2006.docx DHS waiver press release 2008.doc PLAW-109publ367 Secure Fence Act2006.pdf

Hi Aislinn,
I started pulling together some info on the REAL ID Act of 2005 (HR 418), Secure Fence Act of 2006 (HR 6061, existing MOUs and other info. we have in place as well as some TPs that were developed when DHS exercised waiver authority in 2008. Most of these were in the EA Only drive (some are from the web).

The Senator's staffer referred to both the Real ID and the Secure Fence when asking BP questions. She wanted to know if the lands within Santa Ana NWR had been previously identified in the Secure Fence Act. The question for Rob (and/or Refuges realty) is in the Secure Fence Act's land description (Section 3, construction of fences): "... port of entry to the Brownsville, Texas..." My impression is that BP thought Santa Ana may or may not have been covered before. They weren't sure but they thought more areas not covered in the Secure Fence Act are now being discussed due to the shift in threat assessments.

The Real ID Act is clear that all laws may be waived, if necessary (pg 11, Section 102).

Note: The Real Act ID is 58 pgs long, with a good portion of the law focused on document security standards. On page 11, Section 102, the Act discusses "Waiver of Laws...." However, it isn't until pg 53 that border vulnerability and threat assessment begins. This is Title III. Section 302 is on a pilot program, and section 303 is on enhancement of communications integration and information sharing on border security.

Thoughts?

Chris

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HR 418 Real ID Act of 2005
pg 11

SEC. 102. WAIVER OF LAWS NECESSARY FOR IMPROVEMENT OF BARRIERS AT BORDERS.
Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (8 U.S.C. 1103 note) is amended to read as follows:

‘‘(c) WAIVER.— ‘‘(1) IN GENERAL.—Notwithstanding any other provision of law, the Secretary of Homeland Security shall have the authority to waive, and shall waive, all laws such Secretary, in such Secretary’s sole discretion, determines necessary to ensure expeditious construction of the barriers and roads under this section.

Summary of Title III: Border Infrastructure and Technology Integration
(Sec. 301) Directs the Under Secretary of Homeland Security for Border and Transportation Security to study the technology, equipment, and personnel needed to address security vulnerabilities within the United States for each Customs and Border Protection field office that has responsibility for U.S. borders with Canada and Mexico.

(Sec. 302) Directs the Under Secretary of Homeland Security for Science and Technology to develop and report to specified congressional committees on a pilot program to utilize, or increase the utilization of, ground surveillance technologies to enhance U.S. border security. Requires technologies to include video camera, sensor, and motion detection technologies.

(Sec. 303) Requires the Secretary, acting through the Under Secretary for Border and Transportation Security, to develop and implement a plan to: (1) improve communications systems of Federal agencies to facilitate integrated communications among such agencies, State and local government agencies, and Indian tribes on border security matters; and (2) enhance related information sharing among such entities.

Secure Fence Act of 2006
[H.R. 6061]

SEC. 3. CONSTRUCTION OF FENCING AND SECURITY IMPROVEMENTS IN BORDER AREA FROM PACIFIC OCEAN TO GULF OF MEXICO.
Section 102(b) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (Public Law 104–208; 8 U.S.C. 1103 note) is amended—
PUBLIC LAW 109–367—OCT. 26, 2006 120 STAT. 2639

''(1) SECURITY FEATURES.—
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Can we get something completed by next week?

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Keenan Adams

Acting Assistant Regional Director - External Affairs
August & September 2017
U.S. Fish and Wildlife Service - Southwest Region
Office: 505-248-6285

Make everything as simple as possible, but not simpler. ~Albert Einstein

"Maestas, Aislinn" <aislinn_maestas@fws.gov>

From:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
Sent:	Tue Aug 15 2017 13:00:22 GMT-0600 (MDT)
To:	"Tincher, Chris" <chris_tincher@fws.gov>
CC:	Keenan Adams <keenan_adams@fws.gov>
Subject:	Re: Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act

Thank you both for taking time to walk me through this today. Here is my attempt at crafting a series of clarification questions for the solicitor. I know it's probably not worded in the best way as this subject is far out of my wheel house. I also know it needs to be formatted as a BP, which Chris has generously offered to help with.

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Thoughts?

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>
> Thoughts?
>
> Chris
>
> Christine R. Tincher
> Congressional Liaison / Public Affairs Specialist
> U.S. Fish & Wildlife Service - Southwest Region
> New Mexico * Arizona * Texas * Oklahoma
>
> Office: (602) 889-5954
> Mobile: (505) 449-8776
> Email: chris_tincher@fws.gov
>
> **

SEC. 102. WAIVER OF LAWS NECESSARY FOR IMPROVEMENT OF BARRIERS AT BORDERS.
Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (8 U.S.C. 1103 note) is amended to read as follows:

''(c) WAIVER.— ''(1) IN GENERAL.—Notwithstanding any other provision of law, the Secretary of Homeland Security shall have the authority to waive, and shall waive, all laws such Secretary, in such Secretary's sole discretion, determines necessary to ensure expeditious construction of the barriers and roads under this section.

Summary of Title III: Border Infrastructure and Technology Integration
(Sec. 301) Directs the Under Secretary of Homeland Security for Border and Transportation Security to study the technology, equipment, and personnel needed to address security vulnerabilities within the United States for each Customs and Border Protection field office that has responsibility for U.S. borders with Canada and Mexico.

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Secure Fence Act of 2006
[H.R. 6061]

SEC. 3. CONSTRUCTION OF FENCING AND SECURITY IMPROVEMENTS IN BORDER AREA FROM PACIFIC OCEAN TO GULF OF MEXICO.
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PUBLIC LAW 109–367—OCT. 26, 2006 120 STAT. 2639

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--
Aislinn Maestas
Public Affairs Specialist
External Affairs
Southwest Region, US Fish and Wildlife Service
Phone: 505-248-6599

aislinn_maestas@fws.gov

"Adams, Keenan" <keenan_adams@fws.gov>

From:	"Adams, Keenan" <keenan_adams@fws.gov>
Sent:	Tue Aug 15 2017 14:38:07 GMT-0600 (MDT)
To:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
CC:	"Tincher, Chris" <chris_tincher@fws.gov>
Subject:	Re: Aislinn - Materials to aid in pulling together a BP: Briefing Paper Seeking Clarification REAL ID Act

Looks good. I would say get it in a BP format, then pass this on to Kelly. He should run the rest up his chain, as this is their issue...not EA's per se.

On Tue, Aug 15, 2017 at 1:00 PM, Maestas, Aislinn <aislinn_maestas@fws.gov> wrote:

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HR 418 Real ID Act of 2005
pg 11

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September 18, 2007

MEMORANDUM FOR: The President

FROM: Dirk Kempthorne
Secretary of the Interior

Michael Chertoff
Secretary of Homeland Security

SUBJECT: Department of the Interior/Department of Homeland Security Collaboration to Protect Public Lands at the Border

This memorandum describes substantial efforts by the Department of the Interior (DOI) and the Department of Homeland Security (DHS) to improve security and safety on DOI lands along the southwest border.

With your important focus on investments to gain control of the border, we have renewed and extended the commitment of our two departments to work jointly on these issues. Sustained collaboration is imperative to gain control of our borders, assure the security and safety of public lands for the visiting public, and for the DOI employees who work on public lands along the border.

DOI lands cover almost 800 miles (41 percent) of the southwest border, and include vast, uniquely beautiful and environmentally sensitive areas. Some of the tracts of greatest concern cover large portions of New Mexico and the Sonoran desert in Arizona.[1]

Patterns and methods of illegal activity -- particularly drug trafficking, illegal entry and human smuggling -- have historically evolved as we have improved security and strengthened enforcement along specific portions of the border. As improvements in many areas have occurred, impacts have shifted to DOI-managed lands, posing dangers to visitors and employees.

---

[1] DHS border investments and ongoing enforcement operations touch the following DOI-managed and tribal lands: Organ Pipe Cactus National Monument; Cabeza Prieta National Wildlife Refuge; Buenos Aires National Wildlife Refuge; San Pedro Riparian National Conservation Area; San Bernardino National Wildlife Refuge; several BLM sections to the east of Naco and Douglas, Arizona; and the Tohono O'odham tribal reservation

For example, improvements in border security in the San Diego area led to a noticeable displacement of this illegal activity beginning in 1995 into the more remote areas of Arizona and a substantial increase in illegal border activity there. In 2005, five homicides occurred at Buenos Aires National Wildlife Refuge. Today, both DHS and DOI employees are the subjects of surveillance by drug smugglers, some of whom have established observation posts on our lands, and are equipped with assault weapons, encrypted radios, a network of signal repeaters hidden in the mountains, night vision optics and other sophisticated equipment. Nearly 600,000 pounds of marijuana and three thousand pounds of cocaine were seized on DOI-managed lands in 2006. National parks and wildlife refuge lands are supposed to be open to the public on the southwest border. Because visitors to public lands also face increased risk of harm, however, significant areas are being closed to the public, compromising public expectations and the mission of these public lands.

DOI dedicates as much as 50 percent of its budgets for those properties to security and law enforcement activities. DOI statistics show that total federal law enforcement apprehension of illegal aliens on DOI and tribal lands increased dramatically, from an estimated 17,000 arrests in 2001 to 240,000 arrests in 2006. That trend has begun to reverse in 2007, with apprehensions on DOI and tribal lands down by approximately 30,000 in the first six months of 2007. The illegal traffic has also resulted in significant physical damage to public land resources, sensitive fish and wildlife habitats, and valuable archeological resources.

As we continue to increase the size of the Border Patrol and bring on-line significant new investments with the Secure Border Initiative (SBI), we are gaining control of segments of the border that have been significant corridors for illegal activity. This will place greater pressure on the criminal organizations that move people and drugs. These organizations will no doubt evolve their own tactics and continue to deploy more sophisticated technologies and techniques to evade detection. In order to be nimble in containing illegal cross-border activity, DOI and DHS must continue to strengthen our work together. We must continue to secure the border and protect visitors and employees in areas along the border.

There is a strong history of cooperation in the field between Border Patrol and DOI law enforcement staff. DHS (and its legacy agencies) has established formal agreements with public land law enforcement personnel and agencies. For example, in 2006 DHS, DOI, and USDA signed a formal border cooperation agreement to strengthen enforcement. We plan to continue efforts to coordinate and share radio communications and encryption capability and protocols to improve law enforcement interoperability.

DHS, through the Border Patrol, initiated a Public Lands Liaison Agent program throughout its sectors. DOI personnel attended the training of these agents. As a result, the Border Patrol has engaged DOI in Borderlands Management Task Forces in locations west of Texas. The task forces assist our mutual work through regular meetings. To strengthen these efforts, CBP will initiate Borderlands Management Task Force efforts in Texas Border Patrol sectors, and DOI will include both law enforcement and resource management personnel as liaisons.

At the headquarters level, we are building on that partnership to manage these issues. DOI has established a multi-disciplinary senior leadership team to work with Customs and Border

Protection (CBP) to address the border issues of concern to DOI. We plan to identify a streamlined mechanism to address funding reimbursements for DOI support of DHS's SBI activities.

We both have increased collaboration of DHS and DOI law enforcement to achieve solid law enforcement alignment in the field. There is now routine coordination between CBP and DOI headquarters law enforcement leaders. Moreover, DOI is placing resource experts next month in the SBI headquarters office in Washington. This will further facilitate project design and construction of border technology and infrastructure investments, including DHS's fencing, vehicle barriers, ground-based radars, cameras and other sensors. DOI plans to work with CBP to make skilled DOI employees available for the environmental assessment process to facilitate and expedite reviews and to help ensure that the border control infrastructure decisions being made integrate DOI visitor security, employee safety and land management imperatives. DOI agencies will be named as formal cooperating agencies during the review of infrastructure and other projects at the border. DOI and DHS will collaborate upon a timeline for the investment of resources affecting DOI lands on the border.

In sum, DHS and DOI remain jointly committed to strong collaboration to achieve the goals of the border security initiative. DHS has the principal responsibility to control traffic across the U.S./Mexico border. DOI will continue its efforts to integrate DOI mission considerations, including the safety of DOI visitors and employees and the protection of sensitive land resources, into the SBI planning process and assist DHS in meeting its considerable obligations to ensure border security. DOI's FY2009 budget submission proposes increased funding to meet its obligations to protect public lands near the border as well as visitors and our employees, as part of the broad national focus on enhancing homeland security.

U.S. Customs and Border Protection

Thursday, July 6, 2017
08:30 AM – 12:30 PM
U.S. Fish and Wildlife Service
Santa Ana National Wildlife Refuge Visitor Center

AGENDA:

08:15 – 08:30	**FWS Starts Conference Line** • TBD (if needed)
08:30 – 08:35	**Welcome, Opening Remarks & Introductions**
08:35 – 08:45	**CBP: FY17 Projects in RGV & General Overview**
08:35 – 08:45	**CBP: FY18 Budget Projects – RGV Border Wall System**
08:45 – 09:15	**USACE: RGV Levee Wall Design** **(Scope, Schedule, RE/ENV, etc.)**
09:15 – 09:30	**Open Discussion Re: USFWS & IBWC Coordination**
09:30 – 12:00	**Onsite Field Visit of Levee Site at Santa Ana NWR**
09:30 – 12:00	**Closing Comments & Action Items**

Label: "Border Patrol/Border Patrol FOIA 2017 (2)"

Created by:bryan_winton@fws.gov

Total Messages in label:233 (49 conversations)

Created: 09-25-2017 at 06:47 AM

Conversation Contents

Planning Meeting at Santa Refuge in McAllen, TX

Attachments:

/44. Planning Meeting at Santa Refuge in McAllen, TX/1.1 invite.ics
/44. Planning Meeting at Santa Refuge in McAllen, TX/1.2 CBP-FWS Meeting Agenda_DRAFT as of 070317_v2.doc
/44. Planning Meeting at Santa Refuge in McAllen, TX/2.1 CBP-FWS Meeting Agenda_DRAFT as of 070317_v2.doc

[redacted] @cbp.dhs.gov>

From:	[redacted] @cbp.dhs.gov>
Sent:	Mon Jul 03 2017 12:26:59 GMT-0600 (MDT)
To:	Jonathan Andrew <Jonathan_Andrew@ios.doi.gov>, "Range, Brent" <brent_range@ios.doi.gov>, [redacted] @cbp.dhs.gov>, '[redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @lmi.org>, "Jess, Robert" <robert_jess@fws.gov>, [redacted] @cbp.dhs.gov>, [redacted] cbp.dhs.gov>, [redacted] cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>, "Reyes, Ernesto" <ernesto_reyes@fws.gov>, "'kelly_mcdowell@fws.gov'" <kelly_mcdowell@fws.gov>, "'Perez, Sonny'" <sonny_perez@fws.gov>, "bryan_winton@fws.gov" <bryan_winton@fws.gov>, [redacted] @usace.army.mil>
CC:	[redacted] @cbp.dhs.gov>, [redacted] @cbp.dhs.gov>, [redacted] cbp.dhs.gov>
Subject:	Planning Meeting at Santa Refuge in McAllen, TX
Attachments:	invite.ics CBP-FWS Meeting Agenda_DRAFT as of 070317_v2.doc

[redacted]
SUPERVISORY BORDER PATROL AGENT
Public Lands Liaison Agent, Rio Grande Valley Sector
[redacted] [redacted]

Label: "Border Patrol/Border Patrol FOIA 2017 (2)"

Created by:bryan_winton@fws.gov

Total Messages in label:233 (49 conversations)

Created: 09-25-2017 at 06:49 AM

Conversation Contents

Checking in

Attachments:

/49. Checking in/14.1 image001.jpg
/49. Checking in/18.1 image002.jpg

[redacted] @cbp.dhs.gov>

From:	[redacted] cbp.dhs.gov>
Sent:	Fri May 05 2017 08:41:56 GMT-0600 (MDT)
To:	"robert_jess@fws.gov" <robert_jess@fws.gov>, "bryan_winton@fws.gov" <bryan_winton@fws.gov>
Subject:	Checking in

Gents,
Good morning and happy Friday! Just checking in to see how things are going. Wanted to try and get together for lunch sometime week after next just to visit- nothing "official" like our last meeting!

Let me know.
Have a good weekend!
[redacted]

[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Fri May 05 2017 08:51:04 GMT-0600 (MDT)
To:	[redacted] cbp.dhs.gov>
CC:	Rob Jess <robert_jess@fws.gov>
Subject:	Re: Checking in

Everything is going fine for as I know! Can you offer up a couple dates for lunch and we'll get back with you on the one that will work for both Rob and I.

bryan

On Fri, May 5, 2017 at 9:41 AM, [redacted] @cbp.dhs.gov> wrote:

> Gents,
> Good morning and happy Friday! Just checking in to see how things are going. Wanted to try and get together for lunch sometime week after next just to visit- nothing "official" like our last meeting!
>
> Let me know.
> Have a good weekend!
> [redacted]
>
> [redacted]
> Division Chief
> Law Enforcement Operational Programs
> Rio Grande Valley Sector
> U.S. Border Patrol
> [redacted] (office)
> [redacted] (iPhone)

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

[redacted] @cbp.dhs.gov>

From:	[redacted] cbp.dhs.gov>
Sent:	Fri May 05 2017 09:39:50 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>
Subject:	RE: Checking in

Good deal. How does April 16 or 17 look? I will likely bring [redacted] and/or [redacted] with me, too.

[redacted]
DC- LEOPD
[redacted] (office)
[redacted] (iPhone)

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Friday, May 05, 2017 9:51 AM
To: [redacted] @CBP.DHS.GOV>
Cc: Rob Jess <robert_jess@fws.gov>
Subject: Re: Checking in

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>
> [redacted]
> Division Chief
> Law Enforcement Operational Programs
> Rio Grande Valley Sector
> U.S. Border Patrol
> [redacted] (office)
> [redacted] (iPhone)

--
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"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Mon May 08 2017 07:17:42 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>
Subject:	Fwd: Checking in

I'm assuming he means May 16 or 17. I've not got back to him. Waiting to learn your availability.
bryan

---------- Forwarded message ----------
From: [redacted]@cbp.dhs.gov>
Date: Fri, May 5, 2017 at 10:39 AM
Subject: RE: Checking in
To: "Winton, Bryan" <bryan_winton@fws.gov>
Cc: Rob Jess <robert_jess@fws.gov>

Good deal. How does April 16 or 17 look? I will likely bring Bob Duff and/or [redacted] with me, too.

[redacted]
DC- LEOPD
[redacted] (office)
[redacted] (iPhone)

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Friday, May 05, 2017 9:51 AM
To: [redacted]@CBP.DHS.GOV>
Cc: Rob Jess <robert_jess@fws.gov>
Subject: Re: Checking in

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> [redacted]
> Division Chief
> Law Enforcement Operational Programs
> Rio Grande Valley Sector
> U.S. Border Patrol
> [redacted] (office)
> [redacted] (iPhone)

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Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge

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Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Tue May 09 2017 06:13:49 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	Re: Checking in

either day looks good for me Bryan...

On Mon, May 8, 2017 at 8:17 AM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> I'm assuming he means May 16 or 17. I've not got back to him. Waiting to learn your availability.
> bryan
>
> ---------- Forwarded message ----------
> From: [redacted]@cbp.dhs.gov>
> Date: Fri, May 5, 2017 at 10:39 AM
> Subject: RE: Checking in
> To: "Winton, Bryan" <bryan_winton@fws.gov>
> Cc: Rob Jess <robert_jess@fws.gov>
>
> Good deal. How does April 16 or 17 look? I will likely bring [redacted] and/or [redacted] with me, too.
>
> [redacted]
> DC- LEOPD
> [redacted] (office)
> [redacted] (iPhone)
>
> **From:** Winton, Bryan [mailto:bryan_winton@fws.gov]
> **Sent:** Friday, May 05, 2017 9:51 AM
> **To:** [redacted]@CBP.DHS.GOV>
> **Cc:** Rob Jess <robert_jess@fws.gov>
> **Subject:** Re: Checking in
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[redacted]

[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

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--
robert jess
project leader
south texas refuge complex
alamo, texas

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Tue May 09 2017 07:18:25 GMT-0600 (MDT)
To:	[redacted] cbp.dhs.gov>
CC:	Rob Jess <robert_jess@fws.gov>
Subject:	Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

On Fri, May 5, 2017 at 10:39 AM, [redacted] @cbp.dhs.gov> wrote:

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> DC- LEOPD
> [redacted] (office)
> [redacted] (iPhone)
>
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> **Sent:** Friday, May 05, 2017 9:51 AM
> **To:** [redacted] @CBP.DHS.GOV>
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(956) 784-7521 office; (956) 874-4304 cell

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Tue May 09 2017 11:54:29 GMT-0600 (MDT)
To:	"Nicholopoulos, Joy" <joy_nicholopoulos@fws.gov>, Aaron Archibeque <aaron_archibeque@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>
CC:	Bryan Winton <bryan_winton@fws.gov>, Sonny Perez <sonny_perez@fws.gov>
Subject:	Fwd: Checking in

Joy,

BP Agent [redacted] was at our sit down meeting for the border fence discussion and was assigned as the BP Sector point of contact. He'll likely bring [redacted] and [redacted] who are Chiefs over Logistics and Operations for the Sector as well. As we've done in the past over lunch, our discussions will focus on any concerns such as- BP updates on trafficking trends for Illegals and drugs and what our needs are for BP agent location (regarding specific tracts of land we are seeing activity in), then we address their needs (road repair, tree trimming, specific operations that might affect our daily operations, etc). Basically, this is the same as our quarterly border management task force meetings (BMTF) but with no formality and upper echelon BP agents rather than the field agents...

I wanted to make sure you are aware of the meeting but that we are continuing to do business as usual- if any discussion other than this comes up, I'll apprise you of those conversations.

Hope all is well in the Regional Office!
rob

---------- Forwarded message ----------
From: [redacted]@cbp.dhs.gov>
Date: Fri, May 5, 2017 at 9:41 AM
Subject: Checking in
To: "robert_jess@fws.gov" <robert_jess@fws.gov>, "bryan_winton@fws.gov" <bryan_winton@fws.gov>

Gents,
Good morning and happy Friday! Just checking in to see how things are going. Wanted to try and get together for lunch sometime week after next just to visit- nothing “official” like our last meeting!

Let me know.

Have a good weekend!
[redacted]

[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

--
robert jess
project leader
south texas refuge complex
alamo, texas

[redacted] **@cbp.dhs.gov>**

From:	[redacted] cbp.dhs.gov>
Sent:	Tue May 09 2017 12:15:55 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>
Subject:	RE: Checking in

How about the 17th at 1130? Name the place and we'll meet you all there.

Thanks!

[redacted]
DC-RGV
[redacted]

From: Winton, Bryan
Sent: Tuesday, May 09, 2017 7:18:25 AM
To: [redacted]
Cc: Rob Jess
Subject: Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

On Fri, May 5, 2017 at 10:39 AM, [redacted] @cbp.dhs.gov> wrote:

Good deal. How does April 16 or 17 look? I will likely bring [redacted] and/or [redacted] with me, too.

[redacted]
DC- LEOPD
[redacted] (office)
[redacted] iPhone)

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Friday, May 05, 2017 9:51 AM
To: [redacted] @CBP.DHS.GOV>
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Have a good weekend!
[redacted]

[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

--
Bryan R. Winton, Refuge Manager
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"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Mon May 15 2017 07:54:38 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>
Subject:	Fwd: Checking in

did you set up a meeting with these folks or is this pending Joy's approval?
bryan

---------- Forwarded message ----------
From: [redacted]@cbp.dhs.gov>
Date: Tue, May 9, 2017 at 1:15 PM
Subject: RE: Checking in
To: "Winton, Bryan" <bryan_winton@fws.gov>
Cc: Rob Jess <robert_jess@fws.gov>

How about the 17th at 1130? Name the place and we'll meet you all there.

Thanks!

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From: Winton, Bryan
Sent: Tuesday, May 09, 2017 7:18:25 AM
To: [redacted]
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Subject: Re: Checking in

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[redacted] (office)
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Sent: Friday, May 05, 2017 9:51 AM
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> U.S. Border Patrol
> [redacted] (office)
> [redacted] (iPhone)

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Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
c/o
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Mon May 15 2017 12:00:44 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	Re: Checking in

Spoke to Kelly last Friday and we can attend. I prefer that we listen with no commitment nor feedback on the requests or suggestions. My goal is to hold any significant decisions against a solicitors opinion and validated with the refuge supervisor and chief of refuges- keeps you and i on the right side of this whole issue...

On Mon, May 15, 2017 at 8:54 AM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> did you set up a meeting with these folks or is this pending Joy's approval?
> bryan
>
> ---------- Forwarded message ----------
> From: [redacted]@cbp.dhs.gov>
> Date: Tue, May 9, 2017 at 1:15 PM
> Subject: RE: Checking in
> To: "Winton, Bryan" <bryan_winton@fws.gov>
> Cc: Rob Jess <robert_jess@fws.gov>
>
> How about the 17th at 1130? Name the place and we'll meet you all there.
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> Thanks!
>
> [redacted]
> DC-RGV
> [redacted]
>
> ---
>
> **From:** Winton, Bryan
> **Sent:** Tuesday, May 09, 2017 7:18:25 AM
> **To:** [redacted]
> **Cc:** Rob Jess
> **Subject:** Re: Checking in
>
> [redacted]
>
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bryan

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> DC- LEOPD
> [redacted] (office)
> [redacted] (iPhone)
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> **From:** Winton, Bryan [mailto:bryan_winton@fws.gov]
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> **Subject:** Re: Checking in
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>> Division Chief
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>> Rio Grande Valley Sector
>> U.S. Border Patrol
>> [redacted] (office)
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bryan_winton@fws.gov

--
robert jess
project leader
south texas refuge complex
alamo, texas

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Mon May 15 2017 12:28:37 GMT-0600 (MDT)
To:	[redacted] cbp.dhs.gov>
CC:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	Re: Checking in

Sounds great- Bryan and I can meet you all at Fat Daddy's, 1322 S International Blvd, Weslaco, TX · (956) 969-3668 at 11:30 on Wednesday may 17, 2017.

See you then...

On Tue, May 9, 2017 at 1:15 PM, [redacted] @cbp.dhs.gov> wrote:

> How about the 17th at 1130? Name the place and we'll meet you all there.
>
> Thanks!

[redacted]
DC-RGV
[redacted]

From: Winton, Bryan
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To: [redacted]
Cc: Rob Jess
Subject: Re: Checking in

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>> Division Chief
>> Law Enforcement Operational Programs
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>> U.S. Border Patrol

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--
robert jess
project leader
south texas refuge complex
alamo, texas

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Wed May 17 2017 09:26:00 GMT-0600 (MDT)
To:	[redacted]@cbp.dhs.gov
Subject:	Fwd: Checking in

[redacted]
Can you find out if we are still on for today for Lunch with [redacted] and [redacted]
I'm not sure we got confirmation back. Just trying to make sure we are still on for lunch in an hour at Fat Daddy's
bryan

---------- Forwarded message ----------
From: **Jess, Robert** <robert_jess@fws.gov>
Date: Mon, May 15, 2017 at 1:28 PM
Subject: Re: Checking in
To: [redacted]@cbp.dhs.gov>
Cc: "Winton, Bryan" <bryan_winton@fws.gov>

Sounds great- Bryan and I can meet you all at Fat Daddy's, 1322 S International Blvd, Weslaco, TX · (956) 969-3668 at 11:30 on Wednesday may 17, 2017.

See you then...

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> DC-RGV
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> **Cc:** [redacted] Rob Jess
> **Subject:** Re: Checking in
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>> **Subject:** Re: Checking in
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>> bryan
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Gents,
Good morning and happy Friday! Just checking in to see how things are going. Wanted to try and get together for lunch sometime week after next just to visit- nothing "official" like our last meeting!

Let me know.
Have a good weekend!
[redacted]

[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

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robert jess
project leader
south texas refuge complex
alamo, texas

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c/o
Santa Ana National Wildlife Refuge
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(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

[redacted]@cbp.dhs.gov>

From:	[redacted]@cbp.dhs.gov>
Sent:	Wed May 17 2017 09:54:58 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	RE: Checking in

Bryan

I reached out to [redacted] and awaiting his response. Will let you know what he says.

[redacted]

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Wednesday, May 17, 2017 10:26 AM
To: [redacted]@CBP.DHS.GOV>
Subject: Fwd: Checking in

[redacted]
Can you find out if we are still on for today for Lunch with [redacted] and [redacted]
I'm not sure we got confirmation back. Just trying to make sure we are still on for lunch in an hour at Fat Daddy's
bryan

---------- Forwarded message ----------
From: **Jess, Robert** <robert_jess@fws.gov>
Date: Mon, May 15, 2017 at 1:28 PM
Subject: Re: Checking in
To: [redacted]@cbp.dhs.gov>
Cc: "Winton, Bryan" <bryan_winton@fws.gov>

Sounds great- Bryan and I can meet you all at Fat Daddy's, 1322 S International Blvd, Weslaco, TX · (956) 969-3668 at 11:30 on Wednesday may 17, 2017.

See you then...

On Tue, May 9, 2017 at 1:15 PM, [redacted]@cbp.dhs.gov> wrote:

> How about the 17th at 1130? Name the place and we'll meet you all there.
>
> Thanks!
>
> [redacted]
> DC-RGV
> [redacted]
>
> ---
>
> **From:** Winton, Bryan
> **Sent:** Tuesday, May 09, 2017 7:18:25 AM
> **To:** [redacted]
> **Cc:** Rob Jess
> **Subject:** Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

On Fri, May 5, 2017 at 10:39 AM, [redacted] @cbp.dhs.gov> wrote:

> Good deal. How does April 16 or 17 look? I will likely bring [redacted] and/or [redacted] with me, too.
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> [redacted]
> DC- LEOPD
> [redacted] (office)
> (iPhone)
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> **From:** Winton, Bryan [mailto:bryan_winton@fws.gov]
> **Sent:** Friday, May 05, 2017 9:51 AM
> **To:** [redacted] @CBP.DHS.GOV>
> **Cc:** Rob Jess <robert_jess@fws.gov>
> **Subject:** Re: Checking in
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>> [redacted]
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bryan_winton@fws.gov

[redacted]@cbp.dhs.gov>

From:	[redacted]@cbp.dhs.gov>
Sent:	Wed May 17 2017 10:25:28 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	RE: Checking in
Attachments:	image001.jpg

Bryan

I reached out to him and [redacted]. [redacted] is on leave all week and won't be back until next Monday. I have not heard anything from [redacted]. I hope he reaches out to you.

[redacted]

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Wednesday, May 17, 2017 10:26 AM
To: [redacted]@CBP.DHS.GOV>
Subject: Fwd: Checking in

[redacted]
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> **From:** Winton, Bryan
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DC- LEOPD
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bryan_winton@fws.gov

[redacted]@cbp.dhs.gov>

From:	[redacted] cbp.dhs.gov>
Sent:	Wed May 17 2017 12:06:55 GMT-0600 (MDT)
To:	"Jess, Robert" <robert_jess@fws.gov>
CC:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	RE: Checking in

Gentlemen,
I can't apologize enough. I completely missed this email- and then didn't confirm either way. We can try another day- my treat.

Again- my apologies.

Thanks,
[redacted]
DC- LEOPD
[redacted] (office)
[redacted] (iPhone)

From: Jess, Robert [mailto:robert_jess@fws.gov]
Sent: Monday, May 15, 2017 1:29 PM
To: [redacted]@CBP.DHS.GOV>
Cc: Winton, Bryan <bryan_winton@fws.gov>
Subject: Re: Checking in

Sounds great- Bryan and I can meet you all at Fat Daddy's, 1322 S International Blvd, Weslaco, TX · (956) 969-3668 at 11:30 on Wednesday may 17, 2017.

See you then...

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>
> [redacted]
> DC-RGV
> [redacted]
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> **From:** Winton, Bryan
> **Sent:** Tuesday, May 09, 2017 7:18:25 AM
> **To:** [redacted]
> **Cc:** Rob Jess
> **Subject:** Re: Checking in
>
> [redacted]
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robert jess
project leader
south texas refuge complex
alamo, texas

"Jess, Robert" <robert_jess@fws.gov>

From: "Jess, Robert" <robert_jess@fws.gov>
Sent: Wed May 17 2017 12:21:45 GMT-0600 (MDT)

To: [redacted] cbp.dhs.gov>, Bryan Winton <bryan_winton@fws.gov>

Subject: Re: Checking in

[redacted]

No problem and its understandable. We can catch up another time! Hope all is well.
rob & Bryan

On Wed, May 17, 2017 at 1:06 PM, [redacted]@cbp.dhs.gov> wrote:

> Gentlemen,
> I can't apologize enough. I completely missed this email- and then didn't confirm either way. We can try another day- my treat.
>
> Again- my apologies.
>
> Thanks,
> [redacted]
> DC- LEOPD
> [redacted] (office)
> [redacted] (iPhone)
>
> **From:** Jess, Robert [mailto:robert_jess@fws.gov]
> **Sent:** Monday, May 15, 2017 1:29 PM
> **To:** [redacted]@CBP.DHS.GOV>
> **Cc:** Winton, Bryan <bryan_winton@fws.gov>
> **Subject:** Re: Checking in
>
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>
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>
> On Tue, May 9, 2017 at 1:15 PM [redacted]@cbp.dhs.gov> wrote:
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>>
>> Thanks!
>>
>> [redacted]
>> DC-RGV
>> [redacted]
>>
>> ---
>>
>> **From:** Winton, Bryan
>> **Sent:** Tuesday, May 09, 2017 7:18:25 AM
>> **To:** [redacted]
>> **Cc:** Rob Jess
>> **Subject:** Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

On Fri, May 5, 2017 at 10:39 AM, [redacted]@cbp.dhs.gov> wrote:

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> DC- LEOPD
> [redacted] (office)
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> **From:** Winton, Bryan [mailto:bryan_winton@fws.gov]
> **Sent:** Friday, May 05, 2017 9:51 AM
> **To:** [redacted]@CBP.DHS.GOV>
> **Cc:** Rob Jess <robert_jess@fws.gov>
> **Subject:** Re: Checking in
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> bryan
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>> Division Chief
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alamo, texas

[redacted]@cbp.dhs.gov>

From:	[redacted] cbp.dhs.gov>
Sent:	Wed May 17 2017 12:23:29 GMT-0600 (MDT)
To:	"Jess, Robert" <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
Subject:	RE: Checking in

I appreciate that. It isn't like me to do that…not sure why I missed that email.

At any rate- I'm looking forward to sitting down with you all.

Thanks,
[redacted]
DC- LEOPD
[redacted] (office)
[redacted] (iPhone)

From: Jess, Robert [mailto:robert_jess@fws.gov]
Sent: Wednesday, May 17, 2017 1:22 PM
To: [redacted]@CBP.DHS.GOV>; Bryan Winton <bryan_winton@fws.gov>
Subject: Re: Checking in

[redacted]

No problem and its understandable. We can catch up another time! Hope all is well.
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> **Subject:** Re: Checking in
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>> Thanks!
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>> [redacted]
>> DC-RGV
>> [redacted]
>>
>> ---
>>
>> **From:** Winton, Bryan
>> **Sent:** Tuesday, May 09, 2017 7:18:25 AM
>> **To:** [redacted]
>> **Cc:** Rob Jess
>> **Subject:** Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

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Cc: Rob Jess <robert_jess@fws.gov>
Subject: Re: Checking in

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Have a good weekend!
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alamo, texas

[redacted] **@cbp.dhs.gov>**

From:	[redacted]@cbp.dhs.gov>
Sent:	Wed May 17 2017 12:24:14 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
Subject:	FW: Checking in
Attachments:	image002.jpg

FYI

From: [redacted]
Sent: Wednesday, May 17, 2017 12:15 PM
To: [redacted]@CBP.DHS.GOV>
Subject: RE: Checking in

Damn- no I am caught up. I see they had a place picked but I may have missed an email from them? I didnt think I got a response. I'll check but have to reschedule by now. I'll call them.

[redacted]
DC-RGV
[redacted]

From: [redacted]
Sent: Wednesday, May 17, 2017 9:53:56 AM
To: [redacted]
Subject: FW: Checking in

Sir

Good morning and hope you are doing great. Will you be able to meet with USFWS today???

v/r

[redacted]

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Wednesday, May 17, 2017 10:26 AM
To: [redacted]@CBP.DHS.GOV>
Subject: Fwd: Checking in

[redacted] Can you find out if we are still on for today for Lunch with [redacted] and [redacted]
I'm not sure we got confirmation back. Just trying to make sure we are still on for lunch in an hour at Fat Daddy's
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Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
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bryan_winton@fws.gov

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Wed May 17 2017 12:35:36 GMT-0600 (MDT)
To:	[redacted] cbp.dhs.gov>
Subject:	Re: Checking in

Not a problem! Next time!
bryan

On Wed, May 17, 2017 at 1:06 PM, [redacted] @cbp.dhs.gov> wrote:

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Cc: Winton, Bryan <bryan_winton@fws.gov>
Subject: Re: Checking in

Sounds great- Bryan and I can meet you all at Fat Daddy's, 1322 S International Blvd, Weslaco, TX · (956) 969-3668 at 11:30 on Wednesday may 17, 2017.

See you then...

On Tue, May 9, 2017 at 1:15 PM, [redacted] @cbp.dhs.gov> wrote:

How about the 17th at 1130? Name the place and we'll meet you all there.

Thanks!

[redacted]
DC-RGV
[redacted]

From: Winton, Bryan
Sent: Tuesday, May 09, 2017 7:18:25 AM
To: [redacted]
Cc: Rob Jess
Subject: Re: Checking in

[redacted]

Either date works for Rob or I. Please let us know what date works best so we can block out those date/time.

thanks
bryan

On Fri, May 5, 2017 at 10:39 AM, [redacted] @cbp.dhs.gov> wrote:

Good deal. How does April 16 or 17 look? I will likely bring [redacted] and/or [redacted] with me, too.

[redacted]
DC- LEOPD
[redacted] (office)
[redacted] (iPhone)

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Friday, May 05, 2017 9:51 AM
To: [redacted]@CBP.DHS.GOV>
Cc: Rob Jess <robert_jess@fws.gov>
Subject: Re: Checking in

Everything is going fine for as I know! Can you offer up a couple dates for lunch and we'll get back with you on the one that will work for both Rob and I.

bryan

On Fri, May 5, 2017 at 9:41 AM, [redacted]@cbp.dhs.gov> wrote:

Gents,
Good morning and happy Friday! Just checking in to see how things are going. Wanted to try and get together for lunch sometime week after next just to visit- nothing "official" like our last meeting!

Let me know.
Have a good weekend!
[redacted]

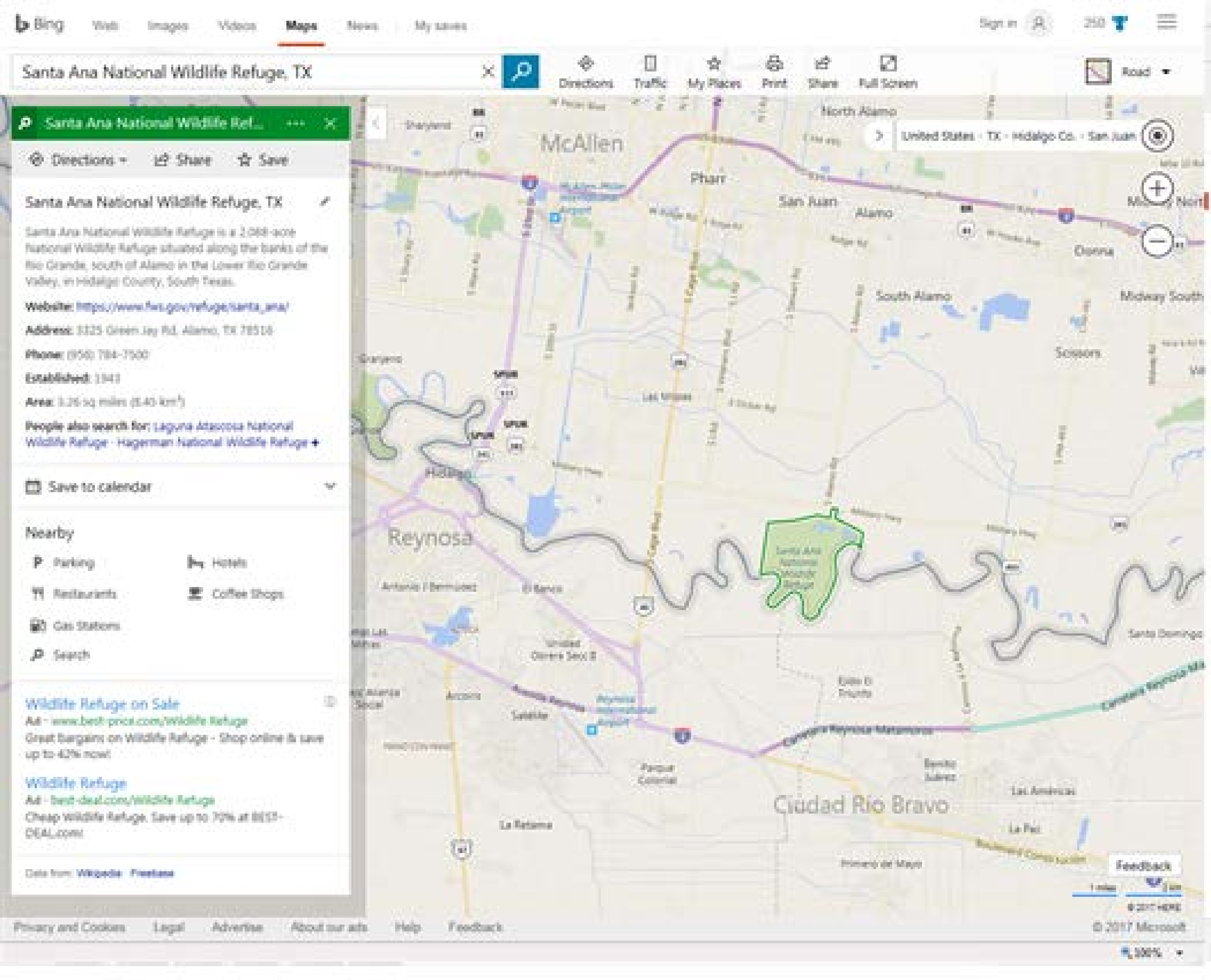
[redacted]
Division Chief
Law Enforcement Operational Programs
Rio Grande Valley Sector
U.S. Border Patrol
[redacted] (office)
[redacted] (iPhone)

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge

> > 3325 Green Jay Road
> > Alamo, Texas 78516
> > (956) 784-7521 office;   (956) 874-4304 cell
>
> --
> robert jess
> project leader
> south texas refuge complex
> alamo, texas

--
Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
c/o
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office;   (956) 874-4304 cell
bryan_winton@fws.gov



Bing
Web
Images
Videos
Maps
News
My saves
Sign in
Santa Ana National Wildlife Refuge, TX
Directions
Traffic
My Places
Print
Share
Full Screen
Road
Santa Ana National Wildlife Ref...
Directions
Share
Save
Santa Ana National Wildlife Refuge, TX
Website:
Address:
Phone:
Established:
Area:
People also search for:
Save to calendar
Nearby
Parking
Hotels
Restaurants
Coffee Shops
Gas Stations
Search
Wildlife Refuge on Sale
Wildlife Refuge
United States · TX · Hidalgo Co. · San Juan
McAllen
Pharr
San Juan
Alamo
North Alamo
South Alamo
Donna
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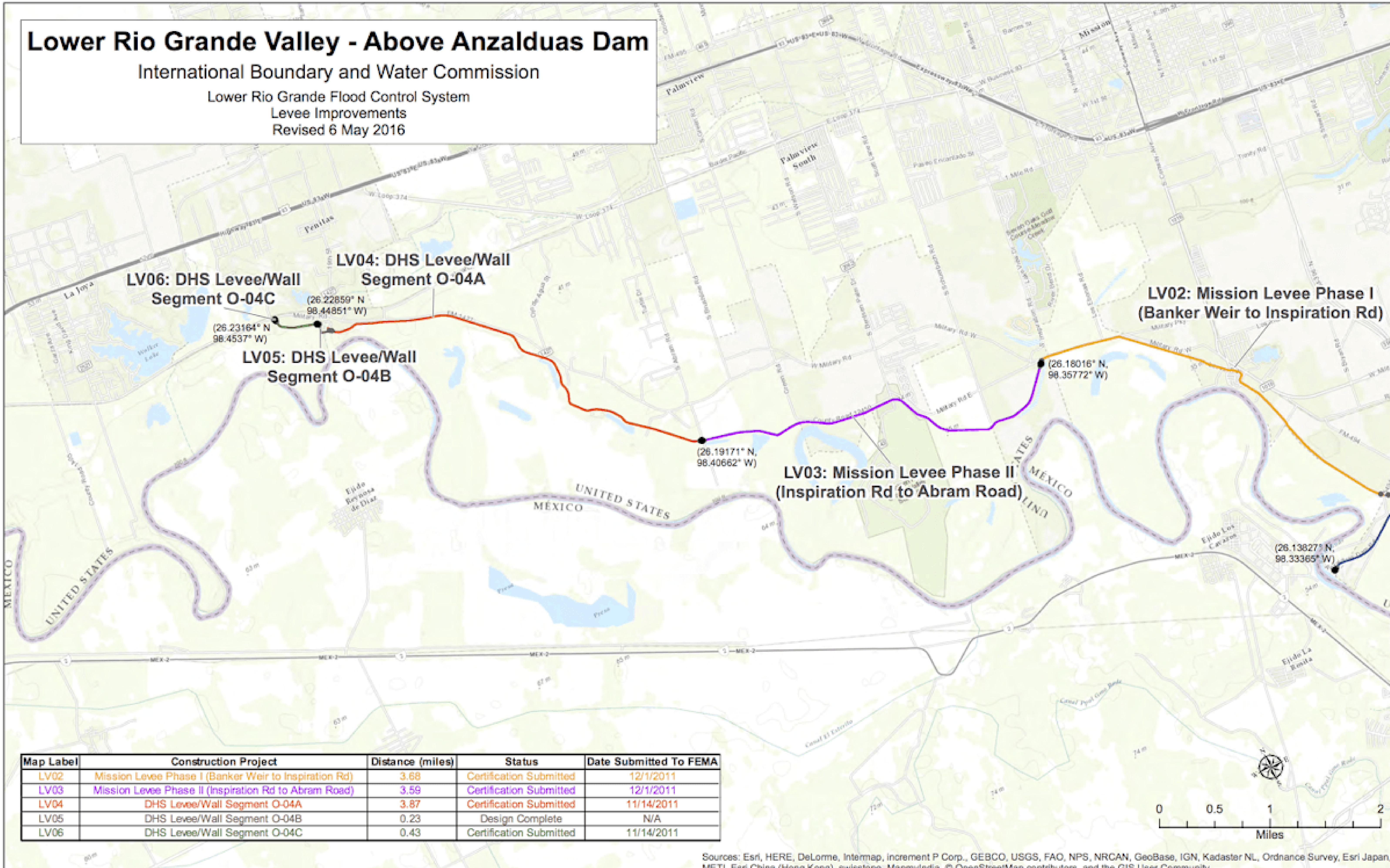
Lower Rio Grande Valley - Above Anzalduas Dam

International Boundary and Water Commission

Lower Rio Grande Flood Control System
Levee Improvements
Revised 6 May 2016



Map Label	Construction Project	Distance (miles)	Status	Date Submitted To FEMA
LV02	Mission Levee Phase I (Banker Weir to Inspiration Rd)	3.68	Certification Submitted	12/1/2011
LV03	Mission Levee Phase II (Inspiration Rd to Abram Road)	3.59	Certification Submitted	12/1/2011
LV04	DHS Levee/Wall Segment O-04A	3.87	Certification Submitted	11/14/2011
LV05	DHS Levee/Wall Segment O-04B	0.23	Design Complete	N/A
LV06	DHS Levee/Wall Segment O-04C	0.43	Certification Submitted	11/14/2011

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Listed coordinates are approximate, and use the NAD83 horizontal datum.

Basemap Provided By ESRI

Label: "Border Wall"

Created by:aislinn_maestas@fws.gov

Total Messages in label:361 (98 conversations)

Created: 04-12-2018 at 13:06 PM

Conversation Contents

Article - Texas Wildlife Refuge for First Border Wall Segment - clarification on levee referenced in news articles

Attachments:

/63. Article - Texas Wildlife Refuge for First Border Wall Segment - clarification on levee referenced in news articles/1.1 image.png
/63. Article - Texas Wildlife Refuge for First Border Wall Segment - clarification on levee referenced in news articles/1.2 170418-ibwc_1.png

"Tincher, Chris" <chris_tincher@fws.gov>

From:	"Tincher, Chris" <chris_tincher@fws.gov>
Sent:	Tue Jul 25 2017 17:58:59 GMT-0600 (MDT)
To:	Devin Helfrich <devin_helfrich@fws.gov>
CC:	Andy Devolder <andy_devolder@fws.gov>, Aislinn Maestas <aislinn_maestas@fws.gov>, Beth Ullenberg <beth_ullenberg@fws.gov>
Subject:	Article - Texas Wildlife Refuge for First Border Wall Segment - clarification on levee referenced in news articles
Attachments:	image.png 170418-ibwc_1.png

Hi Devin,
You were asking about information referenced in recent news coverage. In particular you asked about the referenced earthen levee and for maps. I asked about the levee and was informed it is not on Santa Ana National Wildlife Refuge. No core samples were taken from the Refuge. At the moment, we don't have access to any maps showing the levees in relationship to the Refuge.

We believe the levee is managed by the U.S. Section of the International Boundary and Water Commission (IBWC). The U.S. IBWC operates and maintains three flood control systems on the Rio Grande. The Lower Rio Grande Flood Control System contains 270 miles of U.S. flood control levee along the Rio Grade from Penitas, Texas to beyond Brownsville, Texas. (Info from IBWC's website.)

I will be out of the office beginning tomorrow afternoon through Monday. Please contact Aislinn, Andy or Beth, if you need more information related to levee or border interests.

Chris

FYI

Below is a statement in a piece aired by KRGV News 5 from CBP on the soil testing (Note: CBP's statement does not say the levee is on our Refuge).

http://www.krgv.com/story/35906063/wildlife-refuge-soil-samples-under-review-for-border-infrastructure

...

U.S. Customs and Border Protection Public Affairs Officer Roderick Kise explained the soil testing is being done under the federal government’s fiscal year 2017 budget. Kise sent CHANNEL 5 NEWS the following statement about the soil sampling in the wildlife refuge, which reads in part:

> “Michael Baker & Associates is under contract with the U.S. Army Corps of Engineers to gather geotechnical data at sites in the Rio Grande Valley (RGV) Border Patrol Sector of Texas and other locations through the southwest border. A drilling rig was used to gather soil samples along the existing alignments. The data will assist CBP in future planning. No FY18 construction projects will begin without an approved budget.”

Below is a general map and attached is a map from the IBWC's site of the Lower Rio Grande Flood Control System levee improvements in Texas.

Inline image 3

https://www.ibwc.gov/Recovery/RGF.html
Lori Kuczmanski, Public Affairs Officer, for the U.S. Section of IBWC

https://www.ibwc.gov/home.html
International Boundary & Water Commission

The levee is also referenced in the following:

- *Texas Wildlife Refuge for First Border Wall Segment* at https://www.texasobserver.org/trump-border-wall-texas-wildlife-refuge-breaking/
- http://www.kens5.com/news/jewel-of-wildlife-refuge-system-in-path-of-possible-levee-border-wall/457471514
- Stateman: Border wall may sidestep review and cut off access to wildlife refuge found at www.mystatesman.com/news/state--regional/border-wall-may-sidestep-review-and-cut-off-access-wildlife-refuge/vqdQYH1UXpRdUYX76VtGAN/

Hidalgo Co. Affected Tract (W to E)	150 ft. (Acreage Impacts within refuge bdy polygon) See KMZ files	75 ft. (Approximate acreage impacts	100 ft. (Approximate acreage impacts)	50 ft. (Approximate acreage impacts)
Abrams West	3	1.5	2	1
Kiskadee WMA	2.3	1.9	1.5	0.8
Abrams	2.7	1.4	1.8	0.9
La Parida	8	4	5.4	2.7
Madero	10	6.2	8.3	4.2
Pate Bend	26.2	13.7	18.2	9.1
Hidalgo Bend	23.5	12 2	16.2	8.1
Vela Woods	2.5	1.7	2.3	1.1
Milagro East	5.4	3.2	4.3	2.1
Marinoff	9	3.5	4.6	2.3
Santa Ana NWR	42.6	21.6	28.8	14.4
Monterrey Banco	14.3	7.5	9.9	5
La Coma	2.7	1.5	2	1
Rosario Banco	5.4	3.2	4.2	2.1
Llano Grande Banco	6.7	7.2	9.6	4.8
Santa Maria	4.8	2.9	3.9	2
Totals (Acres Impacted)	169.1	93 2	123	61.6

Polygon Length (ft)
876
686
806
2370
3639
7965
7095
1013
1870
2013
12579
4336
906
1850
4188
1710
53902

Tract Name:	Acreage	Wetlands?	Current Swath Size	Vegetation Quality*	Notes:	Restoration Opp?:
Santa Maria	585	yes	45’	1 – High Quality		Y
Llano Grande Banco	186	no	70’	2 – Med. Quality (High)		
Rosario Banco	34	yes	38’ (25’)	2 – Med. Quality		Y
La Coma	776	yes (entire)	45’	2 – Med. Quality		Y
Monterrey Banco	101	yes (portion)	40’	2 – Med. Quality (Low)	Orchard Oriole	Y
Santa Ana NWR						
Marinoff						
Milagro East	846	yes (ditch)	Base of Levee	2 – Med. Quality (Low)		
Vela Woods	225	no	Base of Levee	1 – High Quality		
Hidalgo Bend	547	no	20’-23’	2 – Med. Quality (Low)		
Pate Bend	456	no	45’-55’	2 – Med. Quality		
Madero	273	yes (small amt)	Base of Levee	1 – High Quality		Y
La Parida Banco	447	no	Base of Levee	2 – Med. Quality		
Abrams	220	no	-	3 – Low Quality		
KiskadeeWMA	13	yes	45’	3 – Low Quality		
Abrams West	257	yes	60’	3 – Low Quality		

*Criteria for Ranking Vegetation Quality: Size/height of trees; Number of Species; Type(s) of Species; Understory; Density; Bird nesting habitat?;
Quality Ranks: 1- High; 2 – Medium; 3- Low

Label: "Border Wall"

Created by:aislinn_maestas@fws.gov

Total Messages in label:361 (98 conversations)

Created: 04-12-2018 at 13:07 PM

Conversation Contents

Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts

Attachments:

/66. Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/1.1 Impacted Tracts Ranking Data Form Completed 7.20.2017.docx
/66. Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/1.2 CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx

Monica Kimbrough <monica_kimbrough@fws.gov>

From:	Monica Kimbrough <monica_kimbrough@fws.gov>
Sent:	Fri Jul 21 2017 11:38:03 GMT-0600 (MDT)
To:	aislinn_maestas@fws.gov
Subject:	Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts
Attachments:	Impacted Tracts Ranking Data Form Completed 7.20.2017.docx CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx

FYI

Monica Kimbrough
Assistant Refuge Supervisor
USFWS, National Wildlife Refuge System
Southwest Region
office: 505-248-7419
cell: 505-366-4628

Please excuse errors, sent from my iPhone

Begin forwarded message:

> **From:** "Jess, Robert" <robert_jess@fws.gov>
> **Date:** July 21, 2017 at 10:38:39 AM MDT
> **To:** Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>
> **Subject: Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts**
>
> We have a meeting with Border Patrol scheduled for Tuesday and are trying to prepare some initial information of impacts of the proposed 150' buffer. These are preliminary (draft).
> rob

---------- Forwarded message ----------
From: **Winton, Bryan** <bryan_winton@fws.gov>
Date: Thu, Jul 20, 2017 at 4:52 PM
Subject: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts
To: Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, Chris Perez <chris_perez@fws.gov>
Cc: Scot Edler <scot_edler@fws.gov>

See Attached. I also took a lot of photos that will be plugged into a Powerpoint and used to stimulate future discussion among leadership and with CBP. Hopefully I can have this available for a Monday discussion (prior to Tuesday, July 25, 1pm meeting with CBP).

Also, thanks to Chris for computing the acreage impacts by size of the Enforcement Zone, assuming we may be able to negotiate reduced impacts on higher priority properties, like Santa Ana, Madero, Santa Maria. Width impacts included that proposed (150') and 100', 75', 50'.

Lastly, Ernesto and I will need to look more closely to Santa Ana and Marinoff on Monday, since this is the property to be most impacts and of highest resource value/concern by most if not all of us.

--
Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

--
robert jess
project leader
south texas refuge complex
alamo, texas

Like Comment Share

Save Santa Ana National Wildlife Refuge shared **Lower Rio Grande Valley Sierra Club**'s **event**.

1 hr ·

We are calling on everyone to come help us protest Trump's border wall Saturday, August 12 at the Historic **La Lomita Mission**, with a protest hike at Santa Ana National Wildlife Refuge on Sunday, August 13.

#SaveSantaAna #SaveLaLomita #NoBorderWall

AUG
12

Save the Mission! Save the River! Resist the Wall!

Cause · 704 people

63 1 Comment

Like Comment Share

LDS Living

Label: "Border Wall"

Created by:aislinn_maestas@fws.gov

Total Messages in label:361 (98 conversations)

Created: 04-12-2018 at 13:07 PM

Conversation Contents

Fwd: planned protest at Santa Ana - August 13

Attachments:

/67. Fwd: planned protest at Santa Ana - August 13/1.1 ATT00001.txt
/67. Fwd: planned protest at Santa Ana - August 13/1.2 IMG_2065.PNG

"Nicholopoulos, Joy" <joy_nicholopoulos@fws.gov>

From:	"Nicholopoulos, Joy" <joy_nicholopoulos@fws.gov>
Sent:	Fri Jul 21 2017 08:07:22 GMT-0600 (MDT)
To:	Aislinn Maestas <aislinn_maestas@fws.gov>, [redacted] [redacted]@ios.doi.gov>, Lance Wenger <lance.wenger@sol.doi.gov>
CC:	"Lupo, Frank" <frank.lupo@sol.doi.gov>, "Devolder, Andy" <andy_devolder@fws.gov>
Subject:	Fwd: planned protest at Santa Ana - August 13
Attachments:	ATT00001.txt IMG_2065.PNG

FYI
---------- Forwarded message ----------
From: **Archibeque, Aaron** <aaron_archibeque@fws.gov>
Date: Fri, Jul 21, 2017 at 8:02 AM
Subject: Fwd: planned protest at Santa Ana - August 13
To: Joy Nicholopoulos <Joy_Nicholopoulos@fws.gov>, Andy Devolder <andy_devolder@fws.gov>

FYI
---------- Forwarded message ----------
From: **Monica Kimbrough** <monica_kimbrough@fws.gov>
Date: Fri, Jul 21, 2017 at 7:33 AM
Subject: Fwd: planned protest at Santa Ana - August 13
To: aaron_archibeque@fws.gov

Monica Kimbrough
Assistant Refuge Supervisor
USFWS, National Wildlife Refuge System
Southwest Region
office: 505-248-7419
cell: 505-366-4628

Please excuse errors, sent from my iPhone

Begin forwarded message:

From: "Jess, Robert" <robert_jess@fws.gov>
To: Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>
Cc: Sonny Perez <sonny_perez@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, [redacted]@fws.gov>, [redacted]@fws.gov>, [redacted]@fws.gov>
Subject: Fwd:

Monica,

Saw this posted on FaceBook last night. It looks like a group is planning to hold an Anti-Border Wall protest here on Sunday, August 13, 2017. I plan to work with my law enforcement officers and visitor services staff in preparation for the protest. I'm sure there will be media and other outlets as well. I'll plan to be here that day as well to ensure coordination and safe operations among staff...

rob
---------- Forwarded message ----------
From: **Robert Jess** <dangimissed@yahoo.com>
Date: Fri, Jul 21, 2017 at 6:46 AM
Subject:
To: Robert Jess <Robert_jess@fws.gov>

--
robert jess
project leader
south texas refuge complex
alamo, texas

--
Aaron M. Archibeque
Regional Chief
National Wildlife Refuge System
Southwest Region
505-248-6937 wk
505-401-1397 cell

Robin Daley ▸ **U.S. Fish & Wildlife Service Southwest Region**

July 15 at 8:34pm ·

Please comment about the report that the US Customs and Border Patrol officials have been preparing to build the first part of Trump's border wall through the Santa Ana Wildlife Refuge in South Texas. (Texas Observer 7/15/17). Have there been environmental studies of the impact of this wall upon the wildlife this refuge was designed to protect? Has there been a public comment period and a public report of the findings? Has there been due process for this non-conservation activity on a protected federal wildlife reserve? Thank you for a reply.

Robin Daley ▸ U.S. Fish & Wildlife Service Southwest Region

July 15 at 8:34pm ·

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Robin Daley ▸ U.S. Fish & Wildlife Service Southwest Region

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Robin Daley ▸ U.S. Fish & Wildlife Service Southwest Region

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Robin Daley ▸ U.S. Fish & Wildlife Service Southwest Region

July 15 at 8:34pm ·

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Label: "Border Wall"

Created by:aislinn_maestas@fws.gov

Total Messages in label:361 (98 conversations)

Created: 04-12-2018 at 13:07 PM

Conversation Contents

Santa Ana story and social response

Attachments:

/69. Santa Ana story and social response/1.1 image.png
/69. Santa Ana story and social response/2.1 image.png
/69. Santa Ana story and social response/3.1 image.png
/69. Santa Ana story and social response/4.1 image.png
/69. Santa Ana story and social response/6.1 image.png
/69. Santa Ana story and social response/7.1 image.png

"Zobel, Abra" <abra_zobel@fws.gov>

From:	"Zobel, Abra" <abra_zobel@fws.gov>
Sent:	Mon Jul 17 2017 07:31:40 GMT-0600 (MDT)
To:	aislinn_maestas <aislinn_maestas@fws.gov>, Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>
CC:	Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>
Subject:	Santa Ana story and social response
Attachments:	image.png

Hi all,

We're being approached on social and asked for comment on the story published by the Texas Observer. It's been light so far, but I expect we'll see more. This is what we received on Facebook:

Inline image 1

While you're formulating a response to the story, we should figure out a few short statements we can make in reply to people that ask questions on our social feeds.

I'll check in with HQ as well and see if they're hearing anything on social.

--
Abra Zobel
U.S. Fish & Wildlife Service, Southwest Region
Division of Visitor Services

24518 FM 1431
Marble Falls, TX 78654
(830) 220-4690 m

USFWS Southwest Region | Facebook | Twitter

"Zobel, Abra" <abra_zobel@fws.gov>

From:	"Zobel, Abra" <abra_zobel@fws.gov>
Sent:	Mon Jul 17 2017 11:17:42 GMT-0600 (MDT)
To:	aislinn_maestas <aislinn_maestas@fws.gov>, Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>
CC:	Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject:	Re: Santa Ana story and social response
Attachments:	image.png

There is a hashtag on twitter we should be aware of, and following #SaveSantaAna.

On Mon, Jul 17, 2017 at 8:31 AM, Zobel, Abra <abra_zobel@fws.gov> wrote:

> Hi all,
>
> We're being approached on social and asked for comment on the story published by the Texas Observer. It's been light so far, but I expect we'll see more. This is what we received on Facebook:
>
> Inline image 1
>
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>
> --
> Abra Zobel

U.S. Fish & Wildlife Service, Southwest Region
Division of Visitor Services

24518 FM 1431
Marble Falls, TX 78654
(830) 220-4690 m

USFWS Southwest Region | Facebook | Twitter

--
Abra Zobel
U.S. Fish & Wildlife Service, Southwest Region
Division of Visitor Services

24518 FM 1431
Marble Falls, TX 78654
(830) 220-4690 m

USFWS Southwest Region | Facebook | Twitter

"Maestas, Aislinn" <aislinn_maestas@fws.gov>

From:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
Sent:	Mon Jul 17 2017 11:22:33 GMT-0600 (MDT)
To:	"Zobel, Abra" <abra_zobel@fws.gov>
CC:	Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>, Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject:	Re: Santa Ana story and social response
Attachments:	image.png

Thanks for the heads up Abra. As soon as we receive guidance from DOI about how to respond, we will share with all SM managers.

- A

On Mon, Jul 17, 2017 at 11:17 AM, Zobel, Abra <abra_zobel@fws.gov> wrote:

> There is a hashtag on twitter we should be aware of, and following #SaveSantaAna.
>
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--
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Marble Falls, TX 78654
(830) 220-4690 m

USFWS Southwest Region | Facebook | Twitter

--
Aislinn Maestas
Public Affairs Specialist
External Affairs
Southwest Region, US Fish and Wildlife Service
Phone: 505-248-6599
aislinn_maestas@fws.gov

"Zobel, Abra" <abra_zobel@fws.gov>

From: "Zobel, Abra" <abra_zobel@fws.gov>

Sent: Fri Jul 21 2017 07:17:00 GMT-0600 (MDT)
To: "Maestas, Aislinn" <aislinn_maestas@fws.gov>
CC: Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>, Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject: Re: Santa Ana story and social response
Attachments: image.png

Hi Aislinn,

Have we heard anything back from DOI? Are we still not commenting on this? I know there is a protest march being planned there and I expect we'll see some twitter activity in the lead up to that. We also received another facebook message asking about the veracity of the story.

On Mon, Jul 17, 2017 at 12:22 PM, Maestas, Aislinn <aislinn_maestas@fws.gov> wrote:

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>>> **Abra Zobel**
>>> U.S. Fish & Wildlife Service, Southwest Region
>>> Division of Visitor Services
>>>
>>> 24518 FM 1431

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Beth Ullenberg <beth_ullenberg@fws.gov>

From:	Beth Ullenberg <beth_ullenberg@fws.gov>
Sent:	Fri Jul 21 2017 07:41:17 GMT-0600 (MDT)
To:	"Zobel, Abra" <abra_zobel@fws.gov>
CC:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>, Andy Devolder <andy_devolder@fws.gov>, Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject:	Re: Santa Ana story and social response

Abra, have you heard when the protest is expected to take place?

Sent from my iPhone

On Jul 21, 2017, at 7:17 AM, Zobel, Abra <abra_zobel@fws.gov> wrote:

> Hi Aislinn,
>
> Have we heard anything back from DOI? Are we still not commenting on this? I know there is a protest march being planned there and I expect we'll see some twitter activity in the lead up to that. We also received another facebook message asking about the veracity of the story.
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"Zobel, Abra" <abra_zobel@fws.gov>

From:	"Zobel, Abra" <abra_zobel@fws.gov>
Sent:	Fri Jul 21 2017 07:42:31 GMT-0600 (MDT)
To:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
CC:	Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>, Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject:	Re: Santa Ana story and social response
Attachments:	image.png

There are a few things coming up down in the Valley. The first is a procession hosted by Our Lady of Guadalupe Catholic Church and some other groups, that is scheduled for Aug 12. The second march is the next day and is being hosted by a group called Save Santa Ana National Wildlife Refuge and the Lower Rio Grande Sierra Club.

I'll keep my eyes open for other things and update periodically, if that's helpful.

On Fri, Jul 21, 2017 at 8:17 AM, Zobel, Abra <abra_zobel@fws.gov> wrote:

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> > > > USFWS Southwest Region | Facebook | Twitter
> > >
> > > --
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"Maestas, Aislinn" <aislinn_maestas@fws.gov>

From:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
Sent:	Fri Jul 21 2017 08:34:35 GMT-0600 (MDT)
To:	"Zobel, Abra" <abra_zobel@fws.gov>
CC:	Beth Ullenberg <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>, Alma Barrus <al_barrus@fws.gov>, Lesli Gray <lesli_gray@fws.gov>, Ken Garrahan <ken_garrahan@fws.gov>
Subject:	Re: Santa Ana story and social response
Attachments:	image.png

Thank you for the info Abra. FYI, we should have a statement you can begin using to respond to inquiries on SM today.

Thanks again,
- A

On Fri, Jul 21, 2017 at 7:42 AM, Zobel, Abra <abra_zobel@fws.gov> wrote:

> There are a few things coming up down in the Valley. The first is a procession hosted by Our Lady of Guadalupe Catholic Church and some other groups, that is scheduled for Aug 12. The second march is the next day and is being hosted by a group called Save Santa Ana National Wildlife Refuge and the Lower Rio Grande Sierra Club.
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aislinn_maestas@fws.gov

Border Fence Coordination Meeting
July 25, 2017 1pm; @ RGV Sector Headquarters, CBP – Edinburg, TX

No sign-in sheet was passed around for signatures
Conference call participants were IBWC (2 representatives; 1 from El Paso; Dawn Gardiner, ES, and Jon Andrew, DOI)

Focus of Discussion: 2.9 mile segment of Border Wall (Santa Ana NWR and Marinoff Tract, Lower Rio Grande Valley NWR)

[redacted]
- there is an aggressive schedule – 15% design discussed today
- Michael Baker – Engineer on the project
- RVSS, Lights, Wall, Enforcement Zone – proposed attributes will little input from FWS
- Decisions have been made by CBP but, "… nothing has been set in stone"
- anticipated that by mid/end of August – 65% design meeting will be needed
- 15% design was just shown to CBP on July 24, 2017 (the day previously to our meeting)
- CBP is vetting internally and anticipate a meeting with Chief [redacted] on July 26

Rob Jess:
- FWS will maintain flexibility in the process
- 150' Enforcement Zone is our issue of highest concern
- [redacted] or others stated this is a SW Border-Wide requirement for Border Wall
- Limitations were identified: Pedestrian crossing; wetlands, drain ditches
- Some concessions should be expected on the part of CBP due to physical limitations

[redacted]
- Commitement by RGV Sector (Deputy Chief [redacted] particularly) to work with and maintain partnership/flexibility with FWS
- Any deviations to what has been proposed will be discussed locally (Chief [redacted] will decide)

[redacted]
- Construction anticipated to begin in January 2018

Rob Jess:
- officially requested a 30-minute meeting with Chief, [redacted] and Deputy Chief [redacted] with RGV Sector

[redacted]:
- Geotechnical tests – nothing of surprise (project will proceed)
- Baker Engineering is evaluating how to expand ramps (for wildlife benefit)
- Availability of fill material will be salvaged from the IBWC levee
- Goal is to not have to import additional soil so Recinos is requesting Engineering firm to adjust border wall within toe of levee in a variety of locations based on how much soil could potentially be salvaged from the inside of the levee for use in construction of the Enforcement Zone
- Open to further discussion on number of gates; seeking opportunity to reduce number of gates if possible (due to cost; $250K ea).
- CBP (and IBWC) would like to see the road on the top of the levee expanded from 16' to 24', which goes against Engineering interest to move levee north to obtain maximum quantity of fill material. Purpose is more space on top is needed to accommodate RVSS towers, lights, etc.
- a 20' aggregate (caliche) patrol road is being proposed. The location of the road this round will be at the southern end of the Enforcement Zone, NOT against the wall like on previous wall and fence segment. At the southern extreme of the Enforcement Zone will be the "drag road"
- there is a possibility that the entire Enforcement Zone could be subject to dragging
- again it was mentioned that mid/late August will be the 65% design meeting, and at that time lights and camera towers will be identified

Regarding the Pedestrian Access—there were mention of Tunnel/Underpass like is used elsewhere along the Border; also discussion of a huge box culvert beneath the pedestrian access

Rob Jess:
Formally requested that CBP consider a 0' Enforcement Zone on Santa Ana (i.e. no buffer south of the fence).

[redacted]
Stated that was not a viable option for CBP

Dawn Gardiner: (on conference line):
Asked about the wetlands on Santa Ana and how they might be impacted?

[redacted] (R&D): "Classified Discussion"
Sensor system to be buried (Top Secret)
- UGS (Unattended Ground Sensors) – senses people, vehicles, aircraft, boat wake, et al.
- will require a 10' plow traverse the site initially to install the line
- to follow: much discussion viewing powerpoint map of where it might be proposed on Santa Ana. River bank, trails, tour loop, etc.
- also discussed installing cable beneath Stewart Road through the Marinoff Tract, under Fred Schuster property and onto tour loop

- an Environmental Stewardship Plan was brought up but no notes on the discussion

[redacted]
- requested GIS map of Santa Ana buffer (150', 100', 75', 50')
- meeting with Chief [redacted] on July 26, 2017 (the following day)

Meeting concluded:

Reconvened at Santa Ana NWR at 3:30pm for site visit/further discussion

Met on concrete path south of the levee for additional discussion on concerns by FWS (Rob Jess) for maintaining the vegetation around the sidewalk so visitors continue to view the refuge as a sanctuary and not as a combat zone.

Rob led a tour with [redacted] and [redacted] to view the river and discuss surveillance interests and ideas further.

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:07 PM

Conversation Contents

Meeting Notes

Attachments:

/86. Meeting Notes/1.1 Border Fence Coordination Meeting 7.25.2017.docx

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Thu Jul 27 2017 07:56:21 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>
Subject:	Meeting Notes
Attachments:	Border Fence Coordination Meeting 7.25.2017.docx

--
Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

July 25, 2017

U.S. CUSTOMS AND BORDER PROTECTION AND USFWS BORDER FENCE MEETING AT THE RGV SECTOR HEADQUARTERS IN EDINBURG, TEXAS

- CBP is on an aggressive schedule; 15 % wall design was presented along with the proposed 150' enforcement zone.
- 150' enforcement zone will include a caliche road and a drag road adjacent to road.
- CBP knows that USFWS will have some concerns
- Nothing is set in stone yet.
- There will be an internal discussion with Sector Chief ([redacted] to decide on enforcement zone needed for their operations.
- CBP is only talking about 2.9 miles which covers Santa Ana NWR only for now.
- FWS asked if there will be flexibility or no flexibility on the width of the enforcement road? CBP said that they will decide by end of week.
- USFWS stated that Secretary of Interior is the only one that can say "No" to the border wall, but will there be any flexibility to reduce the width of the enforcement zone? CBP said that they will be open for discussion.
- USFWS asked how CBP came up with a 150' enforcement zone? CBP responded that it's a national requirement throughout the Southern Border. Also, some areas cannot have 150' due to wetlands, certain situations like topography, lakes, wetlands, etc.
- Engineers working for CBP need feedback by end of the week.
- Start by end of calendar year on fence.
- Waiver is coming in by September

- Rob Jess (South Texas Refuge Complex) Project Leader asked if he could talk with the Sector Chief this week for 30 minutes and CBP will let him know when the Sector Chief would be available.
- Engineers are looking at building up the dirt ramps on the south side of the proposed access road to let wildlife have a high place to go to incase we have a flood like we did in 2010 at the Santa Ana NWR. Engineers need to coordinate with International Boundary and Water Commission.
- Engineers are looking at having a bollard fence with a gate tying to existing handicap wheelchair and pedestrian walkway into the Refuge.
- CBP said that there will be a total of 5 gates for the SANWR. CBP said that gates are very expensive at $250,000 each CBP asked USFWS if we needed all the gates. These gates are needed to access the Refuge for management of Santa Ana wetlands and habitat.
- The border wall will be aligned 10-15'south from the crest of levee. [redacted] – Lead engineer said that they could push the border wall alignment several feet north of the crest of the levee to minimize some clearing of vegetation within the enforcement zone; he will work with his engineer team and the International Boundary and Water Commission who has to approve the border wall design on their levee.
- CBP is proposing 24 feet width on levee for road, wall, and poles for cameras.
- There will be a 20' road in the enforcement zone south of the border wall
- Not putting a road in the Resaca.
- Drag roads will also be within the enforcement zone.
- USFWS asked CBP if they needed patrol roads and drag roads on the east and west side of the SA walkway due to safety concerns for visitors and birders walking along the border wall at the ground level and coming across a CBP agent in a vehicle. Also roads and especially drag roads will

cause dust into the air impacting the visible view shed and experience of a National Wildlife Refuge. Be more aesthetically pleasing to the visitor of a natural area.

- Bollards will be placed on both sides of the walkway – approximately 300’ without having a wall in this section of the levee. If the enforcement zone adjacent to the walkway is too wide, then it will impact wetlands and will have a safety issue with visitors and patrol vehicles.
- CBP will look at reducing or eliminating the patrol road near the walkway entrance into the Refuge or put an overhead ramp. CBP will be looking at placing an underpass or box culverts for patrol vehicles to go through.
- Santa Ana and Bentsen State Park have similar issues along the border wall with dense habitat and view shed for visitors and birders.
- The USFWS recommended pushing the border wall as far north from the crest of the levee to minimize clearing of habitat.
- Lighting will be redirected in sensitive areas like the Santa Ana NWR by using less candles per light and directing the light to the enforcement zone only and not the vegetation, and using a shield to direct the light in the cleared area.
- The USFWS is only making recommendations to minimize impacts to Santa Ana NWR as per our mission, but the final decision will be made by CBP on the width of the enforcement zone.
- The USFWS made CBP and the engineers aware that farmers have a borrow ditch between the levee and the end of their agriculture field to drain off water in their fields because the water (sheet flow) flows north of the river, and if a ditch is removed for the enforcement zone, then CBP will have to replace the burrow ditch for the farmer, otherwise the rain or flood water will flow towards the enforcement zone and wash it out.
- The next 75% design will be done by the end of August.

- CBP and engineers will look at purchasing an inholding between Santa Ana and the Marinoff tract of land (Lower Rio Grande Valley NWR), and will eliminate one proposed gate, and give access for CBP between these two tracts of land which is in private control; estimated to be around 80 acres which is in agriculture use at the time. In the long run, this will be a cost savings for the proposed gate and maintenance for the life of the project, and give CBP access closer to the river between both Refuge tracts. The engineers will look at the feasibility of the gate versus acquiring the piece of inholding.

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:08 PM

Conversation Contents

Notes from Border Wall Meeting

Attachments:

/88. Notes from Border Wall Meeting/1.1 FWS and CBP Border Fence Meeting July 25, 17.doc

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Wed Jul 26 2017 13:13:25 GMT-0600 (MDT)
To:	Robert Jess <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
Subject:	Notes from Border Wall Meeting
Attachments:	FWS and CBP Border Fence Meeting July 25, 17.doc

Please add if I have missed something on my notes.

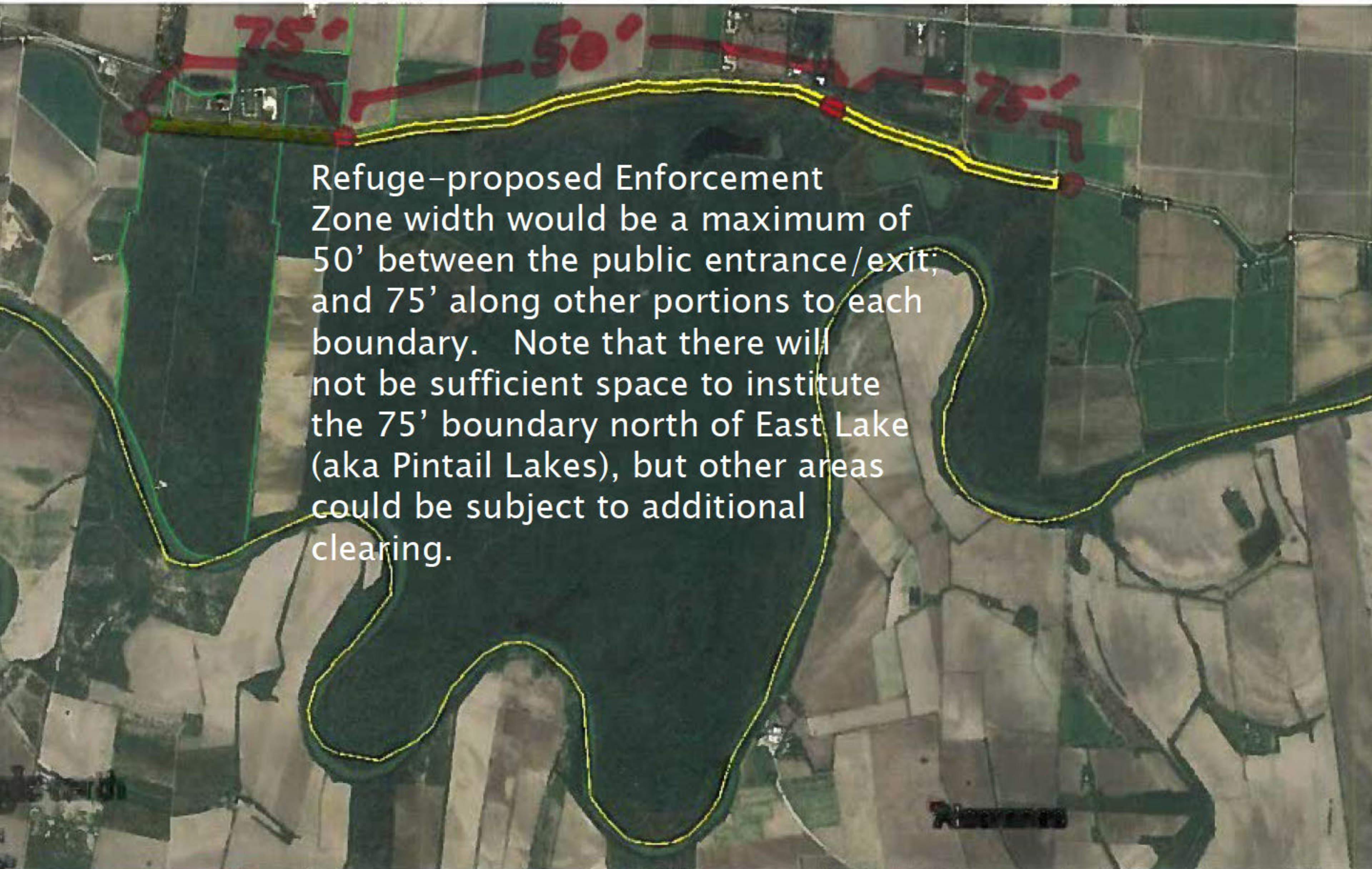
Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
3325 Green Jay Rd
Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

Recommended Enforcement Zone Widths by USFWS

for Santa Ana National Wildlife Refuge in Hidalgo County, Texas

Robert Jess, Project Leader, South Texas Refuges
Ernesto Reyes, Wildlife Biologist (ES)
Bryan Winton, Refuge Manager (NWRS)

RGV Sector, Customs & Border Protection HQ
1-4pm; July 25, 2017


75'
50'
75'
Refuge-proposed Enforcement Zone width would be a maximum of 50' between the public entrance/exit; and 75' along other portions to each boundary. Note that there will not be sufficient space to institute the 75' boundary north of East Lake (aka Pintail Lakes), but other areas could be subject to additional clearing.


Refuge recommendation is to seek to preserve
High quality vegetation, which is why a reduced
Enforcement Zone is requested.

SANTA ANA NWR – 2,088 acres

Buffer acreage: 150' (42.6 acres); 100' (28.8 acres); 75' (21.6 acres); 50' (14.4 acres)

Range of Enforcement Zone Buffers and Related Acreage Impacts

Enforcement Zone Widths on existing Border Wall segments in Refuge lands in Hidalgo County, Texas for purposes of seeing a variety of current Enforcement Zone Widths.

- Hidalgo Bend Tract – 20’–23’
- Monterrey Banco Tract – 40’
- Pate Bend Tract – 50’
- Llano Grande Banco Tract – 70’ (widest anywhere currently)

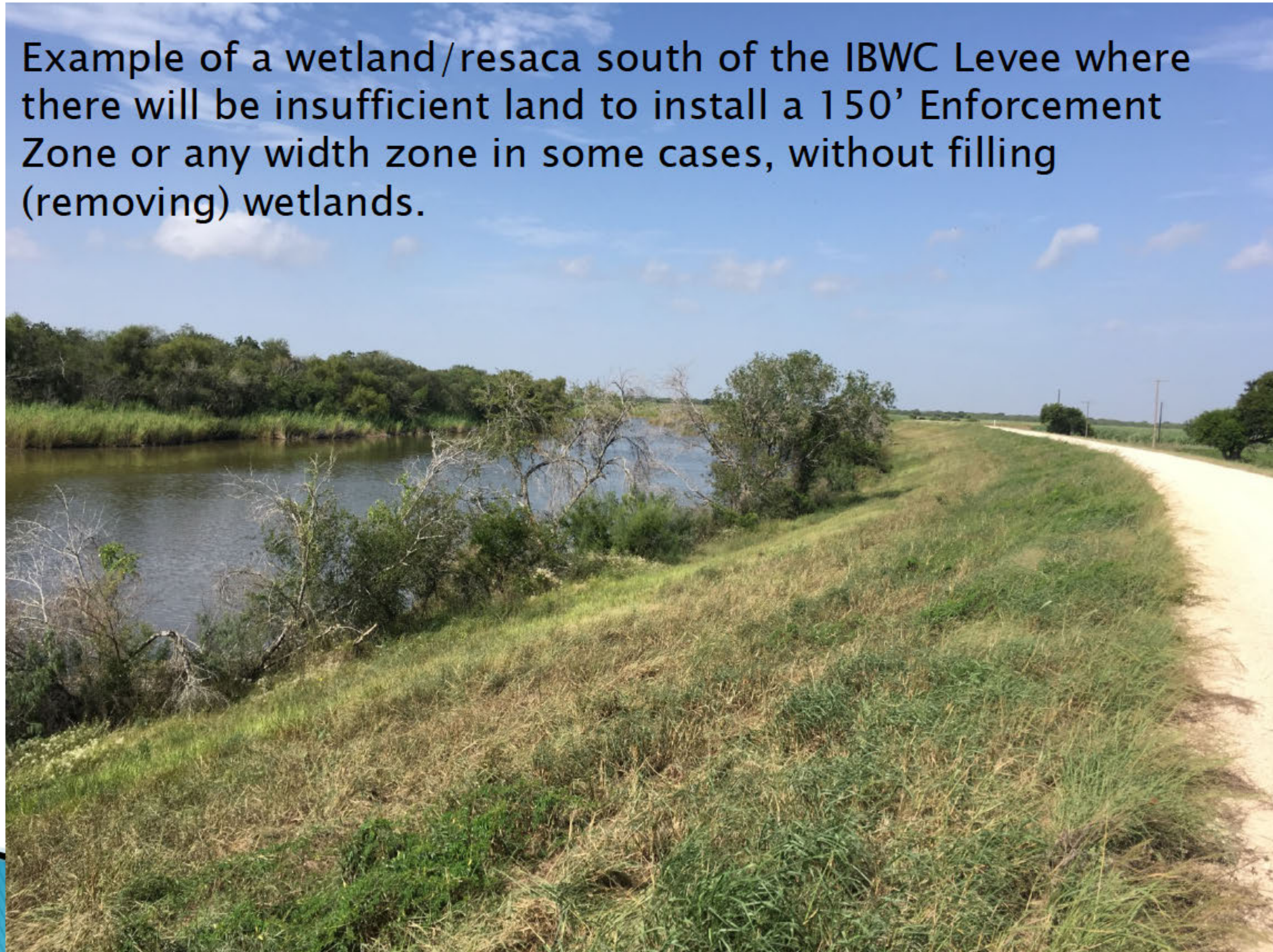

Hidalgo Bend Tract – 20’–23’ Enforcement Zone

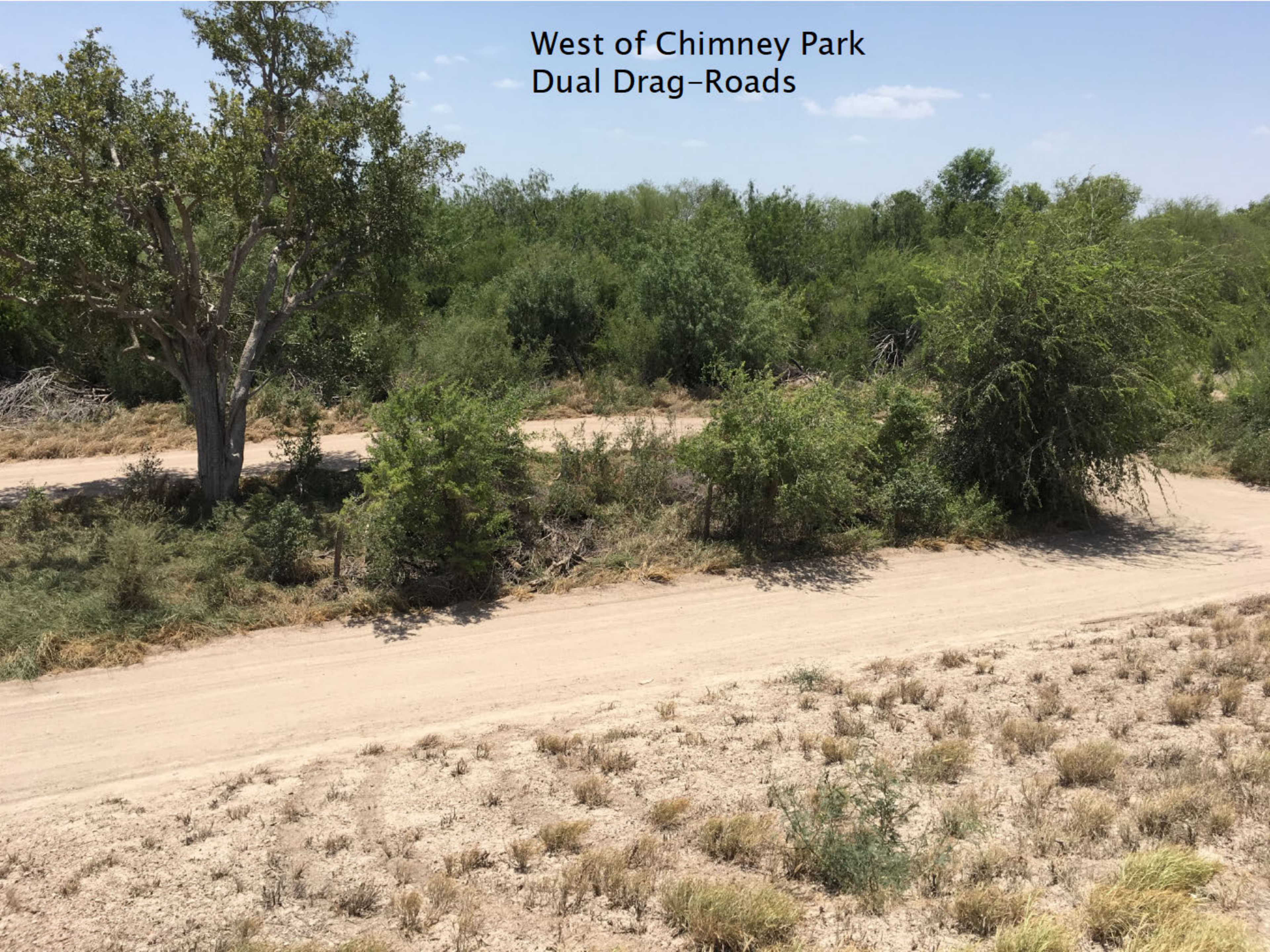

Monterrey Banco Tract – 40’ Enforcement Zone

Pate Bend Tract – 50' Enforcement Zone

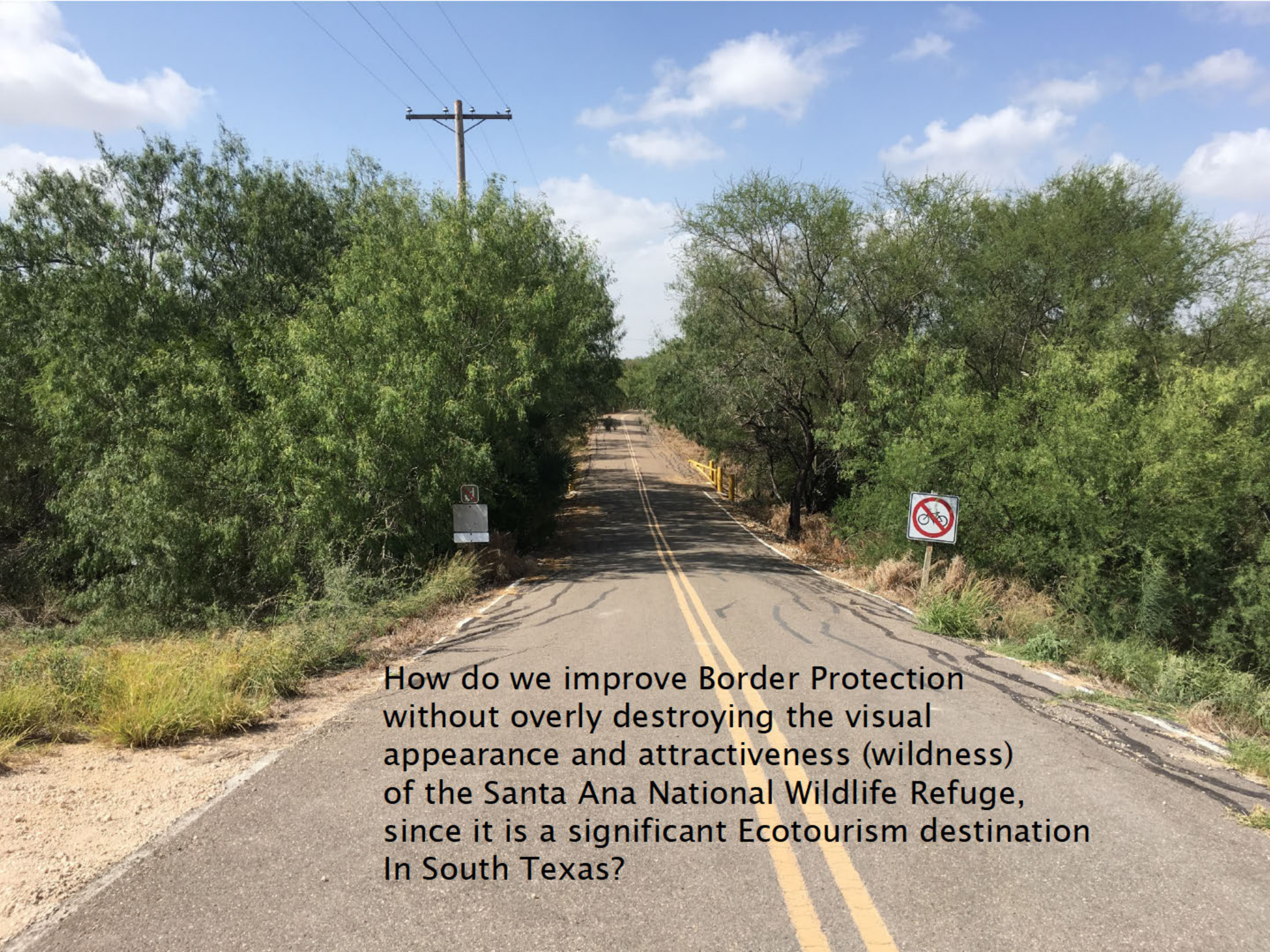
Llano Grande Banco Tract – 70’ Enforcement Zone

Enforcement Zones and Wetlands




West of Chimney Park
Dual Drag-Roads


Madero Tract – between Anzalduas Park and Pepe's on the River
No Drag Roads


How do we improve Border Protection
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Santa Ana NWR
Border Wall Issues/Concerns

Largest remaining block of intact Riparian Forest Habitat (2,088 acres)

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Safety for Visitors

Quality of the Visitor Experience (relates to continued Tourism revenue)

Separation of Administrative Area and Refuge Proper

Lighting

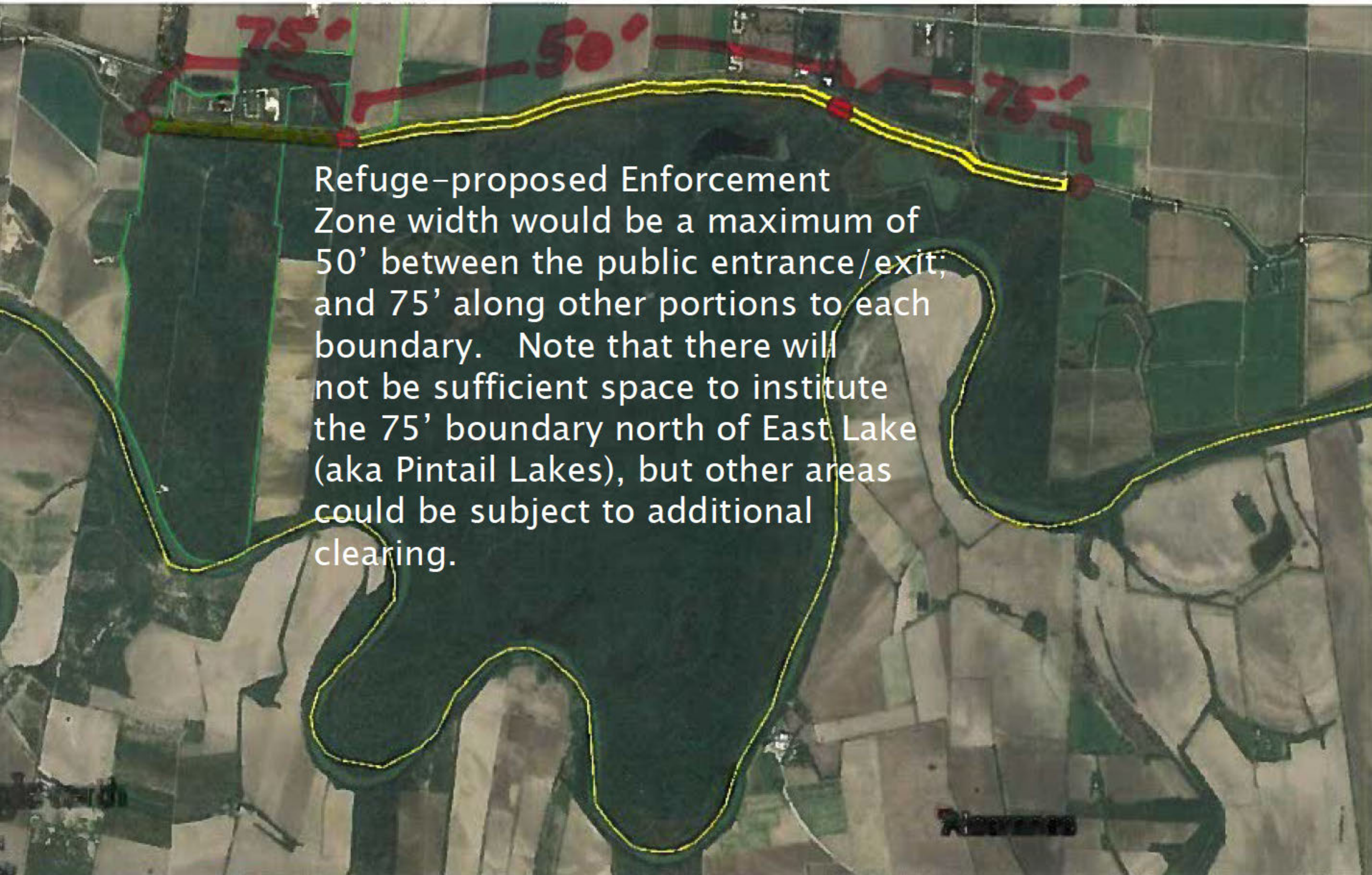
2557
907
281
Image © 2016 DigitalGlobe
Texas Orthoimagery Program
© 2016 Google

Recommended Enforcement Zone Widths by USFWS

for Santa Ana National Wildlife Refuge in Hidalgo County, Texas

Robert Jess, Project Leader, South Texas Refuges
Ernesto Reyes, Wildlife Biologist (ES)
Bryan Winton, Refuge Manager (NWRS)

RGV Sector, Customs & Border Protection HQ
1-4pm; July 25, 2017


75'
50'
75'
Refuge-proposed Enforcement Zone width would be a maximum of 50' between the public entrance/exit; and 75' along other portions to each boundary. Note that there will not be sufficient space to institute the 75' boundary north of East Lake (aka Pintail Lakes), but other areas could be subject to additional clearing.


Refuge recommendation is to seek to preserve
High quality vegetation, which is why a reduced
Enforcement Zone is requested.

SANTA ANA NWR – 2,088 acres

Buffer acreage: 150' (42.6 acres); 100' (28.8 acres); 75' (21.6 acres); 50' (14.4 acres)

Range of Enforcement Zone Buffers and Related Acreage Impacts

Enforcement Zone Widths on existing Border Wall segments in Refuge lands in Hidalgo County, Texas for purposes of seeing a variety of current Enforcement Zone Widths.

- Hidalgo Bend Tract – 20’–23’
- Monterrey Banco Tract – 40’
- Pate Bend Tract – 50’
- Llano Grande Banco Tract – 70’ (widest anywhere currently)


Hidalgo Bend Tract – 20’–23’ Enforcement Zone


Monterrey Banco Tract – 40’ Enforcement Zone

Pate Bend Tract – 50’ Enforcement Zone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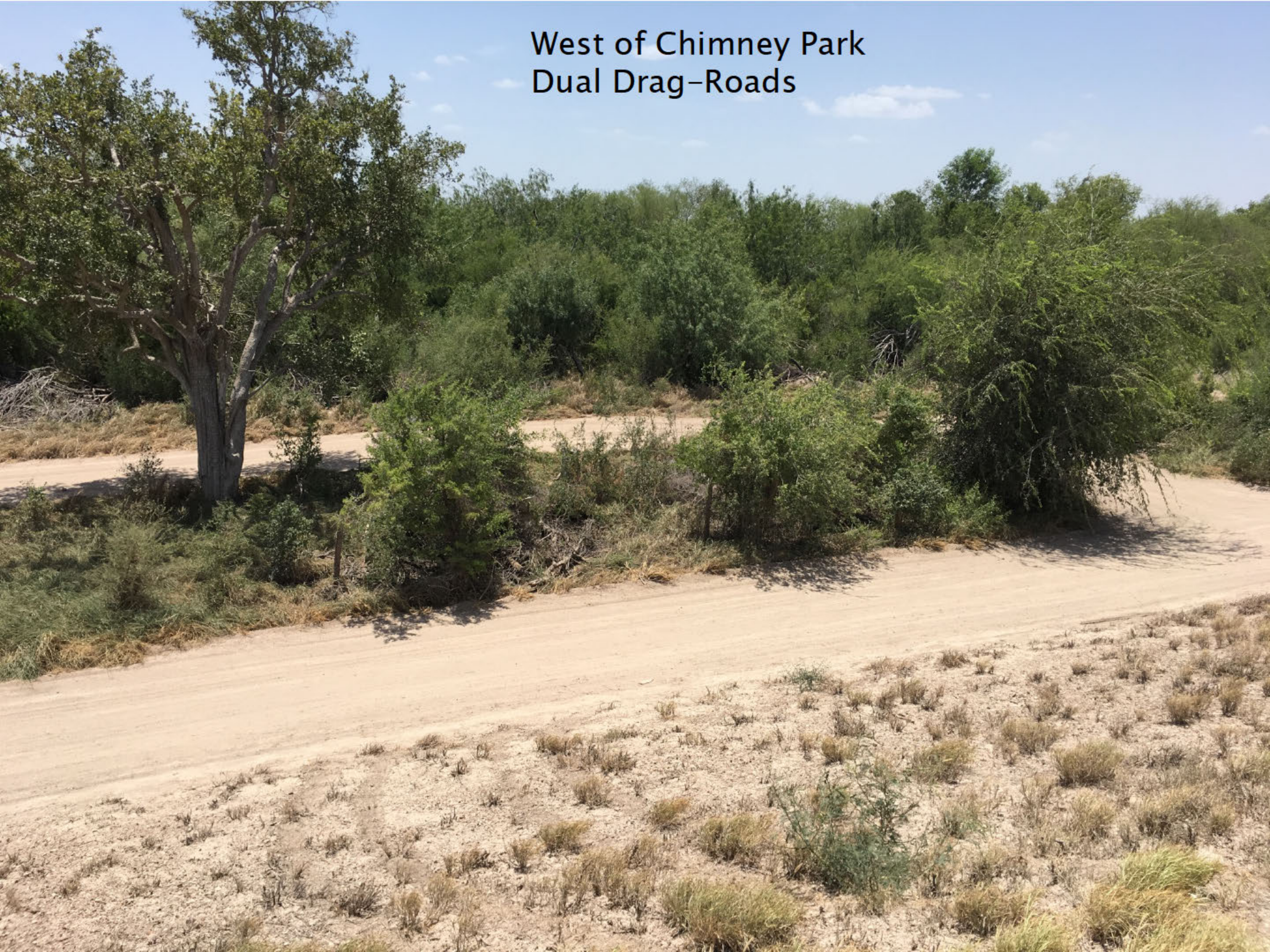
Enforcement Zones and Wetlands

Example of a wetland/resaca south of the IBWC Levee where there will be insufficient land to install a 150' Enforcement Zone or any width zone in some cases, without filling (removing) wetlands.


West of Chimney Park
Dual Drag-Roads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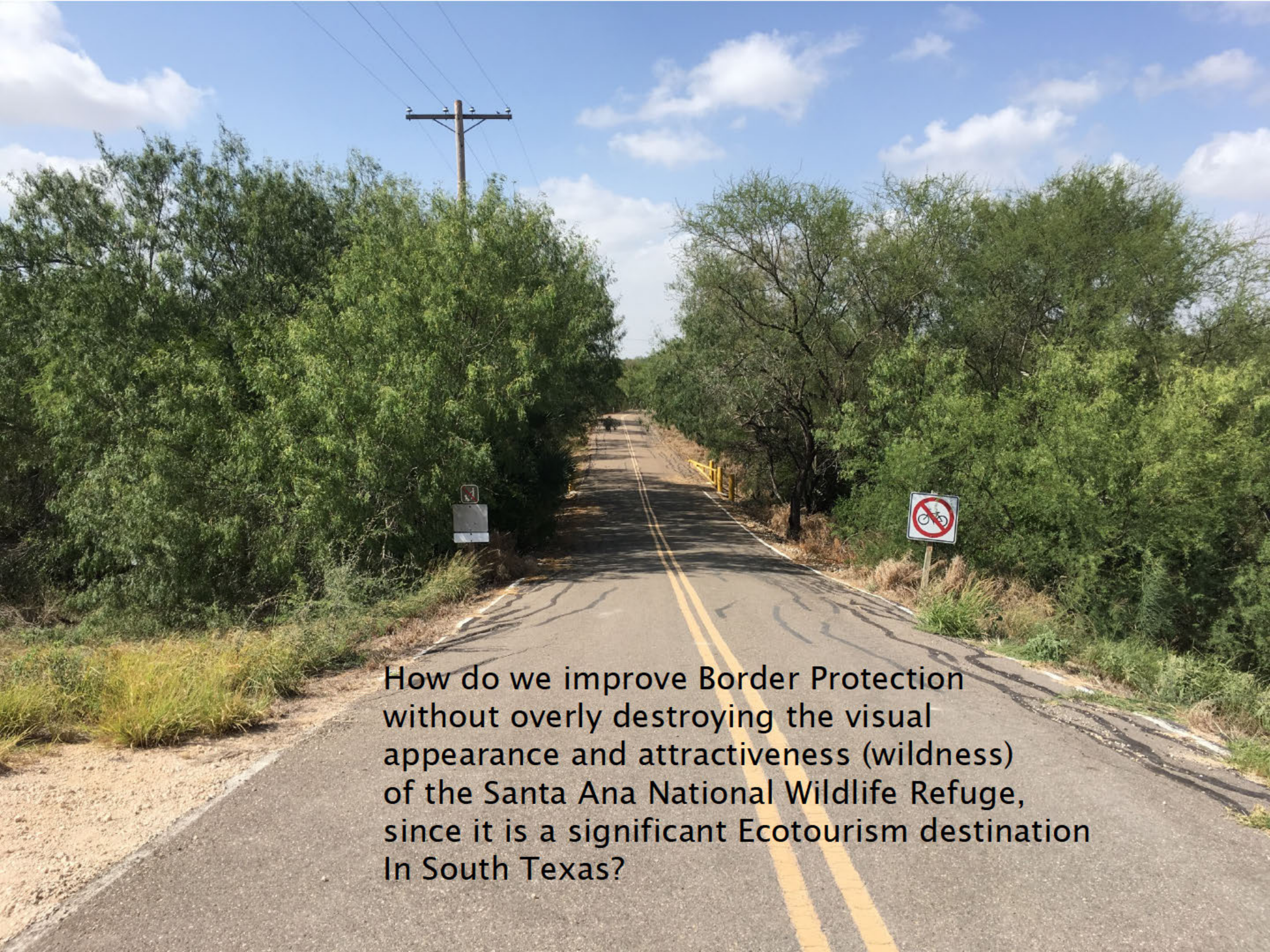
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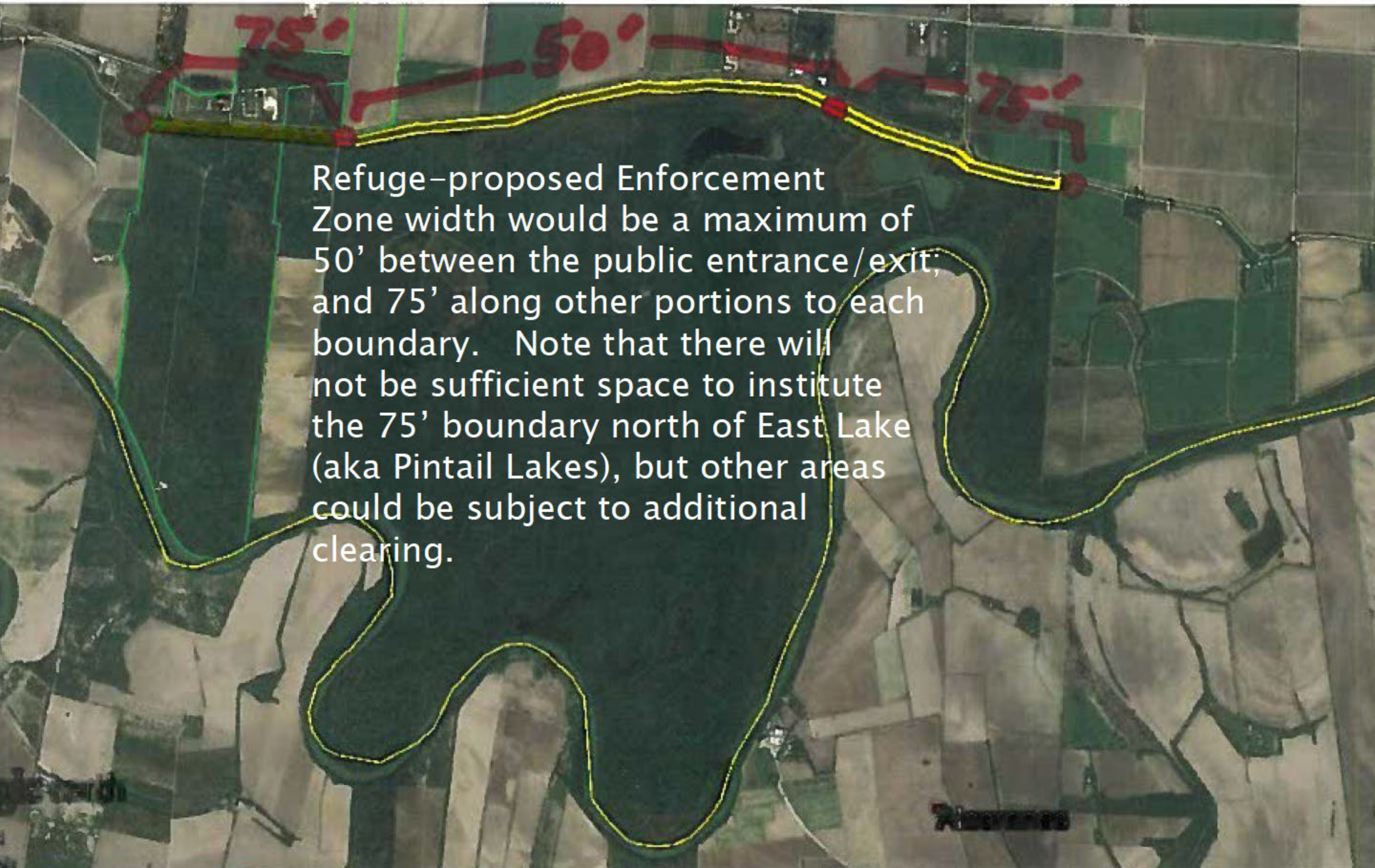
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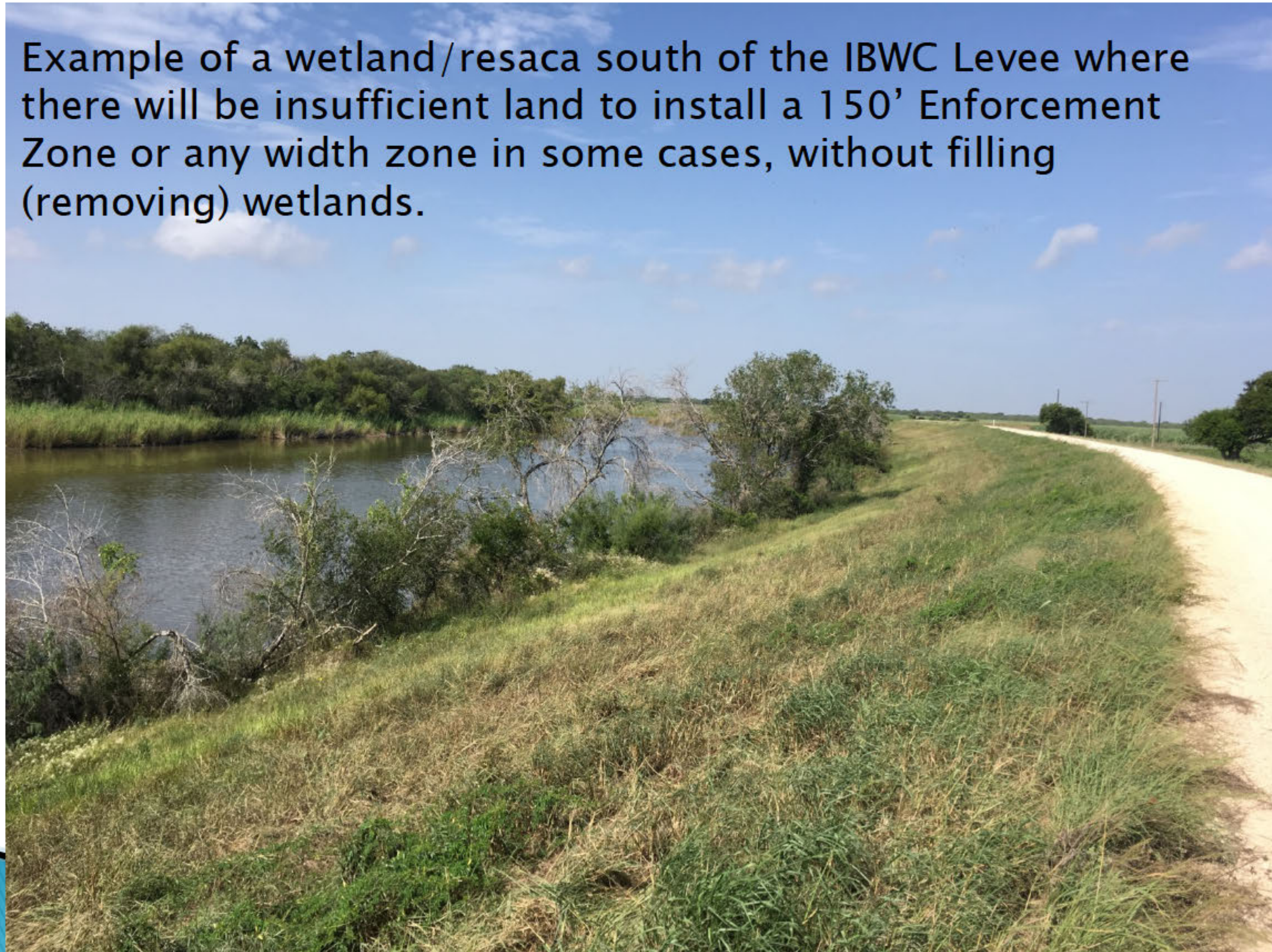

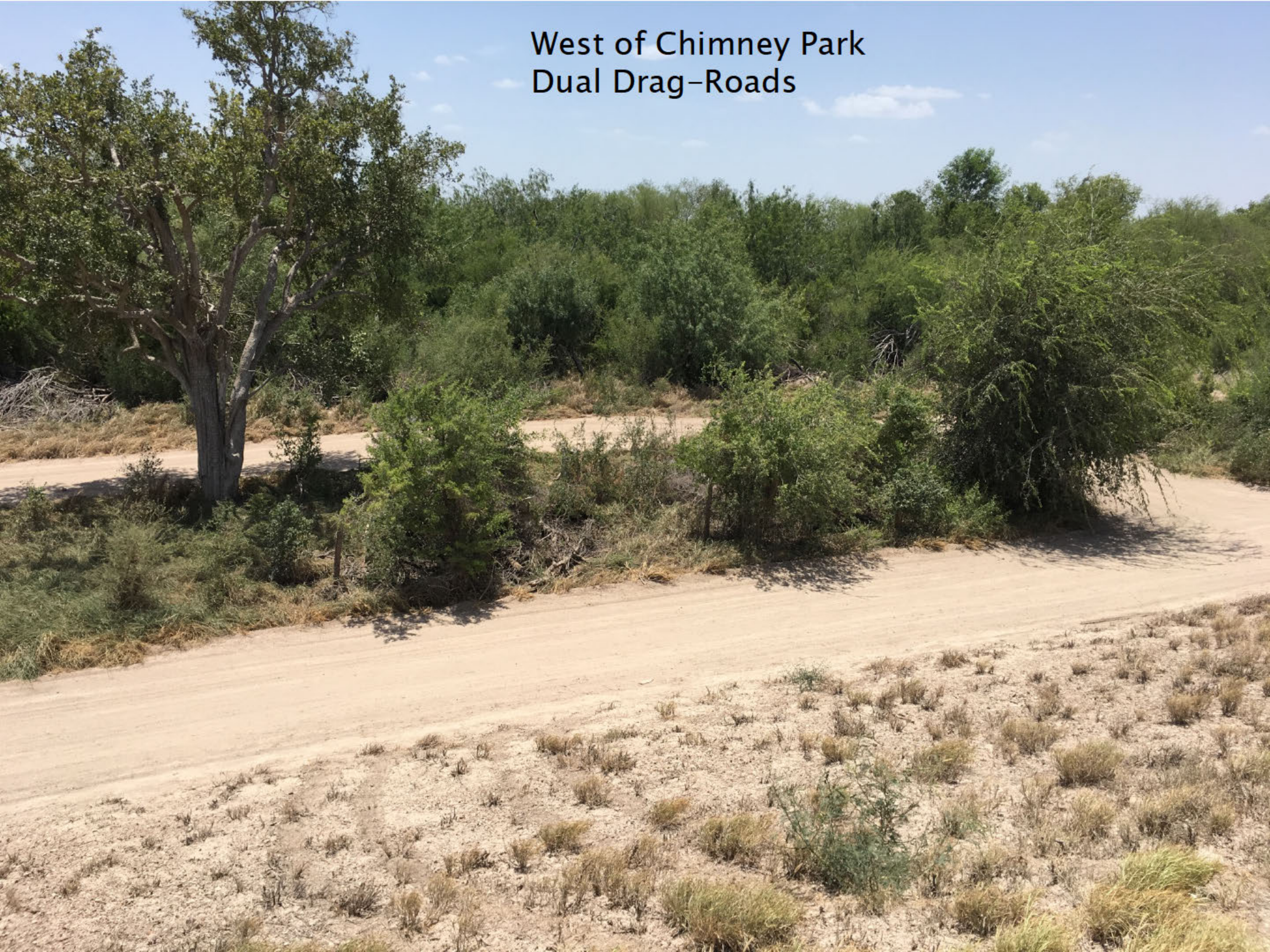
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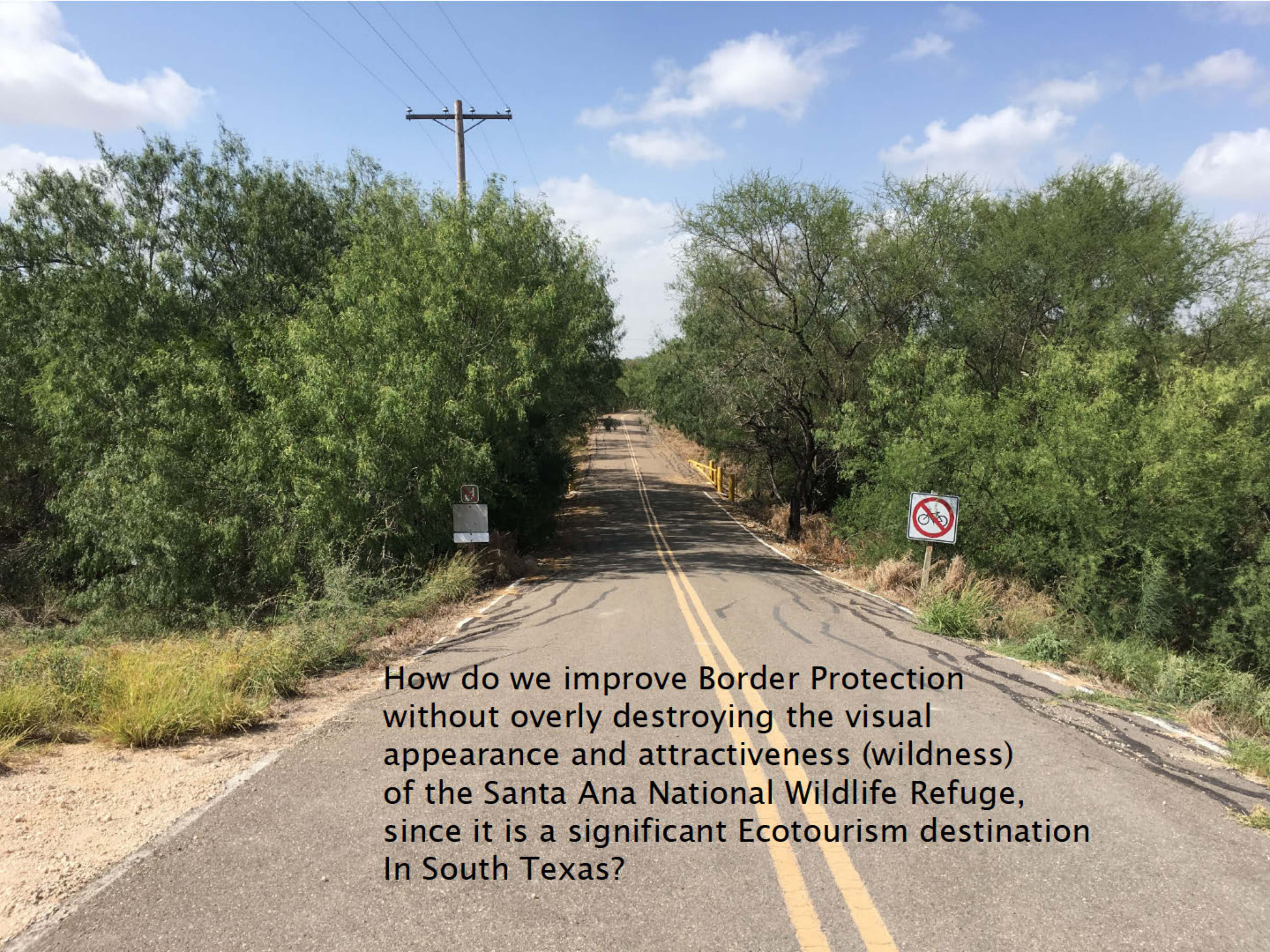
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Google earth

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:08 PM

Conversation Contents

Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

Attachments:

/89. Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale/1.1 Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx
/89. Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale/3.1 Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx
/89. Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale/7.1 Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Tue Jul 25 2017 16:11:52 GMT-0600 (MDT)
To:	(b) (6), (b) (7)(C) [redacted]@cbp.dhs.gov
CC:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>
Subject:	Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale
Attachments:	Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx

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Sincerely,

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Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

[redacted]@cbp.dhs.gov>

From:	[redacted] cbp.dhs.gov>
Sent:	Tue Jul 25 2017 16:37:02 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, [redacted] @cbp.dhs.gov>
Subject:	RE: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

Thank you very much Bryan.

We'll make sure and pass your message to our chief and will continue to work together.

Respectfully,

[redacted]
RGV Sector Wall Project Delivery Team
[redacted]

"Become the kind of leader that people would follow voluntarily, even if you had no title or position." --*Brian Tracy*

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Tuesday, July 25, 2017 5:12 PM
To: [redacted]@cbp.dhs.gov>
Cc: Rob Jess <robert_jess@fws.gov>; Ernesto Reyes <ernesto_reyes@fws.gov>
Subject: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

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bryan_winton@fws.gov

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Wed Jul 26 2017 07:10:44 GMT-0600 (MDT)
To:	"Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>, Jonathan Andrew <Jonathan_Andrew@ios.doi.gov>, [redacted] @ios.doi.gov>, Robert Jess <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
Subject:	Fwd: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale
Attachments:	Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx

Here is a request (powerpoint) from CBP to FWS after we had our meeting yesterday, so they can present it to [redacted] (CBP RGV Sector Chief) for his review of the proposed 50' and 75' enforcement zone for Santa Ana NWR that we (FWS) proposed instead of the 150' zone that was proposed for clearing by CBP. Thanks to Bryan for putting this powerpoint together at the end of the day on a quick turnaround, so the CBP Chief and his staff could discuss this proposal this morning, so they can make a decision by the end of the week.

Ernesto

---------- Forwarded message ----------
From: **Winton, Bryan** <bryan_winton@fws.gov>
Date: Tue, Jul 25, 2017 at 5:11 PM
Subject: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale
To: [redacted] @cbp.dhs.gov
Cc: Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>

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bryan_winton@fws.gov

--
Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
3325 Green Jay Rd
Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Wed Jul 26 2017 07:22:40 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>, Robert Jess <robert_jess@fws.gov>
Subject:	Re: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

Thanks Bryan for putting this together on a short notice. Great Job on the presentation.

Ernesto

On Tue, Jul 25, 2017 at 5:11 PM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> Attached is a short powerpoint that shows a variety of current Enforcement Zone widths on existing Lower Rio Grande Valley NWR tracts, from Border Wall constructed in 2008. Also, is a recommendation on requested Enforcement Zone reductions from the refuge. Please call if you have any questions. Photos were all taken by myself and are available for your reuse if needed.
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> bryan_winton@fws.gov

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Ernesto Reyes

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Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

"Andrew, Jonathan" <jonathan_andrew@ios.doi.gov>

From:	"Andrew, Jonathan" <jonathan_andrew@ios.doi.gov>
Sent:	Wed Jul 26 2017 07:39:39 GMT-0600 (MDT)
To:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
CC:	"Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>, [redacted] @ios.doi.gov>, Robert Jess <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
Subject:	Re: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

Nice job on this.

It appears as though 50 feet would allow for an access road at least. Maybe they can try a reduced cleared area at the refuge and see if it works sufficiently well. If it does not they can always clear later - clearing vegetation is not a part of engineering design so it seems like they could expand the zone as needed.

This is a tough one for all to work on. Perhaps the highest visibility, most visited tract on the river - Bentsen is similar but not as visited - can't think of any others like it.

On Wed, Jul 26, 2017 at 9:10 AM, Reyes, Ernesto <ernesto_reyes@fws.gov> wrote:

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> To: [redacted]@cbp.dhs.gov
> Cc: Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>
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--
Jon Andrew
Interagency Borderlands Coordinator
Office of the Secretary
Department of the Interior

202-320-0718 (cell)

"Gardiner, Dawn" <dawn_gardiner@fws.gov>

From:	"Gardiner, Dawn" <dawn_gardiner@fws.gov>
Sent:	Wed Jul 26 2017 10:21:10 GMT-0600 (MDT)
To:	"Andrew, Jonathan" <jonathan_andrew@ios.doi.gov>
CC:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>, "Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, [redacted] @ios.doi.gov>, Robert Jess <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
Subject:	Re: Recommendations for a Reduced "Enforcement Zone" on

Santa Ana NWR -- Rationale

When I was with Austin ES my staff and I worked with developers and they were able to reduce planned road width from 30 something down to 17 feet. This was in the Hill Country to reduce edge effects from opening closed canopy old growth cedar on golden-cheeked warblers. This occurred at the Crossings a resort/retreat center north of Austin if anyone would like to see what that looks like in Google Earth or in person. Frankly it does feel narrow but is doable at slow speeds. Just fyi.

On Wed, Jul 26, 2017 at 8:39 AM, Andrew, Jonathan <jonathan_andrew@ios.doi.gov> wrote:

> Nice job on this.
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Jon Andrew
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Office of the Secretary
Department of the Interior

202-320-0718 (cell)

--

E. Dawn Gardiner
Assistant Field Supervisor
Texas Coastal Ecological Services Field Office
P.O. Box 81468
Corpus Christi, TX 78468-1468

(361) 994-9005 x 259
(361) 533-6765 work cell

Bryan Winton <bryan_winton@fws.gov>

From:	Bryan Winton <bryan_winton@fws.gov>
Sent:	Wed Jul 26 2017 12:44:20 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>

Subject: Fwd: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale

Attachments: Santa Ana Enforcement Zone Width Recommendations 7.25.2017.pptx

Made it back from the Dr. everything's good. Wanted to let you know I've made a couple other longer Powerpoints that you are welcome to use if and when you get the call to brief RO leadership. I'll put them on the S:/ tomorrow so you can review and modify. Bryan

Sent from my iPhone

Begin forwarded message:

> **From:** "Reyes, Ernesto" <ernesto_reyes@fws.gov>
> **To:** "Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>, Jonathan Andrew <Jonathan_Andrew@ios.doi.gov>, [redacted] @ios.doi.gov>, Robert Jess <robert_jess@fws.gov>, Bryan Winton <bryan_winton@fws.gov>
> **Subject: Fwd: Recommendations for a Reduced "Enforcement Zone" on Santa Ana NWR -- Rationale**
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3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

--

Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
3325 Green Jay Rd
Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

Tract Name:	Acreage	Wetlands?	Current Swath Size	Vegetation Quality*	Notes:	Restoration Opp?:
Santa Maria	585	yes	45’	1 – High Quality		Y
Llano Grande Banco	186	no	70’	2 – Med. Quality (High)		
Rosario Banco	34	yes	38’ (25’)	2 – Med. Quality		Y
La Coma	776	yes (entire)	45’	2 – Med. Quality		Y
Monterrey Banco	101	yes (portion)	40’	2 – Med. Quality (Low)	Orchard Oriole	Y
Santa Ana NWR						
Marinoff						
Milagro East	846	yes (ditch)	Base of Levee	2 – Med. Quality (Low)		
Vela Woods	225	no	Base of Levee	1 – High Quality		
Hidalgo Bend	547	no	20’-23’	2 – Med. Quality (Low)		
Pate Bend	456	no	45’-55’	2 – Med. Quality		
Madero	273	yes (small amt)	Base of Levee	1 – High Quality		Y
La Parida Banco	447	no	Base of Levee	2 – Med. Quality		
Abrams	220	no	-	3 – Low Quality		
KiskadeeWMA	13	yes	45’	3 – Low Quality		
Abrams West	257	yes	60’	3 – Low Quality		

*Criteria for Ranking Vegetation Quality: Size/height of trees; Number of Species; Type(s) of Species; Understory; Density; Bird nesting habitat?; Quality Ranks: 1- High; 2 – Medium; 3- Low

Hidalgo Co. Affected Tract (W to E)	150 ft. (Acreage Impacts within refuge bdy polygon) See KMZ files	75 ft. (Approximate acreage impacts	100 ft. (Approximate acreage impacts)	50 ft. (Approximate acreage impacts)	Polygon Length (ft)
Abrams West	3	1.5	2	1	876
Kiskadee WMA	2.3	1.9	1.5	0.8	686
Abrams	2.7	1.4	1.8	0.9	806
La Parida	8	4	5.4	2.7	2370
Madero	10	6.2	8.3	4.2	3639
Pate Bend	26.2	13.7	18.2	9.1	7965
Hidalgo Bend	23.5	12.2	16.2	8.1	7095
Vela Woods	2.5	1.7	2.3	1.1	1013
Milagro East	5.4	3.2	4.3	2.1	1870
Marinoff	9	3.5	4.6	2.3	2013
Santa Ana NWR	42.6	21.6	28.8	14.4	12579
Monterrey Banco	14.3	7.5	9.9	5	4336
La Coma	2.7	1.5	2	1	906
Rosario Banco	5.4	3.2	4.2	2.1	1850
Llano Grande Banco	6.7	7.2	9.6	4.8	4188
Santa Maria	4.8	2.9	3.9	2	1710
Totals (Acres Impacted)	169.1	93.2	123	61.6	53902

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:16 PM

Conversation Contents

Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts

Attachments:

/108. Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/1.1 Impacted Tracts Ranking Data Form Completed 7.20.2017.docx
/108. Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/1.2 CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx
/108. Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/2.1 Impacted Tracts Ranking Data Form Completed 7.20.2017.docx
/108. Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts/2.2 CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Thu Jul 20 2017 15:52:11 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, Chris Perez <chris_perez@fws.gov>
CC:	Scot Edler <scot_edler@fws.gov>
Subject:	Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts
Attachments:	Impacted Tracts Ranking Data Form Completed 7.20.2017.docx CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx

See Attached. I also took a lot of photos that will be plugged into a Powerpoint and used to stimulate future discussion among leadership and with CBP. Hopefully I can have this available for a Monday discussion (prior to Tuesday, July 25, 1pm meeting with CBP).

Also, thanks to Chris for computing the acreage impacts by size of the Enforcement Zone, assuming we may be able to negotiate reduced impacts on higher priority properties, like Santa Ana, Madero, Santa Maria. Width impacts included that proposed (150') and 100', 75', 50'.

Lastly, Ernesto and I will need to look more closely to Santa Ana and Marinoff on Monday, since this is the property to be most impacts and of highest resource value/concern by most if not all of us.

--
Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office;   (956) 874-4304 cell
bryan_winton@fws.gov

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Fri Jul 21 2017 10:38:39 GMT-0600 (MDT)
To:	Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>
Subject:	Fwd: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts
Attachments:	Impacted Tracts Ranking Data Form Completed 7.20.2017.docx CBP Enforcement Zone Impacts wadditional info7.20.2017.xlsx

We have a meeting with Border Patrol scheduled for Tuesday and are trying to prepare some initial information of impacts of the proposed 150' buffer. These are preliminary (draft).
rob

---------- Forwarded message ----------
From: **Winton, Bryan** <bryan_winton@fws.gov>
Date: Thu, Jul 20, 2017 at 4:52 PM
Subject: Evaluation of Proposed Border Infrastructure -- Impact concerns on Affected STRC Tracts
To: Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, Chris Perez <chris_perez@fws.gov>
Cc: Scot Edler <scot_edler@fws.gov>

See Attached. I also took a lot of photos that will be plugged into a Powerpoint and used to stimulate future discussion among leadership and with CBP. Hopefully I can have this available for a Monday discussion (prior to Tuesday, July 25, 1pm meeting with CBP).

Also, thanks to Chris for computing the acreage impacts by size of the Enforcement Zone, assuming we may be able to negotiate reduced impacts on higher priority properties, like Santa Ana, Madero, Santa Maria. Width impacts included that proposed (150') and 100', 75', 50'.

Lastly, Ernesto and I will need to look more closely to Santa Ana and Marinoff on Monday, since this is the property to be most impacts and of highest resource value/concern by most if not all of us.

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Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

--
robert jess
project leader
south texas refuge complex
alamo, texas

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:17 PM

Conversation Contents

Fwd: Santa Ana

Attachments:

/117. Fwd: Santa Ana/1.1 image001.png
/117. Fwd: Santa Ana/2.1 image001.png
/117. Fwd: Santa Ana/3.1 image001.png
/117. Fwd: Santa Ana/4.1 image001.png

"Chapa, Gisela" <gisela_chapa@fws.gov>

From:	"Chapa, Gisela" <gisela_chapa@fws.gov>
Sent:	Wed Jul 19 2017 10:09:40 GMT-0600 (MDT)
To:	Robert Jess <robert_jess@fws.gov>
Subject:	Fwd: Santa Ana
Attachments:	image001.png

FYI - see below.

Gisela Chapa
Acting National Urban and Vision Coordinator through 7/28/17
National Wildlife Refuge System
U.S. Fish & Wildlife Service Headquarters
5275 Leesburg Pike
Falls Church, VA 22041-3803
----
work (703) 358-2432; cell (979) 220-5851

fws.gov/urban | fws.gov/refuges/vision

Gisela Chapa
Urban Wildlife Refuge Coordinator
South Texas National Wildlife Refuge Complex
3325 Green Jay Road
Alamo, Texas 78516

956-784-7541
956-357-1222 (C)
956-787-8338 (F)

https://www.youtube.com/watch?v=6eTg6FQT5hM
http://www.fws.gov/refuge/santa_ana/

---------- Forwarded message ----------
From: **Ramiro Gonzalez** <ramiro.gonzalez@cob.us>
Date: Wed, Jul 19, 2017 at 9:46 AM
Subject: Santa Ana
To: "gisela_chapa@fws.gov" <gisela_chapa@fws.gov>
Cc: "Suzanne Dixon (sdixon@npca.org)" <sdixon@npca.org>

Gisela,

Been reading all the articles in the paper about the Border Wall at Santa Ana. Is there anyway that we can help? We are working very closely with Suzanne Dixon with the National Parks Conversation Association on some other projects and she has already reached out to Cong. Vela to see how they can help in any way.

Thanks,

Ramiro Gonzalez, AICP, CNU-A

Government Affairs

City of Brownsville | Office of the City Manager
1001 E. Elizabeth St. | Brownsville, TX 78526

Tel: 956-548-6048 | Cell: 956-346-1925

Ramiro.gonzalez@cob.us | www.cob.us

Description: unnamed

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opinions expressed in this message are those of the individual sender and not necessarily those of the City of Brownsville.

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Wed Jul 19 2017 10:28:21 GMT-0600 (MDT)
To:	Aislinn Maestas <aislinn_maestas@fws.gov>
CC:	Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>
Subject:	Fwd: Santa Ana
Attachments:	image001.png

Aislinn,
another border wall inquiry-

Monica,
This is a partner and I'd like some clarification specific to partners and answering their questions...
rob

---------- Forwarded message ----------
From: **Chapa, Gisela** <gisela_chapa@fws.gov>
Date: Wed, Jul 19, 2017 at 11:09 AM
Subject: Fwd: Santa Ana
To: Robert Jess <robert_jess@fws.gov>

FYI - see below.

Gisela Chapa
Acting National Urban and Vision Coordinator through 7/28/17
National Wildlife Refuge System
U.S. Fish & Wildlife Service Headquarters
5275 Leesburg Pike
Falls Church, VA 22041-3803
----
work (703) 358-2432; cell (979) 220-5851

fws.gov/urban | fws.gov/refuges/vision

Gisela Chapa
Urban Wildlife Refuge Coordinator
South Texas National Wildlife Refuge Complex
3325 Green Jay Road
Alamo, Texas 78516

956-784-7541
956-357-1222 (C)
956-787-8338 (F)

https://www.youtube.com/watch?v=6eTg6FQT5hM
http://www.fws.gov/refuge/santa_ana/

---------- Forwarded message ----------
From: **Ramiro Gonzalez** <ramiro.gonzalez@cob.us>
Date: Wed, Jul 19, 2017 at 9:46 AM
Subject: Santa Ana
To: "gisela_chapa@fws.gov" <gisela_chapa@fws.gov>
Cc: "Suzanne Dixon (sdixon@npca.org)" <sdixon@npca.org>

Gisela,

Been reading all the articles in the paper about the Border Wall at Santa Ana. Is there anyway that we can help? We are working very closely with Suzanne Dixon with the National Parks Conversation Association on some other projects and she has already reached out to Cong. Vela to see how they can help in any way.

Thanks,

Ramiro Gonzalez, AICP, CNU-A

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City of Brownsville | Office of the City Manager
1001 E. Elizabeth St. | Brownsville, TX 78526

Tel: 956-548-6048 | Cell: 956-346-1925

Ramiro.gonzalez@cob.us | www.cob.us

Description: unnamed

CITY OF BROWNSVILLE PRIVACY NOTICE: This information is intended only for the use of the individual or entity to which it is addressed and contains information that may be privileged, confidential or exempt from disclosure under applicable federal or state law. If the reader of this message is not the intended recipient or the employee or agent responsible for delivering the message to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, contact the sender and delete the original and all copies from any computer. Any views or opinions expressed in this message are those of the individual sender and not necessarily those of the City of Brownsville.

--
robert jess
project leader
south texas refuge complex
alamo, texas

"Maestas, Aislinn" <aislinn_maestas@fws.gov>

From:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
Sent:	Wed Jul 19 2017 10:42:34 GMT-0600 (MDT)
To:	"Jess, Robert" <robert_jess@fws.gov>
CC:	Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>, "Ullenberg, Beth" <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>
Subject:	Re: Santa Ana
Attachments:	image001.png

Thank you Rob,

We are working on statements to share with partners and also the media. The moment we have approved language we will share with you.

Hang tight,
- Aislinn

On Wed, Jul 19, 2017 at 10:28 AM, Jess, Robert <robert_jess@fws.gov> wrote:

> Aislinn,
> another border wall inquiry-
>
> Monica,
> This is a partner and I'd like some clarification specific to partners and answering their questions...
> rob
>
> ---------- Forwarded message ----------
> From: **Chapa, Gisela** <gisela_chapa@fws.gov>

Date: Wed, Jul 19, 2017 at 11:09 AM
Subject: Fwd: Santa Ana
To: Robert Jess <robert_jess@fws.gov>

FYI - see below.

Gisela Chapa
Acting National Urban and Vision Coordinator through 7/28/17
National Wildlife Refuge System
U.S. Fish & Wildlife Service Headquarters
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https://www.youtube.com/watch?v=6eTg6FQT5hM
http://www.fws.gov/refuge/santa_ana/

---------- Forwarded message ----------
From: **Ramiro Gonzalez** <ramiro.gonzalez@cob.us>
Date: Wed, Jul 19, 2017 at 9:46 AM
Subject: Santa Ana
To: "gisela_chapa@fws.gov" <gisela_chapa@fws.gov>
Cc: "Suzanne Dixon (sdixon@npca.org)" <sdixon@npca.org>

Gisela,

Been reading all the articles in the paper about the Border Wall at Santa Ana. Is there anyway that we can help? We are working very closely with Suzanne Dixon with the National Parks Conversation Association on some other projects and she has already reached out to Cong. Vela to see how they can help in any way.

Thanks,

Ramiro Gonzalez, AICP, CNU-A

Government Affairs

City of Brownsville | Office of the City Manager
1001 E. Elizabeth St. | Brownsville, TX 78526

Tel: 956-548-6048 | Cell: 956-346-1925

Ramiro.gonzalez@cob.us | www.cob.us

Description: unnamed

CITY OF BROWNSVILLE PRIVACY NOTICE: This information is intended only for the use of the individual or entity to which it is addressed and contains information that may be privileged, confidential or exempt from disclosure under applicable federal or state law. If the reader of this message is not the intended recipient or the employee or agent responsible for delivering the message to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, contact the sender and delete the original and all copies from any computer. Any views or opinions expressed in this message are those of the individual sender and not necessarily those of the City of Brownsville.

--
robert jess
project leader
south texas refuge complex
alamo, texas

--
Aislinn Maestas
Public Affairs Specialist
External Affairs
Southwest Region, US Fish and Wildlife Service
Phone: 505-248-6599
aislinn_maestas@fws.gov

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Wed Jul 19 2017 11:19:54 GMT-0600 (MDT)
To:	"Maestas, Aislinn" <aislinn_maestas@fws.gov>
CC:	Monica Kimbrough <monica_kimbrough@fws.gov>, kelly mcdowell <kelly_mcdowell@fws.gov>, "Ullenberg, Beth" <beth_ullenberg@fws.gov>, Andy Devolder <andy_devolder@fws.gov>
Subject:	Re: Santa Ana
Attachments:	image001.png

Thanks Aislinn for the response...

We hope that before any language is rolled out that we at the refuge can also review and approve. When the dust settles on the issue, we will be the ones left for cleanup so the more eyes reviewing the better...
rob

On Wed, Jul 19, 2017 at 11:42 AM, Maestas, Aislinn <aislinn_maestas@fws.gov> wrote:

> Thank you Rob,
>
> We are working on statements to share with partners and also the media. The moment we have approved language we will share with you.
>
> Hang tight,
> - Aislinn
>
> On Wed, Jul 19, 2017 at 10:28 AM, Jess, Robert <robert_jess@fws.gov> wrote:
>
>> Aislinn,
>> another border wall inquiry-
>>
>> Monica,
>> This is a partner and I'd like some clarification specific to partners and answering their questions...
>> rob
>>
>> ---------- Forwarded message ----------
>> From: **Chapa, Gisela** <gisela_chapa@fws.gov>
>> Date: Wed, Jul 19, 2017 at 11:09 AM
>> Subject: Fwd: Santa Ana
>> To: Robert Jess <robert_jess@fws.gov>
>>
>> FYI - see below.
>>
>> Gisela Chapa
>> Acting National Urban and Vision Coordinator through 7/28/17

National Wildlife Refuge System
U.S. Fish & Wildlife Service Headquarters
5275 Leesburg Pike
Falls Church, VA 22041-3803
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work (703) 358-2432; cell (979) 220-5851

fws.gov/urban | fws.gov/refuges/vision

Gisela Chapa
Urban Wildlife Refuge Coordinator
South Texas National Wildlife Refuge Complex
3325 Green Jay Road
Alamo, Texas 78516

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956-787-8338 (F)

https://www.youtube.com/watch?v=6eTg6FQT5hM
http://www.fws.gov/refuge/santa_ana/

---------- Forwarded message ----------
From: **Ramiro Gonzalez** <ramiro.gonzalez@cob.us>
Date: Wed, Jul 19, 2017 at 9:46 AM
Subject: Santa Ana
To: "gisela_chapa@fws.gov" <gisela_chapa@fws.gov>
Cc: "Suzanne Dixon (sdixon@npca.org)" <sdixon@npca.org>

Gisela,

Been reading all the articles in the paper about the Border Wall at Santa Ana. Is there anyway that we can help? We are working very closely with Suzanne Dixon with the National Parks Conversation Association on some other projects and she has already reached out to Cong. Vela to see how they can help in any way.

Thanks,

Ramiro Gonzalez, AICP, CNU-A

Government Affairs

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1001 E. Elizabeth St. | Brownsville, TX 78526

Tel: 956-548-6048 | Cell: 956-346-1925

Ramiro.gonzalez@cob.us | www.cob.us

Description: unnamed

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--
robert jess
project leader
south texas refuge complex
alamo, texas

--
Aislinn Maestas
Public Affairs Specialist
External Affairs
Southwest Region, US Fish and Wildlife Service
Phone: 505-248-6599
aislinn_maestas@fws.gov

--
robert jess
project leader
south texas refuge complex
alamo, texas

FY18 Proposed Border Wall

Anticipated Acreage Impacts at Santa Ana NWR & Lower Rio Grande Valley NWR Tracts in Hidalgo County, Texas

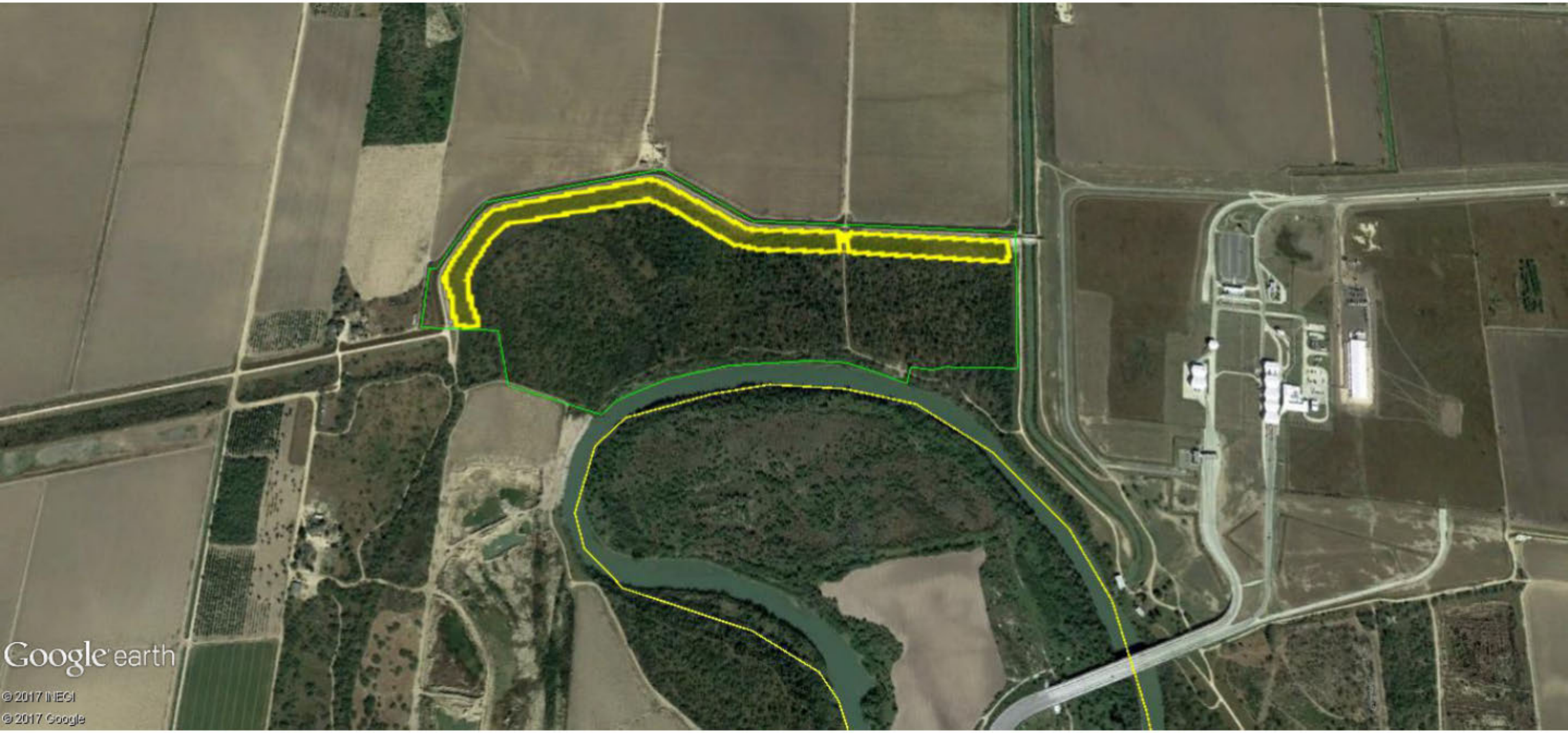
Chris Perez, Wildlife Biologist
Bryan Winton, Refuge Manager

SANTA ANA NWR – 2,088 acres

Buffer acreage: 150' (42.6 acres); 100' (28.8 acres); 50' (14.4 acres)

MONTERREY BANCO TRACT – 101 acres

Buffer acreage: 150' (14.3 acres); 100' (9.9 acres); 50' (5.0 acres)



LLANO GRANDE BANCO – 186 acres

Buffer acreage: 150’ (42.6 acres); 100’ (28.8 acres); 50’ (14.4 acres)

ROSARIO BANCO – 34 acres

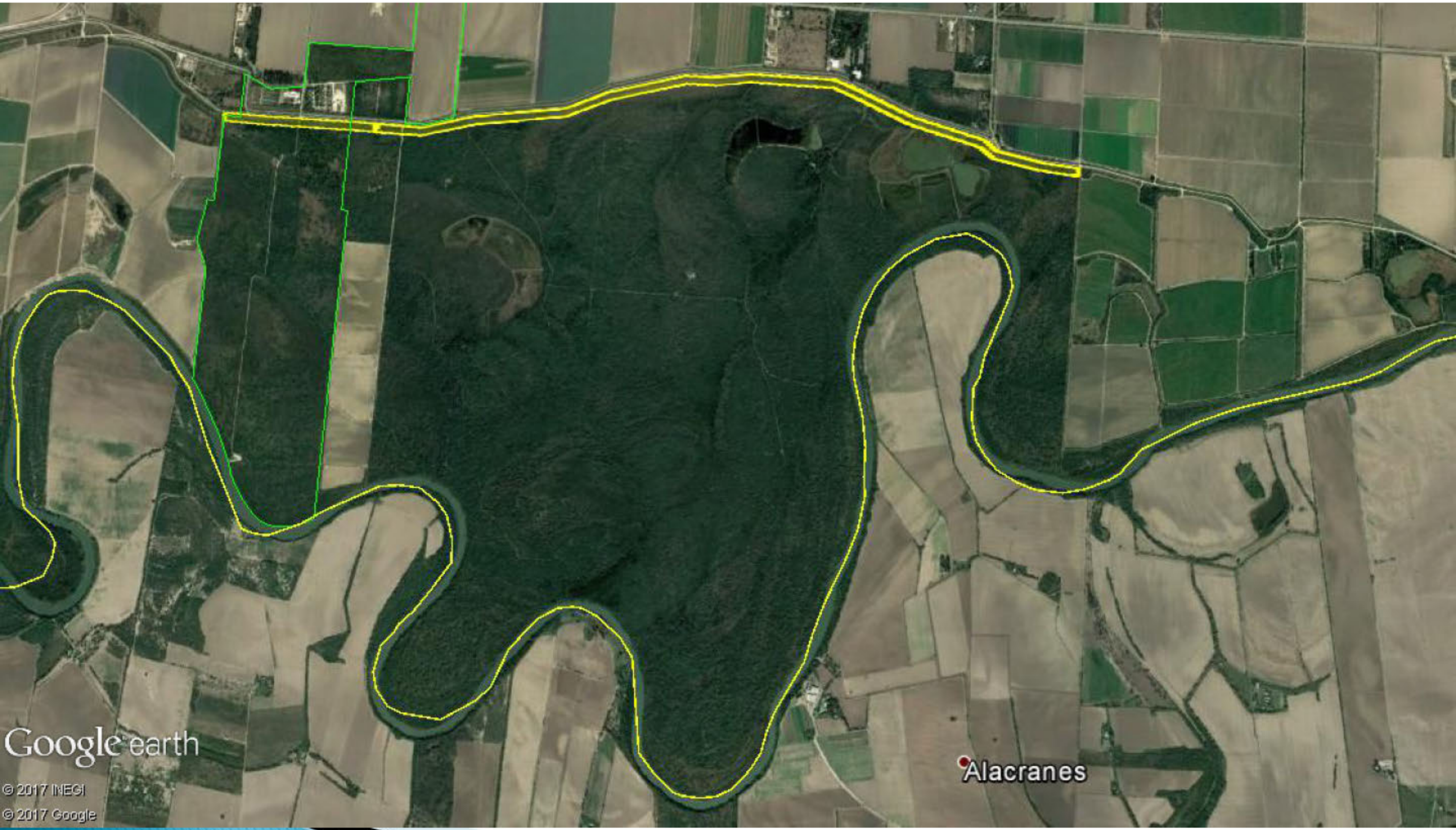
Buffer acreage: 150’ (5.4 acres); 100’ (4.2 acres); 50’ (2.1 acres)

SANTA MARIA – 585 acres

Buffer acreage: 150' (4.8 acres); 100' (3.9 acres); 50' (2.0 acres)

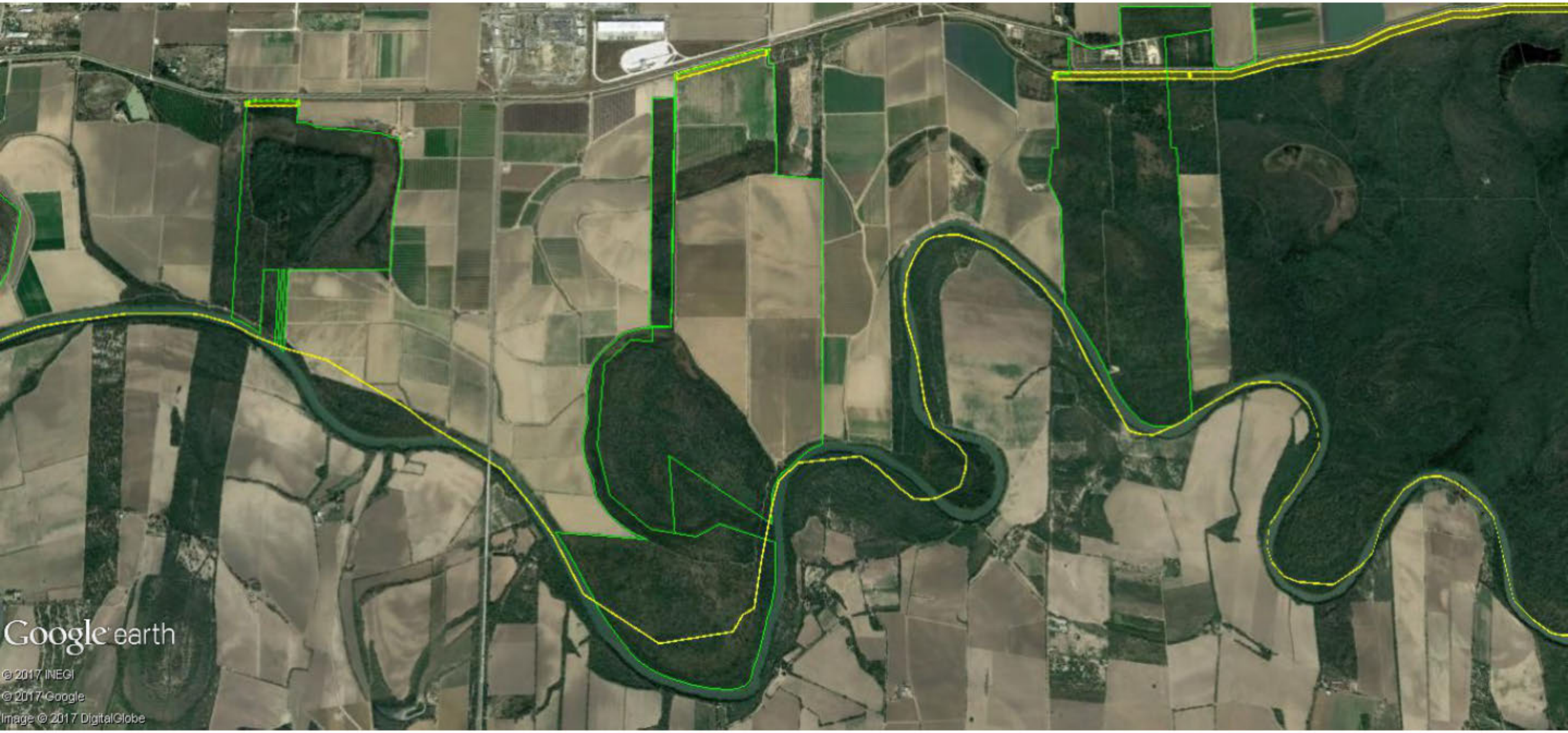
SANTA ANA NWR – 2,088 acres

Buffer acreage: 150' (42.6 acres); 100' (28.8 acres); 50' (14.4 acres)



MILAGRO – 846 acres

Buffer acreage: 150' (5.4 acres); 100' (4.3 acres); 50' (2.1 acres)



VELA WOODS – 225 acres

Buffer acreage: 150' (2.5 acres); 100' (2.3 acres); 50' (1.1 acres)

PATE BEND – 456 acres & HIDALGO BEND – 547 acres

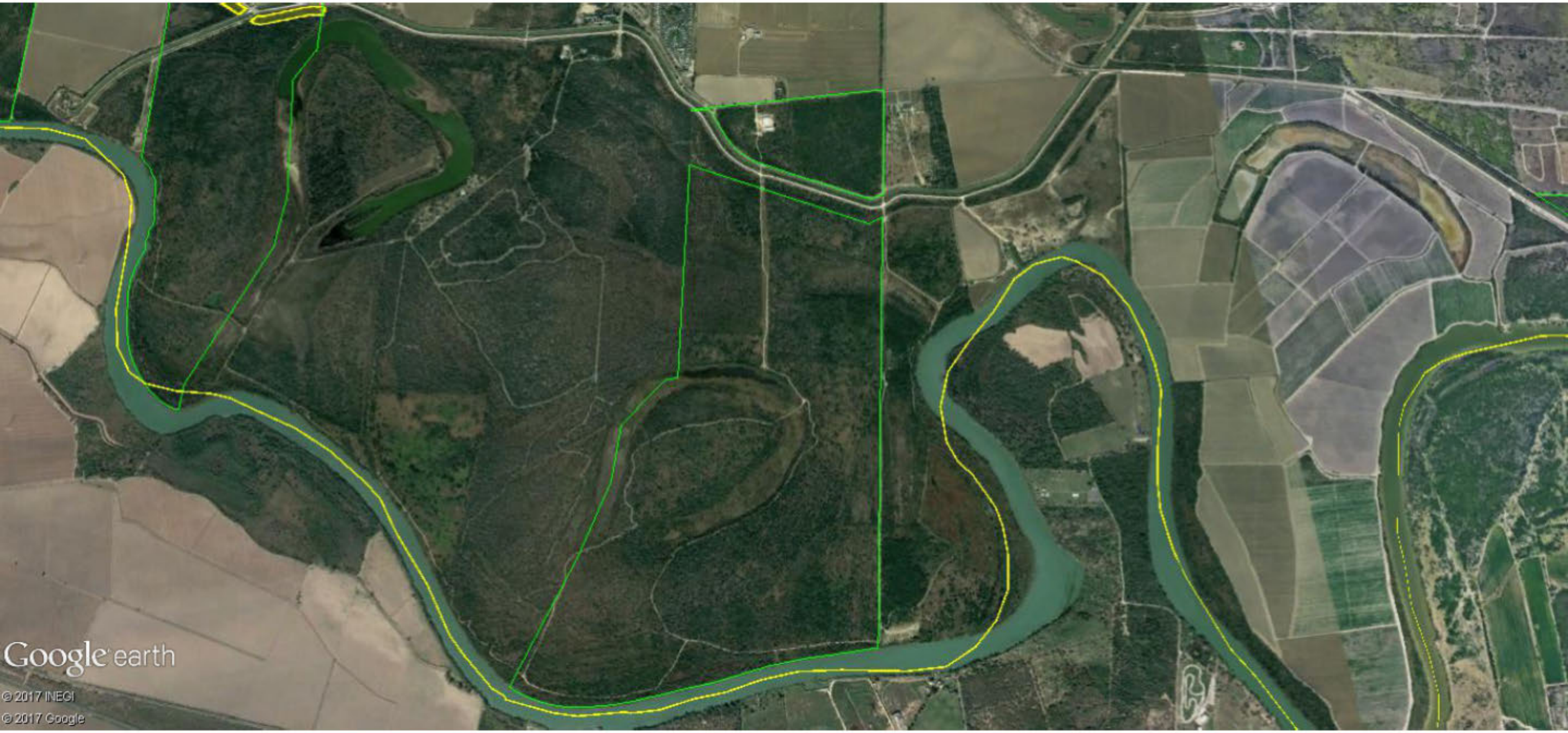
PB: Buffer acreage: 150’ (26.2acres); 100’ (18.2 acres); 50’ (9.1 acres)

HB: Buffer acreage: 150’ (23.5 acres); 100’ (16.2 acres); 50’ (8.1 acres)

MADERO – 273 acres

Buffer acreage: 150' (10.0 acres); 100' (8.3 acres); 50' (4.2 acres)

EL MORILLO BANCO – 654 acres



LA PARIDA BANCO – 447 acres

Buffer acreage: 150’ (8.0 acres); 100’ (5.4 acres); 50’ (2.7 acres)

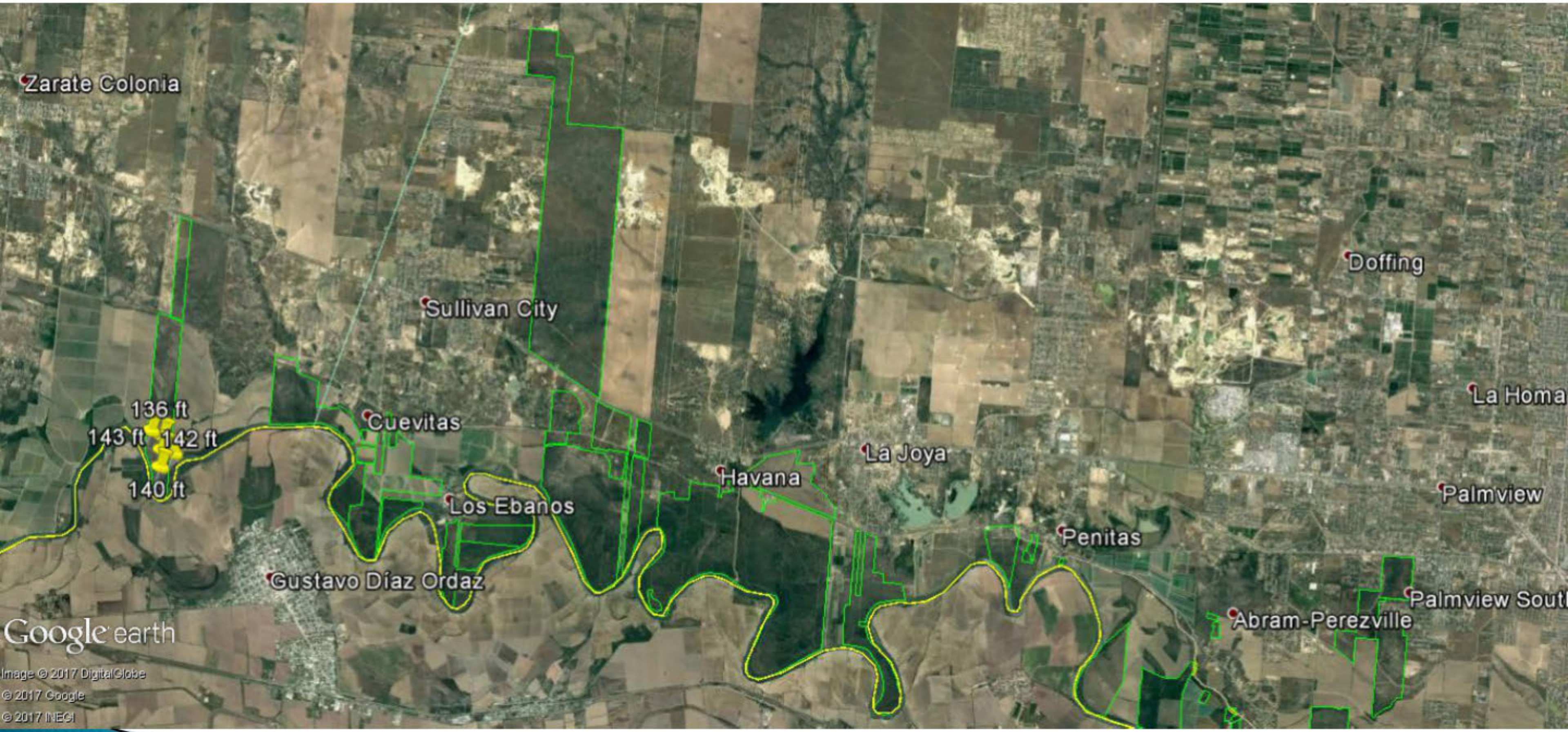
ABRAMS WEST – 257 acres, KISKADEE WMA, – 14 acres, ABRAMS – 220 acres

AW: Buffer acreage: 150' (3 acres); 100' (2 acres); 50' (1 acres)

A: Buffer acreage: 150' (2.7 acres); 100' (1.8 acres); 50' (0.9 acres)

WESTERNMOST HIDALGO COUNTY LRGV NWR TRACTS

Buffer acreage: 150' (42.6 acres); 100' (28.8 acres); 50' (14.4 acres)



Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:17 PM

Conversation Contents

Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts

Attachments:

/118. Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts/1.1 Proposed Border Wall 2017.pptx

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Mon Jul 17 2017 15:51:52 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, Scot Edler <scot_edler@fws.gov>, Chris Perez <chris_perez@fws.gov>
Subject:	Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts
Attachments:	Proposed Border Wall 2017.pptx

The attached Powerpoint shows the Santa Ana and LRGV NWR Hidalgo County lands proposed to be impacted from additional border infrastructure projects along with corresponding acreage impacts associated with the proposed "enforcement zone" - 150'. Also included is acreage impacts for reduced enforcement zone widths (100' and 50'). Thanks to Chris Perez for putting the GIS together and computing the acreage impacts for each.

--
Bryan R. Winton, Wildlife Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
Santa Ana National Wildlife Refuge
3325 Green Jay Road, Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell
bryan_winton@fws.gov

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Tue Jul 18 2017 06:49:17 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>, Scot Edler <scot_edler@fws.gov>, Chris Perez <chris_perez@fws.gov>, "Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>
Subject:	Re: Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts

Bryan,

It was my understanding from our previous meeting with CBP last Friday that the 150' proposed enforcement zone will not apply to existing tracts with Border Fence like Monterrey Banco, Rosario Banco, etc. because this will only apply to new fence under a different waiver. Might want to get clarification with CBP. Also, would be good to have 75' which would be half of 150' for acreage.

Ernesto

On Mon, Jul 17, 2017 at 4:51 PM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> The attached Powerpoint shows the Santa Ana and LRGV NWR Hidalgo County lands proposed to be impacted from additional border infrastructure projects along with corresponding acreage impacts associated with the proposed "enforcement zone" - 150'. Also included is acreage impacts for reduced enforcement zone widths (100' and 50'). Thanks to Chris Perez for putting the GIS together and computing the acreage impacts for each.
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> --
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> bryan_winton@fws.gov

--
Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
3325 Green Jay Rd
Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Wed Jul 19 2017 08:59:31 GMT-0600 (MDT)
To:	"Perez, Chris" <chris_perez@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>
Subject:	Re: Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts

Very good! Thank you Chris!

If you aren't feeling good you can leave early today. Please do your Quiktime this morning either way.

thanks
bryan

On Wed, Jul 19, 2017 at 9:48 AM, Perez, Chris <chris_perez@fws.gov> wrote:

> Bryan: Attached is a new spreadsheet with the 75-feet zone showing approximate acreage to be impacted. With a 75-foot enforcement zone, approximately 93 acres may be potentially impacted by the project or 76 acres less than for a 150-foot enforcement zone on the refuge tracts. Hope this helps.
>
> ---------- Forwarded message ----------
> From: **Reyes, Ernesto** <ernesto_reyes@fws.gov>
> Date: Tue, Jul 18, 2017 at 7:49 AM
> Subject: Re: Proposed FY18-Funding Contingent CBP Border Infrastructure Segments & Corresponding Acreage Impacts
> To: "Winton, Bryan" <bryan_winton@fws.gov>
> Cc: Rob Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>, Scot Edler <scot_edler@fws.gov>, Chris Perez <chris_perez@fws.gov>, "Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>
>
> Bryan,
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> It was my understanding from our previous meeting with CBP last Friday that the 150' proposed enforcement zone will not apply to existing tracts with Border Fence like Monterrey Banco, Rosario Banco, etc. because this will only apply to new fence under a different waiver. Might want to get clarification with CBP. Also, would be good to have 75' which would be half of 150' for acreage.
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> On Mon, Jul 17, 2017 at 4:51 PM, Winton, Bryan <bryan_winton@fws.gov> wrote:
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> Fax:956-787-8338

--
Chris Perez, Wildlife Biologist
Lower Rio Grande Valley NWR
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Alamo, TX 78516
Phone: 956-784-7553
Fax: 956-787-8338

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bryan_winton@fws.gov

[redacted]

Communications Director
RGV Sector Border Patrol

O: [redacted]
C: [redacted]

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:20 PM

Conversation Contents

Mayor's Meeting tomorrow - Tuesday, July 18, 2017

Attachments:

/124. Mayor's Meeting tomorrow - Tuesday, July 18, 2017/1.1 image001.png
/124. Mayor's Meeting tomorrow - Tuesday, July 18, 2017/2.1 image001.png
/124. Mayor's Meeting tomorrow - Tuesday, July 18, 2017/3.1 image001.png

[redacted]@cbp.dhs.gov>

From:	[redacted]@cbp.dhs.gov>
Sent:	Mon Jul 17 2017 15:49:31 GMT-0600 (MDT)
To:	"Jess, Robert" <robert_jess@fws.gov>, "Winton, Bryan" <bryan_winton@fws.gov>, "Chapa, Gisela" <gisela_chapa@fws.gov>
CC:	[redacted]@cbp.dhs.gov>, [redacted]@cbp.dhs.gov>, '[redacted]@cbp.dhs.gov>
Subject:	Mayor's Meeting tomorrow - Tuesday, July 18, 2017
Attachments:	image001.png

Good afternoon Mr. Jess,
On behalf of Chief Patrol Agent [redacted] we would like to invite you to the RGV Sector Border Patrol headquarters tomorrow (Tuesday, July 18, 2017) at 2pm for a discussion on the border "wall" with local mayors.
Numerous articles have been published lately referencing the construction of the border wall and we want to ensure our local stakeholders have the most accurate information on the topic. We appreciate your role as a partner agency and would appreciate your support at the meeting tomorrow. Members of the RGV Communications team will be following up with your offices for RSVPs.
We look forward to seeing you here at [redacted]. If you have never been here, please use the frontage road entrance.

"Winton, Bryan" <bryan_winton@fws.gov>

From: "Winton, Bryan" <bryan_winton@fws.gov>
Sent: Tue Jul 18 2017 11:02:40 GMT-0600 (MDT)
To: [redacted]@cbp.dhs.gov>
CC: Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>
Subject: Re: Mayor's Meeting tomorrow - Tuesday, July 18, 2017
Attachments: image001.png

[redacted]

Rob had prior commitments today and unfortunately won't be able to attend the Chief's 2pm meeting with City Mayors. Hopefully at some point in the near future it will be important that our agencies unite publicly to discuss funded plans for additional border infrastructure and how those plans will seek to minimize impacts to the area's wildlife refuges and the tourism industry for our area, in general. Hopefully there will be opportunities for further discussion on how border security can be increased while also preserving the natural heritage of this area.

Sincerely,

bryan winton

On Mon, Jul 17, 2017 at 4:49 PM, [redacted]@cbp.dhs.gov> wrote:

> Good afternoon Mr. Jess,
> On behalf of Chief Patrol Agent [redacted] we would like to invite you to the RGV Sector Border Patrol headquarters tomorrow (Tuesday, July 18, 2017) at 2pm for a discussion on the border "wall" with local mayors.
> Numerous articles have been published lately referencing the construction of the border wall and we want to ensure our local stakeholders have the most accurate information on the topic. We appreciate your role as a partner agency and would appreciate your support at the meeting tomorrow. Members of the RGV Communications team will be following up with your offices for RSVPs.
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bryan_winton@fws.gov

[redacted]@cbp.dhs.gov>

From:	[redacted]@cbp.dhs.gov>
Sent:	Tue Jul 18 2017 11:21:48 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, [redacted] cbp.dhs.gov>
Subject:	RE: Mayor's Meeting tomorrow - Tuesday, July 18, 2017
Attachments:	image001.png

Bryan,
We agree wholeheartedly, appreciate you and your team.
This was a last minute meeting as so many news articles are hitting the internet and air waves.

From: Winton, Bryan [mailto:bryan_winton@fws.gov]
Sent: Tuesday, July 18, 2017 12:03 PM
To: [redacted]@cbp.dhs.gov>
Cc: Rob Jess <robert_jess@fws.gov>; Ernesto Reyes <ernesto_reyes@fws.gov>
Subject: Re: Mayor's Meeting tomorrow - Tuesday, July 18, 2017

[redacted]

Rob had prior commitments today and unfortunately won't be able to attend the Chief's 2pm meeting with City Mayors. Hopefully at some point in the near future it will be important that our agencies unite publicly to discuss funded plans for additional border infrastructure and how those plans will seek to minimize impacts to the area's wildlife refuges and the tourism industry for our area, in general. Hopefully there will be opportunities for further discussion on how border security can be increased while also preserving the natural heritage of this area.

Sincerely,

bryan winton

On Mon, Jul 17, 2017 at 4:49 PM, [redacted]@cbp.dhs.gov> wrote:

Good afternoon Mr. Jess,
On behalf of Chief Patrol Agent [redacted] we would like to invite you to the RGV Sector Border Patrol headquarters tomorrow (Tuesday, July 18, 2017) at 2pm for a discussion on the border "wall" with local mayors.

Numerous articles have been published lately referencing the construction of the border wall and we want to ensure our local stakeholders have the most accurate information on the topic. We appreciate your role as a partner agency and would appreciate your support at the meeting tomorrow. Members of the RGV Communications team will be following up with your offices for RSVPs.

We look forward to seeing you here at [redacted]. If you have never been here, please use the frontage road entrance.

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Santa Ana NWR

Border Fence Meeting - CBP/FWS

7/14/17

- LRGV is working on veg. clearing of 150', 100', 50' to look at acreage for proposed clearing, on ArcGIS.
- CBP looking at coming out to the public on the proposed Border Fence in August.
- Look to put out sensors out along the river to reduce 150' enforcement zone along the fence on SANWR to reduce impacts.
- Pedestrian access through the border fence on SA will need to be designed for wheel chair ramp acess
- There will be leway on the proposed 150' enforcement zone depending on the area.
- There will be a road + sensors + drag road within the proposed 150' zone.
- This CBP group will coordinate with local FWS personel throughout the border fence process to get our local FWS issues and recomendations up to their management.
- Proposed 200 miles of new roads; evaluate proposed roads.
- Existing fence will not have any additional road widen to 150' like the new border fence because it will be a different waiver.

Meeting w/ CBP & FWS - Border Infrastructure

Name	email	Agency	Phone
Bryan Winton	bryan_winton@	FWS.gov	956 784-7521
[redacted]	[redacted]@cbp.dhs.gov	USBP	[redacted]
[redacted]	[redacted]@CBP-DHS-Gov	USBP	[redacted]
[redacted]	[redacted]@cbp.dhs.gov	USBP	[redacted]
[redacted]	[redacted]@cbp.dhs.gov	USBP	[redacted]
Scot_Edler@fws.gov		FWS	956-883-5200
Ernesto Reyes	Ernesto_Reyes@fws.gov	FWS	956-784-7560

[redacted]@cbp.dhs.gov

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:22 PM

Conversation Contents

Border Fence Meeting with CBP

Attachments:

/134. Border Fence Meeting with CBP/1.1 07171701.PDF

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Mon Jul 17 2017 07:29:01 GMT-0600 (MDT)
To:	"Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>, Robert Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, Jonathan Andrew <Jonathan_Andrew@ios.doi.gov>, "[redacted] @ios.doi.gov>, Kelly McDowell <kelly_mcdowell@fws.gov>
Subject:	Border Fence Meeting with CBP
Attachments:	07171701.PDF

Here are the notes from our meeting this past Friday at SA with CBP. [redacted] with CBP called Bryan on Friday morning that he wanted to meet with Bryan at 10 am at SA. Bryan told me about the meeting and I attended. I turned out that these CBP agents on the list are going to be on the local border fence core team that will be coordinating with us throughout the entire process to listen to our concerns and recommendations, so they can make recommendations to their management in CBP. That is similar what we had in 2008 where the CBP core team worked with us and addressed our concerns like having wildlife openings, etc.

Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
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Hidalgo Co. Affected Tract (W to E)

Abrams West
Kiskadee WMA
Abrams
La Parida
Madero
Pate Bend
Hidalgo Bend
Vela Woods
Milagro West
Marinoff
Santa Ana NWR
Monterrey Banco
La Coma
Rosario Banco
Llano Grande Banco
Santa Maria

Totals

150 ft. (Acreage Impacts within refuge bdy polygon) See KMZ files

3
2.3
2.7
8
10
26.2
23.5
2.5
5.4
9
42.6
14.3
2.7
5.4
6.7
4.8
169.1

100 ft. (Approximate acreage impacts)	50 ft. (Approximate acreage impacts)
2	1
1.5	0.8
1.8	0.9
5.4	2.7
8.3	4.2
18.2	9.1
16.2	8.1
2.3	1.1
4.3	2.1
4.6	2.3
28.8	14.4
9.9	5
2	1
4.2	2.1
9.6	4.8
3.9	2
123	61.6

Polygon Length (ft)
876
686
806
2370
3639
7965
7095
1013
1870
2013
12579
4336
906
1850
4188
1710
53902

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:23 PM

Conversation Contents

Fwd: Map work

Attachments:

/138. Fwd: Map work/1.1 150ft Buffer Zone Impacts.kmz
/138. Fwd: Map work/1.2 LRGVNWR_Acquired2014.kmz
/138. Fwd: Map work/1.3 CBP Proposed Protection Zone Impacts.xlsx

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Thu Jul 13 2017 13:35:40 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>
Subject:	Fwd: Map work
Attachments:	150ft Buffer Zone Impacts.kmz LRGVNWR_Acquired2014.kmz CBP Proposed Protection Zone Impacts.xlsx

I am looking to organize this into a presentation format for presentation to you both and if there is collective agreement, when we meet with CBP, as it may help us discuss/negotiate reduced impacts on some segments of the refuges. Note: For western Hidalgo refuge properties likely to be affected, I've left a phone message with [redacted] requesting a copy of the Powerpoint they showed last Thursday. Also, so we can send it to Kelly--since he was on a conference line and probably wasn't able to see/understand what/where they were talking about.
bryan

---------- Forwarded message ----------
From: **Perez, Chris** <chris_perez@fws.gov>
Date: Wed, Jul 12, 2017 at 10:09 AM
Subject: Re: Map work
To: "Winton, Bryan" <bryan_winton@fws.gov>

Bryan:
As requested, attached are Google Earth polygons used to calculate potentially affected acreages for the tracts affected by the proposed CBP project. The primary calculation of affected acreage (150-ft zone) comes from the polygons which only include within refuge boundaries. Obviously, there will be much private land impacts as well. These calculations are also based on the assumption that the 150-foot zone will be measured from the toe of the south levee where no fence currently exists or as measured from existing fence. The attached spreadsheet shows all the measurements and totals from the affected tracts in Hidalgo County, as you provided. You can open these Google Earth files by downloading and clicking on them. Then save them to your Google Earth (program will prompt you to do so). You can also print out selected polygons with tract boundaries (which I also included here in case you don't have them).
Let me know if you need anything else.

On Tue, Jul 11, 2017 at 8:41 AM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> I have a marked up copy as an example if you want to use it as a guide. I've thought of an expedited way you can get me the info I need too so when you're up to it.... I'll be around.
> bryan

On Tue, Jul 11, 2017 at 8:11 AM, Perez, Chris <chris_perez@fws.gov> wrote:

I'll see what I can do; I'll be working on that this morning and following up on the Yturria plan if time permits.

On Mon, Jul 10, 2017 at 4:52 PM, Winton, Bryan <bryan_winton@fws.gov> wrote:

Attached is a summary of maps that are slated to be impacted in one way, shape or form, with regard to recent proposals by CBP for additional border wall in Hidalgo County, and for revisiting all wall segments previously constructed and establishing a 150' "enforcement zone" on the inside of those border segments as well. Therefore the attachment shows tracts previously receiving infrastructure and the new tracts to be impacted if CBP proceeds with construction of Border Wall in all remaining areas of Hidalgo county.

Since their first priority is Marinoff and Santa Ana (2.9 mile segment), I need a buffer showing 150' inside the mid-slope of the levee, to show how many acres of vegetation will be lost if they proceed with the buffer. Creating additional maps of 100' and 50' buffer will show acreage/vegetation impacts associated with a negotiated/reduced impact, if we are able to do that.

Can we create separate files for the 3 buffers for each of the tracts affected. I can sit down with you and describe what needs done on each of the attached maps.

First priority is for the 3 maps for Santa Ana NWR so we can begin the negotiation and know what the acreage impact is for the 3 buffer distances.

I tried doing this in Google Earth today but am not well versed in doing this. Scot Edler mentioned he did something like this when Kelly was here to create "buffers" in Arc GIS for light and noise in Cameron County. I asked him to relocate the maps he created then but he didn't get back to me before end of day. Between he, me, and you, I want to get this done as soon as possible.

bryan

--
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"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Thu Jul 13 2017 14:12:34 GMT-0600 (MDT)
To:	"Winton, Bryan" <bryan_winton@fws.gov>
CC:	Rob Jess <robert_jess@fws.gov>, "Ardizzone, Chuck" <chuck_ardizzone@fws.gov>, Dawn Whitehead <dawn_gardiner@fws.gov>
Subject:	Re: Map work

Bryan,

I think we should shoot for 75 feet as a median from the proposed 150 foot clearing as an option between 100' and 50' especially for SA if 50' is not doable for them and 100' is too much clearing for us.

Ernesto

On Thu, Jul 13, 2017 at 2:35 PM, Winton, Bryan <bryan_winton@fws.gov> wrote:

> I am looking to organize this into a presentation format for presentation to you both and if there is collective agreement, when we meet with CBP, as it may help us discuss/negotiate reduced impacts on some segments of the refuges. Note: For western Hidalgo refuge properties likely to be affected, I've left a phone message with [redacted] requesting a copy of the Powerpoint they showed last Thursday. Also, so we can send it to Kelly--since he was on a conference line and probably wasn't able to see/understand what/where they were talking about.
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Nov 07

DRAFT
COMPATIBILITY DETERMINATION

Use: engineering-environmental Management, Inc. (e^2M) proposes to conduct cultural resources surveys on fourteen (14) Refuge tracts within the Lower Rio Grande Valley National Wildlife Refuge (LRGVNWR). These surveys are directly associated with determining the environmental impact(s) of the proposed Border Fence (PF-225) in the Lower Rio Grande Valley, Texas.

Refuge Name: Lower Rio Grande Valley National Wildlife Refuge. Refuge tracts likely to be surveyed: Arroyo Ramirez, Los Negros Creek, Rio San Juan, Granjeno, Kiskadee, Penitas, Los Velas, Los Ebanos, Monterrey Banco, La Coma, Rosario Banco, Phillips Banco, Boscaje de La Palma, and Southmost.

Establishing and Acquisition Authorities:

- Fish and Wildlife Act of 1956 [16 U.S.C. 742f(a)(4)], [16 U.S.C. 742f(b)(1)]
- An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes [16 U.S.C. 667b]
- Refuge Recreation Act, as amended [16 U.S.C. 460k-1], [16 U.S.C. 460k-2]
- Migratory Bird Conservation Act [16 U.S.C. 715d]
- National Wildlife Refuge System Improvement Act of 1997

Refuge Purpose(s): As excerpted from the enabling legislation used to authorize the acquisition of the Refuge, the following are the Refuge purposes:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." [16 U.S.C. 742f(a)(4)] "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)

"... particular value in carrying out the national migratory bird management program." [16 U.S.C. 667b] (An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes)

"... suitable for: (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." [16 U.S.C. 460k-1] "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." [16 U.S.C. 460k-2] (Refuge Recreation Act [16 U.S.C. 460k-460k-4], as amended)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." [16 U.S.C. 715d] (Migratory Bird Conservation Act)

The Lower Rio Grande Valley and Santa Ana National Wildlife Refuges Comprehensive Conservation Plan (CCP) of 1997 satisfies the CCP requirement of the National Wildlife Refuge System Improvement Act of 1997 and identifies the following five goals of the Lower Rio Grande Valley National Wildlife Refuge:

- To restore, enhance and protect biological diversity.
- To protect and obtain additional water rights, improve water management, and protect, restore and enhance wetlands.
- To improve water quality and reduce contaminant related fish and wildlife resource losses.
- To protect, maintain and plan for cultural resources.
- To offer compatible wildlife dependent public uses, recreational opportunities, and interpretation and education.

National Wildlife Refuge System Mission: "The Mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Description of Proposed Use:
Cultural Resources Surveys
e²M has been tasked by the Corps of Engineers – Fort Worth District, with conducting cultural resources surveys within the above listed Refuge tracts. The nature of the cultural resources survey would depend upon the potential of the specific portion of the alignment to contain cultural resources. The least invasive approach, which would be used for areas determined to have low potential for cultural resources, would be simple pedestrian surveys of all the identified alignments. There are no known cultural resource sites within the proposed corridors of the surveys. However, e²M has included in their request contingencies for areas that present a moderate or high potential for presence of cultural resources. In areas that present moderate potential, shovel testing would be employed. Shovel testing involves the careful excavation of areas up to 2 feet in diameter and 5 feet in depth. Depending upon the level of perceived potential in an area, shovel tests may be conducted at up to 16 points per mile. Finally, in areas that have a high probability to contain cultural resources and present deep alluvial sediments, backhoe trenching may be required. Ditches would be up to 33 feet deep, approximately 3.5 feet wide, and may extend for up to 60 feet in length. Backhoe trenching would be the last option utilized for documenting cultural resources. The cultural resources surveys are scheduled to commence as soon as possible (pending the issuance of a special use permit) and would be conducted over a 10-day period. Follow-up surveys to further investigate and/or archive sites potentially eligible for listing on the National Register of Historic Places may be required. Any collections of cultural resources would require the issuance of a permit under the Archeological Resources Protection Act and the Antiquities Act. This permit is issued by the Regional Director.

Availability of Resources: No additional fiscal resources will be needed due to this use as long as surveys are carried out utilizing pedestrian surveys (only). If areas are identified during the surveys that indicate moderate or high potential cultural resources, additional fiscal and staff resources may be required. The LRGVNWR staff will provide oversight during all aspects of the investigation to ensure compatibility stipulations are met, and to insure permit compliance with on-refuge work. The effort required to issue and oversee the special use permit can be accomplished with existing resources as long as pedestrian-only surveys are employed. More intensive surveys for moderate to high potential sites will require additional staff and fiscal resources as well as permits.

Anticipated Impacts of the Use: Cultural resource surveys conducted by e²M will be conducted on foot or using existing trails or roads within each of the listed Refuge tracts. Vehicles will be permitted only on existing roads and only hand-trimming of tree branches will be authorized. Cultural resource surveys will disturb and temporarily displace wildlife but this affect is expected to be temporal and insignificant. Surveys would occur during daylight hours only and would not affect nocturnal species. Due to the methods employed in areas of low potential for cultural resources, there should be little if any damage to wildlife or vegetation. This use is expected to have negligible impacts to Refuge resources. However, upon the identification of moderate to high potential sites by the contractor and proposals to utilize hand digging and/or heavy equipment, amended special use permits or archeological permits will be required. These amended permits or archeological permits may contain additional stipulations as necessary to protect wildlife and vegetation. It is also possible that activities prescribed for moderate or high potential sites would not be permitted. Depending on the proposed action, it may be necessary to reevaluate this Compatibility Determination. If a new Compatibility Determination is required, it would include additional public comment.

Public Review and Comment: Public notices of the Draft Compatibility Determination will be advertised in local newspapers (*The Valley Morning Star, Brownsville Herald, The Monitor, The Rio Grande Guardian Times)*. Comments will be received from November 5 through November 19, 2007. All comments must be written and received via mail, email or delivered in person to the Santa Ana Refuge Headquarters.

Determination (check one below):

___ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Prior to the implementation of the project:

1. No work will begin without obtaining a Special Use Permit from the Refuge Manager. Daily work activities will be closely coordinated with the LRGVNWR Refuge Manager regarding particular sites/locations and access routes.
2. Vegetated areas will be surveyed on foot only.
3. Vegetation may be cut using hand tools only and only for the purpose of conducting the survey.
4. No digging with shovels or heavy equipment is permitted without prior consultation with the Refuge Manager.
5. All efforts will be made to recognize and avoid terrestrial wildlife to reduce the risk of unnecessary mortality.
6. While work is being conducted, vehicles and equipment must remain on designated Refuge roads. No off-road access is permitted. Vehicles will not be permitted on Refuge roads

during wet conditions.

7. All survey personnel will be accompanied by Refuge Law Enforcement Officers (as available) or Border Patrol Agents when present on Refuge lands.
8. All other stipulations and/or rules from *General Conditions and Operating Procedures While on the Lower Rio Grande Valley National Wildlife Refuge* will be strictly adhered to.

Justification: Though the overall objective of these surveys is to gather cultural resource information related to the development of an Environmental Impact Statement (EIS) and identification of endangered and threatened species related to Section 7 (Endangered Species) Consultation for the future construction of the Border Fence, these surveys have the potential to provide much needed cultural resource information to the Refuge. Little information is currently available to the Refuge Staff regarding the presence or absence of cultural resources on these Refuge tracts. Gathering of cultural resource data on Refuge tracts is important, and can be useful baseline information for Refuge Managers and Biologists assigned to the Lower Rio Grande Valley National Wildlife Refuge. Service Policy related to cultural resources is established in Service Manual 614 FW 1-5. Under Section 1.2 Objectives, A. the objectives for managing cultural resources are to: "Protect, maintain, and plan for the use of Service managed cultural resources for the benefit of present and future generations." The Santa Ana/Lower Rio Grande Valley Comprehensive Conservation Plan goals and objectives include: 5.4 Cultural Resources. GOAL: "to protect, maintain, and plan for Service managed cultural resources on the Lower Rio Grande Valley/Santa Ana NWR for the benefit of present and future generations." Objectives: 1. "Coordinate with the SHPO to identify cultural resources on the refuge. Evaluate the status of new sites such as the Casa Yanqui ruins in the Starr County District and submit for additional protection (i.e., National Register) if necessary." These cultural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to the Refuge's basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a Border Fence on Refuge lands is not considered a factor in determining whether the use is Compatible.

Signature: Project Leader___ ____________________________

(Signature and Date)

Concurrence: Regional Chief ____________________________

(Signature and Date)

Mandatory 10- or 15-year Re-Evaluation Date: __November 20, 2017__

Fish and Wildlife Service policy states that after November 17, 2002 no uses on a refuge will be permitted for a period longer than 10 years, unless the terms and conditions for such long-term permits (e.g., easements) specifically allows for the modification to the terms and conditions of the permit, if necessary, to ensure compatibility.

Signature: Project Leader ___Kenneth L. Merritt 11/28/07___
(Signature and Date)

Concurrence: Regional Chief ___Chris S... 11-30-07___
(Signature and Date)

Mandatory 10- or 15-year Re-Evaluation Date: Not Applicable
Fish and Wildlife Service policy states that after November 17, 2002 no uses on a refuge will be permitted for a period longer than 10 years, unless the terms and conditions for such long-term permits (e.g., easements) specifically allows for the modification to the terms and conditions of the permit, if necessary, to ensure compatibility.

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Refuge Name: Lower Rio Grande Valley National Wildlife Refuge. Refuge tracts likely to be surveyed: Arroyo Ramirez, Los Negros Creek, Rio San Juan, Los Velas, Los Ebanos, Penitas, Granjeno, Monterrey Banco, La Coma, Rosario Banco, Kiskadee, Phillips Banco, Boscaje de La Palma, and Southmost.

Establishing and Acquisition Authorities:

- Fish and Wildlife Act of 1956 [16 U.S.C. 742f(a)(4)], [16 U.S.C. 742f(b)(1)]
- An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes [16 U.S.C. 667b]
- Refuge Recreation Act, as amended [16 U.S.C. 460k-1], [16 U.S.C. 460k-2]
- Migratory Bird Conservation Act [16 U.S.C. 715d]
- National Wildlife Refuge System Improvement Act of 1997

Refuge Purpose(s): As excerpted from the enabling legislation used to authorize the acquisition of the Refuge, the following are the Refuge purposes:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." [16 U.S.C. 742f(a)(4)] "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)

"... particular value in carrying out the national migratory bird management program." [16 U.S.C. 667b] (An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes)

"... suitable for: (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." [16 U.S.C. 460k-1] "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." [16 U.S.C. 460k-2] (Refuge Recreation Act [16 U.S.C. 460k-460k-4], as amended)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." [16 U.S.C. 715d] (Migratory Bird Conservation Act)

The Lower Rio Grande Valley and Santa Ana National Wildlife Refuges Comprehensive Conservation Plan (CCP) of 1997 satisfies the CCP requirement of the National Wildlife Refuge System Improvement Act of 1997 and identifies the following five goals of the Lower Rio Grande Valley National Wildlife Refuge:

- To restore, enhance and protect biological diversity.
- To protect and obtain additional water rights, improve water management, and protect, restore and enhance wetlands.
- To improve water quality and reduce contaminant related fish and wildlife resource losses.
- To protect, maintain and plan for cultural resources.
- To offer compatible wildlife dependent public uses, recreational opportunities, and interpretation and education.

National Wildlife Refuge System Mission: "The Mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Description of Use: engineering-environmental Management, Inc. (e^2M) would conduct natural resource surveys within fourteen tracts (listed above) of the Lower Rio Grande Valley National Wildlife Refuge. The surveys would begin upon the granting of a special use permit for this use by the Refuge. Surveyors would walk the entire accessible length of the proposed fence segment on each of the Refuge tracts, and examine in more detail areas containing unique species compositions or habitat that might be conducive to sensitive species. Plot data (GPS) coordinates, photographs, and plant community composition would be recorded at regular intervals along the proposed fence site and where plant communities present substantial shifts in species composition. These data would be used to generate vegetation classifications and maps to support delineation of habitat types, analysis of potential sensitive species occurrences, and analysis of potential project impacts to biological resources. These surveys would be observational only. Information would also be gathered related to wetland delineation. Minor digging may be required to determine the presence of hydric soils.

Availability of Resources: No additional fiscal resources will be needed due to this use. The proposed work will be completed by e^2M (contracted by the Corps of Engineers – Fort Worth District) and is expected to be completed within a 10-day period. LRGVNWR staff will provide oversight during all aspects of the activity to ensure special use permit requirements are carried out. The effort required to issue and oversee the Special Use Permit can be accomplished with existing resources.

Anticipated Impacts of the Use: Natural resource surveys conducted by e^2M will be conducted on foot or using existing roads within each of the Refuge tracts. Vehicles will be permitted only on existing roads and no clearing or cutting of vegetation will be needed. Natural resource surveys will disturb and temporarily displace wildlife but this affect is expected to be temporal and insignificant. Surveys would occur during daylight hours only and would not affect nocturnal species. Due to the methods employed, there should be little if any damage to wildlife or vegetation.

Public Review and Comment: Public notices of the availability of the Draft Compatibility Determination (for review) will be advertised in local newspapers (*The Valley Morning Star, Brownsville Herald, The Monitor, The Rio Grande Guardian Times*). Written comments will be received from November 5 through November 19, 2007. All comments must be received via mail, email or delivered in person to the Santa Ana Refuge Headquarters.

Determination (check one below):

___ Use is Not Compatible _X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Prior to the implementation of the project:

1. No work will begin without obtaining a Special Use Permit from the Refuge Manager. Daily work activities will be closely coordinated with the LRGVNWR Refuge Manager regarding particular sites/locations and access routes.
2. Vegetated areas will be surveyed by foot only.
3. All efforts will be made to recognize and avoid terrestrial wildlife to reduce the risk of accidental mortality.
4. While work is being conducted, vehicles and equipment must remain on designated Refuge roads. No off-road vehicle access is permitted. Vehicles will not be permitted on Refuge roads during wet conditions.
5. Survey work is authorized during daylight hours only.
6. Cutting or clearing of Refuge vegetation is prohibited.
7. All survey personnel will be accompanied by Refuge Law Enforcement Officers (as available) or Border Patrol agents when present on Refuge lands.
8. All other stipulations and/or rules from *General Conditions and Operating Procedures While on the Lower Rio Grande Valley National Wildlife Refuge* will be strictly adhered to.

Justification: Though the overall objective of these surveys is to gather biological information related to the development of an Environmental Impact Statement (EIS) and identification of endangered and threatened species related to Section 7 (Endangered Species) Consultation for the future construction of a border fence, these surveys have the potential to provide much needed biological information to the Refuge. Little information is currently available to the Refuge staff regarding the presence or absence of plant and animal species on these Refuge tracts. Gathering of biological resource data on Refuge tracts is important, and can be useful baseline information for Refuge Managers and Biologists assigned to the LRGVNWR. Conducting natural resource surveys on specific tracts of the LRGVNWR is consistent with the goals and objectives of the Refuge's Comprehensive Conservation Plan (est. 9/24/97). Under Section 5.1 B. Research Objectives (1.) states: "Conduct floral and faunal inventories throughout the area of ecological concern and develop monitoring strategies to detect significant population trends." Section 5.1 C. Endangered Species Objectives (1.) states "Monitor populations of threatened and endangered floral and faunal species on refuge tracts and throughout the area of ecological concern. Use GIS and Global Positioning Systems to document locations of populations of species of management concern." These natural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to our basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a border fence on Refuge lands is not considered a factor in determining whether this use is Compatible.

Signature: Project Leader___ ____________________________
(Signature and Date)

Concurrence: Regional Chief ____________________________
(Signature and Date)

Mandatory 10- or 15-year Re-Evaluation Date: __November 20, 2017__
Fish and Wildlife Service policy states that after November 17, 2002 no uses on a refuge will be permitted for a period longer than 10 years, unless the terms and conditions for such long-term permits (e.g., easements) specifically allows for the modification to the terms and conditions of the permit, if necessary, to ensure compatibility.

Refuge's Comprehensive Conservation Plan (est. 9/24/97). Under Section 5.1 B. Research Objectives (1.) states: "Conduct floral and faunal inventories throughout the area of ecological concern and develop monitoring strategies to detect significant population trends." Section 5.1 C. Endangered Species Objectives (1.) states "Monitor populations of threatened and endangered floral and faunal species on refuge tracts and throughout the area of ecological concern. Use GIS and Global Positioning Systems to document locations of populations of species of management concern." These natural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to our basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a border fence on Refuge lands is not considered a factor in determining whether this use is Compatible.

Signature: Project Leader Kenneth L. Merritt 11/28/07
(Signature and Date)

Concurrence: Regional Chief Chris [illegible] 11-30-07
(Signature and Date)

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Determination (check one below):

___ Use is Not Compatible

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Stipulations Necessary to Ensure Compatibility:

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during wet conditions.

7. All survey personnel will be accompanied by Refuge Law Enforcement Officers (as available) or Border Patrol Agents when present on Refuge lands.
8. All other stipulations and/or rules from *General Conditions and Operating Procedures While on the Lower Rio Grande Valley National Wildlife Refuge* will be strictly adhered to.

Justification: Though the overall objective of these surveys is to gather cultural resource information related to the development of an Environmental Impact Statement (EIS) and identification of endangered and threatened species related to Section 7 (Endangered Species) Consultation for the future construction of the Border Fence, these surveys have the potential to provide much needed cultural resource information to the Refuge. Little information is currently available to the Refuge Staff regarding the presence or absence of cultural resources on these Refuge tracts. Gathering of cultural resource data on Refuge tracts is important, and can be useful baseline information for Refuge Managers and Biologists assigned to the Lower Rio Grande Valley National Wildlife Refuge. Service Policy related to cultural resources is established in Service Manual 614 FW 1-5. Under Section 1.2 Objectives, A. the objectives for managing cultural resources are to: "Protect, maintain, and plan for the use of Service managed cultural resources for the benefit of present and future generations." The Santa Ana/Lower Rio Grande Valley Comprehensive Conservation Plan goals and objectives include: 5.4 Cultural Resources. GOAL: "to protect, maintain, and plan for Service managed cultural resources on the Lower Rio Grande Valley/Santa Ana NWR for the benefit of present and future generations." Objectives: 1. "Coordinate with the SHPO to identify cultural resources on the refuge. Evaluate the status of new sites such as the Casa Yanqui ruins in the Starr County District and submit for additional protection (i.e., National Register) if necessary." These cultural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to the Refuge's basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a Border Fence on Refuge lands is not considered a factor in determining whether the use is Compatible.

Signature: Project Leader___ ___________________________
(Signature and Date)

Concurrence: Regional Chief ______________________________
(Signature and Date)

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Signature: Project Leader ~~Kenneth L. Merritt~~ 11/28/07
(Signature and Date)

Concurrence: Regional Chief ~~Chris S~~ 11-30-07
(Signature and Date)

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Refuge Name: Lower Rio Grande Valley National Wildlife Refuge. Refuge tracts likely to be surveyed: Arroyo Ramirez, Los Negros Creek, Rio San Juan, Los Velas, Los Ebanos, Penitas, Granjeno, Monterrey Banco, La Coma, Rosario Banco, Kiskadee, Phillips Banco, Boscaje de La Palma, and Southmost.

Establishing and Acquisition Authorities:

- Fish and Wildlife Act of 1956 [16 U.S.C. 742f(a)(4)], [16 U.S.C. 742f(b)(1)]
- An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes [16 U.S.C. 667b]
- Refuge Recreation Act, as amended [16 U.S.C. 460k-1], [16 U.S.C. 460k-2]
- Migratory Bird Conservation Act [16 U.S.C. 715d]
- National Wildlife Refuge System Improvement Act of 1997

Refuge Purpose(s): As excerpted from the enabling legislation used to authorize the acquisition of the Refuge, the following are the Refuge purposes:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." [16 U.S.C. 742f(a)(4)] "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)

"... particular value in carrying out the national migratory bird management program." [16 U.S.C. 667b] (An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes)

"... suitable for: (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." [16 U.S.C. 460k-1] "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." [16 U.S.C. 460k-2] (Refuge Recreation Act [16 U.S.C. 460k-460k-4], as amended)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." [16 U.S.C. 715d] (Migratory Bird Conservation Act)

The Lower Rio Grande Valley and Santa Ana National Wildlife Refuges Comprehensive Conservation Plan (CCP) of 1997 satisfies the CCP requirement of the National Wildlife Refuge System Improvement Act of 1997 and identifies the following five goals of the Lower Rio Grande Valley National Wildlife Refuge:

- To restore, enhance and protect biological diversity.
- To protect and obtain additional water rights, improve water management, and protect, restore and enhance wetlands.
- To improve water quality and reduce contaminant related fish and wildlife resource losses.
- To protect, maintain and plan for cultural resources.
- To offer compatible wildlife dependent public uses, recreational opportunities, and interpretation and education.

National Wildlife Refuge System Mission: "The Mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Description of Use: engineering-environmental Management, Inc. (e^2M) would conduct natural resource surveys within fourteen tracts (listed above) of the Lower Rio Grande Valley National Wildlife Refuge. The surveys would begin upon the granting of a special use permit for this use by the Refuge. Surveyors would walk the entire accessible length of the proposed fence segment on each of the Refuge tracts, and examine in more detail areas containing unique species compositions or habitat that might be conducive to sensitive species. Plot data (GPS) coordinates, photographs, and plant community composition would be recorded at regular intervals along the proposed fence site and where plant communities present substantial shifts in species composition. These data would be used to generate vegetation classifications and maps to support delineation of habitat types, analysis of potential sensitive species occurrences, and analysis of potential project impacts to biological resources. These surveys would be observational only. Information would also be gathered related to wetland delineation. Minor digging may be required to determine the presence of hydric soils.

Availability of Resources: No additional fiscal resources will be needed due to this use. The proposed work will be completed by e^2M (contracted by the Corps of Engineers – Fort Worth District) and is expected to be completed within a 10-day period. LRGVNWR staff will provide oversight during all aspects of the activity to ensure special use permit requirements are carried out. The effort required to issue and oversee the Special Use Permit can be accomplished with existing resources.

Anticipated Impacts of the Use: Natural resource surveys conducted by e^2M will be conducted on foot or using existing roads within each of the Refuge tracts. Vehicles will be permitted only on existing roads and no clearing or cutting of vegetation will be needed. Natural resource surveys will disturb and temporarily displace wildlife but this affect is expected to be temporal and insignificant. Surveys would occur during daylight hours only and would not affect nocturnal species. Due to the methods employed, there should be little if any damage to wildlife or vegetation.

Public Review and Comment: Public notices of the availability of the Draft Compatibility Determination (for review) will be advertised in local newspapers (*The Valley Morning Star, Brownsville Herald, The Monitor, The Rio Grande Guardian Times*). Written comments will be received from November 5 through November 19, 2007. All comments must be received via mail, email or delivered in person to the Santa Ana Refuge Headquarters.

Determination (check one below):

___ Use is Not Compatible _X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Prior to the implementation of the project:

1. No work will begin without obtaining a Special Use Permit from the Refuge Manager. Daily work activities will be closely coordinated with the LRGVNWR Refuge Manager regarding particular sites/locations and access routes.
2. Vegetated areas will be surveyed by foot only.
3. All efforts will be made to recognize and avoid terrestrial wildlife to reduce the risk of accidental mortality.
4. While work is being conducted, vehicles and equipment must remain on designated Refuge roads. No off-road vehicle access is permitted. Vehicles will not be permitted on Refuge roads during wet conditions.
5. Survey work is authorized during daylight hours only.
6. Cutting or clearing of Refuge vegetation is prohibited.
7. All survey personnel will be accompanied by Refuge Law Enforcement Officers (as available) or Border Patrol agents when present on Refuge lands.
8. All other stipulations and/or rules from *General Conditions and Operating Procedures While on the Lower Rio Grande Valley National Wildlife Refuge* will be strictly adhered to.

Justification: Though the overall objective of these surveys is to gather biological information related to the development of an Environmental Impact Statement (EIS) and identification of endangered and threatened species related to Section 7 (Endangered Species) Consultation for the future construction of a border fence, these surveys have the potential to provide much needed biological information to the Refuge. Little information is currently available to the Refuge staff regarding the presence or absence of plant and animal species on these Refuge tracts. Gathering of biological resource data on Refuge tracts is important, and can be useful baseline information for Refuge Managers and Biologists assigned to the LRGVNWR. Conducting natural resource surveys on specific tracts of the LRGVNWR is consistent with the goals and objectives of the Refuge's Comprehensive Conservation Plan (est. 9/24/97). Under Section 5.1 B. Research Objectives (1.) states: "Conduct floral and faunal inventories throughout the area of ecological concern and develop monitoring strategies to detect significant population trends." Section 5.1 C. Endangered Species Objectives (1.) states "Monitor populations of threatened and endangered floral and faunal species on refuge tracts and throughout the area of ecological concern. Use GIS and Global Positioning Systems to document locations of populations of species of management concern." These natural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to our basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a border fence on Refuge lands is not considered a factor in determining whether this use is Compatible.

Signature: Project Leader___ ______________________________
(Signature and Date)

Concurrence: Regional Chief ______________________________
(Signature and Date)

Mandatory 10- or 15-year Re-Evaluation Date: __November 20, 2017__
Fish and Wildlife Service policy states that after November 17, 2002 no uses on a refuge will be permitted for a period longer than 10 years, unless the terms and conditions for such long-term permits (e.g., easements) specifically allows for the modification to the terms and conditions of the permit, if necessary, to ensure compatibility.

Refuge's Comprehensive Conservation Plan (est. 9/24/97). Under Section 5.1 B. Research Objectives (1.) states: "Conduct floral and faunal inventories throughout the area of ecological concern and develop monitoring strategies to detect significant population trends." Section 5.1 C. Endangered Species Objectives (1.) states "Monitor populations of threatened and endangered floral and faunal species on refuge tracts and throughout the area of ecological concern. Use GIS and Global Positioning Systems to document locations of populations of species of management concern." These natural resource surveys will not materially interfere with or detract from the purposes of the Refuge and have the potential to add to our basic understanding and knowledge of the resources present on Refuge lands. Methods and procedures specified in the proposed use are not likely to significantly impact wildlife or wildlife habitat within the Refuge. The fact that these surveys are related to potential future construction of a border fence on Refuge lands is not considered a factor in determining whether this use is Compatible.

Signature: Project Leader Kenneth L. Merritt 11/28/07
(Signature and Date)

Concurrence: Regional Chief Chris [signature] 11-30-07
(Signature and Date)

Mandatory 10- or 15-year Re-Evaluation Date: Not Applicable
Fish and Wildlife Service policy states that after November 17, 2002 no uses on a refuge will be permitted for a period longer than 10 years, unless the terms and conditions for such long-term permits (e.g., easements) specifically allows for the modification to the terms and conditions of the permit, if necessary, to ensure compatibility.

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:27 PM

Conversation Contents

Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)

Attachments:

/150. Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)/1.1 DOC006.pdf
/150. Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)/1.2 DOC007.pdf
/150. Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)/2.1 DOC006.pdf
/150. Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)/2.2 DOC007.pdf

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Thu May 04 2017 13:34:58 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>
CC:	Chris Perez <chris_perez@fws.gov>
Subject:	Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)
Attachments:	DOC006.pdf DOC007.pdf

See Attached. These CD's were prepared for and issued specifically for/to former CBP Contractor, Engineering-Environmental Management, Inc (e2M), so if it is determined that these are again necessary, they would need to be revised. If not, these CD's could potentially still be valid til Oct 2017.

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Thu May 04 2017 14:45:07 GMT-0600 (MDT)
To:	kelly mcdowell <kelly_mcdowell@fws.gov>
Subject:	Fwd: Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)
Attachments:	DOC006.pdf DOC007.pdf

---------- Forwarded message ----------
From: **Winton, Bryan** <bryan_winton@fws.gov>
Date: Thu, May 4, 2017 at 2:34 PM
Subject: Signed CD's to CBP for previous Fence-Related Actions (Biological & Cultural Resource Surveys)
To: Rob Jess <robert_jess@fws.gov>
Cc: Chris Perez <chris_perez@fws.gov>

See Attached. These CD's were prepared for and issued specifically for/to former CBP Contractor, Engineering-Environmental Management, Inc (e2M), so if it is determined that these are again necessary, they would need to be revised. If not, these CD's could potentially still be valid til Oct 2017.

--
Bryan R. Winton, Refuge Manager
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3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell

--
robert jess
project leader
south texas refuge complex
alamo, texas

Major Infrastructure Project
2017

<u>Project Name</u>: North South Corridor

<u>Project Sponsor</u>: Arizona Department of Transportation

<u>Project Description</u>

- **Sector:** Transportation
- **Lead Agency:** Federal Highway Administration
- **Any Identifying Project Numbers:** NA
- **Location:** Maricopa, Pinal, and Pima counties, Arizona
- **Estimated Cost:** Anticipated costs > $100 million, planning and construction combined
- **Other:** The Federal Highway Administration and Arizona Department of Transportation are currently conducting the environmental review under the NEPA process for the proposed North South Corridor Project which entails the construction of a new freeway from the Town of Picacho, located between Phoenix and Tucson, Arizona, to Apache Junction, located east of Phoenix, Arizona. The project is designed to accommodate traffic increases between Tucson and Phoenix. The North South Corridor project has been in the planning stages since 2013.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Arizona ESFO
- **Status of FWS Involvement:** FWS is a Cooperating Agency under NEPA, providing technical assistance on avoiding and minimizing impacts to trust resources. There will likely be a need for ESA section 7 consultation later in the planning process.
- **Project Timeline:** Unknown, early in planning process.

Major Infrastructure Project
2017

<u>Project Name</u>: Second Access to South Padre Island

<u>Project Sponsor</u>: Texas Department of Transportation, and Cameron County Regional Mobility Authority

<u>Project Description</u>

- **Sector:** Transportation
- **Lead Agency:** Federal Highway Administration
- **Any Identifying Project Numbers:** FHWA-TX-EIS-09-02-D
- **Location:** South Padre Island over Laguna Madre, Cameron County to Willacy County, Texas
- **Estimated Cost:** The 2015 Final EIS estimated project cost at $631,350,000
- **Other:** Length of the proposed bridge, including approach roads is 17 miles, extending from the mainland location at FM 510 in Cameron County across the Laguna Madre to connection with State Park Road 100/Ocean Boulevard on South Padre Island.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** FWS will review NEPA and Clean Water Act 404 permit documents. FWS will also complete a consultation for the US Army Corp of Engineers under section 7 of the ESA.
- **Project Timeline:** Anticipate receipt of Biological Assessment to initiate section 7 consultation in 3-6 months.

Major Infrastructure Project
2017

Project Name: World Trade International Bridge Expansion in Laredo, Texas

Project Sponsor: City of Laredo and bridge owner

Project Description

- **Sector:** Transportation
- **Lead Agency:** State Department, International Boundary and Water Commission
- **Any Identifying Project Numbers:** NA
- **Location:** Rio Grande at Laredo, Webb County, TX
- **Estimated Cost:** The total cost of this project will be over $100,000,000 based upon the following estimates: 2015 Texas Department of Transportation report on Texas-Mexico International Bridges, estimates cost for the GSA facilities at over $19.5 million and the roadway improvement costs related to the World Trade International Bridge were estimated at approximately $93 million.
- **Other:** The plan includes expanding the current 8 lanes to 16 lanes in order to expedite the flow of goods across the border and reduce traffic congestion. Alongside the improvements of the World Trade Bridge; exit lanes to Bob Bullock-Loop 20 and Interstate 35 will also need to be improved.

FWS Involvement

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** Providing technical assistance to the development of the Supplemental Environmental Assessment to be prepared to amend existing Presidential Permit
- **Project Timeline:** Start meeting with agencies March 13, 2017. The completion of the project will depend on the final plans that are accepted.

Major Infrastructure Project
2017

<u>Project Name</u>: Texas Central High-Speed Railway (or "TCR")

<u>Project Sponsor</u>: Texas Central Partners, LLC

<u>Project Description</u>

- **Sector**: Transportation/Rail
- **Lead agency**: Federal Railroad Administration
- **Project Numbers**: NA
- **Location**: The proposed route runs through Dallas, Ellis, Navarro, Freestone, Limestone, Leon, Madison, Grimes, Waller, Harris counties, Texas
- **Estimated cost**: estimated costs in excess of $10 billion

<u>FWS Involvement</u>

- **Region**: 2
- **Field Office**: Texas Coastal and Arlington ESFOs
    - **Lead Field Office**: Texas Coastal ESFO
- **Status of FWS Involvement**: The Texas Coastal ESFO staff reviewed species-specific information and assessment of survey protocol for portions of the rail alignment(s) potentially affecting the following species: large-fruited sand-verbena (*Abronia macrocarpa*), Navasota ladies'-tresses (*Spiranthes parksii*), and Houston toad (*Bufo houstonensis).* Starting in Fall 2016, Texas Coastal ESFO staff coordinated with the FWS-Texas Department of Transportation biologist/liaison regarding potential impacts to fish and wildlife trust resources. Our involvement is anticipated to extend into 2019, if effects to listed species are likely. This is due to potential consultation procedures pursuant to Section 7 of the Endangered Species Act.
- **Project Timeline**: The lead federal agency is developing an Environmental Impact Statement under NEPA, and a draft EIS is anticipated within a year. The Texas Coastal ESFO has been involved with this project since 2011. Alignment changes to this project are anticipated therefore, work will likely continue into spring/summer 2019 and include species surveys.

Major Infrastructure Project
2017

<u>Project Name</u>: Salt Bayou Beach Nourishment and Intracoastal Waterway Syphons

<u>Project Sponsor</u>: Jefferson County, Texas

<u>Project Description</u>

- **Sector:** Transportation/Coastal Resiliency
- **Lead Agency:** U.S. Fish and Wildlife Service & Texas Parks and Wildlife
- **Any Identifying Project Numbers:** Permit No: SWG-2015-00444.
- **Location:** Jefferson, Galveston, and Chambers counties, Texas
- **Estimated Cost:** Approximately $100 Million
- **Other:** Project is essential to maintaining freshwater marsh conditions on over 60,000 acres of coastal marsh. Most of this marsh is protected by Sea Rim State Park, J.D Murphy Wildlife Management Area and McFaddin National Wildlife Refuge. This huge marsh complex is in eminent danger of disappearing without this effort. This marsh was proven to be the primary factor of protecting the City of Port Author and a major portion of the petrochemical refinery capacity in the U.S. from tropical storm flooding during Hurricane Ike in 2008. Once restored, this marsh will protect refineries responsible for half the aviation fuel produced in US. More than 20 percent of the nation's fuel is refined behind this 60,000 acre marsh. This marsh also protects one of the busiest portions of the Gulf Intracoastal Waterway and the busiest military port in world.
  Project includes leveeing up 40,000 acre marsh and protecting levee with offshore sands and installing several giant syphons across the Gulf Intracoastal Waterway.

<u>FWS Involvement</u>

- **Region:** Region 2
- **Field Office:** McFaddin National Wildlife Refuge and Texas Coastal ESFO
    - **Lead Field Office:** McFaddin National Wildlife Refuge
- **Status of FWS Involvement:** Advisory and significant portions of project will occur on McFaddin National Wildlife Refuge
- **Project Timeline:** Work will begin on portions of project this May and will continue over next several years.

Major Infrastructure Project
2017

<u>Project Name</u>: Texas Coastal Storm Surge Reduction and Ecological Restoration Feasibility Study

<u>Project Sponsor</u>: Texas General Land Office for the study
No local sponsor for construction has been identified

<u>Project Description</u>

- **Sector:** Transportation/Waterborne Shipping
- **Lead Agency:** U.S. Army Corps of Engineers
- **Any Identifying Project Numbers:** NA
- **Location:** Entire Texas coast
- **Estimated Cost:** The study is $19.1 million; however construction costs are expected to be several billion dollars.
- **Other:** This study aims to protect the nation's commercial interests with respect to oil refineries infrastructure and the import and export of goods and commodities.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** Advisory in the planning process
- **Project Timeline:** The final U.S. Army Corps of Engineers' report to the Chief Engineer is expected in 2020, however our involvement will conclude in 2019. FWS will also be involved in any necessary ESA section 7 consultations related to construction.

Major Infrastructure Project
2017

<u>Project Name</u>: The Houston Ship Channel Improvement Project

<u>Project Sponsor</u>: The Port of Houston Authority

<u>Project Description</u>

- **Sector:** Transportation/Waterborne Shipping
- **Lead Agency:** U.S. Army Corps of Engineers
- **Any Identifying Project Numbers:** NA
- **Location:** Harris and Chambers counties, Texas
- **Estimated Cost:** The Study will finalize in 2020 at a cost of $19.1 million. Project is not clearly defined, however the construction costs equate to $500 million to $1 billion for improvements.
- **Other:** U.S. Army Corps of Engineers is working to identify widening and deepening measures aimed at providing safer passage for larger vessels, increased mooring capacities for emergency and poor weather conditions, and bend easing opportunities, along the entire Houston Ship Channel.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** The FWS provides technical assistance and makes recommendations for the development of an environmentally sound project through Planning Aid Letters and Fish and Wildlife Coordination Act Reports. Our recommendations often focus on the conservation of listed species and migratory birds; however, FWS does provide recommendations and comments on project alternatives that help conserve other fish and wildlife resources as necessary. FWS will also be involved in any necessary section 7 consultations under ESA
- **Project Timeline:** Study will conclude in 2020. There is no timeline for construction.

Major Infrastructure Project
2017

<u>Project Name</u>: Matagorda Ship Channel Improvement Project

<u>Project Sponsor</u>: Port of Calhoun Navigation District

<u>Project Description</u>

- **Sector:** Transportation/Waterborne Shipping
- **Lead Agency:** U.S. Army Corps of Engineers
- **Any Identifying Project Numbers:** NA
- **Location:** Matagorda County, Texas
- **Estimated Cost:** Greater than $100 million
- **Other:** The U.S. Army Corps of Engineers and the local sponsor decided to revisit the 2009 project in hopes of increasing channel depth and width and to create a new dredged material management plan. Environmental Impacts are expected to increase as a result of the channel changes.

<u>FWS Involvement</u>

- **Region: 2**
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** The FWS will provide technical guidance expertise during the planning phases. FWS will also be involved in any necessary ESA section 7 consultations.
- **Project Timeline:** Study completion date is late 2020

Major Infrastructure Project
2017

<u>Project Name</u>: Gulf Intercoastal Waterway Brazos River Floodgates and Colorado River Locks Systems Feasibility Study

<u>Project Sponsor</u>: U.S. Army Corps of Engineers

<u>Project Description</u>

- **Sector:** Transportation/Waterborne Shipping
- **Lead Agency:** U.S. Army Corps of Engineers
- **Any Identifying Project Numbers:** NA
- **Location:** Brazos and Colorado River intersections along the Gulf Intercoastal Waterway
- **Estimated Cost:** $500 million to $1 billion
- **Other:** The study will identify environmentally responsible alternatives for replacing the floodgate/lock structures and will develop alternatives to maintain 40 miles of channel and shorelines along the Gulf Intercostal Waterway.

<u>FWS Involvement</u>

- **Region: 2**
- **Field Office:** Texas Coastal Ecological Services Office
- **Status of FWS Involvement:** The FWS will provide technical guidance and expertise regarding impacts to fish and wildlife trust resources. The FWS will also be involved in any necessary ESA section 7 consultations.
- **Project Timeline:** The study will finalize in 2019 with a U.S. Army Corps of Engineers Chief's report and final recommendations

Major Infrastructure Project
2017

<u>Project Name</u>: Vista Ridge Regional Water Supply

<u>Project Sponsor</u>: Central Texas Regional Water Supply Corporation

<u>Project Description</u>

- **Sector:** Municipal
- **Lead Agency:** Army Corps of Engineers
- **Any Identifying Project Numbers:** NA
- **Location:** Burleson, Lee, Bastrop, Caldwell, Guadalupe, Comal, and Bexar counties, Texas
- **Estimated Cost:** Estimated between $884 million and $3.4 billion
- **Other:** 142-mile raw water pipeline

<u>FWS Involvement</u>

- **Region:** Region 2
- **Field Office:** Austin Ecological Services Field Office
- **Status of FWS Involvement:** Formal section 7 consultation under the Endangered Species Act was initiated in November 2016.
- **Project Timeline:** Final Biological Opinion will be issued in April 2017.

Major Infrastructure Project
2017

<u>Project Name</u>: Arizona Water Settlement Act – Public Law 108–451—Dec. 10, 2004

<u>Project Sponsor</u>: New Mexico Central Arizona Project Unit

<u>Project Description</u>

- **Sector:** Water/Diversion and Storage
- **Lead Agency:** Bureau of Reclamation
- **Any Identifying Project Numbers:** NA
- **Location:** Grant and Hidalgo counties, New Mexico
- **Estimated Cost:** $128 million Federal funds
- **Other:** Part of the Arizona Water Settlement Act will provide 14,000 acre-feet of water for agricultural or municipal use within the two New Mexico counties.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** New Mexico Ecological Services Field Office and Arizona Ecological Services Field Office
    - **Lead Field Office:** New Mexico Ecological Services Field Office
- **Status of FWS Involvement:** FWS is providing technical assistance and in informal consultation under ESA, Fish and Wildlife Coordination Act, and NEPA.
- **Project Timeline:** Record of Decision by December 31, 2019. No project defined at this time, so no timeline can be projected for FWS products (biological opinion and Fish and Wildlife Coordination Report) delivery.

Major Infrastructure Project
2017

<u>Project Name</u>: Annova Liquefied Natural Gas Facility

<u>Project Sponsor</u>: Exelon with Annova LNG

<u>Project Description</u>

- **Sector:** Energy
- **Lead Agency:** Federal Energy Regulatory Commission
- **Any Identifying Project Numbers:** FERC Docket No. PF15-15-000
- **Location:** Port of Brownsville, Cameron County, Texas
- **Estimated Cost:** $3 billion
- **Other:** Natural gas liquefaction facility to liquefy domestic natural gas for export to international markets via ocean-going vessels. Maximum output at optimal operating conditions of 6.95 million tons per annum (mtpa). Liquefaction facility on a 731-acre parcel leased from the Port of Brownsville. Location and size of feed gas pipeline for the facility via an intrastate natural gas pipeline not identified by Annova to date.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** As a Cooperating Agency under NEPA, FWS will review EIS and complete Section 7 ESA Consultation. FWS will review and provide comments and recommendations to U.S. Army Corps of Engineers (USACE) for required Section 10 and 404 permits to be issued by USACE.
- **Project Timeline:** FERC anticipates license issuance mid-2018. USACE anticipates concurrent permit authorization.

Major Infrastructure Project
2017

<u>Project Name</u>: Texas Liquefied Natural Gas Facility

<u>Project Sponsor</u>: Texas LNG Company

<u>Project Description</u>

- **Sector:** Energy/Natural Gas
- **Lead Agency:** Federal Energy Regulatory Commission
- **Any Identifying Project Numbers:** FERC Docket No. PF15-14-000
- **Location:** Port of Brownsville, Cameron County, TX
- **Estimated Cost:** >$100 million
- **Other:** Natural gas liquefaction facility to liquefy domestic natural gas for export to Asian markets via ocean-going vessels. Maximum output at optimal operating conditions of 4 million tons per annum (mtpa). Liquefaction facility on a 625-acre parcel leased from the Port of Brownsville. Location and size of feed gas pipeline for the facility via an intrastate natural gas pipeline not identified by Texas LNG to date.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** Cooperating Agency under NEPA, Application filed 3/31/16. Will review EIS and complete Section 7 ESA consultation. Will review and provide comments and recommendations to U.S. Army Corps of Engineers (USACE) for required Section 10 and 404 permits to be issued by USACE.
- **Project Timeline:** According to project sponsor, Phase 1 (2 mtpa) will begin production in 2022. Phase 2, anticipated to begin production in 2022/2023 depending on market demand, will increase capacity by additional 2 mtpa.

Major Infrastructure Project
2017

Project Name: Rio Grande Liquefied Natural Gas Facility and Rio Bravo Pipeline Project

Project Sponsor: Next Decade, LLC

Project Description

- **Sector:** Energy/Natural Gas
- **Lead Agency:** Federal Energy Regulatory Commission
- **Any Identifying Project Numbers:** FERC Docket No. PF15-20-000
- **Location:** Terminal in Port of Brownsville, Cameron County, TX. Pipelines from Agua Dulce, Nueces County, TX to Brownsville, Cameron County, TX
- **Estimated Cost:** No figure found on cost of construction of the Rio Grande Liquefied Natural Gas Facility. The Federal Energy Regulatory Commission (FERC) application reports that the Rio Bravo Pipeline (for the Rio Grande LNG Terminal) will have a total cost of $2,173,362,909.
- **Other:** Natural gas liquefaction facility to liquefy domestic natural gas for export, via ocean going LNG vessels (with capacities ranging from 125,000 cubic meters to 185,000 cubic meters), to international markets. Also, LNG loaded onto trucks at the Terminal will be used solely for the purpose of supplying LNG to truck fueling facilities in South Texas and will not be re-gasified and reintroduced into the United States of America ("U.S.") natural gas pipeline system. Maximum output of the facility at optimal operating conditions is 27 million tons per annum (mtpa). Liquefaction facility on a 984-acre parcel leased from the Port of Brownsville. Sponsor will also construct the feed gas pipelines. The intrastate, feed gas pipelines, identified as Rio Bravo Pipeline Project include twin 42-inch outside diameter natural gas pipelines, sharing a 137-mile-long right-of-way. The ancillary facilities include a header system, compressor stations, mainline valves, and pigging facilities. The pipelines will extend from the Agua Dulce Hub in Nueces County, transecting Kleberg, Jim Wells, Kenedy, Willacy, and Cameron counties to the liquefaction facility on the Brownsville Ship Channel in Cameron County.

FWS Involvement

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** The FWS is a Cooperating Agency under National Environmental Policy Act. FWS will provide information for the development of the Environmental Impact Statement (EIS) and review both the draft and final EIS. FERC will consult with the FWS under section 7 of the ESA. FWS will also review and provide comments and recommendations to U.S. Army Corps of Engineers (USACE) for the required Section 10 and 404 permits to be issued by USACE.
- **Project Timeline:** The application for a FERC license was filed on 5/05/16. FERC anticipates license issuance in mid-2018

Major Infrastructure Project
2017

Project Name: Valley Crossing Pipeline – Spectra Energy U.S./Mexico Pipeline

Project Sponsor: Enbridge, formerly Spectra Energy

Project Description

- **Sector:** Energy/Natural Gas
- **Lead Agency:** Federal Energy Regulatory Commission
- **Any Identifying Project Numbers:** FERC Docket No. CP17-19-000
- **Location:** Agua Dulce, Nueces County, TX to Brownsville, Cameron County, TX
- **Estimated Cost**: Estimated investment $1.5 billion
- **Other:** The 42-inch diameter natural gas export pipeline would be constructed to interconnect with a pipeline, sponsored by Mexico's state-owned utility, CFE. Interconnection site, to be permitted by Federal Energy Regulatory Commission (FERC), is located in the Gulf of Mexico. Pipeline would have the capacity of carrying 2.6 billion cubic feet per day of natural gas.

FWS Involvement

- **Region:** 2
- **Field Office:** Texas Coastal Ecological Services Field Office
- **Status of FWS Involvement:** Will review NEPA documents and Clean Water Act section 404 and International Boundary and Water Commission permit documents. A section 7 consultation under the ESA will also be conducted with the FWS.
- **Project Timeline:** According to sponsor, completion of project is anticipated to be October 2018.

Major Infrastructure Projects
2017

Project Name: **Cheniere Midcontinent Supply Header Interstate Pipeline (MIDSHIP)**

Project Sponsor: Cheniere Midstream Holdings, Incorporated (Inc.), a subsidiary of Cheniere Energy Inc., Houston, Texas.

Project Description

- **Sector**: Energy/Natural Gas
- **Lead Agency**: Federal Energy Regulatory Commission (FERC)
- **Any Identifying Project Numbers**: NA
- **Location**: Bryan, Canadian, Carter, Garvin, Grady, Johnston, Kingfisher, and Stephens counties, Oklahoma
- **Estimated Cost**: Unknown, but one estimate (Matt Barr with Cheniere) put the cost at $1 billion.
- **Other**: Construction of 200 miles of 30-inch or 36-inch diameter, new-build natural gas pipeline. Project includes 3 metering stations, eight receipt meters and one lateral pipeline. This pipeline would provide a capacity of up to 1,400 million cubic feet per day (MMcf/d).

FWS Involvement

- **Region**: 2
- **Field Office**: Oklahoma Ecological Services Field Office (ESFO)
- **Status of FWS Involvement**: Principally National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) consultation. The FWS has provided initial review responses (February 2017), including lack of concurrence with not likely to adversely affect determinations on certain species. Sponsor is preparing project revisions and conducting species surveys to address ESA issues. Sponsor and FWS are scheduling conference call to discuss new information.
- **Timeline for Completion of FWS Involvement**: Cheniere has proposed to file their FERC application in May 2017 with construction estimated to begin in the summer of 2018. Assuming construction begins in the summer of 2018, FWS involvement should end on or about that date.

Major Infrastructure Project
2017

Project Name: Heart of Texas Wind Energy Habitat Conservation Plan

Project Sponsor: Renewable Energy Systems Ltd / Heart of Texas, LLC.

Project Description

- **Sector:** Wind Energy/Renewable
- **Lead Agency:** U.S. Fish and Wildlife Service
- **Any Identifying Project Numbers:** FR Notice FWS-R2-ES-2016-N212; Permit # TE-13632C
- **Location:** McCulloch County, Texas
- **Estimated Cost:** $260 million.
- **Other:** The project is the installation and operation of up to 70 wind turbines to generate 2 to 3.5 megawatts of electricity. The wind farm will be location on 10,762 acres of private land. The incidental take permit will be for the black-capped vireo on approximately 725 acres. The proposed mitigation property is onsite.

FWS Involvement

- **Region**: 2
- **Field Office:** Austin Ecological Services Field Office
- **Status of FWS Involvement:** The Federal Register Notice will be reviewed in HQ following preparation of a briefing paper and information memo for the BLPS Chief. Once it is published in the Federal Register a 30 day public review period will begin.
- **Project Timeline:** A permitting decision is anticipated by August 2017.

Major Infrastructure Projects
2017

Project Name: **Frontier City Wind Project**

Project Sponsor: Energy Renewal Partners and Duke Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Kay County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the turbine. This project, when complete, would total 119 turbines.
- **Other**: Consists of three phases. Phase one is operational (61 turbines), phase two is on hold due to issues with Federal Aviation Administration, and phase three (58 turbines) is in initial stages of evaluation. Tier 4 post construction studies at phase one began in June 2016.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Anticipate sponsor will apply for Eagle Take Permit but submission date is unknown.
- **Timeline for Completion of FWS Involvement**: Unknown.

Major Infrastructure Projects
2017

Project Name: **Sundance Wind Project**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Alfalfa and Woods counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the turbine. This project, if both phases are completed, would total 376 turbines.
- **Other**: Consists of two phases -- phase one (200 turbines) and phase two (176 turbines).

FWS Involvement

- **Region**: Region 2
  - **Lead Region, if more than one involved:** NA
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
  - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Anticipate sponsor will need Eagle Take Permit. Initial eagle surveys have been completed.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates construction will initiate in 2017.

Major Infrastructure Projects
2017

Project Name: **Red Dirt Wind Project**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Logan and Kingfisher counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the turbine. This project, when complete, would total 130 turbines.
- **Other**: Project will generate 300 MW of energy.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Sponsor has completed Tier 3 studies. The FWS is awaiting a draft Eagle Conservation Plan and a Bird and draft Bat Conservation Strategy. Documents expected in March/April 2017. Construction is slated to begin in Spring 2017.
- **Timeline for Completion of FWS Involvement**: Unknown.

Major Infrastructure Projects
2017

Project Name: **Thunder Ranch Wind Farm**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Noble, Kay and Garfield counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the turbine. This project, when complete, would total 130 turbines.
- **Other**: Project will generate 300 MW of energy. Eagle studies are complete. Numerous eagles and nests were observed.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
  - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Anticipate sponsor will apply for Eagle Take Permit but submission date is unknown.
- **Timeline for Completion of FWS Involvement**: Unknown.

Major Infrastructure Projects
2017

Project Name: **Chisholm View Wind Project**

Project Sponsor: TradeWind Energy, but may have recently been sold to Enel Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Garfield and Grant counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the installed generator. This project is believed to consist of 130 turbines.
- **Other**: Consists of two phases but FWS is unable to confirm. Phase one may already have been constructed.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates construction will initiate in 2017.

Major Infrastructure Projects
2017

Project Name: **Blue North Wind Farm**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Caddo County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 75 to 100 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Tier 3 studies have been completed but FWS has not yet been provided with the study results.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates project will be operational by 2018.

Major Infrastructure Projects
2017

Project Name: **Blue South Wind Project**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Caddo County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 75 to 100 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Tier 3 studies have been completed but FWS has not yet been provided with the study results.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates project will be operational by 2018.

Major Infrastructure Projects
2017

Project Name: **Limestone Bluff Wind Farm**

Project Sponsor: TradeWind Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Caddo County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 75 to 100 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Status as of early 2017 was "on hold."
- **Timeline for Completion of FWS Involvement**: Unknown. Project not currently moving forward. Reasons for current status were not provided to FWS.

Major Infrastructure Projects
2017

Project Name: **South Ridge 1 Wind Project**

Project Sponsor: Apex Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Blaine County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 150 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Project is believed to be conducting Tier 3 studies. Future involvement depends on outcome of Tier 3 studies.
- **Timeline for Completion of FWS Involvement**: Unknown. Plans were to meet with project sponsor in early 2017. Awaiting information from project sponsor. Information available to the FWS indicates project will be operational by 2018.

Major Infrastructure Projects
2017

<u>Project Name</u>: Rock Falls Wind Project

<u>Project Sponsor</u>: EDF Renewable Energy

<u>Project Description</u>

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Kay and Grant counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 182 turbines.
- **Other**: Project is in two phases. The first phase is expected to total 154 MW of generation and is expected to be operational by late 2017. The second phase will be larger and provide an estimated generation capacity of 300 MW. Commercial operation date is reportedly sometime in 2018.

<u>FWS Involvement</u>

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates entire project will be operational by 2018.

Major Infrastructure Projects
2017

Project Name: **Bergen Ranch Wind Project**

Project Sponsor: Apex Clean Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Johnston, Murray and Pontotoc counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 130 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Habitat Conservation Plan and section 10 permit may be needed for the American burying beetle, depending on results of surveys. Project site also has considerable potential for occupancy by bald eagles. The FWS also is awaiting the results of eagle surveys. Plans were to meet with project sponsor once the wildlife studies were complete.
- **Timeline for Completion of FWS Involvement**: Unknown. A meeting is unlikely before late summer 2017. Construction/operational date is unknown.

Major Infrastructure Projects
2017

Project Name: **Fire Wheel Wind Project**

Project Sponsor: Hitchland Wind Land Developments

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: None
- **Any Identifying Project Numbers**: NA
- **Location**: Texas County, Oklahoma; Hansford, Sherman, and Ochiltree counties, Texas
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct a total of 1,000 turbines.
- **Other**: Project will be developed in five phases, two in Oklahoma (300 to 350 turbines) and three in Texas (600 to 650 turbines).

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO; Arlington ESFO; and Migratory Birds - RO.
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO (Lead for Oklahoma phases); Arlington ESFO, (Lead for Texas phases)
- **Status of FWS Involvement**: Advisory only at this point. Phase one is anticipated to be operational in 2017. No information is available on the other phases.
- **Timeline for Completion of FWS Involvement**: Unknown. Information available to the FWS indicates phase one of project will be operational in 2017.

Major Infrastructure Projects
2017

Project Name: **White Rock Wind Farm**

Project Sponsor: Calpine Corporation

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Caddo County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 109 turbines.
- **Other**: NA

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Status of project and FWS involvement unknown.
- **Timeline for Completion of FWS Involvement**: Unknown. No information available.

Major Infrastructure Projects
2017

<u>Project Name</u>: **Horizon Hill Wind Project**

<u>Project Sponsor</u>: Calpine Corporation

<u>Project Description</u>
- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Kingfisher and Logan counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 88 turbines.
- **Other**: NA

<u>FWS Involvement</u>
- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Status of project and FWS involvement unknown.
- **Timeline for Completion of FWS Involvement**: Unknown. No information available.

Major Infrastructure Projects
2017

Project Name: **States Edge Wind Farm**

Project Sponsor: Invenergy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Cimarron and Texas counties, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 1,000 turbines.
- **Other**: Project likely to be developed in phases.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Project is believed to be at Tier one.
- **Timeline for Completion of FWS Involvement**: Unknown. No information available. The FWS last met with sponsor's consultant in fall of 2016.

Major Infrastructure Projects
2017

Project Name: **Turkey Creek Wind Project**

Project Sponsor: NextEra Energy Resources

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Alfalfa County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 120 turbines.
- **Other**: Project is located immediately south of Great Salt Plains National Wildlife Refuge within the heart of the whooping crane migration corridor. Company has agreed to move proposed turbines to the east of the refuge but turbines remain in the central portion of the migration corridor. The sponsor has limited ability to relocate to the east due to the presence of Kegelman Unit of Vance Air Force Base. Kegelman is a single runway used to conduct touch and go landings of military aircraft.

FWS Involvement

- **Region**: Region 2
- **Field Office**: Tulsa, Oklahoma (Lead); Salt Plains National Wildlife Refuge; and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. However, due to concerns regarding potential collision hazard for endangered whooping cranes and migratory waterfowl, project location has been adjusted. A habitat conservation plan and associated section 10 permit may be needed, pending results of additional studies.
- **Timeline for Completion of FWS Involvement**: Unknown. The FWS is awaiting additional survey data from sponsor and sponsor’s consultant.

Major Infrastructure Projects
2017

<u>Project Name</u>: **Nemaha/Osage/Amshore Wind Project**

<u>Project Sponsor</u>: Duke Energy

<u>Project Description</u>

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: None
- **Any Identifying Project Numbers**: NA
- **Location**: Osage County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct about 60 3.3 MW turbines.
- **Other**: NA

<u>FWS Involvement</u>

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Status of project and FWS involvement unknown. Preliminary pre-construction information (Tier 3 data) was provided in February 2017 but project has since been put on hold.
- **Timeline for Completion of FWS Involvement**: Unknown. No information available. Osage Nation is believed to be in opposition to proposed project. Project is on hold.

Major Infrastructure Projects
2017

Project Name: **Caddo Wind Project**

Project Sponsor: Apex Clean Energy

Project Description

- **Sector**: Wind Energy/Renewable
- **Lead Agency**: NA
- **Any Identifying Project Numbers**: NA
- **Location**: Caddo County, Oklahoma
- **Estimated Cost**: Unknown but each turbine is estimated to cost $1-2 million per turbine depending on size of the generator hub. This project has proposed to construct 130 turbines.
- **Other**:

FWS Involvement

- **Region**: Region 2
- **Field Office**: Oklahoma ESFO and Migratory Birds RO
    - **Lead Field Office, if more than one involved:** Oklahoma ESFO
- **Status of FWS Involvement**: Advisory only at this point. Sponsor and consultant have presented the results of the first year of Tier 3 studies in late 2016.
- **Timeline for Completion of FWS Involvement**: Unknown. Construction is expected to begin in 2018.

Major Infrastructure Projects
2017

Project Name: **Clean Line Plains and Eastern Transmission Line**

Project Sponsor: Clean Line Energy Partners, LLC, Houston, TX.

Project Description

- **Sector**: Energy/Transmission
- **Lead Agency**: Department of Energy, the FWS is a cooperating agency
- **Any Identifying Project Numbers**: DOE/EIS-0486
- **Location**: Texas, Beaver, Harper, Woodward, Major, Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, Muskogee, and Sequoyah counties in Oklahoma; Hansford, Ochiltree and Sherman counties in Texas; Pope, Conway, Crawford, Franklin, Johnson, Van Buren, Cleburne, White, Jackson, Cross, Poinsett and Mississippi counties in Arkansas; and, Shelby and Tipton counties in Tennessee.
- **Estimated Cost**: $2.5 billion according to Clean Line Energy
- **Other**: Clean Line proposes to construct and operate an overhead ± 600-kilovolt (kV) high voltage direct current electric (HVDC) transmission system and associated facilities with the capacity to deliver approximately 3,500 megawatts of power primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and Southeast United States via an interconnection in Arkansas and an interconnection with the TVA in Tennessee. Major facilities associated with the proposed Project include converter stations, an approximate 721.5-mile long HVDC transmission line; an alternating current (AC) collection system; and both permanent and temporary access roads.

FWS Involvement

- **Region**: Region 2 and Region 4
  - **Lead Region:** Region 2
- **Field Office**: Oklahoma ESFO; Arkansas ESFO; Tennessee ESFO; and Migratory Birds RO
  - **Lead Field Office:** Oklahoma ESFO
- **Status of FWS Involvement**: Primarily NEPA, ESA consultation and migratory bird conservation (Avian Protection Plan). The Final EIS is dated October 2015 and the Record of Decision was published on March 31, 2016. A Biological Opinion was completed (November 20, 2015), but FWS is still awaiting information from DOE and Clean Line with respect to concluding section 7 consultation. Clean Line and DOE are currently conducting surveys to refine take estimate provided in biological opinion. Although a Mitigation Action Plan has been published (October 2016), the FWS is awaiting detailed information regarding mitigation for impacts to federally-listed species.
- **Timeline for Completion of FWS Involvement**: Unknown. The EIS was finalized in October 2015 and a biological opinion under section 7 of the ESA was completed in November 2015. However neither DOE nor Clean Line has submitted final documents required to complete the consultation process.

Major Infrastructure Project
2017

<u>Project Name</u>: Southline Transmission Project

<u>Project Sponsor</u>: Bureau of Land Management

<u>Project Description</u>

- **Sector:** Energy/Transmission
- **Lead Agency:** Bureau of Land Management
- **Any Identifying Project Numbers:** NA
- **Location:** Dona Ana, Luna, Grant, and Hidalgo counties, New Mexico, and Cochise, Pima, and Pinal counties, Arizona
- **Estimated Cost:** Anticipated costs > $100 million, planning and construction combined
- **Other:** Southline Transmission, LLC, proposes constructing, operating, and maintaining a high-voltage power line in two segments totaling approximately 360 miles. The first segment would be a new double circuit 345-kilovolt line from a substation in Afton, New Mexico (south of Las Cruces), to a substation in Apache, Arizona (south of Willcox). This approximately 240-mile segment would provide up to 1,000 megawatts of initial rated capacity. The second segment would be an upgrading and rebuilding of about 120 miles of existing transmission lines between the Apache substation and the Saguaro substation, northwest of Tucson. It would provide capacity for an additional 1,000 megawatts of electricity.

<u>FWS Involvement</u>

- **Region:** 2
- **Field Office:** Arizona and New Mexico ESFO
    - **Lead Field Office, if more than one involved:** Arizona ESFO
- **Status of FWS Involvement:** Section 7 consultation and reinitiation were completed in November 2015; current involvement anticipated to be advisory at the point construction is initiated related to implementation of the BO.
- **Project Timeline:** Unknown, waiting on BLM decision to determine further involvement in the project.

Major Infrastructure Project
2017

Project Name: SunZia Transmission Line

Project Sponsor: SunZia Transmission, LLC

Project Description

- **Sector:** Transmission
- **Lead Agency:** BLM
- **Any Identifying Project Numbers:** BLM/NM/PL-13-04-1610
- **Location:** Arizona and New Mexico
- **Estimated Cost:** $2 Billion
- **Other:** The Project consists of the construction, operation, and maintenance of two parallel overhead 500 kV transmission lines located on Federal, State, and private lands from the proposed SunZia East Substation in Lincoln County, New Mexico, to the existing Pinal Central Substation in Pinal County, Arizona. The length of the transmission lines in the preferred alternative would be 515 miles in length. Three segments, totaling five miles of the Project in Socorro and Torrance counties in New Mexico, will be buried in order to mitigate impacts to military operations at White Sands Missile Range. The impacts of burial have been analyzed in a Mitigation Proposal Environmental Assessment (EA) that has also been approved. The Project has the potential to add 3,000 to 4,500 megawatts of added electric capacity to the desert southwest region of the United States.

FWS Involvement

- **Region:** Region 2
- **Field Office:** Migratory Bird, Refuges, and Ecological Services in Regional Office, Arizona and New Mexico Ecological Services Office
    - **Lead Field Office, if more than one involved:** Migratory Birds
- **Status of FWS Involvement:** Section 7 consultation was completed in 2013. Currently, advising Project proponent on mitigation for Migratory Birds issues identified in the Environmental Impact Statement and developing an Implementing Agreement for the implementation of the mitigation
- **Project Timeline:** Involvement for mitigation and the Implementation Agreement will likely be completed by May 2017. The FWS will be indirectly involved with some aspects of mitigation, which could extend to 2067 (50 years).

INFORMATION/ BRIEFING MEMORANDUM FOR THE DIRECTOR

DATE:
FROM:
SUBJECT:

Statement of purpose. Although there is no "purpose" heading, the opening paragraph of, or cover sheet for, informational memos and briefings should clearly and succinctly state the purpose of the memo (*i.e.*, to inform the Secretary about an issue, topic, or event she has a need to know more about). Briefing memos should not raise issues for decision.

BACKGROUND

Succinctly provide the necessary background information to frame the issue or topic being briefed.

DISCUSSION

Describe the issue, topic, or event being briefed and include relevant actions or policy implications, if any. If recommending a particular action for the Secretary related to an event associated with this briefing, please put in brackets, as in the example below:

NEXT STEPS

Please provide a look-ahead with a bulleted list of future steps being taken or to be taken on this issue.

ATTACHMENTS

If this is a cover memo for a longer briefing, attach the briefing and supplemental materials.

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:27 PM

Conversation Contents

Fwd: Some helpful guidance on Energy, Infrastructure, and border projects

Attachments:

/152. Fwd: Some helpful guidance on Energy, Infrastructure, and border projects/1.1 Consolidated Major Projects 031717 Region 2 only.docx
/152. Fwd: Some helpful guidance on Energy, Infrastructure, and border projects/1.2 IM Director 20170229.docx

"Reyes, Ernesto" <ernesto_reyes@fws.gov>

From:	"Reyes, Ernesto" <ernesto_reyes@fws.gov>
Sent:	Thu May 04 2017 07:56:10 GMT-0600 (MDT)
To:	Robert Jess <robert_jess@fws.gov>, Sonny Perez <sonny_perez@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, Boyd Blihovde <boyd_blihovde@fws.gov>, Kelly McDowell <kelly_mcdowell@fws.gov>
Subject:	Fwd: Some helpful guidance on Energy, Infrastructure, and border projects
Attachments:	Consolidated Major Projects 031717 Region 2 only.docx IM Director 20170229.docx

FYI. This includes all of our projects in the RGV.

---------- Forwarded message ----------
From: **Gardiner, Dawn** <dawn_gardiner@fws.gov>
Date: Wed, May 3, 2017 at 2:58 PM
Subject: Fwd: Some helpful guidance on Energy, Infrastructure, and border projects
To: Brunilda FuentesCapozello <brunilda_fuentescapozello@fws.gov>, Ernesto Reyes <ernesto_reyes@fws.gov>, Gretchen Nareff <gretchen_nareff@fws.gov>, Mary Orms <mary_orms@fws.gov>, Mary Skoruppa <mary_kay_skoruppa@fws.gov>, Pat Clements <pat_clements@fws.gov>, Robyn Cobb <robyn_cobb@fws.gov>

Here are some thoughts on projects we need to think about sending forward for approval. Also note the attached list of projects that got sent forward already. Quite a few are in our area...

---------- Forwarded message ----------
From: **Tuegel, Marty** <marty_tuegel@fws.gov>
Date: Tue, May 2, 2017 at 2:55 PM
Subject: Some helpful guidance on Energy, Infrastructure, and border projects
To: FW2 ES Project Leaders Plus <fw2_es_pl_plus@fws.gov>

PL and APL,

We have not received any official guidance out of HQ on reporting our recommendations for these types of projects. However, the following is what we received as a possible set of guidelines you might apply in your FO. These were shared as an example of what is occurring in one FO in the southeast region. They have been modified to fit our region and could serve as an informal guide to what needs reporting. As always, use your best professional judgement.

The Department has requested that the Service submit, for departmental review, any official correspondence on certain groups of projects, prior to issuance. Identified groups include:

1. High priority projects that we submitted for the HQ data request last month: See attached

2. Anything potentially controversial (e.g. Congressional interest, etc.), such as controversial species.

3. Anything related to infrastructure (this includes but is not limited to road and pipeline projects)

4. Anything related to the Wall or border security.

5. Anything energy related (includes oil and gas,pipelines, coal, wind, solar, and transmission)

You should further filter these projects through the following:

1. Will the comments result in significant increased costs or time delays?

2. Does it involve a high profile or controversial species (Mexican Wolf, ABB, LPC)?

If you have a project included above you will need to send an IM for the Director (see attached) to the Regional Office. The Region will then make the call as to whether or not it needs to be routed up to HQ. Please recognize that this will impact time frames and plan accordingly. We are working to get clarification on what the Department really wants to see but for now it is all correspondence (e.g. comments under section 7, FWCA, NEPA, etc.) on these categories of projects.

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****
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Article *in* Environmental Impact Assessment Review · September 2013

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Some of the authors of this publication are also working on these related projects:

Graphab project View project

Neighborhood satisfaction View project

All content following this page was uploaded by Xavier Girardet on 27 April 2017.

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Designing a graph-based approach to landscape ecological assessment of linear infrastructures

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ABSTRACT

The development of major linear infrastructures contributes to landscape fragmentation and impacts natural habitats and biodiversity in various ways. To anticipate and minimize such impacts, landscape planning needs to be capable of effective strategic environmental assessment (SEA) and of supporting environmental impact assessment (EIA) decisions. To this end, species distribution models (SDMs) are an effective way of making predictive maps of the presence of a given species. In this paper, we propose to combine SDMs and graph based representation of landscape networks to integrate the potential long distance effect of infra structures on species distribution. A diachronic approach, comparing distribution before and after the linear infrastructure is constructed, leads to the design of a species distribution assessment (SDA), taking into ac count population isolation. The SDA makes it possible (1) to estimate the local variation in probability of presence and (2) to characterize the impact of the infrastructure in terms of global variation in presence and of distance of disturbance. The method is illustrated by assessing the impact of the construction of a high speed railway line on the distribution of several virtual species in Franche Comté (France). The study shows the capacity of the SDA to characterize the impact of a linear infrastructure either as a research con cern or as a spatial planning challenge. SDAs could be helpful in deciding among several scenarios for linear infrastructure routes or for the location of mitigation measures.

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1. Introduction

Landscape fragmentation is a spatial process affecting the number, size and isolation of habitat patches (Forman, 1995). It occurs along with a progressive decline in the overall connectivity required for the proper unfolding of ecological processes and for population per sistence (Fahrig, 1997; Saunders et al., 1991; Taylor et al., 1993). The development of major linear infrastructures contributes to land scape fragmentation and impacts natural habitat and landscape across scales (Coffin, 2007; Forman and Alexander, 1998). Conse quently, the development of knowledge to assess the potential im pacts of existing or future linear infrastructures is becoming a major issue in maintaining biodiversity. In this perspective, Forman (2000) recommends that transportation planning should consider spatial patterns and ecological flows across the landscape.

Although fragmentation and connectivity are familiar and impor tant concepts used by researchers and environmental managers alike, spatial planning really needs to be able to quantify their impacts on ecological processes (Official Journal of the European Communities, OJ, 1985; OJ, 2001). Geneletti (2006) and Gontier et al. (2006) report on the lack of predictive, quantitative and spatially explicit tools at broad spatial scales for environmental impact assessment (EIA) and strategic environmental assessment (SEA). The integration of land scape ecology into the EIA and SEA processes (Fernandes, 2000) pro vides a useful framework at the appropriate regional scale for a structural and functional assessment of alternative transportation infrastructure routes or urban planning scenarios (Mörtberg et al., 2007).

While many fragmentation and connectivity metrics exist (see Calabrese and Fagan, 2004; Rutledge, 2003 for review) it is only in the last decade that proposals have been made to implement them in EIA and SEA processes. Two main approaches can be used to assess the impact of linear infrastructures. (1) A structural approach based on the fragmentation of habitat patches by infrastructure. This is illus trated by Geneletti (2003, 2004) in quantifying the direct loss of hab itat patches, patch isolation, and exposure to disturbance due to a linear infrastructure. Likewise, Jaeger (2000) and Girvetz et al. (2008) integrate barrier effects for infrastructures, urban areas and cropland by means of effective mesh size. Those structural metrics take into account movements of organisms into each natural fragmented feature but they do not properly reflect ecological pro cesses in the entire landscape mosaic. (2) Another approach may be adopted to include functional aspects when assessing the impact of

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linear infrastructures based on connectivity metrics and effective distances between habitat patches (Adriaensen et al., 2003; Vos et al., 2001). The Connectivity Index (CI) (Mancebo Quintana et al., 2010) carries those considerations into the assessment of the impact of a national infrastructure and transportation plan on the connectivity of selected habitat patches for a large area (i.e. Spain). The analysis is performed before and after new infrastructures are constructed, allowing for each cell to be assessed for the loss of connectivity. In the same way, resource selection function (RSF) modeling attempts to capture the influence of linear infrastructures on animal location (Polfus et al., 2011).

However, the structural and functional approaches proposed for EIA focus more on habitat than on target species. This raises the difficulty of the validation process necessary for supporting important planning decisions about major linear infrastructures. Therefore habitat modeling and species distribution models (SDMs) (Guisan and Zimmermann, 2000) appear to be relevant tools for assessing and predicting ecological impacts in a human dominated landscape (Gontier, 2007). Because SDMs are based essentially on the species' environment and not on functional relationships between habitat patches, these empirical approaches have been applied more in EIAs of area urbanization than of linear infrastructures (Gontier, 2007; Gontier et al., 2010; Mörtberg et al., 2007; Scolozzi and Geneletti, 2011).

In order to include linear infrastructures in landscape management decisions for the conservation of a given species, connectivity metrics should be integrated into SDMs. Following the recent literature on landscape connectivity, a graph theoretic approach (Galpern et al., 2011; Urban et al., 2009) seems to be relevant for landscape management (Dale and Fortin, 2010). Several network measures reviewed in Rayfield et al. (2011) have recently been developed to quantify the effect of habitat connectivity on graph structure. Much as Zetterberg et al. (2010) transpose those methods into a landscape ecological assessment for urban planning, it has been demonstrated that graph based connectivity metrics can be used in accounting for the effects of linear infrastructures such as roads or railways in environmental impact assessment processes (Fu et al., 2010; Gurrutxaga et al., 2011; Minor and Lookingbill, 2010; Vasas et al., 2009). Furthermore, species presence was recently considered as a function of environmental variables and of connectivity variables expressing the relative position in the ecological network using a graph based approach (Awade et al., 2012; Decout et al., 2012; Foltête et al., 2012a; Galpern and Manseau, in press; Pereira et al., 2011).

The aim of this study is to propose a methodological framework using a graph based approach to assess the impact of linear infrastructures on potential species distribution at landscape scale. By modeling a landscape network before and after the construction of the infrastructure, a diachronic analysis helps in assessing (1) the direct loss of ecological habitat induced by the fragmentation effect of the infrastructure and (2) the impact of the infrastructure on the overall landscape connectivity due to the barrier effect. As patch level connectivity metrics are integrated into a species distribution model, a species distribution assessment (SDA) enables us to quantify and predict the potential impact of a linear infrastructure on species presence at any point in the study area. This method is applied in a case study in Franche Comté (France), where presence points of a virtual species were simulated.

2. Methods

The species distribution assessment (SDA) is based on the distribution analysis of a species before and after the construction of infrastructure. In order to integrate connectivity metrics into the SDM, for a given species, the first step is to build the spatial graph from a landscape map and to calculate patch level connectivity metrics from this graph. Then, using an occurrence dataset, the SDM can be used to predict the probability of presence at any point in the study area. The SDM is first run without the infrastructure, at time t (i.e. the initial state), and the same model is repeated once the infrastructure has been implemented, at t + 1 (i.e. the final state). Finally, to perform the SDA, the rate of change between the probability of presence at t and t + 1 is calculated locally and globally. In this paper, the methodological background to landscape connectivity analysis and species distribution models that is necessary to perform the SDA is provided in Sections 2.1 and 2.2. The methodological contribution proposed by this paper is detailed in Section 2.3.

2.1. Landscape connectivity analysis

2.1.1. Assemblage of the landscape map

A landscape map in a raster layer format is required to build the graph. It is composed of land cover classes involved in the ecological processes of the species. The largest class represents the preferential habitat, which has to be distinguished from all other classes that are less suitable or unsuitable for the species.

The diachronic analysis proposed in this paper requires two landscape maps, the first representing the initial state of the landscape and the second including the linear infrastructure.

2.1.2. Structure of the landscape graph

A graph is defined as a set of nodes and links. In landscape graphs, the nodes represent suitable habitat patches or other spatial units of interest of a target species. They may be point features or areal features (Fall et al., 2007; Galpern et al., 2011).The links represent the functional relationships that symbolize potential movement between habitat patches. Several types of graph can be developed, depending on the topology (i.e. complete vs. planar graph) and the link thresholding. The selection of the type of graph is dependent on species characteristics and on computational capacities (Galpern et al., 2011). In order to construct an ecologically relevant model, effective distance between patches is frequently considered rather than Euclidean distance (Bunn et al., 2000), including one or more least cost paths (Pinto and Keitt, 2009). For a given species, resistance values have to be defined for each land cover class (parameterization methods are reviewed in Zeller et al., 2012). Resistance values of habitat patches and elements permitting movement (i.e. linear or undersized habitat elements) are usually set to 1, corresponding to the least resistant surface of the landscape. A specific resistance value is assigned to each other class according to the difficulty encountered in crossing it. Thus, each link in the graph is characterized by a distance attribute amounting to the cumulative cost distance between the patches it joins.

Graph thresholding is a key step in assessing a linear infrastructure. If the species is able to cross the infrastructure, the resistance value assigned to this element has to reflect the relative difficulty in crossing it compared with the other classes. It must significantly increase the cumulative cost distance value attributed to the links. On the other hand, if the infrastructure is considered as an impassable barrier, its resistance value has to be high enough to remove all links crossing it when the graph is thresholded. In both cases care must be taken to avoid artificial discontinuities along the infrastructure (Adriaensen et al., 2003; Rothley, 2005).

2.1.3. Calculation of the connectivity metrics

Several connectivity metrics have been imported from graph theory or recently developed by landscape ecologists (Rayfield et al., 2011). They reflect landscape connectivity at multiple levels. Patch level metrics are specific to patch properties and their relative position in the ecological network.

In this study, two patch level metrics detailed in Foltête et al. (2012a) are used. (1) Potential recruitment *R* reflects the ability of a patch to produce organisms independently of the graph. It refers to a quality attribute such as patch size or available resources area within a given radius a_i and weighted by an additional custom parameter k_i such that:

$$R_i \quad a_i k_i \tag{1}$$

(2) The weighted dispersal flux F represents the capacity of a patch to receive organisms related to the accessible amount of surrounding patches characterized by their potential recruitment. It is formally defined by:

$$F_i \quad \sum_{j\ 1}^{n} R_j e^{\ \alpha d_{ij}} \tag{2}$$

where R_j is the recruitment of patch j, d_{ij} is the distance between patches i and j, and α is a parameter representing the intensity of the distance effect.

2.2. Species distribution model

The application of the SDM is based on a set of presence and absence points. Since the absence points of a given species are rarely available, it is often necessary to generate a set of pseudo absence points using a sampling process (Hirzel and Guisan, 2002; Hirzel et al., 2001). The set of presence/absence points is considered as the target variable of statistical modeling, e.g. a logistic regression. The predictive variables include graph based connectivity metrics and possibly other indicators representing key factors for the species under study.

Some recent studies (Awade et al., 2012; Decout et al., 2012; Pereira et al., 2011) use connectivity metrics and SDM in the same framework. However, the direct use of graph based connectivity metrics in the SDM involves a difficulty, because these metrics are computed at the patch level although the points used in the SDM may be located anywhere in the study area (Foltête et al., 2012a; Galpern and Manseau, in press). Here, this disparity may be overcome by applying the spatial generalization of the patch based metrics proposed in Foltête et al. (2012a). This procedure consists of attributing to any point the value of a given metric from the closest patch or from the average of the values of the surrounding patches, each being weighted with a distance dependent and decreasing function such as: $w = \exp(\ \alpha d)$. The neighborhood including the set of surrounding patches is defined as the area delineated by the maximum dispersal distance around the focal point. This procedure can be used to express the ability of any point to benefit to a greater or lesser extent from the proximity of the landscape network. Using this procedure, all the presence/absence points are documented with graph based connectivity metrics.

In the case of a real species for which occurrence points were acquired by field survey, the results of the logistic regression validate or invalidate the assumption about the role of landscape connectivity in the presence of the species. If the graph based metrics prove not to be significant, this role is not confirmed. On the contrary, significant coefficients outline the importance of the landscape network for the species and lead to the assumption that the impact assessment of the infrastructure will be greater. If the statistical model is globally validated, the probability of presence at time t can be mapped as a raster layer covering the entire study area. By extrapolating the same model at time t + 1, a second layer showing the species distribution after the infrastructure has been built can be computed. These two maps will provide a basis for the species distribution assessment.

2.3. Species distribution assessment

To assess the local variation in probability of presence, the rate of change of the probability of presence is calculated for each cell of a raster layer as follows:

$$\Delta p \quad \frac{p_{t+1} - p_t}{p_t} \tag{3}$$

where p_t is the initial probability of presence, and p_{t+1} is the final probability. In the resulting map, null values represent no change, negative values underline potential loss of presence, and positive values reflect an increased probability of presence. An increase might occur where mitigation measures are implemented.

The local variation in the probability of presence can be generalized into a single global indicator by calculating the rate of change of the sums of all cell values of the probability of presence layers at times t and t + 1:

$$\Delta P \quad \frac{\sum p_{t+1} - \sum p_t}{\sum p_t} \tag{4}$$

This global variation in the probability of presence may allow interesting comparisons between several transportation infrastructure routes.

SDA allows us to determine the maximum distance at which a new infrastructure affects species presence. The hypothesis retained is that the greater the distance to the infrastructure the smaller the loss of probability of presence. As the maximum distance of impact is not known ex ante, a point is sampled at each node of a regular grid with a custom spatial resolution over the entire study area. The rate of change of the probability of presence at these points is related to their distance from the infrastructure. To avoid applying this procedure where the species is absent in the initial state, only points with a probability of presence at time t greater than 0.5 (i.e. 50%) are kept. This relation is plotted and the global shape of the scatter plot informs as to the spatial structure of the impact. Finally, a function fitting the retained values of this scatter plot can be used to calculate the distance corresponding to a given rate of loss of probability of presence.

3. Application to virtual species

Here we present the case of a TGV (*train à grande vitesse*) high speed railway line in the region of Franche Comté in the eastern part of France. We use the virtual species simulation developed in Hirzel et al. (2001) to illustrate our methodological approach to assess the impact of the infrastructure. Reptiles are the virtual species here. To overstate the impact of this linear infrastructure on the distribution of virtual species, several populations, such as the western green lizard, are simulated with different maximum dispersal distances so that their presence is dependent on the landscape network. As the maximum distance of impact is not known ex ante, the SDM is performed for the entire study area.

3.1. Study area and geographical context

Although the species considered are virtual, the study area is a real 15,235 km^2 landscape composed mainly of forest, meadows, arable land, and artificial areas in the region of Franche Comté (Fig. 1). The relief of this study area is composed of a succession of uplands in its southeastern part and it is crossed by four major valleys in its central and western part. The Rhine Rhône TGV project connects the existing networks of the north and the south of Western Europe and will be composed of three branches. The eastern branch is the only one under construction at present. It is 138 km long and crosses the study area from west to east following the region's two main valleys.

3.2. Data and software

The landscape map was built at a spatial resolution of 10 m to catch small elements such as hedgerows and roadside verges. It was produced by using the French land cover database (IGN 2009, BD TOPO®) to map forests, rivers, trails, roads, railways and urban areas with 1 m accuracy. Remote sensing imagery was used to distinguish between meadows and arable land in open areas, and to distinguish between deciduous and coniferous forests. Vineyards and orchards were interpreted from

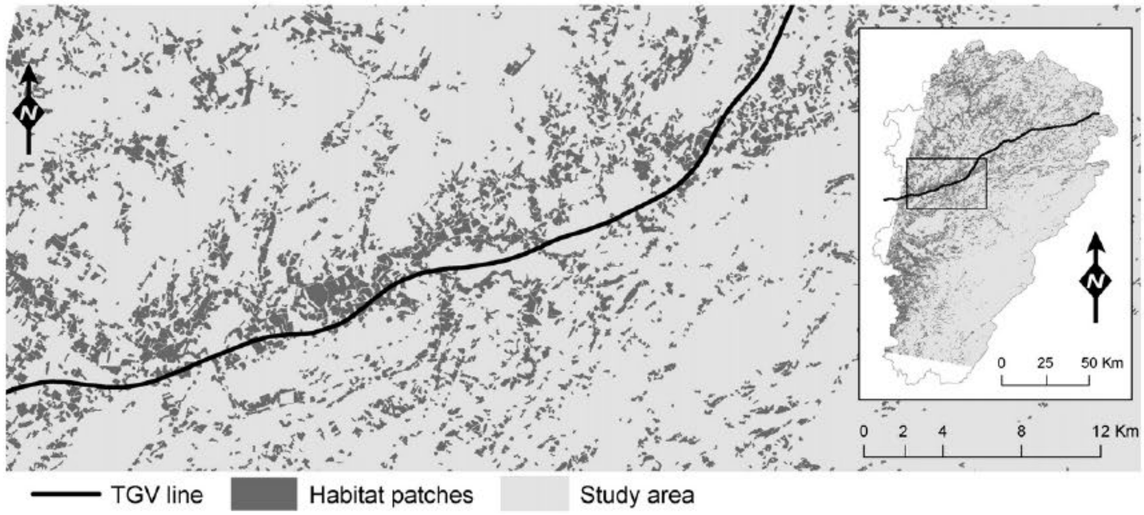

Fig. 1. Study area and closer view of the TGV line.

aerial photography. Hedgerows, forest edges and core areas were dissociated by morphological spatial pattern analysis (MSPA) (Vogt et al., 2007). An expansion of 1 pixel (i.e. 10 m) was executed on secondary level roads and railways to allow for roadside and railway verges. Finally, we obtained a landscape map composed of 14 classes.

Topographical and climatic variables used to model habitat suitability maps (HSM) of virtual species were derived from a digital elevation model (spatial resolution of 25 m) and from the French meteorological office database (spatial resolution 50 m).

Landscape connectivity analysis and species distribution models were computed with Graphab 1.0 (Foltête et al., 2012b), and SDA was performed with ArcGis (ESRI, 2004).

3.3. Simulation of the virtual species distribution

Five environmental variables were used to compute a habitat suitability map (HSM) by the weighted average of these variables (Hirzel et al., 2001) (Table 1).

Two landscape maps were designed from HSM. The first represented the study area at time t, and the second at t + 1, including the TGV line. HSM was ranked into four classes in order to identify habitat patches and to define resistance values to other classes (Table 2). The classes corresponding to the habitat were dissociated by the MSPA method in order to isolate linear habitat structures and undersized patches into a fifth class hereafter considered as elements favorable to movement. Resistance values were fitted to maintain an efficient rate between resistance of habitat patches and unfavorable classes, and to ensure acceptable computation times.

Three minimum planar graphs were built for time t, to simulate several populations characterized by different dispersal distances and depending on their ecological network. The minimum planar graphs were determined in a Euclidean space rather than in a cost space (Fall et al., 2007) to reduce computation time requirements. Each link in the graphs was defined by a cumulative cost distance and a metric distance. Graph thresholding was performed on the cumulative cost distance, but to express these thresholds in a metric unit, cumulative cost distances were converted into metric distances using a linear regression applied to the links. In this regression, the cost distance was considered as a linear function of the Euclidean distance. Thus, we obtained 2060 cost units (cu) for 2000 m, 4800 cu for 5000 m and 9400 cu for 10,000 m. The second landscape map included a sixth class for the TGV line 3 pixels (i.e. 30 m) wide. In order to consider it as an impassable barrier and according to the thresholds defined previously, a resistance value was fixed at 5000. Three other graphs were computed for time t + 1 with the same construction properties as the graphs for time t.

Three steps were required to create the populations of virtual species. (1) A first sample depending on the HSM was performed. Some 15,669 random points were generated in a 1 km^2 grid, one point per cell. HSM values were extracted at those points. Only points with an HSM value higher than 0.35 were kept as potential species presence, which represented 6432 sample points. This HSM value below the 0.5 threshold used to define patches was chosen so as to avoid having intra patch presences only. (2) Then the patch metrics R and F were generalized to this first sample of points using the patch area as the criterion defining R. These points were assigned to the R and F values of the closest patch, using a weighting distance equal to the maximum dispersal distance of each virtual species population. (3) Finally, a second sample depending on F was taken, by keeping only points from the first sample with F values higher than the median. This last sampling composed the final sample of presence points, one for each maximum dispersal distance considered. In order to oppose this sample with an equivalent number of pseudo absence points, a grid of 2000 m sized cells was generated and only one

Table 1
Environmental variables.

Variables	Niche function	Weight
Land cover	Categorical[a]	2
Altitude	Linear (decreasing)	1
Slope	Gaussian	2
Orientation	Gaussian	1
Temperature	Linear (increasing)	2

[a] The landscape map classes were aggregated according to the species artificial preferences. Three classes were obtained with a niche coefficient of 1 for hedgerows, deciduous forest edges, vineyards, orchards and meadows; 0.5 for trails, roadside and railway line verges; and 0 to arable land, roads, railways, forests, urban areas and water.

Table 2
Classification of the HSM and resistance values.

Class	Rank	HSM values	Resistance value
1	Habitat	0.5–1	1
2	Elements favorable to movement	0.5–1	1
3	Favorable	0.35–0.5	30
4	Unfavorable	0.2–0.35	60
5	Unfavorable	0–0.2	100
6	TGV line	–	5000

Table 3
Results of the logistic regression models.

Population	Maximum dispersal distance	Number of presence points	Number of pseudo-absence points	McFadden R^2
A	2000 m	1469	1408	0.309
B	5000 m	1861	1932	0.239
C	10,000 m	1432	1445	0.344

In both cases predictive variables are the R and F metrics and all models are significant with $p < 0.0001$.

presence point per cell was kept. Sets of pseudo absence points were generated by randomly sampling one point per cell without a presence point, with a minimal inter point distance of 1000 m. These last samples were the final target binary variables of the SDM. Three populations depending on their ecological network were obtained (Table 3).

A logistic regression model was performed at time t for the three simulated populations, using R and F metrics as predictive variables (Table 3). The same logistic regression model was repeated with metric values of the graph at time t + 1. Both SDMs were extrapolated to the entire study area with a spatial resolution of 100 m providing a continuous map of the probability of presence ranging from 0 to 1 at t and t + 1. The spatial resolution of 100 m provides a satisfactory compromise between the relevant ecological field survey perimeter and computational time requirements.

3.4. Results

The global statistics of the graphs are presented in Table 4. At time t, the number of patches is identical for the three graphs. The patch sizes range from 1 to 215.46 ha (mean 5.06 ha). The number of links is related to the distance threshold of the graph. Obviously, the number of components decreases as the distance threshold increases. At time t + 1, habitat fragmentation due to the TGV line leads to a loss of habitat. The number of habitat patches increases while the total area of habitat decreases. The TGV line increases isolation in that the number of links decreases and the number of components increases.

From the probability of presence estimated at time t and t + 1 for each virtual species, the rate of change was calculated in each cell. Three continuous maps with a spatial resolution of 100 m were obtained. In each map the local variation of the probability of presence ranges from −0.8 to 0. Fig. 2 shows a closer view of the study area and distinguishes between negative and null values. In this case the spatial extent of the negative values increases with the dispersal distance.

In order to ascertain how the TGV line could impact different populations, the global variation in the probability of presence was calculated for the entire study area for the three populations (Table 5). The global variation in the probability of presence increases with the maximum dispersal distance of the species taken into account.

Table 4
Global descriptors of the graphs.

	Population Maximum dispersal distance	A 2000 m	B 5000 m	C 10,000 m
t	Number of patches	22,634	22,634	22,634
	Total area of habitat (km^2)	1,144.95	1,144.95	1,144.95
	Number of links	55,852	63,457	66,117
	Number of components	633	130	25
t + 1	Number of patches	22,650	22,650	22,650
	Total area of habitat (km^2)	1,144.13	1,144.13	1,144.13
	Number of links	55,576	63,095	65,742
	Number of components	650	131	26

To determine the potential maximum distance of the loss of probability of presence, the local variation of the probability of presence was related to the distance from the TGV line (Fig. 3), giving a scatter plot for each population. The local variation in the probability of presence for each population was fitted to the distance from the infrastructure using an exponential function (Table 6). The maximum distance of the impact was solved by calculating d related to a local variation of the probability of presence (Δp) of −0.05.

4. Discussion

This paper proposes a method for assessing the impact of linear infrastructures on the potential species distribution at the landscape scale, by integrating a graph based approach into an SDM and by performing a diachronic analysis of the potential species distribution. The SDA allows us to assess the local and global variations in the probability of presence of a species and the maximum distance of the impact of a linear infrastructure depending both on its fragmentation and on barrier effects.

In this study the local variation in the probability of presence is closely linked to the decline in landscape connectivity. Fu et al. (2010) show that the combined fragmentation and barrier effects degrade landscape connectivity. The fragmentation effect is structural and local, and occurs only along the route of the linear infrastructure. Ecological effects of a linear infrastructure depend on whether it acts as a barrier to movement of the species considered (Forman, 1995). In addition, in the case of shrinkage or attrition of habitat patches, the measure of the loss of connectivity involves considering patches as stepping stones (Forman, 1995). The graph structure and the weighted dispersal flux calculation used in this study reflect this importance of stepping stones in the connectivity of habitat patches. In the application of the SDA presented for a virtual species, the TGV line is impassable and isolates the patches on either side of it. Nevertheless, the impact of the TGV line on the probability of presence is greater in the south of the study area in the three cases examined (Fig. 2). This is because there are fewer suitable habitat patches than in the north. In the south, the habitat patches are small and poorly interconnected, making them more sensitive to a variation in F. Null values observed close to the TGV line are for a group of patches where area and dispersal weighted flux do not vary at t + 1 due to well connected clusters of patches.

While the local variation in probability of presence is spatially explicit and can guide field surveys, two other generic methods were proposed for characterizing the impact of the infrastructure on an EIA process. The first is species oriented and the second addresses a spatial planning concern.

(1) The global variation in the probability of presence is indicative of the potential disturbance caused by a linear infrastructure on the species under study. The difference of the impact on each population is reflected by the global variation of the probability of presence in Table 5. It shows that the greater the dispersal distance, the greater the loss of probability of presence. With an increasing dispersal distance the weighted dispersal flux (F) takes into account more distant habitat patches at time t. As some of them are isolated by the TGV line at time t + 1, these patches are not taken into account at time t + 1, so values of F are globally lower at time t + 1. Moreover, according to the species distribution model, the global decline in the probability of presence is due to the weighting distance used to generalize connectivity metrics. More areas are dependent on isolated patches and so the loss of the probability of presence is greater. Thus, long distance dispersal species are potentially more sensitive to isolation due to the TGV line than short distance dispersal species. This result is consistent with the findings of Fu et al. (2010), who show that the barrier effect reduces landscape connectivity for long distance dispersal species.

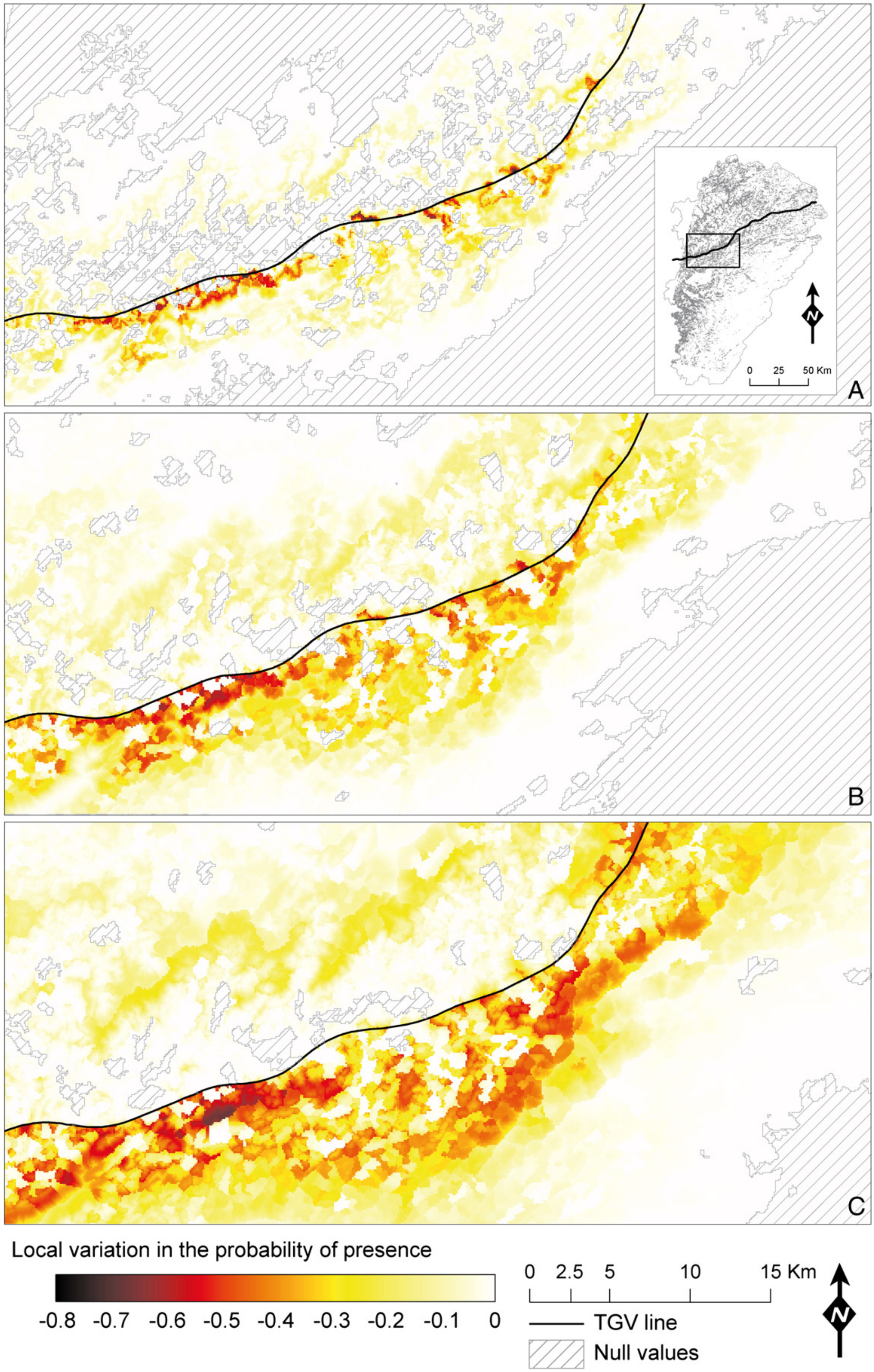

Fig. 2. Local variation in the probability of presence. Populations with a maximum dispersal distance of 2000 m, 5000 m, and 10,000 m correspond respectively to frames A, B, and C. Hatched areas represent no change in probability of presence.

Table 5
Global variation in the probability of presence.

Population	Maximum dispersal distance	$\sum p_t$	$\sum p_{t+1}$	ΔP
A	2000 m	685,134.635	682,629.876	$3.65{*}10^{\ 3}$
B	5000 m	703,993.689	697,001.770	$9.93{*}10^{\ 3}$
C	10,000 m	728,509.296	710,392.221	$24.9{*}10^{\ 3}$

Table 6
Maximum distance of the impact.

Population	Maximum dispersal distance	α	β	R^2	Maximum distance of the impact (m)
A	2000 m	0.284	$2.374{*}10^{\ 3}$	0.288	733
B	5000 m	0.154	$2.349{*}10^{\ 4}$	0.286	4816
C	10,000 m	0.206	$1.235{*}10^{\ 4}$	0.389	11,463

Exponential function used to fit the scatter plots: $\Delta p = \alpha{*}\exp(\ \beta{*}d)$; Δp is the local variation in the probability of presence and d is the distance from the infrastructure.

(2) The maximum distance of impact may guide spatial planners in determining an appropriate perimeter for assessing the impact of a linear infrastructure. The shape of the three scatter plots in Fig. 3 shows a decreasing impact with distance. The functions chosen to fit each scatter plot allow for a given rate of loss of probability of presence to establish the buffer distance from the linear infrastructure in which mitigation measures might be planned.

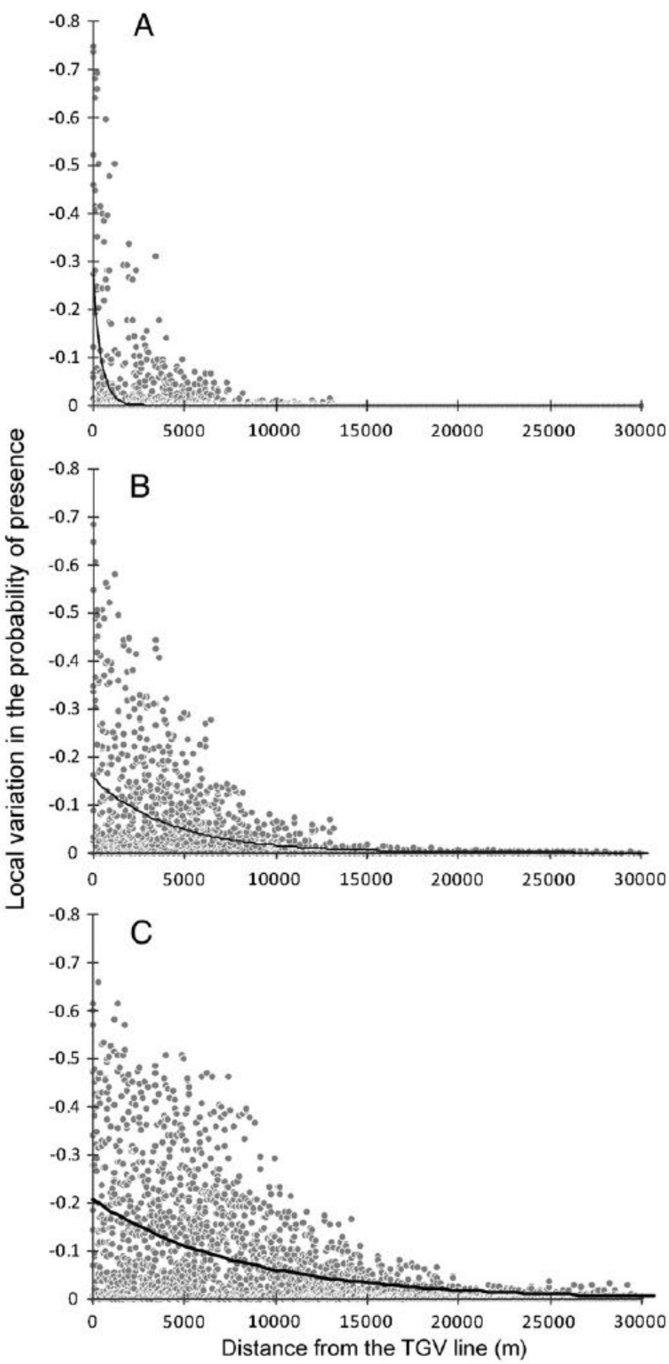

Fig. 3. Scatter plot of the local variation in probability of presence with distance from the TGV line. Populations with a maximum dispersal distance of 2000 m, 5000 m, and 10,000 m correspond respectively to charts A, B, and C. Exponential functions are represented by black curves.

Both the local and global impact assessments can overcome certain common shortcomings in EIA (Geneletti, 2006) such as how to calculate the maximum distance of impact. Potentially they support better decision making in both EIA and SEA processes.

The thresholding of links is a key step in the SDA presented here. In the case of an impassable barrier the resistance value of the linear infrastructure has to be high enough and dictates the link thresholding. But further investigations should be made to assess the permeability of linear infrastructure such as high speed railway lines or highways even if fences are used. In the same way Dale and Fortin (2010) propose determining a dispersal corridor instead of single least cost path (Pinto and Keitt, 2009) to more accurately reflect real animal movement in the landscape and relative resistance of those corridors (McRae et al., 2008).

On the question of integrating graph based connectivity metrics into the species distribution model, we choose to follow the method presented by Foltête et al. (2012a). But several connectivity metrics exist (Rayfield et al., 2011). Instead of the use of area weighted flux (F), other connectivity metrics can be helpful in quantifying landscape connectivity for a specific species, such as delta PC (dPC) and Betweenness Index (BI) (Pereira et al., 2011), Integral Index of Connectivity (IIC) (Decout et al., 2012), and Equivalent Connected Area index (ECA) (Awade et al., 2012). In order to perform a validation phase in the SDA, the choice of the connectivity metric to be used in the SDM should be assessed with respect to its capacity to reflect the species needs in terms of functional connectivity.

The SDA presented in this paper allows spatial planners to assess the impact of a TGV line on landscape connectivity. In this study, the use of a virtual species serves to demonstrate the method but raises the question of the lack of validation. Further applications on real species should be made, followed by a validation process after a sufficient delay after the construction of a linear infrastructure. The same framework could be used to investigate the effects of other linear infrastructures such as roads, power lines, canals (Benítez López et al., 2010) or border fences (Lasky et al., 2011). In this perspective, SDA could be used to assess several scenarios of linear infrastructure routes (Vasas et al., 2009) or to assess the efficiency of different locations for wildlife crossing structures along the linear infrastructure to support decision making (Downs and Horner, 2012). Another application can be made in the domain of land cover changes due to urban sprawl and assessment of different urban forms scenarios (Borgström et al., 2012; Tannier et al., 2012).

5. Conclusion

This paper presents a methodological framework for assessing the impact of a linear infrastructure on species distribution integrating a graph based approach at the landscape scale. Two scales of analysis with two kinds of viewpoint are explored. The first is a species oriented approach referring to the local loss of probability that could be integrated in a conservation plan. The second approach addresses a spatial planning concern by characterizing the global loss of probability of presence and the maximum distance of the impact of a linear infrastructure. This method could be useful for decision making in applications where there is a need to assess the impacts of man made developments or the benefits of mitigation measures.

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Diversity and Distributions

BIODIVERSITY RESEARCH

Conservation biogeography of the US–Mexico border: a transcontinental risk assessment of barriers to animal dispersal

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ABSTRACT

Aim Humans have dramatically transformed landscapes along the US Mexico border. We aim to assess the risk of barriers that may significantly impede animal migrations within this ecologically sensitive region.

Location United States and Mexico.

Methods We examined the intersection of current and possible future barriers along the border with the geographic ranges of 313 amphibian, reptile and non volant mammal species. We considered the areas of intensive human land use and ~ 600 km of pedestrian fence as current barriers along the border. We evaluated the impacts of two scenarios of dispersal barriers continuation of existing and construction of new barriers and identified species vulnerable to global and local extinction.

Results Among the species most at risk from current barriers are four species listed as threatened globally or by both nations, 23 species for which the larger of their two national subranges is $< 10^5$ km^2 and 29 species whose ranges cross the border only marginally. Three border regions, California, Madrean archipelago and Gulf coast, emerge as being of particular concern. These regions are characterized by high overall species richness and high richness of species at risk from existing barriers and from construction of potential new barriers.

Main conclusions New barriers along the border would increase the number of species at risk, especially in the three identified regions, which should be prioritized for mitigation of the impacts of current barriers. The species we identified as being potentially at risk merit further study to determine impacts of border dispersal barriers.

Keywords

Border fence, endemic species, northern Mexico, range margins, southwestern US, species range maps, threatened species, transboundary conservation.

INTRODUCTION

The US Mexico border bisects North America and is marked by intensive human land use and ~ 1200 km of recently constructed barriers to human migration. These modifications may severely threaten the diverse wildlife of the region (Cohn, 2007; de la Parra & Córdova, 2007; Sayre & Knight, 2010). Anthropogenic impacts are expected to increase with future land use change and further expand fences and walls along the border (Flesch *et al.*, 2010). The problem of anti immigration barriers is particularly severe as US law exempts their construction from adherence to all environmental regulatory and review requirements (US Library of Congress (USLOC), 2005b). Under the REAL ID Act of 2005, the Secretary of the Department of Homeland Security (DHS) has authority to construct barriers across the entire border at any time without oversight of environmental regulatory law. To date, a bina tional, transcontinental analysis of the potential threats facing the border fauna, including those posed by dispersal barriers, is lacking.

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The US Mexico border lies roughly east west across North America, while the mountain ranges of the border region (Sierra Madre Occidental, Sierra Madre Oriental, California Coastal) run roughly north south, so that the border crosses the mountain ranges at approximately a 70° angle. These mountain chains exhibit high spatial heterogeneity in precip itation (National Atlas, 2008) and bound major ecosystems, some of which occur in narrow bands [Commission for Environmental Cooperation (CEC), 1997]. As a result, even short anthropogenic barriers along the border could bisect ecosystems and species ranges.

Barriers across large portions of species' ranges may negatively impact populations. Theoretical (e.g. Levins, 1970) and empirical (e.g. Epps *et al.*, 2005) research demonstrates that dispersal barriers need not be entirely impermeable to have strong effects on populations. Species with poor dispersal across the border might have reduced gene flow between populations (Keller & Largiader, 2003), which can lead to drift caused genetic divergence between populations (Mills & Allendorf, 1996) and rapid loss of genetic diversity in small isolated populations (Epps *et al.*, 2005; Jacquemyn *et al.*, 2009). Smaller isolated populations may also be subject to an increased risk of extinction (Shaffer, 1981; Pimm, 1991; Purvis *et al.*, 2000). Populations near species' range margins are often of low density (Brown, 1984) and might be similarly vulnerable if isolated by dispersal barriers. Even slight decreases in dispersal may have large consequences for species' populations such as extinction of a low density metapopulation (Levins, 1970).

There are at least three major types of anthropogenic barriers to cross border animal dispersal: human altered landscapes, fences and walls, and areas of high human activity (Cohn, 2007; Spangle, 2007). Rapid construction of fences began after US President George W. Bush signed legislation mandating ~ 1200 km of fencing along the US Mexico border (Fletcher & Weisman, 2006; USLOC, 2006). These barriers, owing to their linear nature, have a great potential per unit length to bisect populations. Of the two border fence types (vehicle and pedestrian), we focus on potential impacts of pedestrian fences, which currently extend ~ 600 km and are intended to be impermeable to humans [US Government Accountability Office (GAO), 2009]. These fences and walls are typically at least 4.5 m tall, sunk 1 m into the ground and have either no openings or openings of 1 10 cm (US DHS, 2008a). Human disturbance, vegetation removal and additional barri ers, roads and lighting that accompany fences (Spangle, 2007; US Government Printing Office, 2008) likely further reduce border permeability where fences are installed (Trombulak & Frissell, 2000; Cohn, 2007; Flesch *et al.*, 2010; Sayre & Knight, 2010). Co occurring in the region are extensive anthropogenic landscapes that are home to a rapidly growing population of ~ 12 million people (Stoleson *et al.*, 2005; US Mexico Border Health Commission, 2009). Such highly urbanized landscapes likely have low suitability and permeability for native species (Harrison, 1997; Trombulak & Frissell, 2000; McKinney, 2002; Epps *et al.*, 2005).

Researchers have designated the most important areas in the Mexican border region for the conservation of species threatened in Mexico (Koleff *et al.*, 2007). However, a comprehensive binational analysis of species level risk from barriers in the region is lacking. This study is the first large scale evaluation of the threats posed by border dispersal barriers to non volant terrestrial vertebrates. Ideally, evalua tions of the risk of barriers would incorporate detailed data on species' movements, as was carried out for jaguar (*Panthera onca*; McCain & Childs, 2008) and desert bighorn sheep (*Ovis canadensis mexicana*; Flesch *et al.*, 2010). Few data exist, however, for the great majority of the ~ 300 species of amphibians, reptiles, and non volant mammals found at the border. In the absence of such data, we estimated risk by examining species range maps and resulting biogeographic patterns.

Dispersal barriers can have impacts at multiple levels of ecological organization. Our approach proceeds in a top down fashion from ecoregions, which represent relatively self contained biogeographical units, to assemblages of varying richness and composition along the border, to individual species at the most basic unit. In each case, we characterize the extent to which barriers intersect these units. The conservation objectives of these analyses were to (1) prioritize regions for the conservation of transborder connectivity and (2) identify species at risk meriting further study.

Our species level analysis centred around two related aspects of risk: (1) loss of population interconnectivity owing to a reduction in dispersal across the border and (2) reduction in effective population sizes subsequent to loss of connectivity. It is important to recognize that these components of risk can operate both locally and range wide depending on the size of a species range and its location relative to barriers. Relevant scenarios are summarized in Fig. 1. At the global scale, we deem two groups of species as most at risk. First, species already listed as threatened by the International Union for the Conservation of Nature (IUCN) or by both the US and Mexican governments are at risk from a loss of connectivity (risk G1, Fig. 1). Second, species with small geographic ranges that are bisected into evenly sized populations are at high risk because this scenario produces the smallest remnant

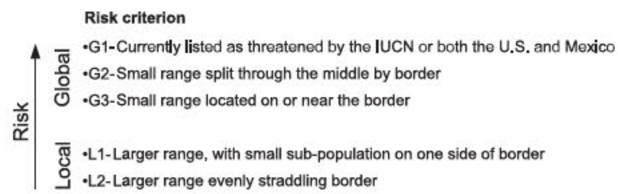

Figure 1 Criteria of species range size and location used to esti mate relative risk to species' global and local populations from barriers along the border. G1, G2 and L1 are species considered at risk to hypothetical extensive barriers. G3 species are at risk globally from general disturbances. L2 species are considered least at risk from range bisection. Note that categories are not mutually exclusive.

populations and ranges (risk G2). Species with small ranges are typically at greater risk of extinction than large ranged species (Purvis *et al.*, 2000). At a local scale, we associate risk with remnant populations that are separated from the rest of the species range by barriers along the border (risk L1). Such geographically marginal populations are often of low density (Brown, 1984) and vulnerable to anthropogenic change. These marginal populations, while not necessarily of global conser vation concern when the overall range is large, are important in the context of local ecosystems. Within this framework, we evaluate risk stemming from range bisection under two scenarios: (1) risk posed by bisecting a species range, a hypothetical scenario that may result from extensive barriers in the future and (2) risk from current conditions of land use and implementation of barriers that threaten to bisect ranges.

METHODS

Data sources

Digital range maps of ecoregions (CEC, 1997) and amphibian (IUCN, 2008), reptile (Conant & Collins, 1998; Stebbins, 2003; IUCN, NatureServe, and Conservation International, 2007) and non volant mammal species (Patterson *et al.*, 2007) were used in all analyses, which were computed in ARC GIS 9.2 (ESRI). We digitized the locations of pedestrian border fences already constructed or planned by US Customs and Border Protection (CBP) as of 1 January 2011 (data primarily from governmental sources, see Appendix S1 in Supporting Infor mation). We included fences with either no openings or openings 1 10 cm and that are ~ 4.5 m tall and sunk 1 m into the ground, although precise specifications are often not available for individual sections of fence (US DHS, 2008a; see Appendices S1 and S2). We did not include the older three strand barbed wire fences that are installed along much of the border because information on their locations is scarce. Nearly all of the fence sections included in analyses have already been constructed as of 1 January 2011, save some segments totalling < 20 km in the lower Rio Grande Valley (US CBP, 2009). Pedestrian fencing extends over 21% of the total length of the border and is most prevalent near the coasts.

Areas of intensive human land use are found scattered across the border, such as the San Diego/Tijuana, Nogales and El Paso/Juarez urban areas and the urban/agricultural Rio Grande Valley. Dispersal limiting anthropogenic landscapes along the border were identified using the Human Footprint Index (HFI), a metric of human impact on ecosystems (Sanderson *et al.*, 2003). Impacts were estimated using data on human population density, access (via roads, railroads, and navigable bodies of water), night time lights, urbanization and agricul ture (Sanderson *et al.*, 2003). Relative human impacts were calculated for each 30 arc second cell and then normalized to a scale of 0 100 for each biome (Sanderson *et al.*, 2003). We then averaged HFI values across a 20 km wide strip about the border for 1 km segments of the border. The width of the 20 km strip was chosen to encompass the range of variation in the size of border urban areas. The choice of the top quartile was arbitrary, but thresholds between the 65th and 95th percentiles identify the same urban centres as barriers. Varying this threshold has little effect because of the large difference in human impact between urbanized vs. non urbanized areas along the border.

We evaluated species risk from two scenarios of border barriers. The first scenario is the current situation at the border, defined by the existing (or imminent) barriers. 'Current barriers' were defined as locations having pedestrian fence or top quartile HFI. We included existing pedestrian fences, in addition to some short pedestrian fence segments (totalling < 20 km) currently under construction or having specific construction plans (US CBP, 2009). We used this scenario to identify species most at risk because of range bisection by current barriers; hereafter, we refer to this scenario as one of 'current barriers.' The second scenario, which is hypothetical, is defined by barriers extensive enough to effectively bisect a species range. We used this scenario to identify species most at risk from range bisection by any extensive border barriers; hereafter, we refer to this scenario as one of 'extensive barriers.' The second scenario may be currently faced by species with extensive barriers across their range, or it may be a potential future scenario for any species.

Quantifying regional biogeographic patterns

It is instructive to examine the intersection of ecoregions (Level III, CEC, 1997), whose boundaries are roughly coinci dent with many species' range edges, and the border. Ecoregional patterns can be representative of biogeographic patterns across many species, including those for which data are lacking (Feeley & Silman, 2009). We measured the width of ecoregions along the border and the length of current barriers contained within them.

Using range maps, we tallied the regional richness of all amphibian, reptile and non volant mammal species, limited to species found within 50 km of the border. Comparisons between local survey data and range maps suggest that expert opinion range maps drawn at continental scales (i.e. our data sets) have rapidly decreasing accuracy at grain sizes below 100 km (Hurlbert & Jetz, 2007). We therefore aggregated species richness within moving, 50 km radius circular win dows. The 50 km radius is a reasonable trade off between resolving variation in diversity and the small scale error common in range maps. We measured richness of all species found within 50 km of the border, rather than merely of species having range maps intersecting the border, because of the previously mentioned error in range maps. Our use of overlapping circles diminishes an artefact (aliasing) that may arise when sampling a continuous signal in discrete intervals. Depending on where a grid is anchored, non overlapping grid cells may show signal variation that is an artefact of variation at much smaller scales than grid cells.

We examined how the richness of border assemblages was related to the occurrence of current barriers. We compared the observed relationship between richness and the location of current barriers to a null expectation where the occurrence of barriers and richness are independent. We calculated the richness of all border species within 50 km windows centred at 1 km intervals on the border. We calculated the cumulative sum of barrier lengths coinciding with all assemblages with richness less than or equal to a given value. We then generated a null expectation of the accumulation of barriers based on the assumption that barriers were evenly distributed across the border irrespective of richness. Finally, we visually compared the observed cumulative distribution to the null to assess whether richness and barriers were independent.

Complementarity, or uniqueness, of local species assem blages is useful to identify locations that contribute most to preserving total species richness across many locations (Wil liams *et al.*, 1996). As a measure of complementarity, we identified which local assemblages most differed from the average border assemblage. Local assemblages with the greatest difference from the border wide average (and thus the highest complementarity) may be prioritized for conservation. Nega tive impacts of border barriers on relatively unique assem blages would be difficult to offset by conservation at other locations with more typical assemblages. We first identified the composition of local assemblages within 50 km windows centred at 1 km intervals on the border. We then created an average border wide assemblage based on species relative frequencies of occurrence. For the average border wide assemblage, each species received a value equal to the frequency of its occurrence in local border assemblages divided by the total number of local assemblages. We then computed the Hellinger distance between all local assemblages and the border wide average assemblage to estimate the complemen tarity of each local assemblage.

Assessing species-level risk

We used species range maps and their relation to the border to determine which species are most at risk at global and local levels. Species were further classified according to the scenario in which they were at risk. The species at risk from general extensive barriers across their range are referred to below as 'at risk in a scenario of extensive barriers,' while those at risk from current border impermeability are referred to as 'at risk from current barriers.' Current border permeability for a given species was estimated as the proportion of border in a species range occupied by current barriers (length of border occupied by barriers in range divided by total border length in its range).

Assessment of global risk

We assessed threats because of range bisection by barriers to species already considered vulnerable by conservation agencies. The statuses of species were taken from the Secretaría del Medio Ambiente y Recursos Naturales of Mexico (SEMARNAT, 2002), the US Fish and Wildlife Service (USFWS) (2009), and the IUCN (2008).

We also developed two proxies for relative global risk. First, we used global range area as an indicator of endemics at risk from general disturbances. Second, for species with their range bisected at the border, persistence may depend on the larger of the two remnant subranges. Thus the relative risk posed by range bisection was estimated using the size of a species' largest subrange north or south of the border. This metric may also be interpreted as indicating risk from failure of management in one nation. If management failure results in extinction in the smaller subrange, then the size of the larger remaining subrange indicates the subsequent global risk.

We considered two groups of species globally at the greatest risk in the extensive barriers scenario: (1) species considered vulnerable by the IUCN or both federal conservation agencies (risk G1, Fig. 1) and (2) species with their largest subrange on either side of border $< 10^5$ km^2 (risk G2, Fig. 1). We identified the subset of species at risk from extensive barriers that are threatened by current barriers. If barriers occupied over 50% of a G1 or G2 species' border range, they were considered at risk from current barriers. We used these arbitrary thresholds to identify the species most at risk.

Assessment of local risk on one side of the border

We assessed risk to subpopulations at their species range margin near the border. We determined range margin status by calculating the greatest distance between the border and the species range edge north and south of the border. The lesser of these two distances was then divided by the greater, giving a ratio that approaches 0 for species for which the border passes through their range margin to unity for species for which the border passes through the centre of their range. Species were considered as locally at risk in the scenario of extensive barriers if this ratio was < 0.15 (risk L1, Fig. 1). A subset of at risk L1 range margin species was considered at risk from current barriers if barriers occupied over 50% of their border range. Again, thresholds were arbitrary, used to identify the species at the greatest relative risk.

Richness of species at risk

Having identified species most at risk globally and locally because of general extensive and current barriers, we priori tized regions for the preservation of transborder connectivity by measuring their richness. The richness of species at risk in a scenario of future extensive barriers (risks G1, G2 and L1) and of the subset of G1, G2 and L1 species at risk from current barriers was calculated. Richness of species at risk was measured in a circle of radius 50 km sliding along the border. We identified ecoregions rich in species at risk by intersecting ecoregion and species range maps. Although we used arbitrary thresholds of risk, more stringent thresholds yielded consistent geographic patterns of species risk. We also measured richness

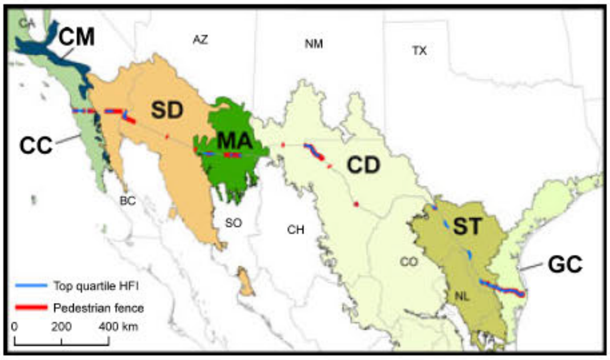

Figure 2 Ecoregions found in both the US and Mexico (CEC, 1997), with pedestrian fences (red) and areas of high Human Footprint Index (blue). Ecoregions are: CC, California coastal; CM, California/Baja California Mountains; SD, Sonoran Desert; MA, Madrean Archipelago; CD, Chihuahuan Desert; ST, South Texas/Interior Plains and GC Western Gulf Coastal Plain. States (grey lines) are as follows: CA, California; AZ, Arizona; NM, New Mexico; TX, Texas; BC, Baja California; SO, Sonora; CH, Chihuahua; CO, Coahuila; NL, Nuevo Leon; TA, Tamaulipas.

of species in different overall range size categories to indicate regions harbouring the most endemic species with small overall ranges and that are sensitive to disturbance in general (risk G3).

RESULTS

Regional biogeography and barriers

Seven ecoregions are found on both sides of the border (Fig. 2, CEC, 1997). Pedestrian fencing is most common in the California and Gulf coastal ecoregions, where 62% and 48% of the border is occupied by pedestrian fences, respectively. These were also the two narrowest ecoregions as measured along the border. Areas of high human impact were present in every ecoregion. Border areas in the top quartile of HFI occupy 25% of the border length. Sections with pedestrian fencing often co occur, but also considerably extend, the barriers represented by high HFI. Combined, these barriers span 975 km or 34% of the border.

Vertebrate groups attained high regional richness in differ ent locations along the border (Table 1). Mammals and reptiles were most species rich in the Madrean archipelago/ Chihuahuan desert, while amphibians were most species rich in the Rio Grande Valley/central Texas (Fig. 3). Range maps showed that 57 amphibian, 178 reptilian, and 134 mammalian species occur within 50 km of the border, with border fence intersecting the ranges of 38, 152 and 113 species, respectively (see Appendix S3). Amphibian species occurring at the border comprise 17% of amphibian species within the entire US and 16% of amphibian species within all of Mexico, border reptiles comprise 49% of the US reptilian fauna (NatureServe 2011) and 18% of the Mexican reptilian fauna (CONABIO 2011), and border mammals comprise 39% of the US mammalian fauna and 40% of the Mexican mammalian fauna. Barriers were more likely to occur among assemblages of moderate species richness, relative to the null expectation based on random placement of barriers (Fig. 4). The extreme lowest and highest diversity assemblages co occurred with barriers at a rate similar to the null expectation. Among species, an average of 28% (SD = 18) of the border length dissecting species' ranges was occupied by pedestrian fence and 41% (SD = 24) by pedestrian fence or areas of high HFI. Thus, pedestrian fences and combined pedestrian fences and areas of high HFI occupy lower percentages of the border as a whole (21% and 34%, respectively) than the average length they occupy within species ranges (28% and 41%, respectively). This difference indicates that barriers are not located at random relative to species ranges and that barriers are more common in areas rich in species with small ranges (Fig. 5).

Complementarity of local assemblages was greatest in the Gulf Coastal Plain, signifying that these assemblages were most different from the border wide average than any other assemblages (Fig. S1). Complementarity also peaked at the California coastal ecoregion, while the middle portion of the continent had the lowest complementarity.

Global risk

Fifty species and three subspecies that are globally threatened (IUCN, 2008) or federally threatened in Mexico or the US (SEMARNAT, 2002; USFWS, 2009) occur within 50 km of the border. The scenario of hypothetical extensive barriers increases risk for the 14 IUCN or binationally threatened species that are found at the border (risk G1). These species, at risk from extensive barriers, peak in richness along the Arizona border, near the boundary between the Sonoran Desert and Madrean Archipelago (Fig. 5). Of the IUCN or binationally threatened species, we consider five coastal species to be most at risk from current barriers (i.e. barriers occupy over 50% of the border length in range; Table 2, Fig. 5).

Endemic species with small geographic range size are particularly at risk from both natural and anthropogenic disturbances. Richness of this group was greatest near the coasts and in the Madrean archipelago region (risk G3, Fig. 5). We considered species globally at risk from extensive barriers if, when their range was bisected at the border, the larger remaining subrange north or south of the border was $< 10^5$ km^2 (risk G2). We identified 45 such small subrange species (Fig. 6). Nearly all IUCN threatened species had relatively small remaining subranges. The Sonoran Desert and California coastal ecoregions contained the greatest richness of species with small remaining subranges (Table 1), consistent with variation in species total range size (Fig. 5). Twenty three of the 45 small subrange species were considered most at risk because of current barriers (i.e. over 50% of the border within their range occupied by barriers; Table 2, Fig. 6). These species were found mainly in the California Coastal and Sonoran Desert ecoregions, which have extensive dispersal barriers (Table 1, Fig. 5). Species with large

Table 1 The richness of all non volant species and of species potentially at risk, identified by analyses of range maps, in the six border ecoregions.

	Ecoregion	CC	SD	MA	CD	ST	GC
All species	Amphibian	12	26	18	24	24	21
	Reptile	60	102	82	104	81	54
	Mammal	55	94	78	90	67	49
	Total	127	222	178	218	172	124
Vulnerability criterion							
IUCN threatened or threatened in both nations	Amphibian	2	3	1	1	1	1
	Reptile	1	3	2	2	1	1
	Mammal	0	3	4	3	3	2
	Total	3	9	7	6	5	4
IUCN threatened or threatened in both nations and > 50% border range with barriers	Amphibian	2	2	0	0	1	1
	Reptile	1	1	0	0	0	0
	Mammal	0	1	1	0	1	1
	Total	3	4	1	0	2	2
Larger subrange < 10^5 km^2	Amphibian	2	3	1	1	2	2
	Reptile	13	18	4	10	6	4
	Mammal	6	9	2	3	0	0
	Total	21	30	7	14	8	6
Larger subrange < 10^5 km^2 and > 50% border range with barriers	Amphibian	2	2	0	1	2	2
	Reptile	9	10	0	1	2	2
	Mammal	6	7	1	0	0	0
	Total	17	19	1	2	4	4
Near range margin	Amphibian	2	2	0	4	8	8
	Reptile	11	14	10	18	14	13
	Mammal	10	19	16	19	13	13
	Total	23	35	26	41	35	34
Near range margin and > 50% border with barriers	Amphibian	2	2	0	3	7	7
	Reptile	7	7	2	4	6	6
	Mammal	4	6	2	3	3	3
	Total	13	15	4	10	16	16

Note that ecoregions vary widely in extent, and thus richness in regions of equal area showed different geographical patterns (Figs 3 & 4). Species considered at risk from future extensive barriers are as follows: (1) those already considered vulnerable by the IUCN or both the US and Mexico (risk G1), (2) those with small remaining subranges (risk G2, larger subrange < 10^5 km^2) and (3) those near range margins (risk L1, ratio of distances from border to range edges < 0.15). Species from these two groups are considered at risk from current barriers if over 50% of their border range is occupied by current barriers. CC, Coastal California; SD, Sonoran Desert; MA, Madrean Archipelago; CD, Chihuahuan Desert; ST, Southern Texas Plains; GC, Gulf Coastal Plain.

remaining subranges tended to have proportionally less of their range occupied by current dispersal barriers (Fig. 6).

Local risk on either side of border

Dispersal barriers potentially threaten populations near their species range margin at the border with local extinction in one nation. Range margin species were identified by the symmetry of their range about the border, calculating the ratio of maximum distances between the border and two range edges (N and S of the border). Species were considered at their range margins if the lesser of these two distances divided by the greater was < 0.15. In total, there were 65 species at their range margin near the border, species that are locally at risk in a scenario of extensive barriers across their range (risk L1). Such species include 10 nationally threatened species and two globally IUCN threatened species (Fig. 6). Range margin species were more likely to be classified as federally threatened by the US or Mexican governments (17%) than non range margin species (12%); this difference was nearly statistically significant at $\alpha = 0.05$ ($\chi^2 = 3.367$, $P = 0.067$). The higher level of officially recognized risk for range margin species supports our contention that species near their range margins at the border represent potentially vulnerable subpopulations. Dozens of range margin species were found within each ecoregion, with total range margin species richness peaking in the Gulf Coastal Plain (Fig. 5).

Of the 65 range margin species at the border, 29 species were considered most at risk from current barriers (i.e. over 50% of the border within their range occupied by barriers) and 16 of

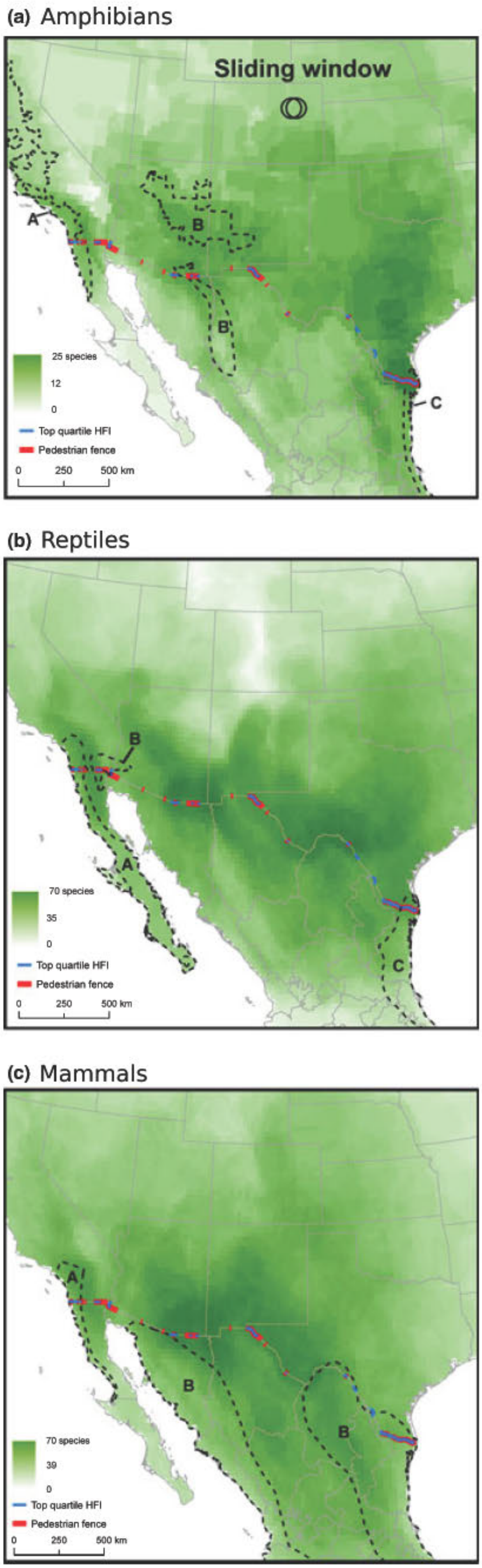

Figure 3 Species richness of (a) amphibians, (b) reptiles and (c) non volant mammals along the US Mexico border, with pedes trian fences (red) and areas of high Human Footprint Index (blue). Richness was tallied within sliding, 50 km radius circles. Species whose closest range margin fell outside a 50 km buffer along the border were excluded. Our analysis likely overestimates local richness because range maps typically do not capture fine scale patchiness in species occurrence. Dotted lines show species' ranges with large portions intersected by fences (a) A *Spea hammondii*, B *Hyla wrightorum* and C *Rhinophrynus dorsalis;* (b) A *Aspidosclis hyperythra*, B *Uma notata* and C *Coniophanes imperalis;* and (c) A *Chaetodipus fallax* and B *Leopardus pardalis.*

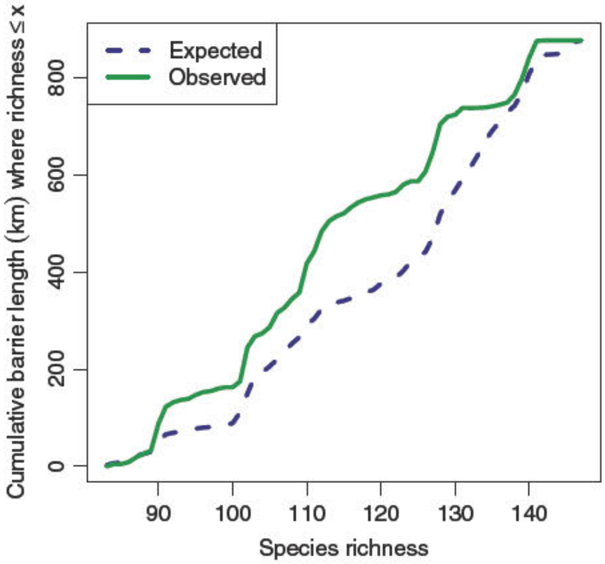

Figure 4 Cumulative barrier length in all assemblages of richness ≤ *x*. The expected distribution assumes that barriers occur independently of the species richness of assemblages.

these species had barriers across over 75% of their range (Table 2, Fig. 6). Range margin species with extensive barriers in their range were principally found towards the coasts (Fig. 5). The ranges of both small subrange size species and species near the edge of their range cross the border for relatively short lengths (data not shown), so that a scenario of barriers bisecting their ranges is highly plausible.

DISCUSSION

Biogeography, species at risk and regions of the border

To prioritize regions for coordinated binational conservation and preservation of transborder connectivity, we have identi fied regions rich in all border species and species most at risk globally and locally. We place the highest priority for mitigation of the impacts of barriers on species identified as at risk under the scenario of current barriers, because these species are confronted with existing barriers. We place the highest priority for the preservation of future transborder

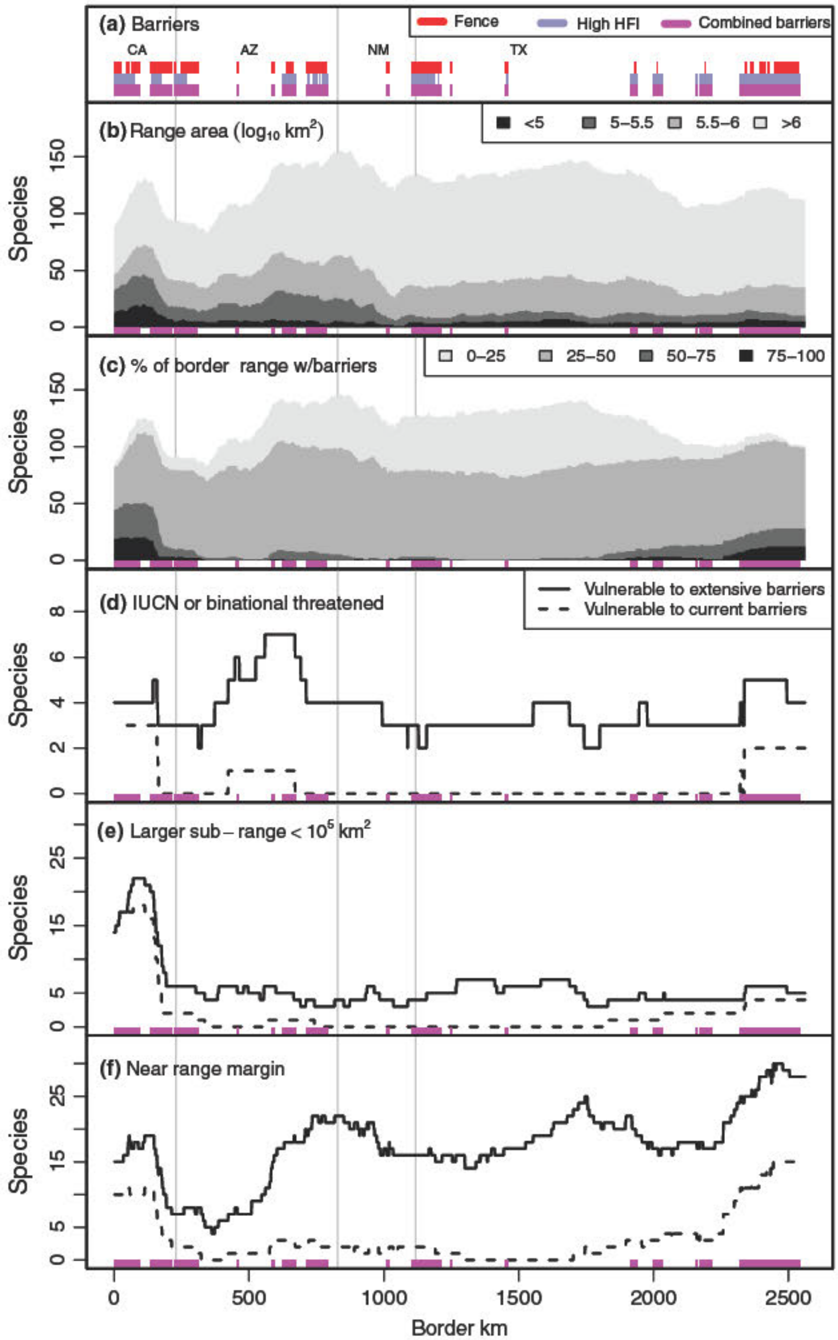

Figure 5 (a) Longitudinal views of potential barriers, (b c) range characteristics of all species, used to illustrate range characteristics for all border species, and (d f) richness of species most at risk from barriers along the border. (a) Locations of pedestrian fence (red), areas of top quartile Human Footprint Index (blue) and both current barriers (purple). (b) Stacked area view of the total range area of all species found at the border. (c) Stacked area view of the percent of species' border range occupied by current barriers (length of barriers in range/length of border in range). (d) Richness of species globally at risk because of classification as threatened by the IUCN or both nations: those at risk from potential extensive future barriers (G1, solid lines) and the subset at risk from current barriers (dashed lines). (e) Richness of species globally at risk because of isolation by barriers into small subranges (G2), risk scenarios shown as in (d). (f) Richness of species at their range margin along the border and locally at risk (L1), risk scenarios shown as in (d). The view is longitudinal from west to east across the border.

connectivity on the species at risk under the hypothetical scenario of extensive barriers that are not at risk from current barriers. The risk to this latter group of species is hypothetical and could emerge if future barriers are constructed within their ranges. The regions of the greatest richness of species at risk from both scenarios indicate where current or future barriers would have the most dramatic impacts on vertebrate assem blages (Fig. 5). The regions of highest border species richness

Table 2 Species identified as potentially at risk from current border dispersal barriers.

Family	Species	English names	IUCN or binational threatened and border barrier > 50% of range	Larger subrange < 10^5 (km^2) and border barrier > 50% of range	Range margin and border barrier > 50% of range
Amphibians					
Bufonidae	*Anaxyrus boreas*	Western toad			
Bufonidae	*Anaxyrus californicus*	Arroyo toad	IUCN E	X	
Bufonidae	*Rhinella marina*	Giant marine toad			X
Eleutherodactylidae	*Eleutherodactylus cystignathoides*	Rio Grande chirping frog		X	
Hylidae	*Pseudacris clarkii*	Spotted chorus frog			X
Hylidae	*Smilisca baudinii*	Mexican treefrog			X
Leptodactylidae	*Leptodactylus fragilis*	American white lipped frog			X
Microhylidae	*Hypopachus variolosus*	Sheep frog			X
Plethodontidae	*Batrachoseps major*	Garden slender salamander		X	
Plethodontidae	*Ensatina eschscholtzii*	Ensatina			X
Ranidae	*Rana draytonii*	California red legged frog	IUCN V		
Rhinophrynidae	*Rhinophrynus dorsalis*	Burrowing toad			X
Salamandridae	*Notophthalmus meridionalis*	Black spotted newt	IUCN E	X	
Sirenidae	*Siren intermedia*	Lesser siren			X
Reptiles					
Colubridae	*Coniophanes imperialis*	Black striped snake			X
Colubridae	*Gyalopion quadrangulare*	Thornscrub hook nosed snake			X
Colubridae	*Opheodrys aestivus*	Rough greensnake			X
Colubridae	*Tantilla planiceps*	Western black headed snake		X	
Colubridae	*Thamnophis hammondii*	Two striped garter snake		X	
Colubridae	*Thamnophis sirtalis*	San Francisco garter snake			X
Crotaphytidae	*Crotaphytus bicinctores*	Great Basin collared lizard			X
Crotaphytidae	*Gambelia copeii*	Long nosed leopard lizard		X	X
Emydidae	*Clemmys marmorata*	Pacific pond turtle	IUCN V		X
Phrynosomatidae	*Holbrookia propinqua*	Keeled earless lizard		X	
Phrynosomatidae	*Petrosaurus mearnsi*	Banded rock lizard		X	
Phrynosomatidae	*Sceloporus occidentalis*	Western fence lizard			X
Phrynosomatidae	*Sceloporus orcutti*	Granite spiny lizard		X	
Phrynosomatidae	*Sceloporus vanderburgianus*	Southern sagebrush lizard		X	
Phrynosomatidae	*Uma notata*	Colorado Desert Fringe toed lizard		X	
Phrynosomatidae	*Urosaurus nigricaudus*	Baja California brush lizard		X	X
Scincidae	*Eumeces skiltonianus*	Western skink			X
Teiidae	*Aspidoscelis laredoensis*	Laredo striped whiptail		X	
Teiidae	*Aspidoscelis sexlineata*	Six lined racerunner			X
Viperidae	*Sistrurus catenatus*	Massasauga			X
Xantusiidae	*Xantusia henshawi*	Henshaw's night lizard		X	
Mammals					
Cricetidae	*Oryzomys couesi*	Coues's rice rat			X
Cricetidae	*Peromyscus fraterculus*	Northern Baja deermouse		X	
Felidae	*Puma yagouaroundi*	Jaguarundi	US E,MX T		X
Heteromyidae	*Chaetodipus californicus*	California pocket mouse			X
Heteromyidae	*Chaetodipus fallax*	San Diego pocket mouse		X	
Heteromyidae	*Chaetodipus rudinoris*	Baja pocket mouse			X
Heteromyidae	*Chaetodipus spinatus*	Spiny pocket mouse		X	
Heteromyidae	*Dipodomys simulans*	Dulzura kangaroo rat		X	

Table 2 Continued.

Family	Species	English names	IUCN or binational threatened and border barrier > 50% of range	Larger subrange < 10^5 (km^2) and border barrier > 50% of range	Range margin and border barrier > 50% of range
Heteromyidae	*Liomys irroratus*	Mexican spiny pocket mouse			X
Sciuruidae	*Sciurus arizonensis*	Arizona gray squirrel		X	
Sciuruidae	*Sciurus griseus*	Western gray squirrel			X
Sciuruidae	*Tamias merriami*	Merriam's chipmunk		X	X
Sciuruidae	*Tamias obscurus*	California chipmunk		X	
Soricidae	*Sorex monticolus*	Dusky Shrew			X

Species were considered at risk from current barriers if they (1) had a larger national subrange < 10^5 km^2 (risk G2), (2) were near range margins at the border (risk L1, ratio of distances from border to range edges < 0.15) *or* (3) were classified as threatened by the IUCN or both nations (risk G1), *and* over 50% of their border range is occupied by current barriers (i.e. length of barriers in range/length of border in range > 0.5). Richness of these species along the border is shown in the dashed lines of Fig. 4. E, endangered; V, vulnerable; T, threatened.

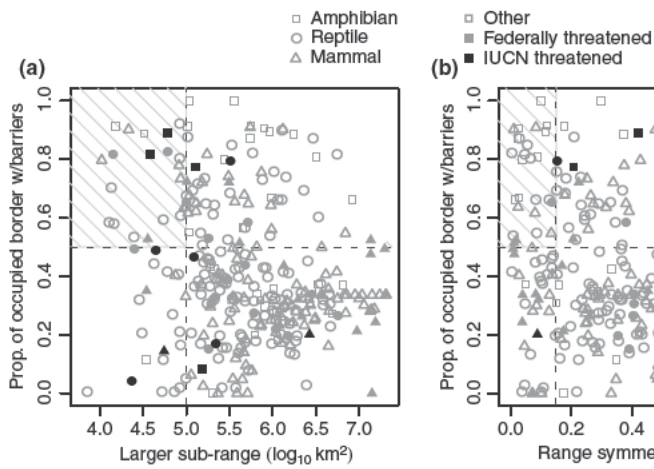

Figure 6 Identification of vulnerable species based on extent of barriers within the range and range area and symmetry. The proportion of species' border ranges occupied by barriers is plotted against (a) the area of the larger national subrange and (b) the symmetry of the range about the border as measured with the ratio of distances from border to range edges. Species approaching the border near their range limit will have a high degree of asymmetry in subranges and equivalently a small ratio of the distance between the border and the edge of one subrange relative to the larger subrange. We identify species to the left of the dashed lines as risk (a) globally or (b) locally because of potential extensive future barriers (G2 & L1). Species above the dashed line in the shaded regions are considered most at risk from current barriers. The species in the shaded regions are listed in Table 2, and spatial patterns of their richness are documented in Table 1 and Fig. 2. Squares amphibians, circles reptiles and triangles mammals. Filled characters represent threatened species: black IUCN threatened, grey federally threatened in at least one nation.

indicate where dispersal barriers could affect the greatest number of species and where barriers along the entire border would bisect the greatest number of species ranges (Fig. 3).

Spatial variation in regional species richness, composition and risk might be explained by regional environmental variation. Species range limits are often coincident with sharp environmental gradients, and the orientation of gradients affects the risk posed by barriers along the border. In North America, mountain ranges are oriented along a north south axis leading to a similar north south orientation of small species ranges for terrestrial vertebrates (Brown & Maurer, 1989). This pattern is repeated in the California, Madrean and Gulf ecoregions, which are narrow along the border and bounded on either side by sharp gradients. The border in these regions passes nearly perpendicular to contours of equal environmental conditions, and as a result, barriers have a high potential to bisect species ranges. In contrast, the Chihuahuan Desert is larger and extends far along the border. Thus, the assemblages of the Chihuahuan Desert had relatively low complementarity, fewer small range size species and fewer species with large portions of their range occupied by current barriers.

The coastal California ecoregion, which was the narrowest ecoregion, is bounded by the two steepest environmental gradients on the border a short distance apart: to the west, the Pacific Ocean, and to the east, the border's steepest drop in mean annual precipitation (National Atlas, 2008). This region coincided with a peak in complementarity and had the most species at risk globally because of potential isolation into small subranges (Purvis *et al.*, 2000). This region was also richest in endemic species with small total range size, although the peak of species with small subranges in this region was more pronounced. A caveat to range size metrics is that they might be biased towards higher threat estimations for small bodied species. Given equal population size between two species (and thus equal risk from inbreeding and stochastic extinction, all else being equal), one large bodied and one small, we would estimate greater risk for small bodied species because their range sizes tend to be smaller (Brown *et al.*, 1996). Nevertheless, range size remains a widely used criterion for assessing species risk (IUCN, 2008).

Peaks in the regional species richness of mammals and reptiles were associated with steep elevation and precipitation gradients and coincident heterogeneity in dominant vegetation physiognomy (Sayre & Knight, 2010). For amphibians, peak diversity was associated with the highest mean annual precipitation along the border (National Atlas, 2008). This distinct pattern of amphibian diversity may have contributed to the high complementarity of Gulf Coast assemblages. Regions of highly diverse border fauna extended hundreds of kilometres away from the border in some regions, and thus drivers of border ecosystem change (e.g. extensive dispersal barriers) might affect ecosystems across a large transborder area (Lopez Hoffman *et al.*, 2010). While regions of greatest overall species richness along the border include areas with peaks in officially threatened species, they do not include the coastal areas of highest complementarity and rich in species most at risk under other criteria (Ceballos & Ehrlich, 2006).

The species we identified as being globally at risk because of small subrange size were generally different than range margin species locally at risk (Table 2). Although these represent two distinct targets of conservation efforts, they coincided spatially in the California border region. Accordingly, previous researchers have prioritized the California border region for global and national conservation and the Madrean archipelago and Gulf coastal plain for national conservation (Dobson *et al.*, 1997; Myers *et al.*, 2000; Koleff *et al.*, 2007; Riemann, 2007).

The species we identified as most at risk from current barriers represent a first list of candidates for studying the impacts of barriers along the border. The richness of these species peaks in the coastal regions. On the west coast, the California border is the location of the metropolitan area of San Diego/Tijuana and many border fences. On the Gulf coast, the Rio Grande Valley currently has extensive fencing, high urbanization and intensive agriculture that have reduced cover of native thorn forest to < 5% (Harveson *et al.*, 2004). Pedestrian fences and highly disturbed landscapes complement each other as barriers in these regions.

Estimates of the intersection of species ranges with barriers may be inaccurate because some barriers are shorter than the scale at which range maps are reliable. For two reasons, we believe this error would introduce negligible, if any, bias and would not alter the general patterns we observed. First, analyses of species range areas and range margins, irrespective of barriers, show the same three regions to be home to species with small ranges or at range margins. Secondly, given that these regions are characterized by small or marginal species ranges and contain many barriers, it follows that barriers in these regions threaten to bisect ranges.

We emphasize that dispersal barriers need not be completely impermeable to have significant effects on populations (Levins, 1970; With *et al.*, 1997; Keitt *et al.*, 2001; Epps *et al.*, 2005). If the populations of species near range margins at the US Mexico border are maintained by cross border dispersal, as authors have suggested, limiting their dispersal could greatly increase the risk of extirpation in one nation (Cohn, 2007; List, 2007; Spangle, 2007; Varas, 2007; McCain & Childs, 2008; Flesch *et al.*, 2010). Marginal populations can be important to species' genetic diversity and may be important to future species' evolution, especially against a background of environmental change (Lesica & Allendorf, 1995). Dispersal may also play a key role in community assembly (MacArthur & Wilson, 1967; Hubbell, 2001; Leibold *et al.*, 2004), so that barriers may also alter ecological communities.

We have likely omitted some species meriting closer attention because of the limited species level data available to estimate risk. Our analyses likely overlooked barriers that may divide populations of vulnerable subspecies (List, 2007; Flesch *et al.*, 2010). Barriers along the border may also impede dispersal of volant animals (Trombulak & Frissell, 2000; List, 2007; Drewitt & Langston, 2008; Flesch *et al.*, 2010). While our metric of assessing risk through small total range and subrange size was likely biased towards small bodied animals, we identified federally threatened large mammals of local conservation interest (e.g. *Ursus americanus*) as range margin species at risk. The large bodied, federally threatened, jaguar (*Panthera onca*) was omitted from the species potentially at risk that we identified, as little information exists on its current range in the United States. However, jaguars' range apparently crosses the border in the Madrean Archipelago region (McCain & Childs, 2008), which we identified as an important region for preserving transborder connectivity.

The biota of North America has a long history of range shifts associated with environmental changes (Webb & Bartlein, 1992). Currently, many species are shifting their ranges polewards in association with global climate change (Parmesan, 2006). This expansion may be necessary for species persistence to offset range contraction on southern range edges. However, reduced permeability of the US Mexico border might slow the dispersal limited process of climate space tracking (Willis *et al.*, 2009) or halt species' range expansion (Keitt *et al.*, 2001). A less permeable southern border may reduce species' ability to colonize suitable environments in the southern United States.

Future studies should use demographic and tracking data from species indicated herein to precisely locate key popula tions and dispersal routes (e.g. McCain & Childs, 2008; Flesch *et al.*, 2010). Researchers should study species' propensity to cross border dispersal barriers (e.g. Flesch *et al.*, 2010). Researchers could then make more informed determinations of whether existing or proposed barriers would put species and populations at risk of extinction. Additionally, exploration of the life history characteristics associated with vulnerability to border barriers could suggest specific mechanisms behind negative impacts on species.

Mitigation and future of border dispersal barriers

Barriers may have the effect of restricting the cross border movement of animals to unfenced portions (McCain & Childs, 2008). Animals may be funnelled to such crossings by main taining natural vegetation around openings in barriers (Cain *et al.*, 2003), although such funnelling would increase distance (and thus energetic cost) of cross border dispersal. Restriction of dispersal to bottlenecks may increase the chance that localized environmental disturbances divide populations. Vegetative cover that allows dispersing animals to obscure themselves conflicts with a goal of US CBP: maintaining visibility of human border crossers (US DHS, 2008b). CBP plans to spray herbicide along the Rio Grande to eradicate the invasive reed *Arundo donax* (US DHS, 2008a). Although this action may have positive effects on native biodiversity, it highlights conflicting goals of law enforcement and dispersing wildlife.

The activity of humans in unfenced areas may also restrict animal dispersal, such that border permeability may be significantly reduced in areas we did not identify as barriers. Areas of high human activity probably do not occur randomly with respect to barriers. Rather, rural areas left unfenced will become bottlenecks for undocumented human traffic and law enforcement, which disturb soil, vegetation and animals (Cohn, 2007; Romo, 2007; Spangle, 2007; McCain & Childs, 2008). Bottlenecking of traffic may exacerbate the problem of human activity by concentrating human activity that was previously dispersed across a larger area. Reductions in illegal traffic because of fencing, however, could have the benefit of reducing disturbance in adjacent areas. Whether this outweighs the negative impacts of fencing requires study. Barriers that limit the dispersal of both humans and animals could lead to humans and animals competing for use of unfenced border lands, which is an asymmetric contest favouring humans.

Mitigation in the priority regions should increase border permeability. Decreasing the anthropogenic impact in unfenced regions and increasing the size and frequency of openings in fences and walls may promote transborder dispersal (Moya, 2007). The richness of species with large portions of their range occupied by current barriers indicates locations where new barriers could bisect ranges of species already in jeopardy (dashed lines, Fig. 5). When planning for additional fences, walls and land use change along the border, the combined effects of all barriers should be a primary consideration. The utility of mitigation actions will be improved by conservation efforts beyond the immediate border regions.

Pedestrian barriers might pose a more immediate threat to border conservation than land use change because of the rapid speed with which pedestrian barriers have been constructed ($\sim$ 800 km in $\sim$ 2 years; Government Accountability Office, 2009). Future border policy of the US government is difficult to predict, although there may be further dramatic increases in barriers. The original legislation expanding fences (although later amended, US Government Printing Office, 2008) man dated installation of pedestrian fencing across nearly the entire Arizona border and lower Rio Grande Valley (USLOC, 2006). In recent years, legislation has been introduced in the US Congress to expand the current level of pedestrian fences (US House of Representatives Committee on Rules, 2009) and to fence the entire US Mexico border (USLOC, 2005a). Lower level governments may also build barriers; the Arizona State Senate has recently passed legislation authorizing construction of pedestrian fences (Arizona State Legislature 2011). President Barack Obama (then a legislator) supported the 2006 law that dramatically expanded border barriers, although the Obama administration has not yet signalled interest in expanding border fences further (Yellin, 2009). However, in the past year, prominent Republican legislators (who control the House of Representatives) have called for constructing additional fences (Goldman, 2010). The Obama administration has been pursuing immigration reform that would be linked to height ened border security (Yellin, 2009), possibly by means of physical barriers (USLOC, 2010).

Under the REAL ID Act of 2005, the Secretary of the DHS has authority to fence the entire border at any time without the oversight of environmental regulatory law that regulates all other infrastructure projects (USLOC, 2005b). This lack of oversight is detrimental to biodiversity conservation efforts and increases the importance of further research on the impacts of barriers along international borders. The REAL ID Act should be amended to reinstate environmental regulation of border security efforts.

CONCLUSIONS

This is the first transcontinental study, to our knowledge, to quantitatively evaluate potential impacts of dispersal barriers on the highly biodiverse ecological communities along the US Mexico border and the first to provide planning recommenda tions based on such an analysis. Notably, the border fauna of the California, Madrean Archipelago and Gulf Coast regions merit attention for further research and conservation of transborder connectivity. Further monitoring and environmental protec tion are recommended for the border region, which is subject to rapid and uncontrolled anthropogenic transformations.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1 Complementarity of local assemblages along the border.

Appendix S1 Locations of border fence and wall.

Appendix S2 Categories describing composition of border fences and walls.

Appendix S3 Amphibian, reptile, and mammal species of the border.

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Placing linkages among fragmented habitats: do least-cost models reflect how animals use landscapes?
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REVIEW

Placing linkages among fragmented habitats: do least-cost models reflect how animals use landscapes?

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Summary

1. The need to conserve and create linkages among fragmented habitats has given rise to a range of techniques for maximizing connectivity. Methods to identify optimal habitat linkages face trade-offs between constraints on model inputs and biological relevance of model outputs. Given the popularity of these methods and their central role in landscape planning, it is critical that they be reliable and robust.

2. The most popular method used to inform habitat linkage design, least-cost path (LCP) analysis, designates a landscape resistance surface based on hypothetical 'costs' that landscape components impose on species movement, and identifies paths that minimize cumulative costs between locations.

3. While LCP analysis represents a valuable method for conservation planning, its current application has several weaknesses. Here, we review LCP analysis and identify shortcomings of its current application that decrease biological relevance and conservation utility. We examine trends in published LCP analyses, demonstrate the implications of methodological choices with our own LCP analysis for bighorn sheep *Ovis canadensis nelsoni*, and point to future directions in cost modelling.

4. Our review highlights three weaknesses common in recent LCP analyses. First, LCP models typically rely on remotely sensed habitat maps, but few studies assess whether such maps are suitable proxies for factors affecting animal movement or consider the effects of adjacent habitats. Secondly, many studies use expert opinion to assign costs associated with landscape features, yet few validate these costs with empirical data or assess model sensitivity to errors in cost assignment. Thirdly, studies that consider multiple, alternative movement paths often propose width or length requirements for linkages without justification.

5. *Synthesis and applications.* LCP modelling and similar approaches to linkage design guide connectivity planning, yet often lack a biological or empirical foundation. Ecologists must clarify the biological processes on which resistance values are based, explicitly justify cost schemes and scale (grain) of analysis, evaluate the effects of landscape context and sensitivity to cost schemes, and strive to optimize cost schemes with empirical data. Research relating species' fine-grain habitat use to movement across broad extents is desperately needed, as are methods to determine biologically relevant length and width restrictions for linkages.

Key-words: animal movement, connectivity, corridor, dispersal, fragmentation, linkage design, model validation

Introduction

Habitat fragmentation and isolation have long been considered among the greatest threats to the persistence of species (Karieva 1987; Quinn & Harrison 1988). Fragmentation increases a species' risk of extinction from inbreeding and genetic and demographic stochasticity (Wilcox & Murphy 1985; Mills & Smouse 1994), and limits the ability of populations to move in response to perturbations (e.g. harvest, habitat degradation or disturbance). The effects of fragmentation on dispersal and colonization, in particular, have received

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increasing attention as planners attempt to predict the response of species to climate change (e.g. Thomas *et al.* 2004; McLachlan, Hellmann & Schwartz 2007). Efforts to mitigate the impacts of habitat fragmentation by preventing or reversing population isolation are encompassed within the growing field of connectivity conservation (Crooks & Sanjayan 2006).

Promoting connectivity, the movement of species or genes between habitats, alleviates problems associated with habitat fragmentation (Crooks & Sanjayan 2006). Most efforts to conserve connectivity rely on the creation or protection of habitat linkages; i.e. land that promotes movement or dispersal of plants or animals between core habitats (Briers 2002; Beier, Majka & Spencer 2008; Fig. 1). However, while researchers generally agree that maintaining connectivity is essential to the persistence of fragmented subpopulations, they often disagree on the process by which linkages are designed for conservation (Rothley 2005). Although placement of linkages/corridors based on empirical observations of dispersal movement may be the most reliable method for designing connectivity networks (Hilty & Merenlender 2004; Graves *et al.* 2007) such data are sparse or non-existent for most species and most locations (Fagan & Calabrese 2006). As a result, conservation relies heavily on models of connectivity that may have little empirical basis. Conservation planners are faced with a critical question: will such models improve placement of linkages/corridors by explicitly incorporating habitat effects on movement, or will they result in misleading and potentially costly recommendations for conservation by concealing invalidated assumptions (Chetkiewicz, St. Clair & Boyce 2006)?

In this review, we evaluate the current use, strengths and weaknesses of least-cost path (LCP) analysis (Fig. 1; see Appendix S3 in Supporting information for a discussion of current LCP terminology), the most widely used modelling approach for design of habitat linkages (LaRue & Nielsen 2008; Phillips, Williams & Midgley 2008). We focus on applications of LCP analysis in which a single path or corridor is identified for placement between pairs of source patches. A detailed description of the steps involved in LCP analysis is provided in Figure 1. In short, LCP analysis evaluates potential animal movement routes across the landscape based on the cumulative 'cost' of movement (Chetkiewicz & Boyce 2009). Resistance of each landscape unit (usually a grid cell on a raster map) is intended to represent the sum of hypothetical energetic expenditures, mortality risks, or other facilitating or hindering effects of landscape elements on movement within the cell (Adriaensen *et al.* 2003; Fig. 1). In practice, resistance values in LCP models are usually assigned on an arbitrary scale meant to reflect 'high' or 'low' suitability (with respect to movement) of different landscape factors (e.g. land cover, human activity, etc.). Resistance values for each factor are weighted according to their perceived importance and combined (e.g. by geometric mean) to produce

Question	What areas need to be connected?	What landscape traits affect species' movement between these areas?	How will variation in these landscape traits affect animal movement?	How can these potential landscape effects be quantified?	To what degree does the landscape facilitate or impede movement between patches?	What is the easiest travel route between identified patches?	How can a least-cost path be translated into an optimal linkage?
Analysis	**Determine source pathces**	**Identify landscape variables to include in cost analysis**	**Rank variables according to resistance to movement**	**Develope cost scheme: assign resistance values and factor weights**	**Calculate cumulative cost surface from source patches**	**Identify least-cost path (LCP) between source patches**	**Design least-cost corridor (LCC)/ linkage (LCL)**
Definitions	**Source patches:** Areas that support or have potential to support the species of interest; sometimes restricted to breeding habitat	**Landscape variables:** Habitat traits *perceptible* by- and *likely to influence* – species' movement ➢ e.g. vegetation type, slope, elevation, water, human activities, food availability, escape cover	**Resistance**: a measure of reluctance to use habitat for movement (Adriaensen *et al.* 2003) or failure to move successfully	**Cost scheme:** Choice of resistance values and factor weights **Resistance value:** numerical score assigned to habitats or landscape traits to quantify resistance **Factor weight:** measure of importance of one habitat trait on movement decisions *relative* to other traits	**Effective distance:** Composite measure of connectivity between patches representing geographic (Euclidian) distance weighted by resistance of landscape elements traversed on a given path (Adriaensen *et al.* 2003)	**Least-cost path:** A swath of landscape that is one pixel wide and represents the lowest cumulative cost between two patches (Verbeylen *et al.* 2003)	**Corridor:** A slice of landscape encompassing the most permeable percentiles of the cost surface **Habitat linkage:** Connective land that promotes movement/dispersal for multiple species between core habitats (Beier *et al.* 2008; 2009)
Examples	Define source patches using: ▪ **Home ranges** ➢ e.g. minimum convex polygon, kernel density estimator ▪ **Point locations** ➢ e.g. direct observations, radio-telemetry, nest/den evidence ▪ **Habitat suitability analysis** ➢ e.g. Percentage of most suitable habitat ➢ Suitable habitat larger than a cut-off ▪ **Protected areas** ▪ **Expert opinion**	Decisions can be based on: ▪ **Expert opinion resource selection functions (RSF) or habitat suitability index (HSI)** ➢ Derived from regression of occurrence data on environmental variables ▪ **Analyses of animal movement behavior** ➢ e.g., radio or satellite telemetry, snow tracking ▪ **Landscape genetic analyses** ➢ e.g., correlation of habitat elements with genetic differences	Resistance may signify: ▪ **Mortality risks** ▪ **Reproductive costs** ▪ **Energetic costs** ▪ **Physical resistance** ▪ **Thermal stress** ▪ **Habitat suitability**	Cost schemes can be determined using: ▪ **Expert opinion** ➢ Analytical Hierarchical Process ➢ Mean response ➢ Qualitative ▪ **Species habitat preferences** ➢ Compositional analysis: time spent in each habitat type relative to availability ➢ RSF/HSI: Probabilistic map regressing presence on habitat variables ▪ **Analyses of animal movement behavior** ➢ Movement choice/speed in different habitat types and transitions ▪ **Gene flow:** ➢ Correlation of gene flow estimates with effective dist. of cost scheme	The cost value in each cell represents effective distance to the source patch, measured in the least effort (lowest cost) of moving over the cost surface	The model creates the most likely travel route by selecting a combination of cells that represent the shortest effective distance between two designated patches (LaRue and Nielsen 2008)	Corridors can be identified by: ▪ **Buffer/minimum width:** ➢ Buffer LCP to chosen width (e.g. home range size) ▪ **Least cost corridor/ Probable movement zone:** ➢ Combine multiple low-cost routes ➢ Lowest percentile (10%, 20%, etc) of cost paths ▪ **Circuit theory:** ➢ Delineate areas of landscape with highest "conductance" between patches ➢ Can incorporate patch characteristics ➢ Can be used to rank potential corridors, explore alternative corridors, and identify bottlenecks (McRae and Beier 2007)

Fig. 1. Introduction to important questions, steps and definitions for least-cost path modelling.

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a single resistance value. We call this series of choices the 'cost scheme'. The 'effective distance', or cost of a path between habitat patches for a species, is the Euclidian distance weighted by the cumulative resistance values of all cells traversed (Adriaensen *et al.* 2003; Beier, Majka & Spencer 2008; Fig. 1). The LCP is the combination of cells that minimizes effective distance between two patches (Verbeylen *et al.* 2003) and is used to inform optimal placement of a linkage (Fig. 1).

Least-cost path analysis is an attractive technique for analysing and designing habitat corridors because it: (i) allows quantitative comparisons of potential movement routes over large study areas, (ii) can incorporate simple or complex models of habitat effects on movement and (iii) offers the potential to escape the limitations of analyses based solely on structural connectivity (i.e. designating areas simply as 'patch', 'matrix' or 'corridor') by modelling connectivity as it might be perceived by a species on a landscape ('functional connectivity'; Taylor, Fahrig & With 2006). However, as with any modelling approach, the effectiveness of LCP analysis is limited by the quality of input data. For instance, modellers often use expert opinion to assign resistance values to remotely sensed landscape traits (e.g. Adriaensen *et al.* 2003; see Fig. 1 & Table 1). Thus, the accuracy and value of these models depends on how strongly these coarse-grain habitat proxies and their assumed resistances correlate with actual habitat use/movement by focal species (Calabrese & Fagan 2004; Beier, Majka & Spencer 2008). Methods for defining habitat patches are often unclear or based largely on human rather than animal perception of habitats (Theobald 2006). In worst-case scenarios, LCP analyses are little more than subjective interpretations of coarse habitat maps, but the method has potential for much more. For example, ideal applications of LCP analysis would employ organism-centric approaches in which practitioners use species- and landscape-specific empirical data to quantify behavioural responses to finer-grain habitat elements (e.g. distribution of critical resources, escape cover and threats), to: (i) consider attributes of surrounding cells when assessing resistance of a cell and (ii) assess the likelihood of use for a path of known width and length (Adriaensen *et al.* 2003; Theobald 2006; Graves *et al.* 2007). While a challenging standard, such organism-centric approaches have the potential to reduce researcher bias and increase the replicability, defensibility and transparency of LCP and related analyses (Chetkiewicz & Boyce 2009).

In reviewing the use and application of LCP approaches we set out to address the following questions: (i) do recent studies employing LCP analysis shift emphasis from structural towards functional connectivity by considering species-specific behaviours and do they provide explicit, empirically derived justification for their choices? (ii) do researchers using LCP analysis attempt sensitivity analysis, model validation or compare multiple model outputs to assess the robustness of their projections? and (iii) how have researchers translated LCP model outputs into optimal linkage or corridor placement for their study areas?

Finally, to demonstrate the challenges of LCP analyses and highlight the sensitivity of LCP model outputs to input data, we present a case study in which we conduct an LCP analysis for desert bighorn sheep *Ovis canadensis nelsoni* (Merriam 1897) in southern California. We use our LCP analysis between two bighorn populations to examine congruence of outputs from two commonly used techniques for assigning cost schemes (expert opinion and gene flow optimization; see Figs. 1 and 2) and two scales of habitat suitability assessment (regionally-significant topographic/anthropogenic variables and locally-specific habitat traits).

Materials and methods

SELECTION OF PAPERS

We limited our analytical review to studies with the stated aim of designing optimal connectivity strategies for focal species. We performed a search in ISI Web of Knowledge (ISI 2010) using the following search terms: *least-cost* OR *cost-distance* OR *least-cost path* OR *least-cost-path* AND *connectivity* OR *corridor* OR *linkage* OR *conservation*. To reflect current trends in the peer reviewed literature, we restricted our search to 373 studies published between 2002 and 2010. We then refined the list to the subject areas Biodiversity and Conservation, Environmental Sciences and Ecology, and Genetics and Heredity, which reduced our pool to 135 results. We then further restricted our review to publications with the following keywords in the study abstract: *identify* OR *predict* OR *model* OR *delineate* OR *place* OR *validate* OR *draw* AND *linkage* OR *corridor* OR *optimal connection* OR *key connectivity area* OR *migration zone*. We excluded studies that used LCP analysis solely to predict occupancy, model species distributions (e.g. Verbeylen *et al.* 2003; Magle, Theobald & Crooks 2009), explain gene flow (e.g. Vignieri 2005) or predict how landscape changes might affect focal species (e.g. Graham 2001) if they did not explicitly aim to design or evaluate linkages. Finally, for each study that met our criteria for inclusion, we evaluated the following methodological choices: type of habitat data, choice of grain (cell size) and study extent, determination of cost schemes and source patches, consideration of effects of adjacent habitat, exploration of different resistance values, sensitivity analysis for other modelling choices and conversion of a 'path' to a 'corridor'.

BIGHORN SHEEP CASE STUDY

To test the sensitivity of LCP model outputs to input data, we compared two LCP models published for bighorn sheep populations in the Mojave Desert of California (Epps *et al.* 2007; Penrod *et al.* 2008), and two additional LCP models based on modifications of those published models. We chose two populations, San Gorgonio and Cushenbury, that exhibit clear evidence of connectivity in the recent past (Epps *et al.* 2010).

The 'Expert' model (Penrod *et al.* 2008) was based on a linkage design for nearby Joshua Tree National Park. The Expert model estimated resistance values using expert opinion and included dense woody vegetation as determined from the California Wildlife Habitat Relationship vegetation type (Mayer & Laudenslayer 1988). Areas of flat topography, urban areas and areas with high road density were all defined as highly resistant (up to 10 times more than the best habitat). The final combined model was calculated as:

$$\text{Cost}_{\text{EXPERT}} = \text{topography} \times 0{\cdot}4 + \text{habitat} \times 0{\cdot}4 + \text{road density} \times 0{\cdot}2$$

where topography, habitat and road density were assigned resistances between 1 and 10, as specified by Penrod *et al.* (2008, pp. 7–10).

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Table 1. Summary of recent studies that used least-cost path (LCP) modelling for habitat connectivity design (see Table S1 in Supporting Information for a more complete summary)

Study	Variables included[1]	Source of cost scheme[2]	Source patches[3]	Adjacent habitat[4]	Cost value ranges	Validation	Sensitivity analysis	Path to corridor[5]
Beazley *et al.* 2005	Forest cover (3); road density	EO; L; HSI; S	All 'suitable' habitat patches (HSI)	No	Unknown	Presence/absence of dung	No	Minimum width
Chetkiewicz & Boyce 2009	LCT (5); subregion; food resources; terrain; road density	RSF; RT	High RSF value polygons	No	Inverse of RSF coefficients	Telemetry locations;	No	Buffered: 350 m
Cushman, McKelvey & Schwartz 2008	LCT (26); elevation; slope; roads	EO; L; G	Individual locations;	No	1–10	Genetic distance	No	Smoothed: 2500 m radius parabolic kernel
Driezen *et al.* 2007	LCT (12); roads; water	L; PS	Unknown	No	1–1000	Experimental dispersal data	Compared 12 sets of costs	No
Epps *et al.* 2007	Slope (2); distance; barriers	G; RT	MCP; suitable habitat; EO	No	0·1–1·0	Radio- telemetry data	Compared multiple gene flow measures	No
Hepcan *et al.* 2009	VT (12); road density	EO; L	'Key Biodiversity Areas'	No	Unknown	No	No	Minimum width: 1 km
Joly, Morand & Cohas 2003	HT (7); roads; rivers	EO; L	Unknown	No	HT: 5–80; roads: 0–1	No	No	No
Kautz *et al.* 2006	LCT (16)	RT	HR and potential habitats (HSI)	No	LCT: 1–11; water: 15; road: 20	No	Partial: road and water	Post-analysis buffer
Kindall & Van Manen 2005	Forest cohesion, diversity, forest-agriculture edge density	Problem of occurrence model	50% fixed kernel HR	No	1–8	No	No	No
Kong *et al.* 2010	LUT (12)	EO	Urban green space > 12 ha connected to areas outside city	No	0·1–50 000	No	No	No
Larkin *et al.* 2004	HT (5) based on suitability model	EO; L	'Suitable' habitat (EO)	No	1; 10; 50; 100	No	Two cost schemes	No
LaRue & Nielsen 2008	LCT (8); distance to road and water; slope, human population density	EO	Areas where cougar may be living (EO)	Distance to road and water	0·19–1·92	No	No	Buffered LCP by 1 km
Li *et al.* 2010	LCT (9), slope; dist to water and human activities (3)	EO	Panda occurrence or suitable habitat	Distance to human activities	Reciprocal suitability: 0·002–0·098	No	No	Smoothed: 90 m cumulative kernel
Meegan & Maehr 2002	HT (2); roads	EO; L; RT	forest patches ≥500 ha	No	1,2 or 3	presence locations	No	No

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Table 1. Continued

Study	Variables included[1]	Source of cost scheme[2]	Source patches[3]	Adjacent habitat[4]	Cost value ranges	Validation	Sensitivity analysis	Path to corridor[5]
Osborn & Parker 2003	HSI (2); distance to river, roads, and settlements	EO	Individual locations	Distance to settlement and road	Unknown	No	No	No
Rabinowitz & Zeller 2010	LCT; % tree/shrub cover; elevation; distance to road and settlement; human population density	EO	Jaguar conservation units	Distance to road and settlement	Integers 0–10	field interviews on-going	No	Selected lowest 0·1% of grid cell values
Rouget *et al.* 2006	'Suitability' (foraging model)	Unknown	Unknown	No	0; 300; 600; 900	No	No	Buffered to 1 km
Schadt *et al.* 2002	LCT (5); roads	EO; L	'Suitable' habitat: size, isolation, and forest cover	No	1–1000	No	Partial: 'matrix'	No
Shen *et al.* 2008	LC; bamboo cover; slope, elevation; aspect; distance to road and residential areas	EO	'Core' habitats based on LCT	Distance to residential area and road	1–50	No	Partial: land and bamboo cover	No
Singleton, Gaines & Lehmkuhl 2004	LCT (13); road density; human population density; slope	EO; L	Largest areas of low human influence with suitable LCT	No	0·1–1·0	No	No	Selected lowest 10% of cost surface
Stevens *et al.* 2006	LCT (6); water	Movement behaviour	Population MCP	No	3 Models: 1–10 000	Genetic dispersal rates	Compared multiple gene flow measures	No
Wang *et al.* 2008	NDVI; slope; aspect; distance to LCT	HSI on S	Individual locations	Distance to LUT	1–1 000	Presence; Gene flow	No	No
Wang, Savage & Shaffer 2009	VT (3)	EO; S	Breeding pair locations	No	1–10	Gene flow estimates	No	No
Wikramanayake *et al.* 2004	HT (3); elev.; LCT in buffer (5); patch size	EO; PS	Unknown	Distance to agriculture or population centre	1–25	No	No	Selected 10, 20 and 30% of lowest cost cells

[1]LCT, land cover type; LUT, land use type; HT, habitat type; VT, vegetation type; NDVI, Normalized Difference Vegetation Index. Number of cover/type categories is indicated in parentheses.
[2]L, literature; EO, expert opinion; RT, radiotelemetry; G, genetics; S, species presence locations; PS, previous studies HSI, habitat Suitability Index; RSF, resource selection function.
[3]HR, home range; MCP, minimum convex polygon.
[4]Did study consider adjacent habitat characteristics when determining resistance of cell?
[5]Did study go beyond least-cost path (LCP) to make a more biologically relevant recommendation, or least-cost corridor (LCC)?

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The 'Optimized' model (Epps *et al.* 2007; Appendix S1 Supporting information) considered only topography and optimized resistance values using observed gene flow among populations over the entire study area, including those in our case study:

$$\text{Cost}_{\text{OPTIMIZED}} = \text{topography}$$

where areas with >15% slope and <15% slope were assigned resistances of 1 and 10 respectively.

Epps *et al.* (2007) recognized that their model was optimized for the southern California population as a whole, and would not account for locally specific habitat variables, such as the large amount of wooded habitat in the vicinity of the San Gorgonio and Cushenbury populations. Bighorn sheep typically avoid wooded habitat, presumably because of higher predation risk (e.g. DeCesare & Pletscher 2006). Therefore, we developed a third model ('Optimized Local') that added high resistance for any urban area (10 times higher) or wooded area (10 times higher) and calculated the final model as:

$$\text{Cost}_{\text{OPTIMIZED LOCAL}} = \text{topography} \times 0{\cdot}33 + \text{wooded habitat} \times 0{\cdot}33 + \text{urban area} \times 0{\cdot}33$$

where areas with >15% and <15% slopes were assigned resistances of 1 and 10, respectively, wooded habitat was assigned a cost of 10, and urban habitat was assigned a cost of 10. Non-wooded and non-urban areas were assigned a cost of 1.

Finally, to simulate the common situation where little is known about dispersal, we constructed a fourth model ('Incomplete') that was biologically relevant but omitted several important factors:

$$\text{Cost}_{\text{INCOMPLETE}} = \text{wooded habitat}$$

where areas with and without tree cover were assigned a cost of 10 and 1 respectively.

All input grids were re-sampled to 100 m resolution before combining into final cost grids. We calculated a single LCP for each model using Pathmatrix (Ray 2005). We used ArcMap and Corridor Designer (http://www.corridordesign.org/) to generate 'least-cost corridors' (Beier, Majka & Newell 2009; Fig. 1) representing the lowest 10% of possible least-cost paths for each model and estimated the area of overlap of those least-cost corridors.

Results

LITERATURE REVIEW

Twenty-four studies met our criteria for review. Each of the 24 used remotely-sensed land cover or habitat type as a proxy for habitat suitability and movement of focal species (Table 1). Study extent ranged from 10 to 4 000 000 km^2; and study grain (cell size) varied from 1 to 1 km^2 but most commonly corresponded with the grain of freely available Landsat imagery (900 m^2; see Table S1 in Supporting information for a complete summary of reviewed studies' methodological choices). Two studies distinguished only two types of habitat while all others included at least three habitat categories (Table 1). None of the 24 studies directly considered more organism-centric measures of microhabitat suitability, including those identified by authors as affecting animal habitat selection/movement, such as percentage habitat cover or distribution of food (Binzenhofer *et al.* 2005), presence of nutrient sources such as salt licks (Beazley *et al.* 2005), denning/nesting habitats (Singleton, Gaines & Lehmkuhl 2004), prey availability (Rabinowitz & Zeller 2010) or cover or escape terrain for predator avoidance (Wang *et al.* 2008). While some studies stated that habitat types serve as reliable proxies for predator presence and/or abundance of preferred foods (e.g. Driezen *et al.* 2007; Shen *et al.* 2008), no studies validated this assumption or included habitat distribution models of either predator or prey species.

Fourteen of the 24 studies evaluated in our review based their LCP analysis cost schemes (Fig. 1) on expert opinion, published literature, or both, although explanations of cost surface derivation were often lacking in sufficient detail to replicate analyses (Table 1). Of those, only three attempted to systematically and objectively translate expert opinion into cost schemes [e.g. using analytic hierarchy process or similar approaches (Banaikashani 1989; see Table S1 Supporting information)]. Six studies used telemetry or trapping (presence) data to designate costs. Three studies used relative gene flow, or combined gene flow and telemetry data, and two studies assigned resistance values using behavioural data from focal species. Across the surveyed studies, source habitat patches were variably defined as 'known population/individual locations' (10 studies), habitat deemed most 'suitable' by size, habitat type, or both (nine studies), or 'key conservation areas' (one study). Four studies did not define their source patches (Table 1). Eight studies included some effect of surrounding habitat in their cost designation (Table 1). Six studies partially based pixel cost on distance to particular habitat types or human activities. Kindall & Van Manen (2005) included forest/agriculture edge density in their cost measures while Wikramanayake *et al.* (2004) considered all areas within 1 km of agriculture or population centres to be 'poor habitat', regardless of habitat type.

Only four studies (17%) quantitatively assessed sensitivity of model-selected paths to *different* cost schemes for all variables, and these four consistently found their model outputs to be highly sensitive to input decisions (Table 1). Larkin *et al.* (2004) found overlap of only 0–51% among paths generated using different cost schemes. Stevens *et al.* (2006) and Epps *et al.* (2007) used multiple measures of gene flow to test LCP models and discovered that models were highly sensitive to different resistance values. Driezen *et al.* (2007) showed that the measurement of a species' ability to find low-cost sites depends heavily on the cost scheme used. Three other studies conducted partial sensitivity analysis: Schadt *et al.* (2002) found that changing resistance values of the matrix led to significantly different LCPs while Shen *et al.* (2008) discovered high model sensitivity to costs of bamboo and land cover. Kautz *et al.* (2006) did not detect model sensitivity to costs of roads and water. Only nine of the 24 studies attempted some form of model validation in the published results (Table 1). Four studies examined relative support for cost schemes based on gene flow. Four studies used presence data (telemetry or trapping) to validate their models, while one used presence and absence data (Beazley *et al.* 2005).

Only 10 of the 24 studies we evaluated attempted to move beyond a single-pixel wide path to consider more biologically relevant (Majka, Jenness & Beier 2007) least-cost corridors

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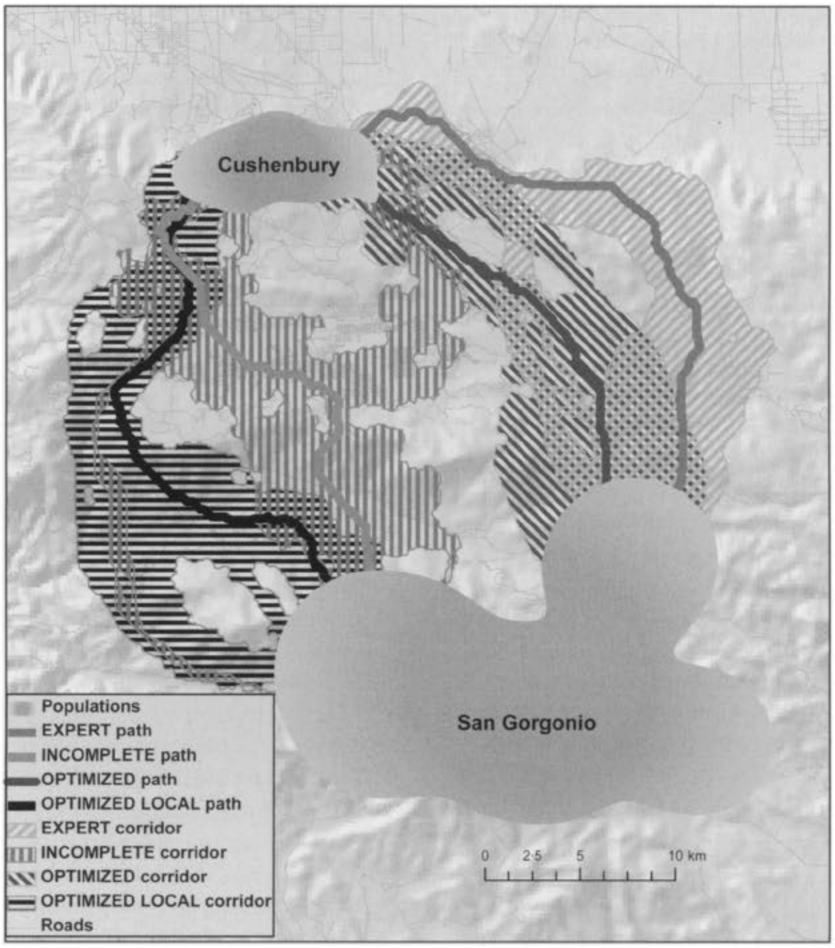

Fig. 2. A comparison of four least-cost path models between two bighorn sheep populations in southern California highlights the sensitivity of results to model inputs. Cost surfaces used to produce the four paths incorporate the following landscape characteristics: topography alone (Optimized model); wooded habitat alone (Incomplete model); topography, habitat and road density (Expert model); or topography, wooded habitat and urban areas (Optimized Local model). Total least-cost path length overlapped less than 2%; least-cost corridors based on the lowest 10% of the resistance surface overlapped from 0 to 44%.

(LCC; see Fig. 1) either by including minimum acceptable widths, buffering paths or selecting a percentage of least-cost cells (Table 1). Two studies included a minimum acceptable width cut-off. Kautz *et al.* (2006) found that one-pixel wide paths can go through extremely unsuitable habitat, and therefore buffered LCPs and rejected paths that passed through poor-quality habitat types. Four additional studies buffered their LCPs to make them wider. Three studies took a percentage of lowest grid cell values to make a least-cost corridor. However, empirical justifications for most of these analytical choices, such as buffer width, were not presented when defining LCCs.

CASE STUDY: LCP ANALYSIS OF BIGHORN SHEEP

The four LCP models compared in our analysis of two populations of desert bighorn sheep produced LCPs that varied widely in location and length (Fig. 2). Along-path distances for the four paths were 34·6 km (Expert), 21·6 km (Optimized), 31·7 km (Optimized Local) and 28·5 km (Incomplete); those paths overlapped < 2% of total length (Fig. 2). Least-cost corridors overlapped from 0 to 44% (average 13%; Table 2).

Discussion

LITERATURE REVIEW

Although LCP modelling has been touted as combining detailed geographical information with animal behaviour to move beyond structural towards functional connectivity

Table 2. Percentage overlap of least-cost corridors based on four connectivity models between two bighorn sheep populations

Model	Incomplete (%)	Expert (%)	Optimized (%)
Expert	0	–	–
Optimized	5	44	–
Optimized Local	30	0	0

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analysis (Adriaensen *et al.* 2003; Theobald 2006), our review suggests current LCP model implementation often ignores factors that affect how animals utilize landscapes. Nearly, all recent LCP analysis-based studies employed coarse-grain environmental data layers to determine habitat connectivity, an approach that is often biased by researcher-perceived structural connectivity and runs the risk of missing important biological aspects of species' connectivity (Mortelliti & Boitani 2008). For instance, although scale of analysis has been shown to greatly impact strength of detected relationships, study grain was typically dictated by freely available remotely sensed data (see Table S1 Supporting information) rather than species perceptions of landscape features (Cushman & Lewis 2010; see Appendix S2 in Supporting information for recommendations on improving application of LCP analysis).

Overall, the strength of the correlation between remotely-sensed habitat layers and species' movement is relatively unknown and poorly validated (Chetkiewicz, St. Clair & Boyce 2006; Beier, Majka & Spencer 2008). Our analysis in no way rejects the utility of coarse proxy data, especially given the need to model movement over large landscapes, but illustrates the need to explore effects of scale, explicitly justify choice of scale, and conduct model sensitivity and validation (see Appendix S2 Supporting information). In many cases, remotely-sensed proxies may provide adequate coverage at limited cost, and may prove to be efficient for conservation planning in the face of limited time and funding [e.g. fishers (*Martes pennanti*): Caroll, Zielinski & Noss 1999; large carnivores: Schadt *et al.* 2002; bighorn sheep: Epps *et al.* 2007]. However, animals frequently select high-quality microhabitats in areas that appear unsuitable at a macro-level (Mortelliti & Boitani 2008). Animals often select against low quality habitat within largely suitable areas as well, and accounting for the presence of low quality habitat within otherwise high-quality habitat patches may significantly improve model predictions (e.g. Wang *et al.* 2008).

We suggest that those using LCP analysis should strive to evaluate the predictive power of coarse-grain proxies for focal species movement over a portion of the study range before constructing analytical models (see Appendix S2 Supporting information). For species and linkages above the scale of rapid dispersal movements, using resource selection function models (RSF) with LCP analysis appears to be a step forward from more arbitrary methods (e.g. Chetkiewicz & Boyce 2009). Hypothesis testing and model selection that compares critical scales of habitat use or movement for taxa will help to build a stronger foundation for linkage-design methodology. Better understanding of a species' perception of its environment will help modellers to identify appropriate scales of analysis and, thus, provide more reliable and accurate model outputs for practitioners (With, Gardner & Turner 1997; Uezu, Metzger & Vielliard 2005; Cushman & Lewis 2010).

LCP ANALYSIS OF BIGHORN SHEEP

Our LCP analysis of bighorn sheep in California demonstrated many of the challenges and uncertainties we highlight above. The four models used to identify LPCs for desert bighorn sheep were derived at different scales (e.g. metapopulation vs. population level) and yielded very different paths (Fig. 2). Use of 10% least-cost corridors for each scheme did little to reduce differences between the models (Fig. 2, Table 2). For instance, the corridor suggested by the Optimized model (developed over a much larger geographic area) did not overlap with the Optimized Local model, which included wooded and urban habitat (Fig. 2). The Optimized model only partly overlapped the Expert model corridor, which was based only on coarse habitat maps and expert opinion (Fig. 2). This case study makes clear that reasonable alternative models can lead to strikingly different conclusions regarding prioritization of land acquisition, easements or other management actions for linkage conservation.

HOW CAN WE IMPROVE LCP MODELLING?

Organisms respond differently to landscape elements depending on their perceptive range and characteristics of surrounding areas (Coulon *et al.* 2008; Richard & Armstrong 2010). Species' movements in one habitat type will often be affected by nearby disturbances such as man-made structures and light pollution (Beier 1995; Coulon *et al.* 2008), width of habitats (Laurance & Laurance 1999; Hilty & Merenlender 2004), traits of and distance to adjacent habitat (Binzenhofer *et al.* 2005; Anderson, Rowcliffe & Cowlishaw 2007; Richard & Armstrong 2010), and level of perceived cover and safety (Rizkalla & Swihart 2007; Beier, Majka & Spencer 2008). However, only 2 of 24 studies in this review were able to validate their model with behavioural data (Stevens *et al.* 2006; Driezen *et al.* 2007). Given the sensitivity of least-cost models to incorrect resistance specification, the best way to evaluate model performance would be comparison of predictions based on multiple methods and independent data sets (e.g. radiotelemetry movement data and landscape genetics: Cushman & Lewis 2010). Testing the role of individual behaviour, preference and perceptual range in habitat selection or movement decisions (e.g. radio or global positioning system tracking: Beier 1995; Cushman, Chase & Griffin 2010; Driezen *et al.* 2007; Richard & Armstrong 2010; experimental data: Stevens *et al.* 2006; Hadley & Betts 2010) and using model selection to better integrate these behavioural with ecological and landscape data will greatly improve connectivity design (see Appendix S2 Supporting information).

Determining the relationship between movement or gene flow and effective distance under a given cost scheme, and thus the maximum effective distance at which a corridor is useable by a given species, may be the most biologically important and widely ignored aspect of LCP and other connectivity analyses. Even the best-supported paths will not function as planned if their lengths exceed the movement capability of a focal species. For example, gene flow estimates (Epps *et al.* 2005, 2007) suggest that in our bighorn sheep example, only the corridors produced by the Optimized and Incomplete models would serve a connective function (21·6 and 28·5 km along-path lengths respectively) while the Expert and Optimized Local models

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would result in corridors too long to promote connectivity (35 and 31·7 km respectively). Yet, only two studies reviewed here (Schadt *et al.* 2002; Singleton, Gaines & Lehmkuhl 2004) considered cut-offs for maximum useable effective distance (the greatest effective distance a species can travel between patches) based on knowledge of species dispersal. One study used gene flow estimates to determine maximum effective distance (Epps *et al.* 2007; Appendix S1 Supporting information). We recommend that wherever possible, defensible estimates of maximum useable effective distance should be developed by analysing genetic or movement data as functions of effective distance (see Appendix S2 Supporting information). An alternative approach is to define resistance more explicitly in terms of biological parameters, such as mortality risk or energy expenditure based on demographic, diet or metabolic data, and use movement models based on those parameters to explore modelling choices (see Chetkiewicz, St. Clair & Boyce 2006). In general, a more explicit discussion of resistance in each study would improve linkage design and interpretation. For instance, does the resistance value used in an LCP analysis reflect the physical costs of moving through a cell, its mortality risk, or habitat value? Each definition may be defensible depending on the goals and scale of analysis, but each will have different implications, especially when considering maximum path lengths.

Individual animals rarely use a single optimum route, and single-pixel-wide LCPs are of limited biological value (Majka, Jenness & Beier 2007; McRae & Beier 2007; McRae *et al.* 2008; Pinto & Keitt 2009). Although alternative paths with comparable costs may exist on a landscape, studies regularly failed to consider larger swaths of low-cost grid cells (i.e. a least-cost corridor). Recently, circuit theory has been used to incorporate multiple pathways and patch characteristics when evaluating connectivity designs (McRae & Beier 2007; McRae *et al.* 2008). This method allows modelling alternative linkages, ranking potential corridors and reassigning values as pathways are removed (Fig. 1; see Appendix S2 Supporting information), but it is equally reliant on a biologically realistic resistance surface. Alternatively, researchers can select lowest percentiles of cost surfaces (Beier, Majka & Newell 2009; this study Fig. 2) or combine multiple low-cost routes in an LCP analysis to delineate 'probable movement zones' (Rayfield, Fortin & Fall 2010; see Appendix S2). While these alternatives may increase robustness to uncertainty in model parameters, selection of a percentile cut-off (e.g. lowest 10%) or combining a number of low-cost routes is still a subjective decision with unclear biological justification. Some of the techniques we describe above for optimizing or validating models of effective distance should also be applied to this problem.

Few studies examined in this review conducted sensitivity or uncertainty analyses, which are essential to the landscape planning process and should be a requirement of any LCP or related connectivity model (Beier, Majka & Newell 2009; Rayfield, Fortin & Fall 2010). Studies that conducted sensitivity analyses (Table 1) found that different cost schemes (both choice of factors incorporated in the resistance surface, as well as the weights and resistance values assigned) produced very different LCPs, although Beier, Majka & Newell (2009) found their models robust to uncertainty. Indeed, Beier, Majka & Newell (2009) methods for evaluating uncertainty should prove useful where data for optimizing cost schemes are sparse (see Appendix S2 Supporting information). Sensitivity to the choice of habitat factors, factor weights, resistance values, grain and definitions of least-cost corridors should all be considered (see Appendix S2 Supporting information). Our LCP analysis for desert bighorn sheep highlights the disparity of LCPs based on expert opinion, gene flow optimization models, and other reasonable combinations, as well as the point that models optimized over large areas may still need local modifications. Researchers should strive for replicability, objectivity and organism-centred methodology to improve efficacy of LCP and other models in connectivity conservation planning (see Appendix S2 Supporting information). To avoid accusations of 'black-box' modelling (e.g. Shrader-Frechette 2004), studies must clearly address details of model construction, assumptions and uncertainties. Through these improvements, connectivity science will more ably inform landscape planning.

Least-cost path analysis and other connectivity conservation approaches should be viewed as one piece of a larger landscape conservation puzzle. Least-cost modelling cannot fully incorporate quality, size or importance of individual source patches, thus, it is best applied as part of a wider conservation strategy for focal species. A current debate questions whether connectivity conservation strategies like LCP analysis bear consideration in conservation planning, or simply detract focus from more certain measures to protect high-quality breeding habitats (Doerr, Barrett & Doerr 2011; Hodgson *et al.* 2011). This debate promotes a dichotomy between high-quality breeding habitat and habitats designated for connectivity that may represent an overly simplistic view of connective habitats. Regardless, recent summaries (e.g. McLachlan, Hellmann & Schwartz 2007; Hodgson *et al.* 2011) emphasise that conservation of diverse and connected habitat mosaics is likely to be the safest approach for sustaining species on our rapidly changing planet.

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Supporting Information

Additional Supporting Information may be found in the online version of this article.

Appendix S1. Background information for the desert bighorn sheep case study on LCP methods.

Appendix S2. Recommendations for effective LCP analysis.

Appendix S3. A note on variation in least-cost terminology.

Table S1. Complete summary of recent studies that used least-cost path (LCP) modelling for habitat connectivity design.

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FORUM

On the limitations of graph-theoretic connectivity in spatial ecology and conservation

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Summary

1. Applications of graph-theoretic connectivity are increasing at an exponential rate in ecology and conservation. Here, limitations of these measures are summarized.
2. Graph-theoretic connectivity measures are fundamentally limited as they require specification of a habitat quality threshold to allow definition of habitat patches (nodes). Frequently, a second threshold (critical dispersal distance) is applied in the identification of graph edges.
3. Graph-theoretic measures are poorly applicable to large-scale, high-resolution, grid-based data that describe distributions of species in habitats of varying quality.
4. Graph-theoretic connectivity primarily concerns the emigration-immigration component of spatial population-dynamics. Therefore, it cannot alone answer questions about the regional population size, resilience or persistence of a focal species.
5. *Synthesis and applications:* Conservation managers in particular should appreciate these limitations before applying graph-theoretic analysis to spatial conservation planning.

Key-words: conservation planning, dispersal, fragmentation, habitat quality, isolation, metapopulation, species distribution modeling, threshold

Introduction

Connectivity is a fundamental variable in spatial ecology and biodiversity conservation (e.g. Hanski 1998; Calabrese & Fagan 2004; Crooks & Sanjayan 2006; Kindlmann & Burel 2008), and improving connectivity has been the most prevalent proposed solution for conservation under climate change (Heller & Zavaleta 2009). Therefore, it is no surprise that every year, thousands of publications develop new connectivity-based analyses or apply connectivity as part of an ecologically based analysis. Here, I comment on a branch of connectivity research that has been gaining popularity at an exponential rate during the past decade, that is, graph-theoretic connectivity (Urban & Keitt 2001; Pascual-Hortal & Saura 2006; Minor & Urban 2008; Urban *et al.* 2009). While in year 2000, there were just two citations to graph-theoretic connectivity in ecology and conservation, in 2010, there were >450, with the citation rate doubling approximately every 1.5 years (Fig. 1). With enthusiasm on the rise, it is hard to locate a unified critical perspective about the applicability of graph-theoretic connectivity. Such will be provided here. But, first, what are graphs, really?

Graphs originate from mathematics and computer science. A graph defines relationships between entities, which are frequently called edges and nodes. Graphs are used most naturally when there are relatively few edges between nodes, in which case the graph is easy to visualize and computationally efficient algorithms can be applied to it (Urban *et al.* 2009; Rayfield, Fortin & Fall 2010). Clear visualization, compact standard representation, efficient computation, and centuries-long mathematical background lead to graphs being appealing structures for applied sciences, including ecology. One example of profitable import of graph-theoretic methodology is connectivity motivated by electric circuit theory, where the ecologically relevant feature is that alternative connectivity pathways are accounted for (McRae *et al.* 2008), improving from analysis based on least cost path distances. For more background about graphs, see the comprehensive and well-illustrated review of Newman (2003). An excellent summary from the fields of ecology and conservation is given by Urban *et al.* (2009) and reviews from other biological disciplines by May (2005) and Proulx, Promislow & Phillips (2005).

Integral to the concept of a graph is that it must be possible to define its nodes and edges – something highly relevant below. This is easily carried out in engineering systems, such as energy supply, transportation, or communications networks,

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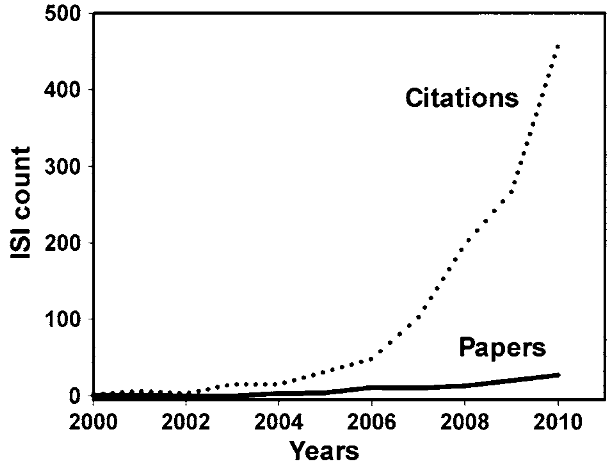

Fig. 1. ISI Web-of-Science search on April 22, 2011, for topic = ('graph-theory' OR 'graph-theoretic') AND (connectivity OR connectedness OR isolation OR dispersal OR migration) AND (ecology OR population OR conservation OR biodiversity). From four papers and 31 citations in 2005, research volume has grown to 27 papers and 458 citations in 2010.

where nodes represent supply and demand points and edges represent actual physical connections between nodes. In spatial ecology, the nodes are habitat patches and edges are interpreted as connectivity between patches (Urban & Keitt 2001).

Limitations of graph-theoretic connectivity

Limitations of graph-theoretic connectivity are below structured around four themes:

1 A multitude of measures with uncertain ecological relevance and novelty value.

2 Thresholding leads to significant loss of information.

3 Computational limitations in application to high-resolution GIS grids.

4 Overemphasis on relevance of landscape connectivity.

A MULTITUDE OF MEASURES WITH UNCERTAIN ECOLOGICAL RELEVANCE AND NOVELTY VALUE

How novel is graph-theoretic connectivity exactly? A graph can be represented by a matrix, where entries on rows and columns indicate the strength of the connection between the two patches. If nodes have a low average number of connections, the matrix can be efficiently stored as a sparse matrix, and easily visualized as a network of circles connected with lines.

Full pair-wise connectivity matrixes have been used to represent connectivity in metapopulation studies earlier than graphs have been used in ecology and conservation (e.g. Hanski 1994), a connection recognized by some of the literature of graph-theoretic connectivity (Urban & Keitt 2001; Urban *et al.* 2009). Consider also buffer (a.k.a. neighborhood) measures of connectivity, in which a distance is specified and connectivity is assumed to occur within this distance. Such measures have been extensively used in metapopulation studies (see Moilanen & Nieminen 2002 for early review) and in statistical species distribution modeling (Elith & Leathwick 2009), where they measure quantities such as 'the amount of forest within a 500-m radius around the focal grid cell'. There is no meaningful difference between buffer measures and critical distances used to construct graph-based representations of a landscape: both lead to an effectively identical characterization of local connections in the landscape – of course different things can subsequently be performed with this description of the landscape.

The language of graph-theoretic connectivity is not fully ecologically pertinent – a recent review about graph theory in spatial analysis (Urban *et al.* 2009) define among others the following technical terms with variably clear ecological relevance: arc, characteristic path length, centrality, closeness, clustering, community structure, component, degree centrality, diameter, digraph, directed graph, dual graph, least cost path, least cost link, link, link weight, minimum planar graph, minimum spanning tree, multigraph, node, node betweenness, node failure, order, path, planar graph, regular graph, scale free graph, small world graph, spanning tree, subgraph, walk, and value. One might opine that the already abundant terminology of structural, functional, regional, landscape, and metapopulation connectivity would benefit from a consolidation of operational terms rather than from proliferation of them. Fundamentally, connectivity is about (i) how do you define the patches, (ii) how do you calculate potential connections between patches, and (iii) what do you do with this description of the landscape? Sensible connectivity measures – whatever they are called – should turn out very similar results when based on the same structural description (i and ii) of the landscape. Instead of labeling an analysis as metapopulation, landscape ecological, landscape connectivity, graph theoretic, statistical distribution modeling, spatial PVA, or something else, it would be more profitable to concentrate on the operational structure of the analysis: how are habitat area, habitat quality, spatial considerations, multiple species (or whatever biodiversity features), temporal dynamics, and analysis resolution handled?

THRESHOLDING LEADS TO SIGNIFICANT LOSS OF INFORMATION

Use of graphs relies on the ability to define nodes and edges. In ecology, this implies that it must be possible to delineate habitat patches and to define connections between them. Natural delineation of patches may be feasible, for example when forest fragments occur in an agri-urban habitat matrix. In contrast, assume a semi-continuous forest landscape with varying tree species composition and human impacts; delineating patches becomes less easy and requires application of thresholding to divide the landscape into habitat patches and other habitat types. This requirement of classification of the landscape to habitat and non-habitat is a fundamental limitation in particular for multi-species analysis, frequently applied across spatial ecology, in island biogeography, metapopulation studies, and landscape ecology (Chetkiewicz, Clair & Boyce 2006).

A second thresholding may occur when connections (graph edges) are delineated. Frequently, graph edges are defined via

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critical distance inside which patches are connected and outside which no connections exist (see e.g. Pascual-Hortal & Saura 2006 for comparisons). Effectively, such a threshold equates to a dispersal kernel that is a step function of distance, which does not correspond ideally to ecological reality: dispersing individuals do not suddenly drop dead when hitting an invisible critical distance. Not all applications of graph-theoretic connectivity apply critical distances; several studies have used pair-wise 'probability of connectivity' matrixes that can be constructed either via the use of a declining-by-distance dispersal kernel or via more complicated path-type calculations (Urban & Keitt 2001; Saura & Pascual-Hortal 2007). In fact, the PC-index of Saura & Pascual-Hortal (2007), based on a pair-wise connectivity matrix, was the only graph-theoretic measure out of nine that satisfied 13 given conditions required for the sensible behavior of a connectivity metric.

Problems with thresholds compound when going from single to multi-species analysis. Different species have different habitat requirements and dispersal behavior, implying much work and significant simplification when thresholds for habitat quality and dispersal-distances are defined for up to tens of thousands of species. It is a common technique in graph-theoretic analysis that measures of network structure is recalculated for a range of critical distances, facilitating identification of distances where the structure of the network changes rapidly (e.g. Urban *et al.* 2009; Bodin & Saura 2010). Such an approach is feasible for a few species, but becomes arduous and hard to summarize with many species that inhabit different networks.

Furthermore, twice thresholded graphs could be applied within the context of systematic conservation planning, where conservation targets are effectively defined as minimum thresholds to species occurrence levels (representation), connectivity and other quantities (Margules & Sarkar 2007). One then does applied conservation on a thrice thresholded system where the objectives (targets) and the ecological model (habitat quality, connectivity distances) have all been thresholded, resulting in a somewhat black-and-white view of the world.

COMPUTATIONAL LIMITATIONS IN APPLICATION TO HIGH-RESOLUTION GIS GRIDS

Statistical species distribution modeling (Elith & Leathwick 2009) is typically carried out on high-resolution GIS grids, where explanatory variables represent factors such as topology, temperature, rainfall, and vegetation cover. Such data are becoming available at very high resolutions, for example, the global Landsat data and the European Corine data both have spatial resolutions in the order of tens of metres. Landscapes may be small-scale and fragmented in industrialized countries, and the average sizes of individual properties may be in the order of hectares – implying that both ecological analysis and conservation management ideally should happen at spatial resolutions of hectares (or less) for them to correspond to realities of ecology and land ownership. Such resolutions imply national-scale analysis on grids consisting of tens of millions of grid cells of information per species or ecosystem type. At the time of the review of Urban *et al.* (2009), it appeared that some more complex graph-theoretic analyses were only possible for landscapes of some thousands of nodes, implying a need to simplify landscape descriptions via thresholding.

This deficiency would be meaningless if there were no alternatives that would be applicable to data such as described earlier. However, it turns out that arbitrary species-specific kernel-based declining-by-distance connectivity measures that do not require habitat quality thresholding or specification of a critical distance can indeed be computed on large grids, within a species (Moilanen & Wintle 2007), between distributions (Rayfield, Moilanen & Fortin 2009), or between many partially similar habitat types (Lehtomäki *et al.* 2009; Leathwick *et al.* 2010) and used in spatial conservation. These computations rely on the application of the fast Fourier transform technique, described by Moilanen (2005), to enable connectivity transforms for grids of tens of millions of elements. Kernel-based connectivity techniques can also be used for calculating connectivity values for use in subsequent graph-based processing.

Some graph-algorithms, originating from computer science, are exact and guaranteed to find optimal results, implying intensive computation in analysis when there are many nodes. Take as an example, the least cost path (LCP), which is the shortest possible path between two nodes. Computationally, intensive graph-theoretic methods are frequently associated with LCP calculation and application (Urban *et al.* 2009). Nevertheless, recent results suggest that LCP distances may approximate functional connectivity poorly (Palmer, Coulon & Travis 2011). This may be because LCP analysis is sensitive

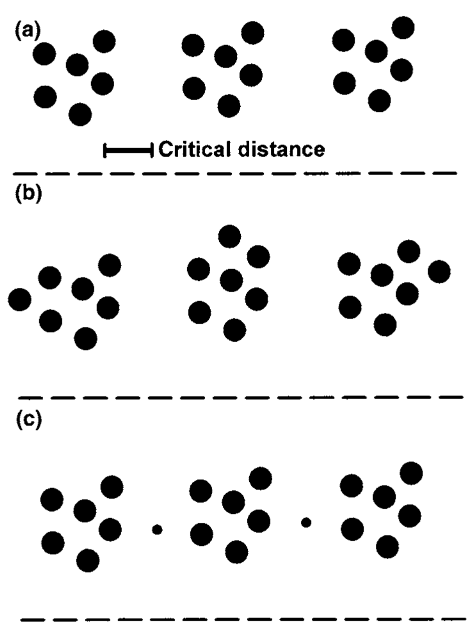

Fig. 2. Spurious results can arise from the use of critical distances. (a) A patch network with three clusters that are separated by more than the critical distance. (b) Extension of the network by adding habitat to each cluster – the clusters remains separated by the critical distance. (c) Addition of two stepping stones connects the entire network according to the critical distance. A spatial population model utilizing a declining-by-distance dispersal kernel would see network (b) as the most stable alternative, while a graph-theoretic connectivity measure might conclude that the addition of stepping stones is critically important for connectivity.

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to the definition of resistance values used (Rayfield, Fortin & Fall 2010) and because it does not acknowledge the existence of multiple alternative paths and their effect on functional connectivity, see Fig. 2 for illustration. Another category of connectivity methods, analysis based on mechanistic movement rules, can both approximate connectivity in an ecologically realistic manner and account for multiple alternative movement paths in a natural manner (Ovaskainen *et al.* 2008; Watts & Handley 2010; Palmer, Coulon & Travis 2011). In summary, it is presently not clear that graph-based analysis is the best available compromise between ecological realism and computational tractability.

OVEREMPHASIS ON RELEVANCE OF LANDSCAPE CONNECTIVITY

The close occurrences of landscape connectivity with graph-theoretic connectivity in ecological literature imply that graph-theoretic connectivity is seen as a vehicle for finding an improved measure of landscape connectivity (Bunn, Urban & Keitt 2000; Urban & Keitt 2001; Pascual-Hortal & Saura 2006; Estrada & Bodin 2008; Minor & Urban 2008). This concept is one of the holy grails of landscape-scale conservation in that it should directly inform about the resilience of the species across the landscape, thereby providing a fundamental measure for conservation planning. Recent reviews have commented about the continuing lack of clear operational definition for (landscape) connectivity (Kindlmann & Burel 2008; Heller & Zavaleta 2009); here I will remark on the fundamental role of connectivity in population ecology.

The basic equation of population ecology states that change in population size equals births – deaths + immigration – emigration. Connectivity only informs about the immigration and emigration components of this equation. [That is, unless the semantic meaning of connectivity is significantly expanded from original to encompass a PVA-like evaluation of persistence.] Thus, no measure of connectivity, whatever it is called, can give a fully reliable estimate of the persistence, extinction risk, or resilience of a species at a regional scale. For comparison, measures such as metapopulation capacity (Hanski & Ovaskainen 2000), 'rapid evaluation of metapopulation persistence' (Drielsma & Ferrier 2009), or spatial population viability analyses integrate analysis of spatial pattern with additional information about population sizes, birth and death rates, thereby providing more direct information about regional persistence.

Figure 3 illustrates a case where a spatial population model and a connectivity-focused measure might plausibly disagree about what would be the best conservation strategy. A connectivity measure, such as the maximum connected subgraph size, utilizing the critical distance shown in the figure would conclude that the network, unsatisfactorily, consists of three separate clusters (maximum connected subgraph size = 1/3). Addition of two stepping stones (Fig. 3c) would, apparently advantageously, connect the entire network with distances shorter than the critical distance. Contrastingly, a spatial population model that uses a declining-by-distance kernel and accounts for births, deaths, and patch sizes would see relatively

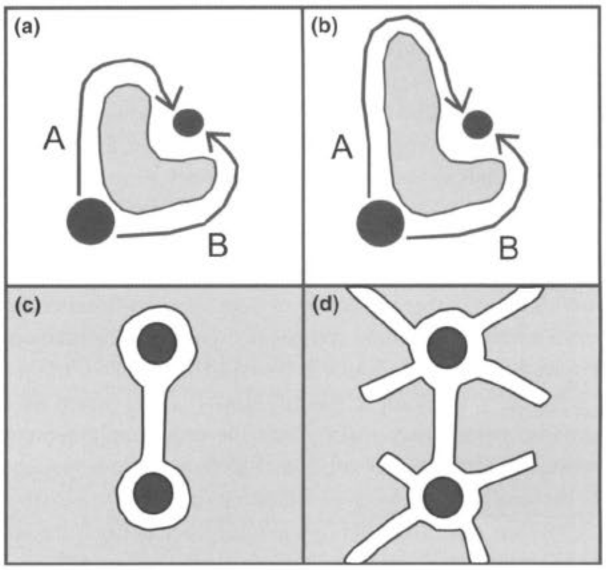

Fig. 3. Illustrating the relevance of accounting for multiple alternative paths. The shortest path between two locations is the same in panels (a) and (b). However, a dispersing individual will not in advance know which path (A or B) to take, leading to functional connectivity being lower in (b) than in (a). This effect only becomes apparent in connectivity analysis when multiple paths between patches are accounted for. Likewise, the per-capita dispersal rate between the two patches would be higher in (c) than in (d). In the figure, breeding habitat is in black, white is suitable for dispersal and gray areas are habitat avoided by the species.

little influence from the stepping stones: if the small stepping stone is within colonization distance from the larger clusters, then direct dispersal between the clusters will be possible as well (although at a lower per-capita rate), and the small patches will not provide significant increase to the total amount of habitat available for the species. This was noticed already by Urban & Keitt (2001): 'A small stepping-stone patch might be important to traversability without contributing substantially to overall productivity or dispersal flux'; see also Bodin & Saura (2010). A population model would prefer addition of three large patches to the system (Fig. 3b) – these would add significant habitat, improve the persistence of the clusters, and therefore also increase the number of migrants moving between clusters. But, put into numbers, how does a 10% addition in area compare with a tripling of connectivity? A situation conceptually similar to Fig. 3c was found in an empirical study by Urban (2005). A likewise spurious result could be produced by varying the habitat quality threshold used in the definition of habitat patches (nodes), with a lower threshold apparently improving landscape connectivity and resilience because of both an apparent increase in habitat amount and reduced distances between patches.

Discussion

The purpose of the present discussion has been to pointedly state limitations of graph-theoretic connectivity – its benefits and promises, including a mathematically coherent framework with efficient computational implementations and transfer of

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knowledge from engineering sciences, have been summarized before (Saura & Pascual-Hortal 2007; Minor & Urban 2008; Urban *et al.* 2009; Zetterberg, Mörtberg & Balfors 2010). Fundamentally, graph-theoretic connectivity is best suited for analysis of naturally patchy landscapes, with connections defined via critical distances. Contrastingly, at least in conservation, there is a need for high-resolution, multi-species analyses that allow for species-specific consideration of variable habitat quality and connectivity.

With respect to the role of connectivity in general, the area of habitat suitable for the species and quality of those habitats are the two primary variables defining the landscape-scale maximal carrying capacity for a species (Hodgson *et al.* 2009). Spatial arrangement, coming next, influences how much of this carrying capacity is utilized. The influence of habitat quality may be generally larger than that of spatial pattern (Travis & Dytham 1999; Hodgson *et al.* 2011). Consequently, simplification of the landscape structure, thresholding of habitat quality, reduction in analysis resolutions, or other similar operations required to fit analysis into any connectivity framework should be treated with caution when working on real-world conservation management.

To conclude and dropping semantics, it is useful to bear in mind the following operationally relevant considerations when working with connectivity: Is connectivity considered as a part of a full population model, or is connectivity measured and applied as a standalone entity? How, if at all, are patches defined? Is patch quality information retained? How are distances between patches calculated? Is distance defined and scaled in a species-specific manner? Are alternative pathways between sites considered? How is connectivity aggregated across a patch network?

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MOLECULAR ECOLOGY

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Why replication is important in landscape genetics: American black bear in the Rocky Mountains

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Abstract

We investigated how landscape features influence gene flow of black bears by testing the relative support for 36 alternative landscape resistance hypotheses, including isolation by distance (IBD) in each of 12 study areas in the north central U.S. Rocky Mountains. The study areas all contained the same basic elements, but differed in extent of forest fragmentation, altitude, variation in elevation and road coverage. In all but one of the study areas, isolation by landscape resistance was more supported than IBD suggesting gene flow is likely influenced by elevation, forest cover, and roads. However, the landscape features influencing gene flow varied among study areas. Using subsets of loci usually gave models with the very similar landscape features influencing gene flow as with all loci, suggesting the landscape features influencing gene flow were correctly identified. To test if the cause of the variability of supported landscape features in study areas resulted from landscape differences among study areas, we conducted a limiting factor analysis. We found that features were supported in landscape models only when the features were highly variable. This is perhaps not surprising but suggests an important cautionary note – that if landscape features are not found to influence gene flow, researchers should not automatically conclude that the features are unimportant to the species' movement and gene flow. Failure to investigate multiple study areas that have a range of variability in landscape features could cause misleading inferences about which landscape features generally limit gene flow. This could lead to potentially erroneous identification of corridors and barriers if models are transferred between areas with different landscape characteristics.

Keywords: connectivity, gene flow, habitat fragmentation, landscape genetics, landscape resistance modelling, noninvasive sampling, *Ursus americanus*

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Introduction

Habitat connectivity and fragmentation are landscape-level processes that affect population structure, dynamics, and evolution (Fischer & Lindenmayer 2007). Investigations of landscape-scale processes are often carried out on relatively large spatial scales, and require large amounts of time and money. As a result, research rarely assesses fragmentation patterns and processes at the landscape-level in replicated studies (Stutchbury 2007). For example, in a review of several hundred studies of habitat fragmentation, McGarigal & Cushman (2002) found that less than 5% of published papers

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reported any sort of replication of representative landscapes and very few had sufficient sample size for statistical inference at the landscape-level. Replication in landscape ecology can be defined as spatial replication or multiple spatial comparisons (Segelbacher *et al.* 2010).

Landscape genetics is a recently developed research approach that combines landscape ecology and population genetics for testing the relative influence of different landscape features on genetic population structure and gene flow (Manel *et al.* 2003; Storfer *et al.* 2007). The genetic characteristics of individuals sampled across landscapes allows identification of populations, localization of genetic discontinuities (barriers or contact zones), and quantification of the relative influence of different landscape features on gene flow. Landscape genetics has also been used in identifying and evaluating connectivity and corridors (Dixon *et al.* 2006; Epps *et al.* 2007; Cushman *et al.* 2008; Schwartz *et al.* 2009; Li *et al.* 2010). Holderegger & Wagner (2008) concluded landscape genetics can potentially infer functional connectivity at spatial scales and for species that other ecological techniques such as radio tracking, global positioning system technology, and mark recapture in animals cannot.

Landscape genetics studies of habitat fragmentation and connectivity need spatial replication to test the generality of inferences about how gene flow is influenced by certain landscape features (Holderegger & Wagner 2008; Segelbacher *et al.* 2010). Replication in landscape genetics refers to replication of the study unit (i.e. the landscape itself) (Holderegger & Wagner 2008). Replication in ecology and landscape genetics is not as highly controlled as in laboratory studies; however, comparison of a fragmented landscape and highly connected landscape can be considered as one treatment. Although some examples of landscape level replication exist (Orrock *et al.* 2006; Peakall & Lindenmayer 2006; Born *et al.* 2008), to our knowledge no landscape genetic studies have included replication of multiple sampled landscapes.

Individual-based, landscape genetic analysis of population connectivity is particularly powerful as a means to quantify habitat fragmentation effects on population structure because it directly associates patterns of genetic relatedness between individuals with cost distances (i.e. cost or resistance on movement) between these individuals on a number of alternative explanatory models (e.g. Cushman *et al.* 2006). Importantly, individual-based landscape genetic analyses using causal modelling (i.e. modelling using simple and partial Mantel correlation coefficients to evaluate the degree of support for alternative hypotheses of causality; Cushman *et al.* 2006) appear to have high power to correctly identify driving processes and reject incorrect alternative models (Cushman & Landguth 2010). This approach facilitates comparison of a range of alternative hypotheses, such as isolation by Euclidean distance, isolation by barriers, and isolation by landscape resistance in a single formal multiple-hypothesis testing framework (Balkenhol *et al.* 2009).

Cushman *et al.* (2006) was one of the first studies to use this multiple-hypothesis testing framework. They evaluated 110 alternative hypotheses related to the effects of landscape structure on gene flow in a black bear population in northern Idaho. Their analysis compared support for 108 landscape resistance models, isolation by Euclidean distance, and isolation by a landscape barrier. They identified forest cover and elevation as strong predictors of gene flow with roads as a potential, but equivocally supported, feature influencing gene flow. They concluded that gene flow in the north Idaho black bear population was most highly correlated with continuous forest cover at middle elevations, and found no independent support for IBD or landscape barriers (i.e. partial Mantel tests for IBD that remove effects of landscape were not significant). The resistance map they developed from the one Idaho site (Cushman *et al.* 2006) was used to map potentially important movement routes across a very large area of western Montana (Cushman *et al.* 2008). The validity of extrapolation of landscape genetic results to broader regions requires demonstration of the generality of inferences obtained from a particular study landscape, for example, by conducting landscape genetic analysis across multiple study areas.

Many factors, such as the number of loci and individuals sampled, need to be carefully considered when designing landscape genetic studies. Through simulations, Murphy *et al.* (2008) observed a greater increase in power from increasing sample size of individuals than increasing the number of loci used in landscape genetics analysis. The effect of the number of loci on the landscape genetics results has not been evaluated with empirical data.

Our general goal was to improve understandings of how landscape features influence population structure and gene flow in black bears in a range of study areas with different landscapes in the Rocky Mountains of northern Idaho and western Montana. For this, we used an identical landscape genetic modelling approach and a similar suite of alternative models (i.e. models of landscape resistance from combinations of different landscape features) as Cushman *et al.* (2006) to black bear populations in 12 different study areas of varying landscape composition, variability, and complexity. The second goal was to evaluate the usefulness of the reduction in number of loci to assess confidence in

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conclusions about which landscape features influence gene flow. Finally, we assessed the effect of the variability of landscape features on their identification as important factors on gene flow and began to identify thresholds of variation in landscape features necessary to influence gene flow of black bears.

Materials and methods

Study areas

Both the Montana Fish, Wildlife and Parks (MFWP) and the U.S. Geological Survey (USGS) provided genotypes derived from samples collected from traps and rub trees from 11 different study areas during 2001 2008. Collectively, these 11 study areas consist of *c.* 32 124 km^2 in western Montana and include the Swan Valley, Glacier National Park (GNP), the Rocky Mountain East Front, the Yaak, Cabinet, Garnet, Gallatin, Big and Little Snowys, Whitefish, Pioneer, and Salish Mountains (Fig. 1). The size of the study areas ranged from 842 to 6574 km^2, with elevation ranging from 554 to 3231 meters (see Table 1 for mean elevations of study areas). We also included the results from the north Idaho study area from Cushman *et al.* (2006) as our 12th replicate landscape.

Field sampling

We sampled all study areas with hair traps constructed following the protocol of Woods *et al.* (1999). Hair traps consisted of double-strand, four-prong barbed wire encircling three to six trees or steel posts at a height of 50 cm. We poured scent lure, a mix of aged cattle blood and liquid from decomposed fish, on forest debris piled in the centre of the wire corral. We hung a canister with a small hole filled with cotton fibre saturated with lure or a cloth saturated with lure in a tree 4 5 m above the centre of the trap. Sampling sessions were 12 14 days. We collected hair from barbs, the ground near the wire, and the lure pile. All hairs from one set of barbs constituted a sample. We placed each hair sample in a paper envelope labelled with a unique number and stored hair samples on silica desiccant at room temperature.

Site selection for study areas 100, 102, 104, 130, 290, 301, 319 and 411 (Fig. 1) was coordinated by Montana Fish, Wildlife and Parks. In these study areas, hair traps were distributed across a 5 × 5-km grid. Site selection for study areas 103, 450, and Glacier National Park were coordinated by the U.S. Geological Survey based on systematically distributing hair traps using a grid of 7 × 7-km cells (Kendall *et al.* 2009). In GNP, we also

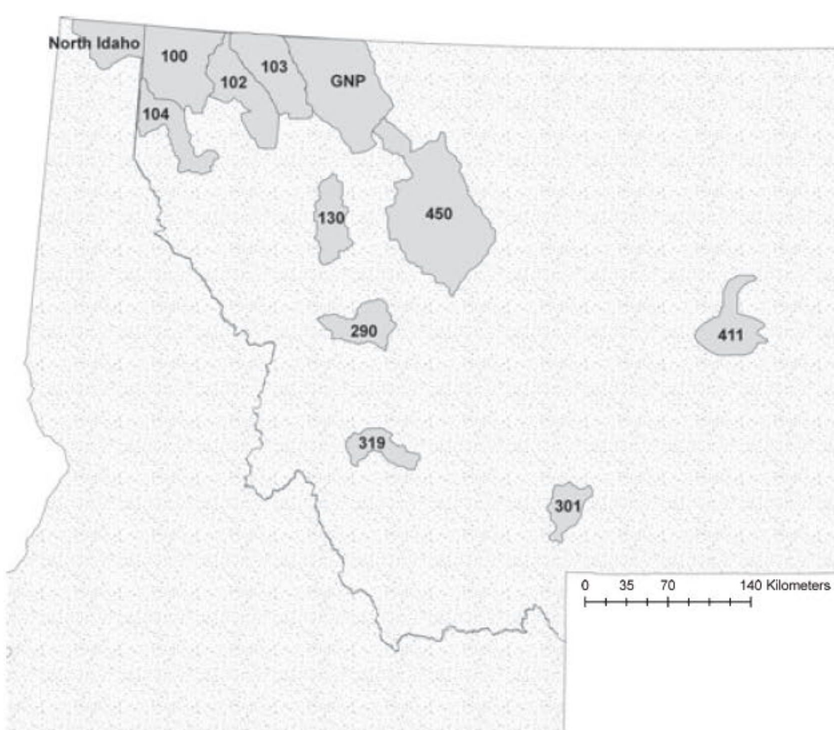

Fig. 1 The location of the study areas in Idaho and Montana: north Idaho (Cushman et al. 2006), 100 (the Yaak), 102 (Salish Moun tains), 103 (Whitefish Mountains), 104 (Cabinet Mountains), 130 (Swan Valley), 290 (Garnet Mountains), 301 (Gallatin Mountains), 319 (Pioneer Mountains), 411 (Big and Little Snowys), 450 (Rocky Mountain East Front), and Glacier National Park (GNP).

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Table 1 Summary of landscape features for each of 11 study areas from Western Montana and North Idaho: area (km^2), mean elevation, standard deviation (SD) of elevation, correla tion length of forest, correlation length of roads

Study area	Area (km^2)	Mean elevation	SD elevation	Correlation length forest	Correlation length road
100	3662	1333	294	20 797	20 303
102	4696	1388	223	21 163	19 602
103	2761	1577	327	21 465	14 377
104	3616	1294	380	25 672	6831
130	1605	1589	388	22 887	6343
290	1287	1571	234	13 227	10 340
301	842	2218	262	10 582	2712
319	1049	2236	286	12 783	3849
411	2168	1582	286	10 031	6553
450	3864	1786	312	23 462	15 643
GNP	6574	1646	380	31 165	14 058
NI	3000	1225	461	12 460	10 228

Correlation length is a landscape metric that quantifies the connectivity of a habitat class across the landscape and is equal to the distance (in meters) an organism placed into a random forest patch can move before encountering an edge.

collected hair during repeated visits to bear rubs using the protocols of Kendall *et al.* (2009).

Extraction and genotyping

Samples were analysed at the Wildlife Genetics International Laboratory, in Nelson, British Columbia, that specializes in low DNA quantity and quality samples, following standard protocols for noninvasive sampling (Woods *et al*. 1999; Paetkau 2003; Roon *et al*. 2005; Beja-Pereira *et al*. 2009). We analysed all samples with ≥1 guard hair follicle or five underfur hairs, and we used up to ten guard hairs plus under-fur when available.

DNA was extracted from hair samples using standard protocols established by the laboratory using QIAGEN DNeasy extraction kits. We genotyped the bears for each study area at a minimum of five microsatellite loci from a suite of twelve microsatellite loci: *G10B*, *G10H*, *G10IV*, *G10J*, *G10L*, *G10M*, *G10P*, *G10U*, *G10X*, *G1D*, *MU23* and *MU59*. Different loci in different study areas were used to maximize heterozygosity to increase the power for other independent studies of population estimation and relatedness that were conducted prior to this study. We have combined those datasets in this analysis. PCRs cycles were the following: for 1 min 20-s denaturation at 94 °C followed by 40 cycles of 94 °C for 20 s, 54 °C for 25 s, 72 °C for 10 s, with a final extension of 1 min 5 s at 72 °C and then cooling down to 4 °C.

The identification of unique individual multilocus genotypes followed a standard three-phase approach. Phase I involved an initial screening of all samples with the selected microsatellite markers. Species identification (to separate black bears from grizzly bears, *Ursus arctos*) was confirmed with an assignment test (Paetkau *et al.* 1995). The reference samples for calculating log genotype likelihoods were grizzly bear genotypes from either the southern Purcells or the Northern Divide Grizzly Bear Project (Kendall *et al.* 2009).

Phase II of the genotyping involved an attempt to fill in missing or weak data for samples that failed to produce reliable genotypes at three, four, or five markers during the initial screening. After a second pass at genotyping, samples with inadequate genotypes (<4 loci) were removed and not included in any further analysis. All pairs of remaining unique genotypes were subjected to exhaustive computerized comparison to check for similar genotypes that might be indicative of genotyping error. All pairs of genotypes that differed at fewer than three markers were scrutinized for possible error. All genotypes that differed from another genotype at just one marker were re-run (PCR, electrophoresis, and scoring).

Phase III involved re-analysing any pair of genotypes that differed at just one or two loci, following the published error-checking protocol established by Paetkau (2003). Once the genotyping was completed and checked for errors, individuals were defined by each unique genotype.

Data analysis

We estimated the number of alleles per locus (A), expected heterozygosity (H_E), heterozygote deficit (F_{IS}), and tested for Hardy Weinberg proportions using the program GENALEX 6.1 (Peakall & Smouse 2006). We also tested for gametic (linkage) disequilibrium using the program GENEPOP 3.4 (Raymond & Rousset 1995).

Landscape genetic analysis

Genetic distance. For each individual we created five- to eight-locus genotypes with the following allelic encodings: a 0 for an absent allele, a 1 for a heterozygote or an allele found at one of two alleles, and a 2 for a homozygous individual with two copies of the same allele. This resulted in a matrix with one column for each allele in the pool of sampled bears and one row representing each individual bear genotype. Then inter-individual genetic distance was calculated following Bray Curtis percentage dissimilarity measure (Legendre & Legendre 1998), to produce a matrix containing the genetic distances among all pairs of sampled bears. This calculation assumes the loci are independent and consistent with linkage disequilibrium results.

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Organizational models. A priori, we considered two potential drivers of genetic structure in these black bear populations, isolation by geographic distance (IBD) and isolation by landscape-resistance. Patterns of genetic structure among individuals can be correlated with landscape features by building resistance surfaces that assign different resistance-to-movement values to different landscape features (e.g. a high resistance-to-movement might be assigned to a known road or a body of water). Cells are given weights or 'resistance values' reflecting the presumed influence of each variable on movement of the species.

We selected 35 landscape-resistance models, representing combinations of three landscape features: elevation, roads, and forest cover (Cushman *et al.* 2006). These landscape features are known to be important to black bear movement and denning (Brody and Pelton 1898; Lyons *et al.* 2003; Mitchell & Powell 2003; Gaines *et al.* 2005; Mitchell *et al.* 2005); and influence gene flow (Cushman *et al.* 2006). Resistance of these features was modelled across four levels for elevation and three levels for roads and forest. The four levels for the feature elevation (E), consisted of a null model (EN), in which there was no penalty for elevation in the resistance surface, and three inverse-Gaussian resistance models, with minimum resistance of 1 at 500 (EL), 1000 (EM), and 1500 m (EH) elevation above sea level, respectively, 500-m standard deviation, and maximum resistance of 10. These three levels reflect a range of potential relationships between resistance to movement and elevation, with increasing resistance to gene flow at elevations higher and lower than the minima, with a maximum resistance of 10 times that of the minima achieved at asymptote (Cushman *et al.* 2006). Similarly, three levels of the forest cover feature were modelled. The first level was the null model (FN) in which forest cover had no effect in the resistance surface. The remaining two levels were models in which we posited that landscape resistance is minimum in closed canopy forest and linearly increases in nonforest cover types. In the forest high (FH) level we stipulated high relative resistance for crossing nonforest cover types, representing a condition where an individual bear strongly favours movement through forest, whereas in the forest low (FL) level nonforest classes have lower landscape resistance. Finally, three levels for the roads (R) were used, consisting of a null model (RN) where there was no effect for resistance of roads, a model with relatively strong effect of roads on resistance (RH), and a model with relatively lower effect of roads on resistance (RL). Isolation by Euclidean distance was included as a 36th model.

The landscape resistance models corresponding to each feature and level were combined into the 35 landscape-resistance models by addition. These hypotheses were represented by maps with cell values equal to the hypothetical resistance of each cell to gene flow. Forest cover data layers were derived using the GAP analysis program. Roads were mapped as a raster, including the two classes: major highways and other roads using TIGER 1997 (http://www.census.give/geo/www/tiger/). Elevation was mapped in meters and the layers were derived from 30-m digital elevation model (DEM). Before analysis, the base maps were re-sampled to a 90-m pixel size and rectified to a Universal Transverse Mercator projection.

Cost models. A matrix of movement costs among all pairs of individual bears in each study area was then computed based on least-cost distance. When an individual was sampled at more than one location we used the first location recorded in the dataset. We used ArcGIS COSTDISTANCE (ESRI Corp., Redlands, CA, USA) to calculate the least-cost distance from the location the individual bear sampled to every other bear's location across each of the 36 resistance surfaces. The cost matrix for the IBD hypothesis was created from the Euclidean distances based on UTM coordinates between all pairs of bears.

Mantel tests. The most widely used method to associate genetic structure with landscape features involves the use of Mantel tests (Mantel 1967) to correlate genetic distances with geographic distance or with alternative ecological distances that test hypotheses of the effect of landscape structure on gene flow (e.g. Broquet *et al.* 2006; Cushman *et al.* 2006; Schwartz *et al.* 2009a,b; Cushman & Landguth 2010; Storfer *et al.* 2010). We used partial Mantel tests (Smouse & Chakraborty 1986) within a causal modelling framework (Legendre 1993; Cushman *et al.* 2006; Cushman & Landguth 2010) to test the 36 resistance hypotheses for the influences of landscape features on gene flow. This framework has been shown to have high power to identify the drivers of gene flow and reject incorrect, correlated alternative hypotheses (Cushman & Landguth 2010).

The partial Mantel test measures the residual association between two dissimilarity matrices, after removing the association with a third dissimilarity matrix. In this study, we report partial Mantel test results, after factoring out the influence of Euclidean distance. This tests for a significant relationship between genetic distances and landscape resistance after accounting for (removing) the effects of the IBD null hypothesis. For each study area, we also partialled out effects of landscape from the Euclidean distance model to test for any independent support of isolation by Euclidean distance. All Mantel tests were conducted using the library ECODIST

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version 1.1.3 (Goslee & Urban 2007) in the statistical software package R (R Development Core Team 2007).

Effect of number of loci

The number of loci varied among study areas from five to nine. Since the majority of our study areas used six loci, we began by testing the effect of the reduction of loci down to six loci on the consistency of our results for study areas with more than six loci (north Idaho, 319, and 411). We conducted Mantel and partial Mantel tests using the genetic distance matrices for all subsets of loci down to six loci for our study areas. Then we further tested the effect of the reduction of loci on the consistency of results for our study areas with six loci. We conducted Mantel and partial Mantel tests using genetic distance matrices for the study areas with six loci (102, 103, 104, 290, 301, 450, and GNP) using all subsets of five loci from the six total loci. We compared the landscape features identified as influencing gene flow of each subset with the landscape features identified for the original data containing all loci.

Variation of landscape features

A priori we developed three hypotheses related to when the effects of particular landscape features (i.e. elevation, forest, and roads) on gene flow will be detected in a given landscape. Our first hypothesis was that elevation will be a landscape feature identified as influencing gene flow in study areas that have a relatively high variance of elevation. In study areas where there is little variation in elevation we posited that elevation would not be related to genetic differentiation among individual bears, as elevation would not limit gene flow where topography is relatively flat. We further posited that the optimal elevation at which resistance to gene flow was minimized would vary across western Montana in relation to regional climate patterns and mean elevation of the study area. Specifically, we hypothesized that gene flow would be maximal at middle elevation (Cushman *et al.* 2006, mean 1000 m, SD 500 m) in study areas located in the north, whereas gene flow would be maximal at high elevation (mean 1500 m, SD 500 m) in the southern part of the greater study area. This is because of regional climate patterns, in which precipitation and snow pack are highest in the northern portion of the study area and lowest in the southern part, resulting in similar biophysical conditions occurring at higher elevations in study areas in the south. We tested the first part of this hypothesis by conducting *t*-tests of the difference in mean standard deviation of elevation between study areas which elevation was in a landscape feature identified as influencing gene flow and those where elevation was not identified as influencing gene flow. We tested the second part of our hypothesis by conducting *t*-tests using the latitudes of the study areas with mid-elevation or high elevation identified as landscape features influencing gene flow.

Our second hypothesis was forest cover will be a landscape feature identified as influencing gene flow in study areas where forest is fragmented or has limited continuity. In study areas where forest is extensive and unfragmented we posited that there will be no relationship between gene flow and forest cover. Forest cover will not limit gene flow of a forest dependent species in landscapes that are continuously forested. In contrast, in landscapes where forests are fragmented we would expect gene flow of a forest dependent organism to be highly related to forest cover as a limiting factor. We tested this hypothesis by conducting *t*-tests evaluating the significance of the differences in the correlation length (McGarigal *et al.* 2002; Cushman *et al.* 2010) of forest cover between study areas in which forest was a landscape feature identified as influencing gene flow and study areas where it was not identified. Correlation length is a landscape metric that quantifies the connectivity of a habitat class across the landscape and is equal to the distance an organism placed into a random forest patch can move before encountering an edge. Correlation length is calculated using FRAGSTATS (McGarigal *et al.* 2002) on the reclassified forest cover map used to derive the forest cover resistance layers described above.

Our last hypothesis was that roads will be in a landscape feature identified as influencing gene flow in study areas that are highly dissected by extensive road networks. Where roads are extensive and highly fragment the landscape, we would expect them to limit gene flow. In contrast, where roads are few and do not dissect the landscape we posited that there should be no relationship between roads and gene flow, even if the species strongly avoids crossing roads. We tested this hypothesis by conducting *t*-tests evaluating the significance of differences in the correlation length (McGarigal and Marks 2002; Cushman *et al.* 2010a,b) of roads between study areas with roads identified as a landscape feature influencing gene flow and study areas with roads not identified as influencing gene flow.

Results

Genetic diversity and disequilibrium

Mean expected heterozygosity ranged from 0.67 (study area 411) to 0.84 (study area 104) with a grand mean = 0.803. The overall mean number of alleles per locus was 11 (range = 5 14; Table 2). The results for F_{IS}

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Table 2 Genetic summary statistics for eleven study areas in Western Montana, plus North Idaho (NI): (*N*) Number of indi viduals sampled, Number (#) of loci genotyped, mean observed heterozygosity (H_O), mean expected heterozygosity (H_E), and mean number of alleles per locus

Study area	*N*	# of loci	Mean F_{IS}	H_O	H_E	Mean alleles
100	160	5	0.019	0.811	0.824	11.6
102	131	6	0.013	0.813	0.824	11.5
103	196	6	0.019	0.844	0.828	11.8
104	148	6	0.009	0.852	0.841	13.5
130	132	5	0.040	0.859	0.827	12.2
290	62	6	0.063	0.839	0.789	9.8
301	60	6	0.029	0.819	0.797	8.3
319	43	8	0.038	0.843	0.812	10.1
411	72	7	0.023	0.685	0.669	5.3
450	166	6	0.017	0.796	0.810	11.5
GNP	508	6	0.006	0.828	0.823	13.0
NI	146	9	0.020	0.779	0.795	10.0
Grand mean	152	6.3	0.013	0.814	0.803	10.7

were near 0 suggesting no cryptic substructure (Wahlund effect) or excessive genotyping error (e.g., allelic dropout). Significant departures from H W proportions ($P < 0.01$) were found at four loci (*MU59*, *G10J*, *G1A* and *G10X*), one in each of four populations. Gametic (linkage) disequilibrium was significant ($P < 0.01$) at five pairs of loci. Only one pair (*G10J* and *G10L*) were in disequilibrium in more than one population (411 and 450).

Landscape genetic analysis

Five of the 11 Montana study areas had statistically significant landscape resistance models ($P < 0.05$; partial Mantel removing IBD) (102, 103, 104, 301, 319). None of these areas had the same most-supported landscape resistance model as the Idaho study area from Cushman *et al.* (2006), and all five areas had a different most-supported landscape resistance model.

The landscape feature of forest (high forest or low forest cover) was a landscape feature identified as influencing gene flow in three study areas (301, 319, Idaho). Elevation (elevation high, or elevation middle) was a landscape feature identified as influencing gene flow in three study areas (103, 104, Idaho). Roads (roads high or roads low) were a landscape feature identified as influencing gene flow in four study areas (102, 103, 301, Idaho) as a high resistance path.

When a partial Mantel test was conducted to test for IBD after removing landscape effects, 10 of the 11 study areas were nonsignificant for IBD when the most-supported landscape resistance model's landscape distance was partialled out (Table 3). IBD was statistically significant in seven of the 11 study areas using a simple Mantel test for correlation of genetic distance to Euclidean distance.

Effect of the number of loci

When we conducted Mantel and partial Mantel tests using the genetic distance matrices created using all subsets of seven of the eight loci in study area 319, we usually obtained the same most-supported landscape resistance model; Seven of the eight subsets produced the same significant most-supported landscape resistance model (FH: forest high) (Table 4). These subsets consistently (100%) produced forest at the high level as a feature within the most-supported landscape resistance model. In the subsets ($n = 28$) of six loci, our original most-supported landscape resistance model occurred 71% of the time and was still significant. FH occurred within the most-supported landscape resistance models of these subsets 86% of the time.

When we conducted Mantel and partial Mantel tests from seven loci down to six loci for study area 411, the original most-supported landscape resistance model from seven loci (RL: roads low) was the most common (57%) most-supported landscape resistance model in the subsets of six loci.

For the Idaho study area from Cushman *et al.* (2006), we found less consistency in the occurrence of the most-supported landscape resistance model (FHEMRH: forest high, mid-elevation, roads high). In the subsets ($n = 9$) of eight loci, the original most-supported landscape resistance model was not produced. However, both EM and FH were factors in 89% of the most-supported landscape resistance models from this group of subsets. In the subsets of seven loci ($n = 36$), the original most-supported landscape resistance model occurred 3% of the time with the FH resistance model having the most support occurring at a frequency of 42% of the time. FH occurred within the most-supported landscape resistance models from the subsets 67% of the time. EM occurred within the most-supported landscape resistance models 33% of the time from these subsets. The last factor from the original most-supported landscape resistance model, RH, occurred within the subsets only 9% of the time. In the subsets of six loci ($n = 84$), the original most-supported landscape resistance model occurred only 8% of the time with FH occurring most frequently with an occurrence of 30% of the time. Similar to the previous subsets, this subset had FH occurring most frequently (62%), EM occurring second most frequently (26%), and RH occurring the least frequently (8%) within the most-supported landscape resistance models.

Subsets of five loci (from six total loci) for our last group of seven study areas produced similar results to

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Table 3 Results of landscape resistance modelling and isolation by distance

Study area	Model	Mantel r	P value	Study area	Model	Mantel r	P value	Study area	Model	Mantel r	P value	Study area	Model	Mantel r	P value
100	EMFH	0.033	0.088	104	EH	0.06	0.023	301	FLRH	0.117	0.018	450	EHRL	0.056	0.061
	EMFL	0.033	0.099		FHEHRL	0.056	0.025		FHRH	0.115	0.023		EHRH	0.055	0.066
	FLRH	0.023	0.115		EHRL	0.057	0.030		FLRL	0.094	0.032		EHRL	0.054	0.069
	FLEMRH	0.030	0.127		FLEHRL	0.056	0.030		FHRL	0.091	0.044		EH	0.052	0.076
	RH	0.031	0.131		EHRH	0.056	0.031		FHEHRH	0.086	0.061		RL	0.054	0.088
	IBD$_{PM}$	0.030	*0.885*		IBD$_{PM}$	0.054	*0.963*		IBD$_{PM}$	0.112	*0.977*		IBD$_{PM}$	0.029	*0.810*
	IBD$_{SM}$	0.025	0.101		IBD$_{SM}$	0.005	0.422		IBD$_{SM}$	0.062	0.058		IBD$_{SM}$	0.066	0.007
102	**RL**	0.059	0.028	130	FHEMRH	0.024	0.135	319	FH	0.132	0.005	GNP	**RL**	0.028	0.094
	RH	0.059	0.036		FHEMRL	0.023	0.141		FHRL	0.124	0.010		RH	0.027	0.096
	ELRH	0.035	0.115		FLEMRL	0.022	0.147		FHRH	0.113	0.014		EHRL	0.016	0.181
	FLELRH	0.033	0.135		FLEMRH	0.023	0.149		FL	0.109	0.018		EHRH	0.016	0.183
	EL	0.032	0.141		EMFH	0.025	0.150		FLRL	0.105	0.024		EH	0.016	0.189
	IBD$_{PM}$	0.016	*0.702*		IBD$_{PM}$	0.007	*0.585*		IBD$_{PM}$	0.118	*0.979*		IBD$_{PM}$	*0.035*	*0.001*
	IBD$_{SM}$	0.046	0.015		IBD$_{SM}$	0.058	0.016		IBD$_{SM}$	0.079	0.044		IBD$_{SM}$	0.035	0.001
103	EMRL	0.038	0.041	290	RH	0.032	0.263	411	**RL**	0.055	0.168				
	EMRH	0.040	0.047		RL	0.032	0.272		RH	0.055	0.183				
	FHEMRH	0.035	0.059		ELFH	0.029	0.284		ELFL	0.001	0.488				
	FLEMRH	0.035	0.059		FHELRL	0.029	0.289		ELFH	0.009	0.565				
	EM	0.037	0.061		FHELRH	0.027	0.292		EL	0.010	0.576				
	IBD$_{PM}$	0.029	*0.896*		IBD$_{PM}$	*0 014*	*0.392*		IBD$_{PM}$	*0.006*	*0.455*				
	IBD$_{SM}$	0.035	0.031		IBD$_{SM}$	0.097	0.001		IBD$_{SM}$	0.078	0.076				

Top five most supported landscape models for each study area with Mantel r statistic and P value for the partial Mantel comparing landscape resistance models partialling out the effect of Euclidean distance. The most frequent top model (RL: roads low) among study areas is in bold. Isolation by distance (IBD$_{SM}$) is from a simple Mantel test. Isolation by distance (IBD$_{PM}$, values in italics) is a partial Mantel test comparing genetics to Euclidean distance after partialling out the effect of the top landscape resistance model for each study area. The two levels of the 'forest' landscape factor (F) are represented as follows: FH, high resistance to nonforest; FL, moderate resistance to nonforest. The two levels of the 'roads' landscape factor (R) are represented as follows: RH, high resistance due to roads; RL, low resistance due to roads. The three levels of the landscape factor of elevation are represented as follows: EL, minimum resistance at low elevation; EM, minimum resistance at mid elevation; EH, minimum resistance at high elevation.

our study areas with more than six loci. For the four study areas with a significant landscape resistance model ($P < 0.05$) using all six loci, most subsets (three of four study areas) of five loci had a significant ($P < 0.05$) most-supported landscape resistance model that produced the same most-supported landscape resistance model as with all six loci (Table 5). For the three study areas with a less significant landscape resistance model ($P > 0.05$), only one study area had the most-supported landscape resistance model identical to that with all six loci.

Given the small tag size associated with most of these studies, we were not able to fully explore the ramifications associated with choosing models based on short tags. However, we believe that re-sampling larger tags can provide significant understandings concerning the relative importance of various factors and the stability of the most highly supported model. For example, forest is the only factor to dominate in all genetic subsets for the Idaho study area. Given the modelling design, each factor occurs in one-thirds of the applied models. Although both elevation and roads are in the best supported model given nine loci, in subsets, roads is present less than expectation in the best supported models for all subsets (Table 5). Thus, the subsampling suggests that for this study area, although RH is in the best nine-locus model, that roads, unlike forest, is not generally supported by the genetic data.

Variation of landscape features

We tested whether the features included in the most-supported landscape resistance models for different study areas were related to variation of a landscape feature in the given landscape. Study areas containing high variation (SD) in elevation were significantly more likely to have elevation as a landscape feature identified as influencing gene flow ($P = 0.019$, Table 6). In addition, they had on average 52% greater SD of elevation than study areas where elevation was not included in the most-supported landscape resistance model.

We also hypothesized that the level of elevation in the most-supported landscape resistance model would be

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Table 4 Summary of the effect of the number of loci on the top landscape resistance models identified for study areas with more than six loci

(a)

	7 loci		6 loci	
411	Percent	*P* value	Percent	Mean *P* value
RL	100	0.168	57	0.068
RH	0	N/A	29	0.280
ELFL	0	N/A	14	0.248

(b)

	8 loci		7 loci		6 loci	
319	Percent	*P* value	Percent	Mean *P* value	Percent	Mean *P* value
FH	100	0.005	88	0.011	71	0.018
FHRH	0	N/A	12	0.029	4	0.069
FHRL	0	N/A	0	N/A	7	0.004
FLRH	0	N/A	0	N/A	7	0.008
RH	0	N/A	0	N/A	7	0.008
EMFH	0	N/A	0	N/A	4	0.030

(c)

	9 loci		8 loci		7 loci		6 loci	
NI	Percent	*P* value	Percent	Mean *P* value	Percent	Mean *P* value	Percent	Mean *P* value
EMFH	0	N/A	67	0.032	14	0.020	8	0.042
EMFL	0	N/A	11	0.001	8	0.030	2	0.010
FH	0	N/A	11	0.028	42	0.027	30	0.018
FHEMRL	0	N/A	11	0.014	0	N/A	1	0.169
FL	0	N/A	0	N/A	8	0.042	15	0.056
FHELRL	0	N/A	0	N/A	5	0.095	12	0.046
FLEMRL	0	N/A	0	N/A	5	0.001	1	0.116
EHFH	0	N/A	0	N/A	3	0.001	0	N/A
ELFL	0	N/A	0	N/A	3	0.017	1	0.083
EMRH	0	N/A	0	N/A	3	0.028	2	0.001
FHEMRH	100	0.011	0	N/A	3	0.014	2	0.009
FLELRH	0	N/A	0	N/A	3	0.045	1	0.026
FLELRL	0	N/A	0	N/A	3	0.035	0	N/A

Results from the partial Mantel tests using the genetic distance matrices created using all subsets of loci down to six loci for study areas 411, 319, and North Idaho (NI). Percent is the percent of occurrence (%) of the top landscape resistance model for all subsets of loci down to six loci. The most supported landscape resistance model with the full set of loci for each study area is in bold. (a) Results from study area 411. (b) Results from study area 319. (c) Results from North Idaho.

EM (mid-elevation), as in Cushman *et al.* (2006) when study landscapes were in the north, and would be EH when study landscapes were in the south. Landscapes in which EM was present in the most-supported landscape resistance model were on average 135 km farther north than landscapes where EH was in the most-supported landscape resistance model ($P = 0.055$; Table 5).

Study areas in which forest cover was a factor identified as influencing gene flow had on average 48% lower correlation length of forest than study areas in which forest was not in the most-supported landscape resistance model. The *t*-test of the differences in correlation length of forest between landscapes in which forest was in the most-supported landscape resistance model and those where it was not was highly significant ($P = 0.001$, Table 6).

There was a very large difference in the correlation length of roads between study areas in which roads

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Table 5 Summary of the effect of the number of loci on the most supported landscape resistance models from study areas with six loci

Study area	6 loci		5 loci		Study area	6 loci		5 loci	
102	Percent	*P* value	Percent	Mean *P* value	301	Percent	*P* value	Percent	Mean *P* value
RL	100	0.028	50	0.021	**FLRH**	100	0.018	67	0.021
RH	0	N/A	33	0.027	FHRH	0	N/A	33	0.041
FLEHRH	0	N/A	17	0.088					
Study area	6 loci		5 loci		Study area	6 loci		5 loci	
103	Percent	*P* value	Percent	Mean *P* value	450	Percent	*P* value	Percent	Mean *P* value
EMRL	100	0.041	0	N/A	**RH**	100	0.064	0	N/A
EMFL	0	N/A	100	0.261	RL	0	N/A	50	0.148
					EHRH	0	N/A	33	0.047
					EHRL	0	N/A	17	0.022
Study area	6 loci		5 loci		Study area	6 loci		5 loci	
104	Percent	*P* value	Percent	Mean *P* value	GNP	Percent	*P* value	Percent	Mean *P* value
EH	100	0.023	50	0.047	**RL**	100	0.094	33	0.073
EHFL	0	N/A	16	0.108	RH	0	N/A	33	0.111
EHRL	0	N/A	16	0.008	EHRL	0	N/A	17	0.022
FHEHRL	0	N/A	16	0.027	EH	0	N/A	17	0.122
Study area	6 loci		5 loci						
290	Percent	*P* value	Percent	Mean *P* value					
RH	100	0.263	0	N/A					
ELFH	0	N/A	33	0.330					
EMFL	0	N/A	17	0.118					
RL	0	N/A	17	0.188					
FHELRH	0	N/A	17	0.013					
FL	0	N/A	17	0.241					

Results from the partial Mantel tests using the genetic distance matrices created using all subsets of five loci (from the six) for study areas 102, 103, 104, 290, 301, 450, and GNP. Percent is the percent of occurrence (%) of the most supported landscape resistance model. The most supported model from the original six loci for each study area is in bold.

were present in the most-supported landscape resistance model and study areas where they were not. The correlation length of roads was on average 120% greater in study areas in which roads appear in the most-supported landscape resistance model than in study areas where they do not ($P = 0.089$, Table 6).

Discussion

The degree to which different landscape features vary in a given landscape may lead to different statistical inferences about which landscape features influence gene flow and movement, even if the species has a globally consistent response to landscape structure. Therefore, landscape-level 'replication' of landscape-genetic research is essential to assess if we can generalize species' habitat requirements for gene flow. Replication provides a means to evaluate whether there is consistency in the landscape genetic relationship across multiple landscapes, and to evaluate different alternative explanations of observed differences in landscape genetic relationships among the different landscapes. Replication could also prevent misleading interpretations that a landscape feature (e.g. forest) is not important for a species, for example when the feature is minimally variable (e.g. continuous forest) across a single study area. Such a misleading interpretation is possible for any statistical inference: where if a factor is not substantially variable, there is no effect of the factor.

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Table 6 Results of *t* tests and power for testing hypotheses regarding the landscape features of elevation, forest, and roads

	Mean 1	Mean 2	SD 1	SD 2	*P* value	Effect size	Power
Elevation	257	389	32	68	0.019	52%	0.442
W to E	177038	164211	62395	100283	0.449	93 km	0.067
N to S	344544	542344	221637	334500	0.055	135 km	0.09
Forest	22767	11942	5706	2108	0.001	48%	0.354
Roads	11729	5339	6421	4051	0.089	120%	0.125

Power is the likelihood of obtaining a significant statistical test if the true difference between means is as large as that observed, given the observed standard deviations (SD). Mean 1 of elevation is the average of the elevation SD (m) of all study areas that do not contain elevation within their top model. Mean 2 of Elevation is the average of the elevation SD (m) of all study areas that contain elevation within their top model. Mean 1 of W to E is the average longitude of study areas with mid elevation as a component of their top model. Mean 2 of W to E is the average longitude of the study areas with high elevation as a component of their top model. Mean 1 of N to S is the average latitude of study areas with mid elevation as a component of their top model. Mean 2 of N to S is the average latitude of study areas with high elevation as a component of their top model. Mean 1 of Forest is the mean correlation length of study areas that do not contain forest as a component of their top model. Mean 2 of Forest is the mean correlation length of study areas with forest as a component of their top model. Mean 1 of Roads is the mean correlation length of roads in study areas that contain roads as a component of their top model. Mean 2 is the mean correlation length of roads in study areas that do not contain roads as a component of their top model. All *P* values are from one tailed tests.

Variability among study areas

There is notable variability in the influence of different landscape features among the 12 study areas, which taken at face value suggests that elevation, roads, and forest cover often influence gene flow in this species, but are inconsistent predictors for different landscapes. None of the five statistically significant study areas had the same most-supported landscape resistance model. Explaining this apparent variability across landscapes assists in obtaining a generalized understanding of the pattern process relationships governing gene flow in the American black bear. Future analyses could use statistical models (e.g. multivariate regression models) to identify the landscape features with the strongest influence on gene flow among study areas.

Most of our study areas (11 of 12) yielded landscape resistance models (partialling out IBD) that explained genetic distance between individuals better than the IBD model (partialling out the effects of landscape), which suggests landscape resistance is a stronger predictor of genetic structure of black bears than the null hypothesis of IBD (as in Cushman *et al.* 2006). In the causal modelling framework (Legendre 1993; Cushman *et al.* 2006; Cushman & Landguth 2010), the only way we would have strong support for IBD is if it is significantly supported when partialling out the most-supported landscape resistance models.

Partialling out landscape (when testing for IBD) showed a lack of independent statistical support for IBD. Failure to compare the IBD hypothesis with the stronger landscape resistance hypotheses in these landscapes could lead to incorrect conclusion that isolation by Euclidean distance is the main process driving gene flow in these landscapes (Legendre *et al.* 2002; Murphy *et al.* 2008). This error would be an example of affirming the consequent in landscape genetics described by Cushman & Landguth (2010), in which multiple logically exclusive hypotheses might have strong spatial correlation with the true driving process and failure to compare multiple models could lead to erroneous conclusions. These findings support the importance of testing multiple alternative hypotheses and in particular of testing landscape resistance hypotheses against a biologically meaningful null model of IBD (Antolin *et al.* 2006; Neville *et al.* 2006; Holderegger & Wagner 2008; Balkenhol *et al.* 2009; Liu *et al.* 2009).

Number of loci

Relatively little is known about how variability in number of loci analysed affects reliability or power to detect correct underlying processes in landscape genetic analysis, although previous simulation studies suggest power increased more rapidly by adding loci than by adding spatial locations (Murphy *et al.* 2008). We conducted Mantel and partial Mantel tests using genetic distance matrices created from subsets of loci in three study areas with more than six loci down to six loci, which was the average number of loci used across study areas. The effect of the number of loci differed among these three study areas. In study area 319, the results suggested little effect on the consistency of model support. In study area 319, forest cover was predicted to be an important facilitator of gene flow in all of the most-supported landscape resistance models identified when we used genetic distance matrices for seven loci and 93% of the models identified at six loci. Our results revealed some apparent instability in model support in study area 411 and in the Idaho study area. Study area

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411 did not have a model with statistical support ($P > 0.10$) with seven loci so it is logical the reduction of loci would not result in a landscape resistance model with statistical support.

In the Idaho study area (Cushman *et al.* 2006) the reduction of the number of loci appeared to result in less stability in the pattern of support for the most-supported landscape resistance models. This inconsistency was primarily driven by models with the roads feature having nearly equivocal support (RH, RL, and RN had very similar support) and roads dropping out of the most-supported landscape resistance models in the subsets. Nonetheless, support for forest cover and elevation was consistent in the Idaho study area when the number of loci was reduced. The results from the Idaho study area seem to indicate that there is high consistency across the number of loci used in identifying the importance of forest as contributing to the genetic structure. Similarly, Cushman *et al.* (2006) identified middle elevation as an important predictor of gene flow. The subsets of eight loci reaffirmed the relationship with middle elevation 87% of the time. However, the identification of middle elevation as important to genetic connectivity dropped dramatically in the subsets of seven and six loci. This seems to suggest that the features that dominate the landscape-genetic pattern process relationship (e.g. forest in the Idaho study area) will usually be consistently identified in analyses of fewer loci. However, it also suggests loss of power to detect the effects of weaker predictors, such as middle elevation and roads in the Idaho study area. Some model instability in north Idaho may have resulted from some individuals having less than nine loci genotyped. In the eleven Montana study areas, nearly all individuals had complete genotypes with no missing data. Missing data might influence model stability and may be a possibility for future research to assess.

For the study areas with six loci, we used genetic distances matrices derived from the subsets of six to five loci and observed study areas with statistical support in the original dataset almost consistently (three of four study areas; 102, 104, 301) resulted in the same significant most-supported landscape features as influencing gene flow. This demonstrates remarkable stability, suggesting limited sensitivity to the number of loci. These results may also suggest a less arbitrary threshold for statistical support than the commonly accepted ($P < 0.05$) to ($P < 0.04$), which produced more stable support for models when the loci were reduced.

Variation of landscape features

There are several potential explanations of the variability among landscapes in terms of the most-supported landscape resistance models. One explanation could be it is possible that variability in which landscape resistance models were supported among study landscapes is related to whether or not each landscape feature is variable and limits gene flow in a given landscape. For example, consider a situation where one is correlating gene flow of a species that is completely dependent upon forest with landscape structure in a landscape that is completely covered in forest. In this situation forest is a necessary element of the species' habitat and its occurrence and movement are totally dependent upon it. However, forest would not appear in a model predicting movement because forest is not limiting in a landscape that is completely covered in forest. Thus, it is possible for a critical dependence upon certain landscape features to be invisible to analysis depending upon whether this landscape element limits movement.

A second explanation may be that while there is a general relationship between spatial genetic structure of this species and landscape features the relatively small sample sizes of individuals in some landscapes and few sampled loci (five to seven) result in imprecision and low power such that we fail to identify the correct underlying process in many landscapes. For example, the low support for landscape resistance models in GNP might result from the hair snares being farther apart (7 km) and the higher density of bears than in other study areas, could lead to less sampling of closely related bears on adjacent home ranges and thus lower power to detect correlations between genetic distance and landscape distance.

We will focus our consideration on the first of these possibilities. Differences in supported models may result when certain landscape features do no limit gene flow in certain landscapes due to their extent or pattern, but do limit gene flow in other landscapes. A priori, we formalized three hypotheses related to this expectation.

Hypothesis 1: Variability in elevation

Our first hypothesis was that elevation will not be a landscape feature identified as influencing gene flow in landscapes where topography is relatively flat and elevation is not highly variable. The reasoning was, even if elevation is highly related to gene flow in American black bear its effect will not be detectible in landscapes that have little variability in elevation because in such landscapes there will be very little difference in movement cost as a function of elevation among individuals. Our results were fully consistent with this hypothesis. When analysis was restricted only to landscapes containing resistance models supported at a Mantel P value of less than 0.05, the effects size was 52% and was statistically significant ($P = 0.019$).

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We began to identify thresholds of variation necessary to have an observable influence on gene flow. The three study areas that we identified elevation as a landscape feature influencing gene flow had SDs in elevation above 300 m. The remaining three study areas had SDs in elevation less than 300 m. These results are all consistent with our hypothesis that elevation will be a landscape feature identified as influencing gene flow only when it is limiting to gene flow, and that it will be limiting only when there is a relatively high variability in elevation across a study area.

1a: Mid-elevation vs. high elevation

The second part of our first hypothesis was that we would expect middle elevation (EM) to be in models including elevation in landscapes to the northern parts of the full study area, and high elevation (EH) to be in models including elevation in landscapes in the southern parts of the study area. The reasoning behind this was that as one moves south lower and upper tree lines move upward in elevation, such that similar ecological conditions occur at higher elevations in the south than the north. This higher snowpack in the northern part of the study area also is related to the lower location of the upper tree lines in the north than the south.

Our hypotheses of mid-elevation (EM) occurring as a landscape feature identified as influencing gene flow in the north and becoming (EH) as you move south was statistically significant and the effects size was 197 km. This is a large effect size given the scale of our entire study area which is *c* 250 km across. The optimal elevation for gene flow is lower in the northern portion of the study area and higher in the south. This shows that nonstationarity in relationships between landscape structure and gene flow across broad geographical extents (e.g. Cushman *et al.* 2010b), which has important implications for conducting broad-scale landscape genetic analyses.

Hypothesis 2: Fragmentation of forest

Our second hypothesis was that we expected that forest cover would be a landscape feature identified as influencing gene flow for landscapes in which forest was highly fragmented and would not be included in landscapes that had low forest fragmentation. The reasoning was that even if forest cover is essential and nonforest is highly impermeable to gene flow, this relationship would only be detectible in landscapes where limited forest extent or substantial forest fragmentation limits gene flow. In landscapes where forest cover does not limit gene flow, such as landscapes that are continuously forested, there would be no statistical relationship between forest connectivity and gene flow across the landscape. Our analysis provided strong statistical support for this hypothesis. We expected that the correlation length of forest would be significantly lower in landscapes in which forest cover was a landscape feature identified as influencing gene flow than in landscapes in which it was not. We observed a large difference between means in the direction we expected. Effects size was 48% which reflects large differences in the connectivity of forest (Neel *et al.* 2004). These differences were highly statistically significant, despite very low power resulting from a small sample size.

Similar to elevation, we attempted to find thresholds of correlation length required to have an observable influence on black bear gene flow. The three study areas with forest identified as a landscape feature influencing gene flow were also the study areas with the lowest correlation lengths. The three study areas with correlation lengths of at least 20 000 m (less fragmentation) did not identify forest as a landscape feature influencing gene flow.

This has important implications for landscape genetic analyses. It is likely that forest cover is an essential component of habitat for American black bears and is likely essential to promote gene flow. However, our results indicate that landscape genetic analyses in many landscapes would fail to detect this relationship. In several of our study landscapes forest cover is high and forest fragmentation is low. It is likely that gene flow across these landscapes is not related to patterns in forest cover, as forest extent and fragmentation are not limiting to movement and dispersal. This does not mean that forest cover is not important, only that it is not limiting. This is an important case of where a relationship with a necessary resource is not detectible because it is not limiting and therefore does not structure the response variable. Landscape genetic analysis in the landscapes where forest is not limiting would not identify forest as an important driver of gene flow. From this it would be tempting to incorrectly conclude that forest cover is not important to black bear gene flow. This would be a logical error of denying the antecedent (Cushman & Huettmann 2010; Murphy *et al.* 2010) which commonly results from misinterpretation of statistical tests in which a model term with low variation it might have no statistical signal (Sokal & Rohlf 1995). This is one of the most important findings of this analysis, and highlights the importance of careful statistical interpretation and of landscape-level replication across a broad range of study landscapes to determine the features that limit gene flow and under what circumstances of landscape structure they become limiting.

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Hypothesis 3: Fragmentation by roads

The inclusion of roads in the most-supported landscape resistance model is predicted in this hypothesis to only occur when roads are at a sufficient density to limit gene flow. The correlation length of roads was 120% higher in study areas in which roads were included in the most-supported landscape resistance model than in study areas in which roads were not in the most-supported landscape resistance model. While this difference is only marginally significant due to high variability, the mean difference of 120% is a very large effects size, and is highly consistent with our expectation. The large number of study areas in which roads was included in a most-supported landscape resistance model suggests that roads are often an important limiting factor to gene flow in black bears. Our analysis suggests that the correlation length of roads in a landscape is related to whether or not roads limit gene flow. Another consideration is we modelled roads as having a resistance against gene flow; however, roads can also serve as movement and dispersal corridors (Balkenhol & Waits 2009).

Synthesis

Given all the above, this study has produced novel findings that have contributed to understandings of black bear ecology, population genetic structure, and gene flow. Using genetic data and individual-based modelling, our study has re-affirmed previous findings (e.g. radio collar data, Cushman & Lewis 2010) of the importance of landscape features such as middle elevation and forest cover for black bear movement. Our study has also evaluated the effect of the number of loci on landscape genetic study results, suggesting that six to eight loci ($H_E \approx 0.80$) might be sufficient if model support is strong ($P < 0.04$), confirming observations from simulated data (Murphy *et al.* 2008). Lastly, through examining the variation in landscape features within each of multiple study areas, we were able to begin to establish thresholds of variation in landscape features necessary to influence gene flow of black bears. For example, if SD in elevation is greater than *c.* 300 m, then elevation appears to influence gene flow.

Limitations and future research

A limitation of this research might be the relatively small number of loci used in the landscape analysis. However, the loci were highly polymorphic and thus have relatively high power to estimate important parameters such as interindividual genetic distance. Future research could include more loci and test for outlier loci, e.g. because of selection (Schwartz *et al.* 2009a,b). In addition, as in any landscape genetic study, there could be a lag time for a landscape signal to develop in the genetic data. Thus very recent landscape changes might not yet be detectable. Future research is needed to quantify the time lag until new barriers become detectable (e.g. Murphy *et al.* 2008; Landguth *et al.* 2010a,b), as well as to quantify the time until ancient historical barrier signals disappear (e.g. Landguth *et al.* 2010b). Future research should test a wider range of resistance models, conduct more extensive model optimization, assess the effect of scale or study area size on stability of support, and carefully quantify effects of noise (e.g. subsampling loci to assess most-supported landscape resistance model stability) vs. landscape signal (i.e. landscape variation).

Conclusion

Conducting studies in different landscapes can help achieve a general understanding of the relative influence of different landscape features on gene flow. This is crucial to understand how landscapes and landscape change can influence a species' ecology and evolution and thus influence management to maintain connectivity. Our results within 12 study areas generally support previous work which shows that gene flow in American black bear is facilitated by forest cover at optimal elevations, whereas nonforest cover and roads can impede gene flow. Our research suggests that using subsets of a full suite of loci can help assess support for landscape genetic models; we recommend future researchers use subsampling of loci to assess confidence in inferences about which features influence gene flow. Our study suggests that failure to study multiple landscape areas could lead to erroneous conclusions about which landscape features generally limit gene flow, and suggests ways to avoid erroneous conclusions. Failure to observe an effect of a given landscape feature in a landscape genetic analysis (e.g. Type I error) does not necessarily show that the feature is not critically related to gene flow. Further, we suggest that even critical landscape features will present strong relationships with genetic differentiation only when their pattern within a given landscape is substantially variable and thus limiting to gene flow. Conclusions that a certain landscape feature is (or is not) important for gene flow or substructure could be specific to a certain landscape or study area. Future research is needed to characterize the limiting factor relationships we describe and further quantify thresholds of variation in elevation, fragmentation of forest and extensiveness of road networks where these landscape conditions begin to influence gene flow in this species.

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Modeling Connectivity of Black Bears in a Desert Sky Island Archipelago

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Modeling connectivity of black bears in a desert sky island archipelago

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ABSTRACT

Landscape features such as rivers, mountains, desert basins, roads, and impermeable man made struc tures may influence dispersal and gene flow among populations, thereby creating spatial structure across the landscape. In the US Mexico borderland, urbanization and construction of the border fence have the potential to increase genetic subdivision and vulnerability to isolation in large mammal populations by bisecting movement corridors that have enabled dispersal between adjacent Sky Island mountain ranges. We examined genetic variation in black bears (*Ursus americanus*) from three regions in central and south ern Arizona, US, to assess genetic and landscape connectivity in the US Mexico border Sky Islands. We found that the three regions grouped into two subpopulations: the east central subpopulation comprised of individuals sampled in the central highland and high desert regions, and the border subpopulation comprised of individuals sampled in the southern Sky Islands. Occupancy for the border subpopulation of black bears was influenced by cover type and distance to water, and occupancy based corridor models identified 14 potential corridors connecting border Sky Island habitat cores with the east central subpop ulation. Biological quality of corridors, defined as length:width ratio and proportions of suitable habitat within corridors, declined with Sky Island dispersion. Our results show that black bears in the border sub population are moderately isolated from the east central subpopulation, the main population segment of black bears in Arizona, and that connectivity for border bears may be vulnerable to anthropogenic activ ities, such as those associated with urbanization and trans border security.

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1. Introduction

Habitat connectivity across a landscape is important to ensuring the persistence of populations through the maintenance of gene flow (Vos et al., 2001), metapopulation dynamics (With et al., 1997), and demographic rescue (Tallmon et al., 2004). Without connectivity, habitat fragmentation constrains animal dispersal and threatens biological diversity (Johnson et al., 1992; Woodroffe and Ginsberg, 1998). Through time, habitat fragmentation yields small isolated populations with elevated extinction probabilities (Lande, 1988; Hanski, 1999). This is particularly true in landscapes where geography leads to spatial structuring of populations, such as large carnivores in the Sky Island (i.e., montane mountain ranges) region of the Sonoran and Chihuahuan deserts of south western US and northern Mexico.

In human dominated landscapes, connectivity is often main tained through corridors (Beier and Noss, 1998). Yet corridors may not be sufficient to facilitate population viability if they do not maintain both structural and functional connectivity. Struc tural connectivity describes the degree to which habitat patches are contiguous or physically linked to one another (With et al., 1997; Tischendorf and Fahrig, 2000), while functional connectivity explicitly incorporates the behavioral responses of animals to de scribe how both habitat and non habitat (i.e., matrix) patches influence movement (Taylor et al., 1993; Wiens, 2001). Decreases in patch size and increased isolation may decrease structural con nectivity, but if the newly created matrix patches do not discour age movement, then functional connectivity may remain high (Baguette and Van Dyck, 2007). By contrast, a landscape may be characterized by a high degree of structural connectivity but have diminished functional connectivity as a result of being bisected by a feature that limits movement by creating exceptional risk of

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crossing (e.g., roads, rivers) or acts as a physical impediment (e.g., a fence) (Proctor et al., 2005; Hayward and Kerley, 2009). Detailed information on structural and functional connectivity of corridors is important for predicting their efficacy to conserve wildlife (Beier and Noss, 1998), especially in areas where species already occupy fragmented habitats.

Arizona's desert Sky Island mountain ranges encompass one of the most biologically diverse regions in the United States. Suitable habitat for many of the region's large carnivores, including black bears (*Ursus americanus*), mountain lions (*Puma concolor*), and jag uars (*Panthera onca*) is found in oak woodland and montane habi tats separated by lowland desert. Rapid urbanization and the construction of the US Mexico border fence have the potential to drive genetic subdivision in large mammal populations by severing corridors that historically enabled dispersal between Arizona and Mexico Sky Island ranges (Flesch et al., 2010). Black bears in the re gion rely heavily on food resources found in these higher elevation montane habitats. The spatial dispersion of montane habitat has likely served to historically subdivide black bear populations, cre ating detectable genetic structure driven by infrequent, long dis tance movements across desert basins (McRae et al., 2005; Onorato et al., 2004). Thus, desert black bears are an ideal candi date for modeling connectivity.

In this study, we integrated landscape genetics with occupancy modeling to assess landscape connectivity for black bears in south ern Arizona's desert Sky Islands. Our objectives were to (i) assess genetic connectivity between black bears along the border with So nora, Mexico, and the main population segment in east central Ari zona, and (ii) identify potential corridors linking core black bear habitats in the border Sky Island ranges. For the former objective, we hypothesized that bears along the border were genetically iso lated from east central bears. For the latter objective, we expected corridor quality to decline as the distance between linked core habitats increased.

2. Methods

2.1. Study areas

We sampled black bears from several sites in east central and southern Arizona (Fig. 1). East central sites were located in the cen tral highlands north of the Mogollon Rim and the high desert imme diately south of the Rim, where black bear habitat is relatively continuous (Fig. 1). The central highlands site was contained mostly within the White Mountains of the Apache Sitgreaves National For est, approximately 230 km east of Phoenix, Arizona (Fig. 1). The area was characterized by rugged terrain with steep slopes and deep can yons, an elevational gradient ranging from 1300 to 3000 m, and Rocky Mountain montane and subalpine habitat associations (Brown and Lowe, 1974). Areas above 1700 m were predominantly comprised of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and blue spruce (*Picea pungens*) associations be tween 2400 and 2750 m; ponderosa pine (*Pinus ponderosa*), Gambel oak (*Quercus gambelii*), and aspen (*Populus tremuloides*) occur at low er elevations (<2400 m). The central highlands encompassed a ma jor portion of the watershed providing water to the Phoenix metropolitan area (population 4,192,887) via the Salt and Gila rivers. Yearly precipitation averaged 192 cm, most of which came during the winter as snowfall. Average daily temperatures ranged from 28 °C in July to −12 °C in December (NOAA, Western Regional Cli mate Center). Predominant land use within the area included timber production, livestock grazing, and recreation. Human population density for the area was 2.39/km^2, and housing density was 1.08/km^2 (http://quickfacts.census.gov/qfd/states/04000.html; accessed 29 June 2011).

The site south of the Mogollon Rim (hereafter referred to as the Tonto site) was located almost entirely within the Tonto National Forest (Fig. 1). The Tonto site was approximately 81 km east of Phoenix and 18 km west of Globe (population 7532), the nearest urban center. Elevations in the area ranged from 700 2300 m, with lower elevations characterized by gently sloping terrain and higher elevations having steep, rocky topography with slopes >45° (Cunn ingham et al., 2003). Primary vegetation at lower elevations was desert scrub and grassland (<900 m) and interior chaparral (900 1850 m) (Brown and Lowe, 1974). Madrean evergreen woodland (e.g., Gamble oak, Emory oak [*Quercus emoryi*], and ponderosa pine) occurred at higher elevations (>1850 m; Brown and Lowe, 1974). Yearly precipitation averaged 63 cm, most of which came during the summer (July and August) monsoons. Average daily temperatures ranged from 37 °C in July to −1 °C in December (NOAA, Western Regional Climate Center). Predominant land use within the area included livestock grazing and recreation. Human population and housing densities were 4.17/km^2 and 2.28/km^2, respectively, for the greater area (http://quickfacts.census.gov/qfd/states/04000.html; accessed 29 June 2011).

At the southern site (hereafter referred to as the border site), sam ples were collected from six Sky Island mountain ranges (i.e., Pata gonia and Huachuca [wildland block 3], Whetstone [wildland block 4], Rincon [wildland block 9], Galiuro [wildland block 11], and Chir icahua [wildland block 7] mountains; Fig. 2), north of the border with Sonora, Mexico, and mostly located within the Coronado National Forest. The border site was mostly southeast of the Tucson metropol itan area (population 980,263); the most intensive sample collection occurred in wildland block 3, 83 km southeast of Tucson and directly adjacent to the town of Sierra Vista (population 43,044) and Fort Huachuca military base (Fig. 1). Elevations at the border site ranged from 1300 to 3000 m, with the lowest elevations (<1370 m) charac terized as desert basin primarily comprised of catclaw acacia (*Acacia greggii*), creosote (*Larrea tridentata*), and mesquite (*Prosopis glandul osa*) (Wallmo, 1955). Desert shrub and grassland associations oc curred at elevations between 1370 and 1524 m, oak woodlands occurred between 1524 and 2130 m, depending on specific site char acteristics, and Madrean evergreen woodland generally occurred at elevations >1800 m (Wallmo, 1955). Yearly precipitation averaged 39 cm, most of which came during the summer (July and August) monsoons. Average daily temperatures ranged from 35 °C in July to 0.5° C in December (NOAA, Western Regional Climate Center). Pre dominant land use for the area includes livestock grazing and recre ation. The distribution of black bear habitat at the border site was discontinuous and constrained to Sky Island mountain ranges (Fig. 1). The human population (9.62/km^2) and housing densities (3.85/km^2) for the greater border area were the highest of the three sampling sites (http://quickfacts.census.gov/qfd/states/04000.html; accessed 29 June 2011).

The Patagonia Huachuca and Tumacacori (i.e., wildland block 1; Fig. 2) wildland blocks straddled the Arizona Sonora border, while all other wildland blocks included in connectivity analyses occurred entirely within Arizona. The Patagonia and Huachuca mountains extended approximately 31 km and 4 km, respectively, into Sonora, with the Patagonia Mountains separated by 7 km from the northern extent of the large (≈5396 km^2) Sierra Mariquita Sierra de los Ajos mountain range complex (Fig. 2). The Tumacacori wildland block extended 5 km into Sonora and the southern most extent was within 7 km and 19 km, respectively, of the Sierra Cib uta and Sierra de Pinitos mountains (Fig. 2). Vegetation in northern Sonora mirrored that of southern Arizona, with shrub and grass land associations at lower elevations, oak woodlands at mid eleva tions, and Madrean evergreen woodlands at higher elevations (Brown, 1994; Bahre and Minnich, 2001). Predominant land use in northern Sonora was livestock grazing (Vasquez Leon and Liver man, 2004). The international boundary between Arizona and So

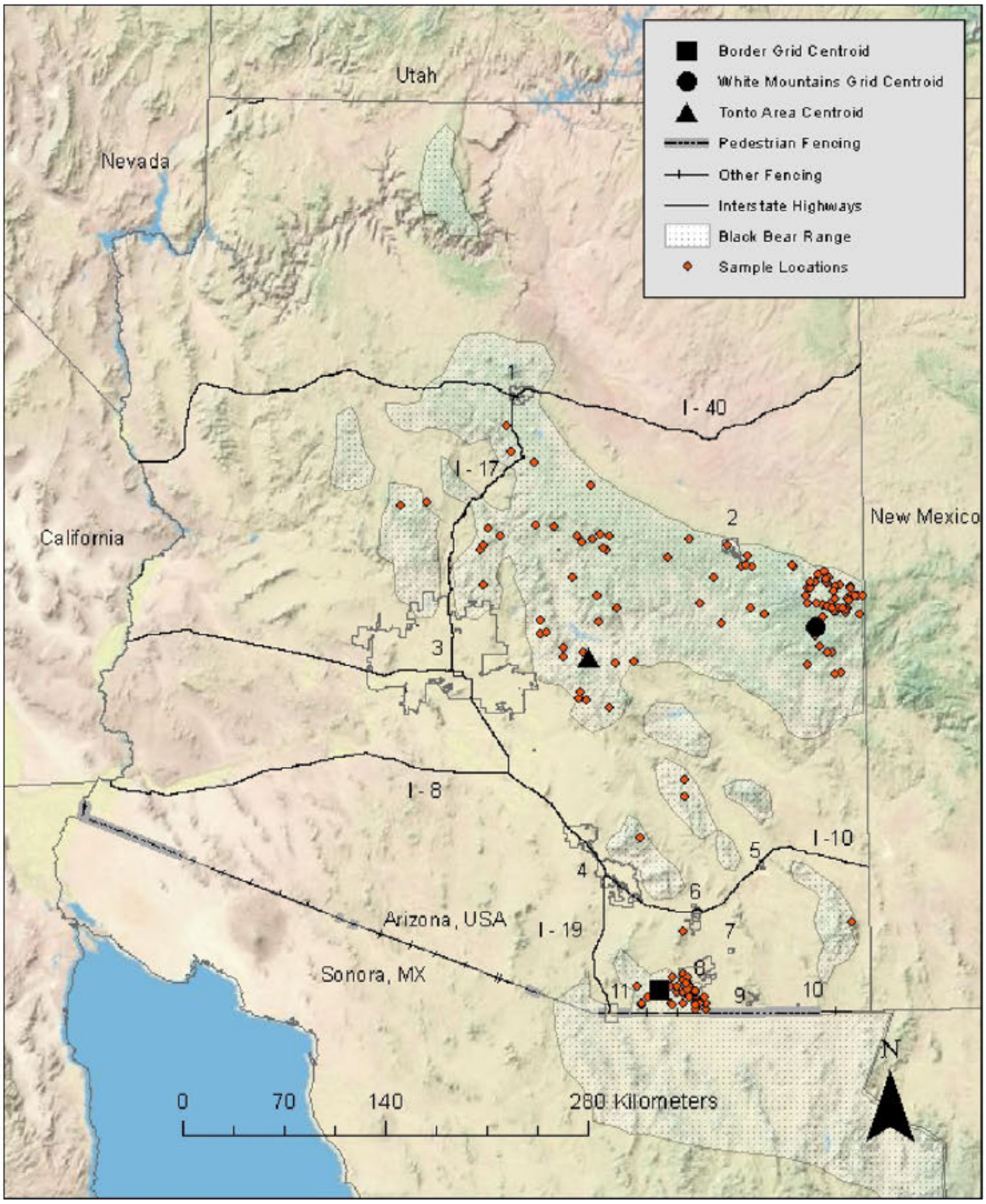

Fig. 1. Distribution of black bear samples collected opportunistically and from hair-snag grids relative to [d]urban centers and major transportation corridors. The Tonto sampling area and White Mountains grid were located in the central highlands region and the border grid was located in the Huachuca and Patagonia mountains. [d]Arizona cities and metropolitan areas: (1) Flagstaff, (2) Show Low, (3) Phoenix metropolitan area, (4) Tucson metropolitan area, (5) Willcox, (6) Benson, (7) Tombstone, (8) Sierra Vista and Ft. Huachuca, (9) Bisbee, (10) Douglas, and (11) Nogales.

nora, Mexico, spans nearly 600 km, approximately 70% of which was fenced. The type of fence structure varies along the border (Fig. 1). Some segments were ⩾4 m tall with either no openings or vertical gaps 5 10 cm wide and thus impermeable to most med ium and large bodied mammals, while other sections consisted of 4 6 strands of barbed wire coupled with "Normandy style" cross bar vehicle barriers (United States Customs and Border Protection, 2009), and were relatively permeable.

2.2. Black bear distribution and status in Arizona and Sonora, Mexico

In Arizona, black bears were classified as a game species and were hunted during the spring and fall. Season lengths and harvest limits varied by game management unit (GMU), with all units being closed for the season when the female harvest approximated 10% of the estimated female population in the unit. For GMU in the border sampling area, harvest limits were conservative and gener ally range from 1 3 females/GMU/yr. Black bears in Mexico were classified as "endangered of extinction" in 1986, and hunting sea sons were closed indefinitely (Doan Crider and Hellgren, 1996). Over the last several decades, the historical distribution of black bears in Mexico is believed to have been reduced by 20% due to habitat loss, poaching, and illegal trade (Doan Crider and Hellgren, 1996; Sierra Corona et al., 2005). Relatively little is known about the status of black bears in Sonora. Sierra Corona et al. (2005), working in the Sierra de San Luis in northeastern Sonora (Fig. 2; wildland block 21), found that bear density was low compared to similar areas on either side of the border (e.g., Coahuila, Mexico: Doan Crider, 1995; east central Arizona: LeCount, 1982), but did not comment on possible reasons.

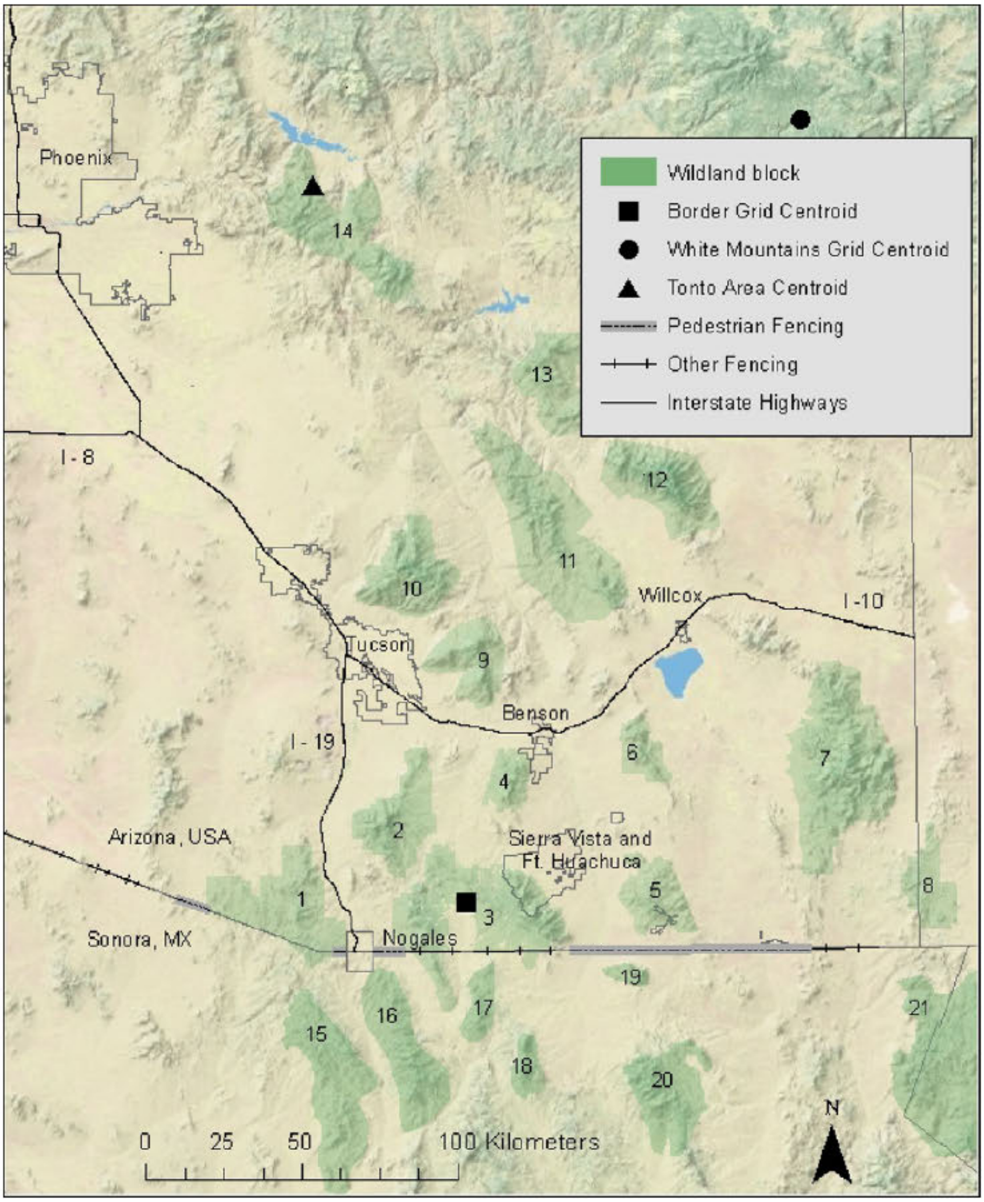

Fig. 2. Sky Island [a]wildland blocks spanning from northern Sonora, Mexico, to the east-central Arizona. [a]Wildland Blocks: (1) Tumacacori, (2) Santa Rita, (3) Huachuca-Patagonia, (4) Whetstone, (5) Mule, (6) Dragoon, (7) Chiricahua, (8) Peloncillo, (9) Rincon, (10) Santa Catalina, (11) Galiuro-Winchester, (12) Pinaleno, (13) Gila, (14) Pinal, (15) Sierra Cibuta, (16) Sierra Pinito, (17) Sierra Chivato, (18) Sierra Elenita, (19) Sierra San Jose, (20) Sierra Los Ajos, and (21) Sierra San Luis.

2.3. Sample collection and genetic analyses

We collected hair samples from black bears using hair snags and hair and tissue from mandatory hunter check in. We deployed two hair snag sampling grids, one at the border site in the Huachuca and Patagonia mountains (i.e., Huachuca Patagonia grid; wildland block 3), and one in the central highlands (i.e., White Mountains grid) (Fig. 1). The Huachuca Patagonia and White Mountains grids consisted of 67 and 74 grid cells (4×4 km), respectively. Sixty three percent of the Huachuca Patagonia grid was comprised of evergreen habitat associations, 23% was desert shrub and grassland, and the remaining 9% was oak woodland. For the White Mountains grid, 79% was comprised of evergreen habitat associations, 13% was montane shrub and grassland, and the remaining 8% was deciduous woodland. In each cell, we built a hair snag "corral" by running a single strand of barbed wire at a height of approximately 45 cm around several trees (Woods et al., 1999). We chose hair snag locations based on black bear sign, natural travel routes, and forage availability, and maintained a minimum distance of 2 km between hair snags located in adjacent cells. We baited the center of corrals with 1L of aged fish oil, and ran 3, 10 14 d capture sessions from May through September. The use of a single lure and a standard volume should control for lure induced heterogeneity in habitat specific detection probabilities (MacKenzie et al., 2006). We used forceps to collect hair samples from barbs, stored individual samples in tooth envelopes, and flamed barbs to prevent cross contamination. Samples also were obtained at the high desert site from hair snags located in the Tonto National Forest that were independently deployed and operated by Arizona Game and Fish Department (AGFD) personnel (Fig. 1). The Tonto hair snags were deployed opportunistically rather than in a grid design, which precluded their use in estimating a site density.

We extracted DNA from samples using a Qiagen DNeasy Blood and Tissue Kit (Qiagen) employing an ammonium acetate protocol (modified from the PUREGENE kit; Gentra Systems). We used a set of 11 microsatellite loci known to amplify in black bears (G10J, G10M, G10X, G10B, G10H, G10C, G10L, G1D, G1a, UarMu50, Uar Mu59; Paetkau et al., 1995, 1998) grouped into three sets based on product size and primer label. Each set of loci was amplified to gether in the same Polymerase Chain Reaction (PCR) in 10 μL PCRs using a Master cycler ep gradient (Eppendorf) and 3 μL of template DNA, 0.2 mM of each dNTP, 0.2 M to 0.4 M of each primer pair, 1 U of *Taq* DNA polymerase (NEB), 1.25 mM $MgCl_2$ and 2× reaction buffer (10 mM Tris HCl, 50 mM KCl, 0.05 mg/mL BSA). Amplifica tion conditions were 94 °C for 2 min, then 94 °C for 30 s, 60 °C for 30 s, 72 °C for 30 s for 35 cycles, then 72 °C for 10 min and a fi nal extension at 60 °C for 45 min. Multiplexed reactions were com bined with an internal lane size standard and electrophoresed through a capillary gel matrix using an ABI 3730 Automated DNA Sequencer. Allele sizes were determined for each locus using GeneMapper software v3.7 (Applied Biosystems).

We ran positive and negative controls within each genotyping set and included an individual of known genotype at each locus within every sample set analyzed to maximize quality and consis tency of genotyping. Each sample was amplified repeatedly until 3 matching genotypes were obtained at each locus within each indi vidual, or until we ran out of DNA, to avoid errors associated with DNA collected with non invasive methods (Taberlet et al., 1996, 1999; Kohn and Wayne, 1997). This resulted in the generation of at least three multilocus genotypes for each sample.

For sex determination, a fragment of the amelogenin gene was amplified using the primers SE47 and SE48 (Ennis and Gallagher, 1994). The amplification conditions were similar to those used for the microsatellites except the annealing temperature was 64 °C and the annealing and extension times were decreased to 15 s per cycle. PCR products were run on a 2% agarose gel stained with ethidium bromide. Samples were scored as female if they exhibited one band and males if there were two bands. DNA sam ples extracted from the tissues of known sex harvested black bears were used as controls for our sexing assessments.

The program GIMLET (Valiere, 2002) was used to generate a consensus multilocus genotype for each sample and to identify matching multilocus genotypes among samples. Samples with genotypes for at least 6 loci were retained in the dataset; loci that did not have three matching genotypes were scored as "missing data." Only unique multilocus genotypes were included in subse quent analyses of basic population genetic parameters for the over all dataset. We calculated the number of alleles per locus, observed heterozygosity (H_O), and expected heterozygosity (H_E) for each lo cus using GDA (version 1.1, Lewis and Zaykin, 1999). Tests for link age disequilibrium and deficiencies of heterozygotes relative to Hardy Weinberg expectations for each locus and globally were performed using the program GENEPOP (version 3.4; Raymond and Rousset, 2000). We employed two Bayesian clustering soft ware programs, STRUCTURE (version 2.2, Pritchard et al., 2000) with the ΔK method (Evanno et al., 2005) and GENELAND (version 3.1.4, Guillot et al., 2005b), to infer the number of subpopulations in our dataset and assign individuals to those subpopulations. All samples with unique multilocus genotypes were used in the STRUCTURE analysis, whereas only those samples with both un ique multilocus genotypes and spatial coordinates were used in the GENELAND analysis.

In STRUCTURE we performed five runs at each value of K (the number of subpopulations) from $K = 1$ to $K = 10$. Each run consisted of 100,000 replicates of the MCMC after a burn in of 30,000 repli cates. We used the admixture model and allowed the allele fre quencies to be correlated among subpopulations. To assign individuals to subpopulations, a final run (100,000 burn in and 500,000 replicates) at the inferred K was performed. The values of q, which are indicative of the proportion of an individual's gen ome characteristic of each subpopulation, were used to assign indi viduals. Individuals were considered unambiguously assigned to a subpopulation when q values were greater than 0.75. When q val ues were less than 0.75, assignments of individuals were distrib uted among multiple subpopulations. To infer the number of subpopulations (K) in GENELAND, we first varied the number of subpopulations from 1 to 5 using 5000 stored MCMC iterations (200,000 iterations, thinning = 40). We set the maximum rate of the Poisson process to 100 (a value close to the number of individ uals in our data set) and the maximum number of nuclei to 300 (3 ∗ maximum rate as suggested by Guillot et al., 2005a). We ran the GENELAND MCMC 10 times with the level of uncertainty attached to our spatial coordinates set to 2 km. We used the mode of the dis tribution of K as a point estimate of K. The assignment of individ uals to subpopulations was performed in a separate run as suggested by Guillot et al. (2005a). For this run, K was set to the in ferred number of subpopulations and all other parameters were similar to those runs with variable K. The posterior probability of subpopulation membership was computed for each pixel of the spatial domain (50 × 50 pixels), using a burn in of 1000 iterations. Individuals with a posterior probability of population membership of greater than 0.75 were unambiguously assigned to that subpopulation.

For each subpopulation inferred in either STRUCTURE or in GENELAND, levels of genetic diversity were estimated by calculat ing the average number of alleles per locus, observed heterozygos ity (H_O), expected heterozygosity (H_E), fixation index, and the number and frequency of unique alleles using GDA. We estimated the levels of genetic differentiation among the inferred subpopula tions by calculating F_{ST} in GDA. Significance of each F_{ST} value was based on 95% confidence intervals determined by bootstrapping across all loci, where confidence intervals bracketing zero indicate no evidence of genetic variance partitioning between sample sub set pairs. Average relatedness of individuals within each subpopu lation was assessed using Wang's (2002) estimator in SPAGeDi (Hardy and Vekemans, 2002).

The program CAPWIRE (Miller et al., 2005) was used to estimate population size within the Huachuca Patagonia and White Moun tains grids. We set the maximum population size to 100 for the Huachuca Patagonia grid and 400 for the White Mountains grid, and used the likelihood ratio test (LRT) to determine which capture probability model was most accurate. Two capture models are available: the even capture probability model (ECM) where every individual is equally likely to be captured and the two innate rates model (TIRM) where individuals do not display equal capture prob abilities. The appropriate model, based on LRT, was then used to estimate population size for each of the two grids.

2.4. Occupancy and landscape modeling

For occupancy analyses, our objective was to determine if bear occupancy (ψ) at the border hair snag grid (i.e., Huachuca and Pat agonia mountains) differed relative to habitat type and landscape covariates. We used the occupancy model option in program MARK (White and Burnham, 1999) to estimate occupancy relative to land cover (Madrean evergreen woodland [MEW], mixed conifer wood land [MXC], semi desert grassland [DG], plains and Great Basin grassland [GBG], and oak woodland [OW]), slope (°), aspect, eleva tion (m), and distances to permanent water and roads (m). We used point extraction and Euclidean distance routines in a 30 m resolu tion (i.e., USGS Seamless Server NED data) GIS to collect informa tion on land cover and landscape covariates for hair snag locations. We tested for collinearity among potential variables by examining tolerance and variance inflation factors (VIF) using weighted least squares regression, and excluded variables with tol erance scores <0.4 from analyses (Allison, 1999).

We formulated 12 models and kept the detection probability (p) constant, assuming it did not vary across time or habitat types and was not influenced by individual covariates. We modeled occupancy (ψ) with and without a habitat effect (i.e., group effect) or individual covariates. We used the variance inflation factor (i.e., c hat in MARK) to guard against overdispersion and the small sample size correction of Akaike's Information Criterion (QAICc). C hat was calculated using the median c hat procedure in program MARK. In addition to reporting model selection results, we also reported the beta parameter and 95% confidence interval for the covariates and evaluated whether or not the beta parameter overlapped zero and used this as further evidence of the significance of each individual covariate for modeling occurrence of bears. We calculated model averaged occupancy values and 95% confidence intervals for the model averaged parameters following procedures in program MARK.

Corridor modeling involved four steps: (i) creating a habitat suitability model; (ii) identifying breeding and population size patches within Sky Island wildland blocks (i.e., polygons estimating the areal extent for each Sky Island range; Fig. 1); (iii) creating a cost surface representing the grid cell resistance to movement; and (iv) applying a cost distance routine to identify pixel swaths (i.e., corridors) linking wildland blocks. We used the results of the border occupancy model to parameterize a habitat suitability model (HSM) for the composite sampling region (i.e., 15 mountain ranges [four of which were combined into two wildland blocks] comprising the sky island complex and 1 mountain range [Pinal Mountains; wildland block 14] representing the southern extent of the high desert sampling region; Fig. 2). The HSM was comprised of grid layers representing land cover, elevation, aspect, slope, distance to water, and distance to road. For all grids we reclassified pixel values using the results from the occupancy models. Distances to road and water were weakly correlated (i.e., tolerance <0.4), but because it has been documented that bears avoid roads (e.g., Brody and Pelton, 1989), we included a reclassified road grid in our HSM.

We reclassified the land cover grid by collapsing 35 landcover classes from the 2001 National Landcover Data (NLCD) set (e.g., Encinal oak woodland) into five broader categories (e.g., oak woodland) and assigning the latter a value from 0 (absolute non habitat) to 100 (optimal habitat) based on detection probabilities scaled from occupancy models (Table 1). For the elevation, aspect, and distances to water and roads grids, we created 5, 4, 3, and 3 evenly spaced bins, respectively, and assigned values (0 100) based on probabilities of occurrence at hair snag stations (Table 1). Slope often is modeled as a discrete value for individual grid pixels. While convenient, that practice may fail to capture neighborhood permeability thresholds that can occur in a rugged landscape, such as the Sky Island region. Accordingly, we used a moving window analysis in a GIS where we characterized the topographic position of a given pixel relative to adjacent pixels found within a 200 m radius. Using this method, we classified pixels as canyon bottom if the focal pixel elevation was at least 12 m less than the neighborhood average, a ridge top if the pixel elevation was at least 12 m greater than the neighborhood average, a gentle slope if the pixel was neither a canyon bottom nor a ridge top and had a slope <6°, and a steep slope if the pixel was neither a canyon bottom nor a ridge top and had a slope >6°. The resulting topographic position index (TPI) grid was then reclassified following the method used for the elevation grid but using three bins. Finally, we combined the six individual grids using a weighted geometric mean algorithm (Table 1) where individual grid weighting factors were scaled to their proportional contribution based on the model averaged Akaike weights.

We used the HSM to identify contiguous areas of suitable habitat that could function as breeding and population size patches within wildland blocks. Based on previous black bear work conducted in Arizona, we selected a minimum breeding patch size of 50 km^2 and extrapolated a minimum population patch ($n = 50$ bears) size of 300 km^2 (LeCount, 1982). We used a moving window analysis (200 m radius) in a GIS to group together pixels with a suitability value of ⩾60 into the breeding and population patches. We chose the 200 m radius to depict suitability relative to the landscape pattern and the spatial requirements and perceptual ability of black bears (Vos et al., 2001). The Sky Island landscape is relatively patchy in nature, owing to the basin and range topography, and the window analysis must be fine enough to detect changes in patch quality at a scale that bears are likely to perceive (Lima and Zollner, 1996). Cunningham and Ballard (2004) found that the home ranges of female black bears in central Arizona's Sky Islands averaged 13 km^2. Our 200 m radius equates to a 12.6 ha neighborhood, which is approximately one tenth the area of the average female home range, and should represent a patch size that bears can detect.

We converted the HSM into a cost surface by calculating cell resistance (i.e., travel cost; cell resistance = 100 pixel suitability) for the entire grid. The resulting cost surface grid was comprised of pixel values that reflected the cost of (or resistance to) movement through each individual grid cell, with increasing cell values representing increasing resistance to movement. We then applied a moving window analysis (200 m radius) to generate corridor models (pixel swaths) that connected habitat cores while minimizing resistance to movement. We selected the best biological corridors (e.g., Bennett et al., 1994) based on the pixel swath that minimized within swath gaps, maximized within swath habitat suitability, and reduced edge effects by maintaining a minimum width equal to the radius of an estimated home range (LeCount, 1982; Cunningham and Ballard, 2004). All habitat and corridor modeling was done using the CorridorDesigner package for ArcGIS (Majka et al., 2007).

Table 1
Grid layers and variables, reclassified grid cell values, weighting factors used to assemble the habitat suitability model for the Arizona border Sky Islands.

Variable	Reclassified cell value	Weighting factor
Land cover type		0.50
Madrean evergreen	100	
Mixed conifer	68	
Oak woodland	84	
Semi-desert grassland	56	
Plains and Great Basingrassland	1	
Distance to water		0.35
<500 m	100	
500–1000 m	50	
>1000 m	25	
Distance to roads		0.05
<500 m	25	
500–1250 m	50	
>1250 m	100	
Aspect		0.04
North	80	
East	35	
South	100	
West	25	
Elevation		0.03
>763 m	20	
163–1219 m	37	
1220–1981 m	100	
1982–2591 m	81	
2592–4000 m	63	
Topographic position		0.03
Canyon bottom	50	
Gentle slope	100	
Ridge top	25	

Table 2
Characterization of the 11 microsatellite loci used in genetic analyses of black bears sampled at central highlands and border sites in Arizona, 2007–2008. Number of samples genotyped (*N*), number of alleles per locus (*A*), expected (H_E) and observed (H_O) heterozygosities and the fixation index are reported.

Locus	*N*	*A*	H_E	H_O	*f*
G10J	157	7	0.679	0.637	0.062
G10M	155	5	0.692	0.587	0.152[a]
G10X	157	6	0.548	0.580	−0.057
G10B	151	7	0.559	0.556	0.072
G10H	157	10	0.484	0.510	−0.052
G1D	158	7	0.743	0.684	0.081[a]
UarMu50	157	3	0.126	0.083	0.343[a]
G10C	156	4	0.329	0.346	−0.051
G10L	157	8	0.815	0.790	0.031
G1A	156	6	0.192	0.186	0.034
UarMu59	148	6	0.663	0.635	0.042
All	155.36	6.27	0.534	0.508	0.048

[a] Significant heterozygote deficiency ($\alpha = 0.05$).

3. Results

3.1. Genetic connectivity

Samples for genetic analyses were distributed over $\approx$31,250 km^2 in the east central region and collected from six Sky Island mountain ranges (Fig. 1). For the White Mountains hair snag grid, samples were collected from 43% of grid cells, with 35% of those hair snags yielding samples from $\geqslant$2 capture sessions. Similarly, samples were collected from 40% of grid cells at the border hair snag grid, with 46% of those hair snags yielding samples from $\geqslant$2 capture sessions. We were able to obtain usable multilocus genotypes for 189 of the 258 samples. Of these 189 multilocus genotypes, 158 were identified by GIMLET as being unique. Of these 158 individuals, 52 were female and 96 were male (10 of unknown sex). For the pooled sample, the overall number of alleles per locus ranged from 3 (UarMu50) to 10 (G10H) and observed single locus heterozygosities ranged from 0.083 (UarMu50) to 0.790 (G10L) (Table 2). Global tests of the pooled dataset revealed an overall significant deviation from Hardy Weinberg equilibrium ($P = 0.003$) and significant deficiencies of heterozygotes at three individual loci were observed, which is not unexpected if there is underlying population subdivision within the pooled data set (Table 2). Linkage disequilibrium was observed between three pairs of loci (G1D G10B, G1D G10L and G1D G10 J) after a sequential Bonferroni correction ($\alpha = 0.00019$). Assuming matching multilocus genotypes indicate re captures, 138 bears were captured only once, 13 bears were captured twice, four were captured three times, two were captured four times, and one was captured five times. In each instance where the data indicated that a bear was recaptured multiple times, all recaptures for that individual occurred within the same grid used for population estimation or within the set of individuals that could not be assigned to a grid. In only four instances did the multilocus genotypes of pairs of unique individuals differ at less than three loci.

STRUCTURE and the ΔK measure indicated the most likely number of subpopulations (K) was 3 (Fig. 3a); however at $K = 3$ few individuals were assigned to any of the three subpopulations with high certainty. When $K = 2$, most individuals were unambiguously assigned to one of two subpopulations (Fig. 3b). These two subpopulation groupings roughly corresponded to the east central ($n = 102$; 62 males, 38 females, 2 unknown sex) and border ($n = 33$; 17 males, 11 females, 5 unknown sex) regions. Twenty

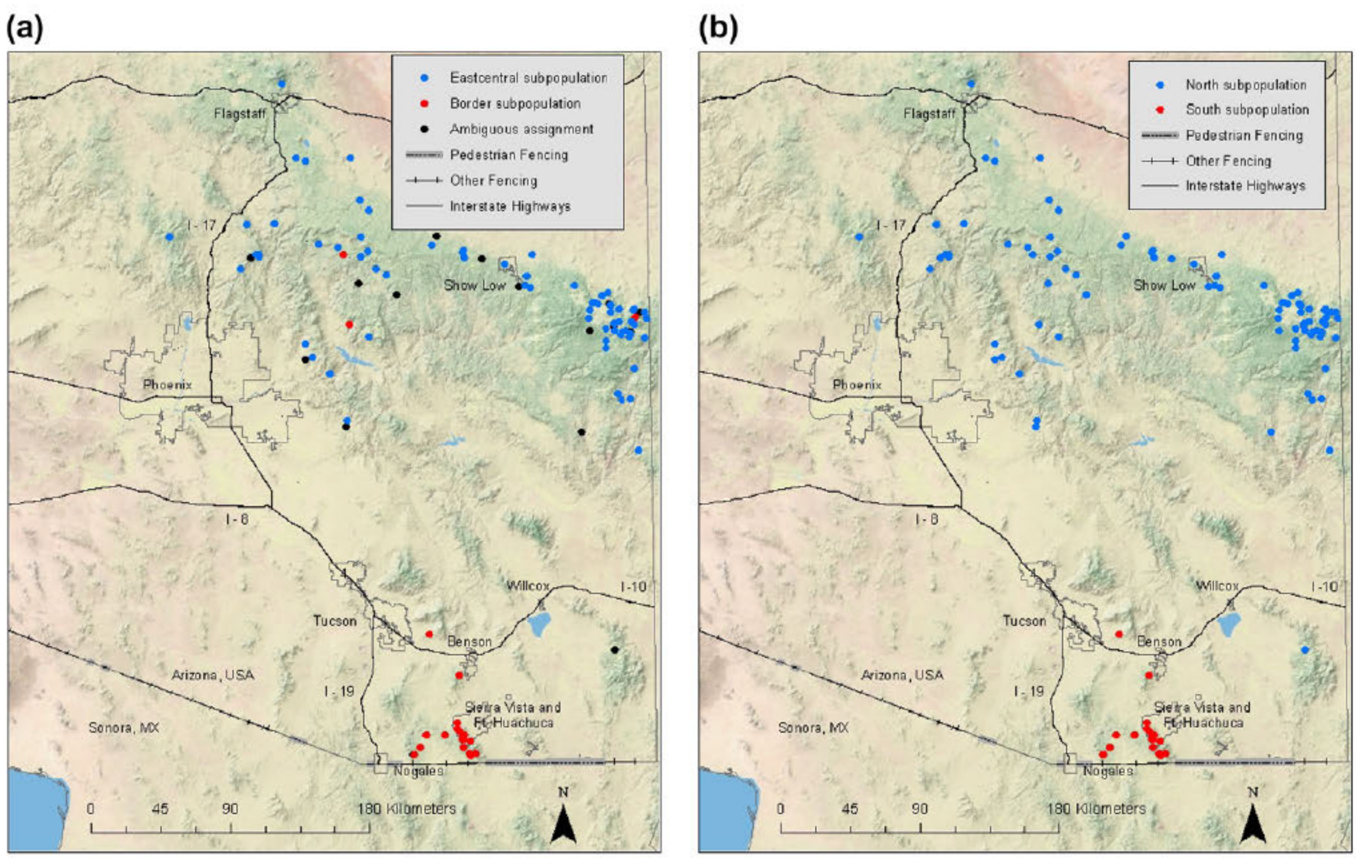

Fig. 3. (a and b) Subpopulation assignments of black bears sampled in Arizona. Assignments were based on genetic information using the programs structure (a) and Geneland (b).

Table 3
Estimates of genetic diversity for the two subpopulations identified from black bears sampled at central highlands and border sites in Arizona, 2007–2008. Number of samples genotyped (N), average number of alleles per locus (A), expected (H_E) and observed (H_O) heterozygosities, fixation index (f) values, and (F_{st}) are reported.

Population	N	A	H_E	H_O	f	F_{st}
Overall	158	6.3	0.534	0.508	0.048	NA
East-central[a]	102	5.8	0.541	0.538	0.006	0.111
Border[a]	33	4.3	0.432	0.422	0.023	
East-central[b]	113	6.2	0.540	0.534	0.011	0.113
Border[b]	28	3.9	0.411	0.401	0.024	

[a] Subpopulations assigned by STRUCTURE. Twenty-three bears with ambiguous assignments were removed from the dataset.
[b] Subpopulations assigned by GENELAND.

three individuals (17 males, 3 females, 3 unknown sex) were assigned to both subpopulations (q values less than 0.75): 19 of the individuals were from the central highlands area, 3 were from the high desert area, and one was from the border area. These ambiguously assigned individuals were not included in the subsequent genetic or demographic analyses of the inferred subpopulations. Similar levels of genetic diversity were observed within each of the two subpopulations defined by STRUCTURE (Table 3). There were large numbers of unique alleles in the east central subpopulation ($n = 22$) compared to the border subpopulation ($n = 5$). Most unique alleles were at low frequency, however at 1 locus (G1D in the border subpopulation) a unique allele was observed at a frequency of 41%. Significant genetic differentiation was observed between the two inferred subpopulations ($F_{ST} = 0.111$; 95% CI: 0.056 0.156; $n = 135$; Table 3). Average relatedness estimates of individuals within subpopulations were 0.16 and 0.37 in the central highlands and border subpopulations, respectively.

The GENELAND analysis indicated that the most likely number of subpopulations was 2. Through the incorporation of spatial coordinates, GENELAND was able to identify a northern subpopulation ($n = 113$, 70 males, 37 females, 6 unknown sex) and a southern subpopulation ($n = 28$, 15 males, 10 females, 3 unknown sex) which corresponded to the east central and border regions of our study. All individuals were unambiguously assigned to one of the two subpopulations. Similar levels of genetic diversity were observed within each of the two subpopulations defined by GENELAND (Table 3). There were large numbers of unique alleles in the east central subpopulation ($n = 26$) compared to the border subpopulation ($n = 1$), however most unique alleles were at low frequency. Significant genetic differentiation was observed between the two inferred subpopulations ($F_{ST} = 0.113$; 95% CI: 0.051 0.167; Table 3). Average relatedness estimates of individuals within subpopulations were 0.16 and 0.41 in the east central and border subpopulations, respectively.

Table 5
Occupancy (ψ) estimates of black bears in different habitat types at Border study site in Arizona. Estimates were generated in program MARK by model averaging values of ψ over the suite of candidate models presented in Table 4.

Habitat type	ψ	SE	Lower95% CI	Upper95% CI
Madrean evergreen (MEW)	0.72	0.10	0.50	0.87
Mixed conifer (MXC)	0.55	0.17	0.25	0.83
Desert grassland (DG)	0.45	0.25	0.10	0.86
Great Basin grassland (GBG)	0.10	0.23	0.001	0.94
Oak woodland (OW)	0.71	0.14	0.39	0.90

The LRT in CAPWIRE identified the TIRM as most appropriate capture probability model for data from the White Mountains grid and estimated the population size to be 252 bears (95% CI: 137 396). The ECM was identified as most appropriate capture probability model for data from the Huachuca Patagonia grid and population size was estimated to be 69 bears (95% CI: 39 82).

3.2. Occupancy and connectivity modeling

For the border data set we estimated probability of detection to be 0.79 (SE = 0.04) and found strong evidence that occupancy differed between habitat types and that distance to water (disw) from hair snags influenced estimates of occupancy (ψ). Models with a habitat effect (group effect) accounted for 85% of the weight (Table 4) and the individual covariate "disw" was in the top two models (accounting for 61% of the model weight), and was the only covariate whose 95% confidence interval around the beta value did not overlap zero (Table 4). Occupancy estimates ranged between 0.72 and 0.10 between habitat types with occupancy highest in MEW followed by OW, MXC, DG and GBG (Table 5). Variance was highest for DG and GBG indicating high levels of uncertainty in our estimates of occupancy for these habitat types. The relationship between distance to water and occupancy was negative.

The habitat suitability model identified population and breeding size patches of suitable and optimal habitat in all Sky Island wildland blocks (Fig. 4). Along the border, the greatest area of population and breeding size patches was found in the Chiricahua block (block 7; 923 km^2), followed by the Huachuca Patagonia (block 3; 831 km^2), and Santa Rita (block 2; 481 km^2) blocks (Fig. 4). The Dragoon Mountains block was the smallest and had the least amount of suitable habitat (Fig. 4, block 6; 307 km^2). Isolation of wildland blocks generally increased from west to east, with the shortest nearest neighbor distances occurring between the Huachuca Patagonia and Santa Rita blocks followed closely by the Huachuca Patagonia and Tumacacori blocks.The structural and qualitative characteristics of potential corridors connecting

Table 4
Models of black bear occupancy for the Border grid (Huachuca and Patagonia mountains) in southern Arizona. We held detection probability constant [$p(\cdot)$] and modeled occupancy (ψ) with and without a group effect (i.e., differences between habitat types) and with five site specific covariates (aspect, distances to water [disw] and roads [disroad], elevation [elev], and slope). We present all models, QAICc, model weight, number of parameters (k), and beta values of individual covariates with corresponding 95% confidence intervals. Cells shaded gray had beta values with 95% confidence intervals not overlapping zero, providing evidence of significance.

Model	QAICc	Model weight	k	Covariate beta value	Lower95% CI	Upper95% CI
p(·) ψ[(group) + (water)]	198.7	0.45	7	−0.003	−0.006	−0.0001
p(·) ψ[(·) + (water)]	200.8	0.16	3	−0.004	−0.006	−0.001
p(·) ψ(group)	200.9	0.15	6	n/a		
p(·) ψ[(group) + (road)]	202.3	0.08	7	0.001	−0.001	0.002
p(·) ψ[(group) + (aspect)]	202.5	0.07	7	0.003	−0.003	0.009
p(·) ψ[(group) + (slope)]	203.3	0.05	7	−0.005	−0.086	0.075
p(·) ψ[(group) + (elev)]	203.3	0.05	7	−0.00002	−0.002	0.002
p(·) ψ(·)	210.2	0.00	2	n/a		
p(·) ψ[(·) + (road)]	210.4	0.00	3	0.0006	−0.0003	0.002
p(·) ψ[(·) + (elev)]	211.3	0.00	3	−0.0004	−0.0004	0.001
p(·) ψ[(·) + (aspect)]	212.2	0.00	3	0.001	−0.004	0.006
p(·) ψ[(·) + (slope)]	212.2	0.00	3	0.013	−0.051	0.076

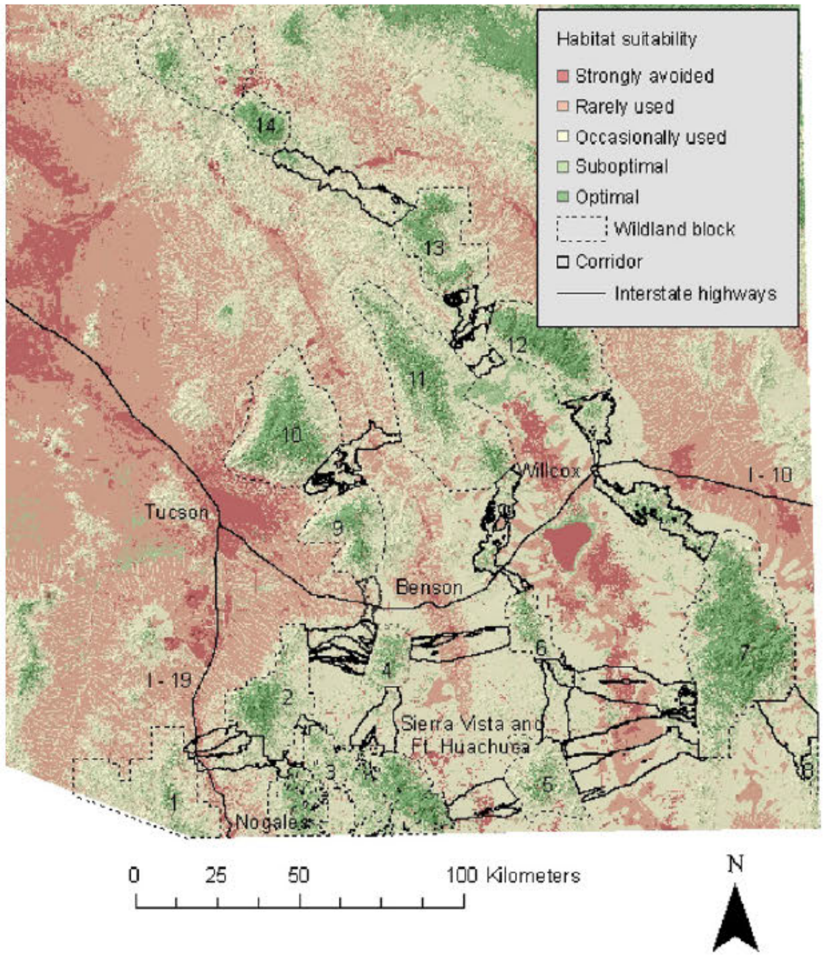

Fig. 4. Habitat suitability map for the area encompassing the Arizona Sky Island wildland blocks and corridors.

the eight border Sky Islands (wildland blocks 1 8; Fig. 5) differed greatly, but generally the western most wildland blocks (i.e., Tumacacori [1], Santa Rita [2], Huachuca Patagonia [3], and Whet stone [4] blocks) were connected by higher quality corridors. For these corridors, length to narrowest width ratios averaged ⩽4.4:1 (range: 1.11:1 9.0:1; SE = 0.95), with ⩾1 corridor within each of the individual linkages containing ⩾57% suitable (either optimal or suboptimal) habitat (Fig. 4). By contrast, the mean length to width ratios of the corridors connecting the eastern most wildland blocks (i.e., Mule [5], Dragoon [6], Chiricahua [7], and Peloncillo [8] blocks) was 6.8:1 (range: 1.2:1 12.1:1; SE = 1.11), and only 1 link age (Dragoon Mule mountains corridor) contained >57% suitable habitat (Fig. 4). The linkages connecting the Huachuca Patagonia and Mule, Whetstone and Mule, Dragoon and Chiricahua, and Mule and Chiricahua blocks all contained <57% suitable habitat and spanned 23 44 km over desert basin habitat (Fig. 5). Corridors con necting the northernmost wildland blocks (blocks 9 14; Fig. 5) were generally of similar suitability to the western most border wildland blocks in that all contained >57% of optimal or subopti mal habitat (Fig. 4), but length to width ratios were more variable ($\bar{x}$ = 4.7:1; range: 1.0:1 17.0:1; SE = 2.08).

4. Discussion and conclusions

Our study revealed several important findings regarding black bear genetic and landscape connectivity in Arizona. First, we de tected significant genetic differentiation between black bears sam pled in the border region and those sampled in the high desert and central highlands regions. Second, based on density estimates de rived from the White Mountains and Huachuca Patagonia hair snag grids, the border subpopulation density (0.06 bear/km^2) was substantially lower than the east central subpopulation (0.21 bear/km^2). Although our grid based density estimates relate only to the area covered by the grids, the bio physical characteristics of grids were very similar to their respective regions (Brown, 1994). Accordingly, we believe the estimated grid densities approximate densities across sampling regions. Finally, while the border Sky Island mountain ranges do provide adequate amounts of suitable habitat to support black bears, there is wide variation in the biological quality of corridors that connect them. While black bears are not a species of concern in US, they are in Mexico, which represents the southern extent of their historic and current range (Pelton et al., 1998). Given the above, black bear persistence in the US Mexico border Sky Islands may be particularly vulnera ble to further loss of habitat due to urbanization and border secu rity activities.

Black bear populations in Arizona exhibit a north south spatial structure in which the border sub population is isolated from, and less genetically diverse than, the main population segment in east central Arizona. These patterns are likely the result of both historic and contemporary impediments to individual movement and thus gene flow (McRae et al., 2005). For example, the harsh environ ment and dispersion of suitable montane habitat patches in a des ert basin matrix have previously been implicated as historic impediments to large mammal gene flow (Onorato et al., 2004; McRae et al., 2005), and likely are complicit in the isolation we de tected between the border and east central subpopulations. Addi

Fig. 5. Linkage design for the southern Arizona Sky Islands. The design represents land that, if conserved, should enhance the ability of black bears to move between wildland blocks.

tionally, it is feasible that Interstate Highways 10 and 19, the expanding human footprint near Tucson and other urban areas in southeastern Arizona, and the US Mexico border fence represent contemporary impediments to movement and function to hasten genetic isolation of black bears in the border region. Indeed, there is a growing body of research indicating that urbanization and linear anthropogenic barriers can drive spatial structure in bear and other large carnivore populations (e.g., Kyle and Strobeck, 2001; Proctor et al., 2005; Burdett et al., 2010). Thus, while the desert basin has likely historically limited bear gene flow between the high desert and border regions, it is also likely that landscape fragmentation due to anthropogenic activities, including border security, has further limited gene flow.

Large carnivores are highly vagile, require a large amount of area to maintain a viable population and, as a result, are often highly vulnerable to habitat fragmentation (Weaver et al., 1996; Burdett et al., 2010) and loss of connectivity (Beckmann et al., 2010). Over the last few decades, central and southern Arizona has experienced rapid human population growth (Primack, 2006); urban expansion in the Tucson metropolitan area alone is expected to increase by 22% over the next decade (Pima Association of Governments: www.pagnet.org/regionaldata/population/populationestimates/tabid/582/default.aspx). Our linkage design (Fig. 5) for Arizona's border Sky Islands provides a template for land use managers and planners to prioritize conservation efforts where future development is most immediate and likely to adversely affect landscape connectivity. For example, we believe that conservation efforts aimed at protecting corridors within the Nogales Sierra Vista Tucson triangle should be prioritized. This area contains relatively high quality corridors linking wildland blocks (e.g., Tumacacori, Santa Rita, and Patagonia Huachuca; Fig. 2) that either extend into Sonora, Mexico, or are immediately adjacent to Sonora wildland blocks (e.g., Sierra Cibuta, Sierra Pinito, and Sierra Chivato), thus providing the best opportunity for trans border movement. Urbanization and additional stretches of the impermeable pedestrian fence along the international border have the po tential to threaten connectivity in an area that may be critically important in facilitating trans border dispersal, ultimately predisposing segments (i.e., the more isolated Sky Island mountain ranges) of the low density border black bear subpopulation to localized extinction.

Populations of black bears in the southwestern US and northern Mexico appear to display a metapopulation structure (Onorato et al., 2004), thus a significant step in ameliorating effects of habitat fragmentation will be to maintain or restore landscape connectivity within the system. The results of our analyses identified opportunities and challenges to maintaining connectivity among border Sky Islands and to the high desert region. A central challenge is that structural connectivity (based on length:width and% suitable habitat metrics: Bennett et al., 1994) between border region wildland blocks varied considerably. Moreover, several adjacent wildland blocks that appear to benefit from sound structural connectivity also appear to be vulnerable to compromised functional connectivity due to increasing infrastructure. For example, the Tumacacori Santa Rita corridor is bisected by Interstate Highway 19 (Fig. 5), which may degrade functional connectivity and reduce the likelihood of migrants from Sonora moving into the Sky Islands east of the interstate. Similarly, three other corridors (Whetstone Rincon, Dragoon Pinaleno, and Chiricahua Pinaleno) potentially important in facilitating gene flow between the border and high desert regions, are bisected by Interstate Highway 10 (Fig. 5). These highway corridor intersections would be ideal areas to target for road mitigation projects (e.g. road crossing structures designed specifically for black bears and other large mammals, see Beckmann et al., 2010) that enhance functional connectivity.

The US Mexico borderland is one of the most biologically diverse and ecologically vulnerable regions in the United States (Cordova and de la Parra, 2007). Because rapid urbanization and border security activities threaten to alter the spatial structure of trans border wildlife populations (Flesch et al., 2010), it is important to identify opportunities to maintain or restore borderland connectivity. We identified suitable habitat and movement corridors for black bears in the Sky Island mountain ranges of southern Arizona, information that can help inform systems level approaches to land use planning and conservation (Moilanen et al., 2005). Currently, in the western US, there is opportunity to integrate connectivity conservation with land planning (Western Governor's Association, 2008). For example, land use planners in the Tucson metropolitan area have developed a regional conservation plan with a specific focus on maintaining wildlife linkages and increasing the permeability of transportation corridors (see Campbell and Kennedy, 2010). The information we present here, if incorporated into land use planning, may aid in ameliorating the adverse effects of inevitable urbanization and border security activities. If connectivity can be maintained, there is greater likelihood of the long term persistence of species such as black bears, mountain lions, and jaguars along the US Mexico border.

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Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:28 PM

Conversation Contents

Fwd: Landscape scale Connectivity

Attachments:

/156. Fwd: Landscape scale Connectivity/1.1 Girardet et al 2013 Foltête Clauzel graph-based approach landscape eco ass linear infrastructures.pdf
/156. Fwd: Landscape scale Connectivity/1.2 Lasky_et_al-2011-Diversity_and_Distributions.pdf
/156. Fwd: Landscape scale Connectivity/1.3 Sawyer et al 2011 placing linkages among fragmented habitats least cost models.pdf
/156. Fwd: Landscape scale Connectivity/1.4 Moilanen 2011 Limits of graph-theoritic connectivity in spatial ecology conservation.pdf
/156. Fwd: Landscape scale Connectivity/1.5 BULL_et_al-2011-Molecular_Ecology.pdf
/156. Fwd: Landscape scale Connectivity/1.6 Attwood et al 2011 Modeling connectivity black bears Biol Conserv.pdf

"Gardiner, Dawn" <dawn_gardiner@fws.gov>

From:	"Gardiner, Dawn" <dawn_gardiner@fws.gov>
Sent:	Thu Apr 27 2017 08:55:10 GMT-0600 (MDT)
To:	Ernesto Reyes <ernesto_reyes@fws.gov>, Erin Fernandez <Erin_Fernandez@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, Chris Perez <chris_perez@fws.gov>, Brunilda FuentesCapozello <brunilda_fuentescapozello@fws.gov>, Mitch Sternberg <mitch_sternberg@fws.gov>, Hilary Swarts <hilary_swarts@fws.gov>
CC:	Kelly McDowell <kelly_mcdowell@fws.gov>, Robert Jess <robert_jess@fws.gov>
Subject:	Fwd: Landscape scale Connectivity
Attachments:	Girardet et al 2013 Foltête Clauzel graph-based approach landscape eco ass linear infrastructures.pdf Lasky_et_al-2011-Diversity_and_Distributions.pdf Sawyer et al 2011 placing linkages among fragmented habitats least cost models.pdf Moilanen 2011 Limits of graph-theoritic connectivity in spatial ecology conservation.pdf BULL_et_al-2011-Molecular_Ecology.pdf Attwood et al 2011 Modeling connectivity black bears Biol Conserv.pdf

---------- Forwarded message ----------
From: **Connor, Patrick** <patrick_connor@fws.gov>
Date: Thu, Apr 27, 2017 at 9:12 AM
Subject: Fwd: Landscape scale Connectivity
To: Dawn Gardiner <dawn_gardiner@fws.gov>, Robyn_ Cobb <robyn_cobb@fws.gov>

Patrick Connor
Fish and Wildlife Biologist

Detail phone: 612 713 5344
Detail Location: Region 3 Fisheries

Mailing address on Detail

US Fish & Wildlife Service
5600 American BLVD, Suite 990
Bloomington, MN 55347

Patrick_Connor AT fws.gov

USFWS Ecological Services
10711 Burnet RD STE 200
Austin, TX 78758

http://www.fws.gov/southwest/es/austintexas/

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---------- Forwarded message ----------
From: **Connor, Patrick** <patrick_connor@fws.gov>
Date: Thu, Apr 27, 2017 at 9:02 AM
Subject: Landscape scale Connectivity
To: Chris Best Botanical <Chris_Best@fws.gov>, Nathan Allan <Nathan_Allan@fws.gov>

http://www.pbs.org/newshour/bb/nature-knows-no-borders-border-security-can-take-heavy-toll-endangered-wildlife/

some references attached

Patrick Connor
Fish and Wildlife Biologist

Detail phone: 612 713 5344
Detail Location: Region 3 Fisheries

Mailing address on Detail

US Fish & Wildlife Service
5600 American BLVD, Suite 990

Bloomington, MN 55347

Patrick_Connor AT fws.gov

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Austin, TX 78758

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E. Dawn Gardiner
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<u>Border Patrol Fence Discussions</u>

Abbreviations

Sector Chief [redacted] Sector Chief, Rio Grande Valley Sector of Border Patrol
Deputy Chief [redacted] Deputy Sector Chief, Rio Grande Valley Sector of Border Patrol
Division Chief [redacted] Sector Division Chief, Rio Grande Valley Sector of Border Patrol
PLLA [redacted], PLLA (Public Lands Liaison Agent) (point of contact for day to day activities)
PL Robert Jess, Project Leader, South Texas Refuge Complex
ARM Scot Edler, Asst. Refuge Manager, LRGV (point of contact for BP day to day activities)
IBWC International Water Boundary Commission
BMTF Border Management Task Force – meeting held to address issues at lowest level
USDA Tick riders used to patrol border for Mexican escaped cattle

Discussion(s)

Note- almost daily discussion occurs with multiple BP reps and staff of STRC. Day to day activities involving both entities occur and necessitate that communication occur. Discussion of existing fence related topics

Thursday (4/06/17) - The BMTF meeting, held quarterly, occurs to address issues at lowest field level for BP, STRC, USDA, and IBWC. Approx. 30 people attended. Jon Andrew from DOI was present and general questions & discussions occurred on the fence topic and a range of possibilities based on local needs.

Wednesday (4/19/17) – PL has discussion with STRC managers (and ARM) to limit further discussions with BP on any fence associated topics. The need to push up any further fence discussions to RO staff is emphasized.

Thursday (4/20/17) - PL received phone call from Sector Chief requesting a meeting to discuss: BP's positive support for/coordination of possible Secretarial visits to area; requests to meet in person to discuss potential outcomes of proposed fence to include re-alignments in Zones 1-5 (areas that begin furthest west at Falcon Lake, TX and go east to La Gruella, TX) and possible "buffer areas" or areas that BP would not recommend fence be installed due to STRC needs. Sector Chief also mentioned that realignment would occur if fence is installed on west side of Sector as "Administration re-evaluated the sites and determined that "point to point" installations… of fence are not possible". ("Point to point" was in reference to drawing lines on a map without verifying contours/obstacles on ground).

Also discussed was the support for use of technology for BP and STRC Mission needs. BP fence needs, as stated by Sector Chief, were to at least complete the three sections of fence not completed on "last go around".

Friday (4/21/17) - PLLA made physical contact with ARM about needs for road maintenance. In the course of discussion, PLLA made it known that Sector is going to request a 150' buffer area south of all fence (no clarification as to whether request to Administration will include both existing and/or new proposed fence). PLLA also noted that Santa Ana Refuge and other sensitive refuge sites "may" not be supported for new fence installation by BP. This is confirmation from prior meetings (in Jan/Feb/Mar) with Station Chiefs and Operations Supervisor in Rio Grande Valley Sector.

Friday (4/21/17) - Sector Chief contacted PL and stated he was to be in Guatemala for week of 4/24/17 so would assign Division Chief to meet with PL for details of Sector proposals being sent to CBP. He also mentions that Santa Ana Refuge and other sensitive refuge sites will likely not be considered as part of new fence construction by BP (though Administration could go in different direction). I suggested that a combined focus on technology in these areas may be better suited for all involved to which he supports.

End of report.

Label: "Border Fence"

Created by:robert_jess@fws.gov

Total Messages in label:672 (227 conversations)

Created: 09-29-2017 at 12:30 PM

Conversation Contents

Border Patrol Communication on Border fence

Attachments:

/158. Border Patrol Communication on Border fence/1.1 Border Patrol Fence Discussions.docx
/158. Border Patrol Communication on Border fence/2.1 Border Patrol Fence Discussions.docx

"Jess, Robert" <robert_jess@fws.gov>

From:	"Jess, Robert" <robert_jess@fws.gov>
Sent:	Tue Apr 25 2017 14:38:20 GMT-0600 (MDT)
To:	kelly mcdowell <kelly_mcdowell@fws.gov>
CC:	Aaron Archibeque <aaron_archibeque@fws.gov>, "Harvey, Thomas" <thomas_harvey@fws.gov>, Monica Kimbrough <monica_kimbrough@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, Sonny Perez <sonny_perez@fws.gov>
Subject:	Border Patrol Communication on Border fence
Attachments:	Border Patrol Fence Discussions.docx

To all,
The attached is a brief synopsis of recent discussions with Border Patrol and staff of STRC. Contact with BP occurs almost daily whether it be with Bryan Winton, Scot Edler and/or myself. Operations of the border and associated issues are such that daily communication is imperative to address roads, infrastructure, shared resources, human and drug activities.
I will try to get any further communication, as it related to the "existing border wall or new fence" to you immediately...

--
robert jess
project leader
south texas refuge complex
alamo, texas

"Winton, Bryan" <bryan_winton@fws.gov>

From:	"Winton, Bryan" <bryan_winton@fws.gov>
Sent:	Tue Apr 25 2017 15:35:24 GMT-0600 (MDT)
To:	Rob Jess <robert_jess@fws.gov>
CC:	Scot Edler <scot_edler@fws.gov>
Subject:	Fwd: Border Patrol Communication on Border fence
Attachments:	Border Patrol Fence Discussions.docx

I've had no (zero) discussions with CBP about Border Fence.... concerns, locations, etc. otherwise. I know the guys on the ground here don't know any more than we do (experience from quizzing them last time). When the word comes down about border fence locations, placement, etc., it will be as much a surprise to them as it will be for us.

bryan

---------- Forwarded message ----------
From: **Jess, Robert** <robert_jess@fws.gov>
Date: Tue, Apr 25, 2017 at 3:38 PM
Subject: Border Patrol Communication on Border fence
To: kelly mcdowell <kelly_mcdowell@fws.gov>
Cc: Aaron Archibeque <aaron_archibeque@fws.gov>, "Harvey, Thomas" <thomas_harvey@fws.gov>, Monica Kimbrough <monica_kimbrough@fws.gov>, Bryan Winton <bryan_winton@fws.gov>, Sonny Perez <sonny_perez@fws.gov>

To all,
The attached is a brief synopsis of recent discussions with Border Patrol and staff of STRC. Contact with BP occurs almost daily whether it be with Bryan Winton, Scot Edler and/or myself. Operations of the border and associated issues are such that daily communication is imperative to address roads, infrastructure, shared resources, human and drug activities.
I will try to get any further communication, as it related to the "existing border wall or new fence" to you immediately...

--
robert jess
project leader
south texas refuge complex
alamo, texas

--
Bryan R. Winton, Refuge Manager
Lower Rio Grande Valley National Wildlife Refuge
3325 Green Jay Road
Alamo, Texas 78516
(956) 784-7521 office; (956) 874-4304 cell