Standard Operating Procedures: How to prepare an "Ecological Risk Screening Summary"

U.S. Fish and Wildlife Service

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Important Notes Regarding This Document

This Standard Operating Procedure (SOP) is intended to explain the purpose of the Ecological Risk Screening Summary (ERSS) and provide rigorous, repeatable steps necessary to obtain and synthesize the species data to complete an ERSS. Several important points regarding this document must be clearly noted:

- The ERSS SOP is intended for use by people with a background in the taxa or species being assessed or (at the least) a background in biology, ecology, or invasive species and that have been trained in preparing ERSSs. It was originally titled 'Standard Operating Procedures for the Rapid Screening of Species' Risk of Establishment and Impact in the United States'.

- The ERSS process is designed to be useful for terrestrial and freshwater animal and plant taxa. The process is not currently applicable to exclusively marine species as current climate matching tools were not developed with consideration of marine environments and climate variables. See Appendix F for how to address estuarine species or species where only a portion of their lifecycle is in marine environments. The process has not been tested on pathogens.

- The draft version of the ERSS SOP underwent peer review without constraint on taxonomic groups to which the process could be applied. The process for the peer review followed U.S. Fish and Wildlife Service (Service) procedures, and the Office of Management and Budget's criteria of peer review for influential scientific information. Five independent expert reviewers, with expertise in invasive species biology, invasive species risk assessment, decision-support modeling, aquatic species biology, aquaculture, and fisheries, participated in the peer review process. Peer reviews were conducted individually, all comments were considered, and the process was revised where necessary. All peer review comments and the Service's response to those comments are available to the public on the Service's website (www.fws.gov/science/peer_review_agenda.html).

- As part of the peer review, several reviewers commented on the need for a separate background and justification document for the ERSS process. That document will be available in the future online at the Service's Fish and Aquatic Conservation website (https://www.fws.gov/fisheries/ANS/prevention.html). The document describes the history of the ERSS development and provides justification for the use of climate matching and history of invasiveness as a basis for preventative risk assessment. It is a companion to this SOP and is titled "Background and Justification for Ecological Risk Screening Summaries."

- All examples and technical directions are given with reference to Microsoft Office 2016, Google Chrome, and ArcGIS Desktop 10.6 software. Earlier or later versions may have different functionality. Mention of commercial products does not necessarily entail endorsement by the U.S. Federal Government.

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PART 1:
INTRODUCTION

Background

Each year, thousands of nonnative species and millions of individual organisms are imported into the United States and moved among States. Although only a small fraction of these organisms escape from intended uses and ultimately cause harm to society and the environment, those that do collectively cost billions of dollars annually in losses and damages, including loss of crops and fisheries, competition with or predation on native species, damage to utility operations and water supplies, and risk to human health from zoonosis (animal to human disease transmission; Pimentel et al. 2005). The most cost-effective and efficient approaches to reduce the effects of these invasive species is to prevent them from entering and establishing in the United States and then limiting secondary spread (Vander Zanden and Olden 2008).

Invasive species become classified as injurious when, through the Service's rule-making process or by Congressional action under Title 18 of the Lacey Act (18 U.S.C. 42; 50 CFR 16), a species has been determined to cause or likely cause harm to human beings, to the interests of agriculture, horticultural, forestry, or to wildlife or the wildlife resources of the United States. The Service has the authority to list wildlife (wild mammals, wild birds, fish, reptiles, amphibians, mollusks, and crustaceans) as injurious. Because Federal law prohibits importation and transport of injurious wildlife between the listed jurisdictions in the shipment clause (the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, and any possession of the United States) (18 U.S.C. 42), listing a species as injurious can be effective in preventing the introduction, establishment, and spread of invasive species. More information on injurious wildlife can be found at www.fws.gov/injuriouswildlife/.

Deciding which of the thousands of imported species to list as injurious[1] or otherwise manage for, however, is not an easy task. An assessment process is necessary to enable rapid screening and prioritization of species as described in Implementation Task P.1.2 from the 2008-2012 National Invasive Species Management Plan (NISC 2008), which directed the Federal Government to: "*Develop screening processes to evaluate invasiveness of terrestrial and aquatic nonnative wildlife (e.g., fish, mollusks, crustaceans, mammals, birds, reptiles and amphibians) moving in trade*." Risk assessments may be used to identify potentially invasive species and can help anticipate problems and focus management. Natural resource management aimed at preventing invasive species introductions and minimizing new invasive species incursions is critical to reduce negative effects on society and the economies on which our society depends. To facilitate this decision-making, the Service developed a rapid risk screening tool, the

[1] Although the SOP describes a risk assessment process that may be applied to both wildlife and plants, it is important to note that the U.S. Fish and Wildlife Service lacks the authority to list plants as injurious species.

ERSS process, to provide rapid risk assessments of species that are being or may be imported to the United States or transported from one ecoregion to another.

Purpose

According to the Food and Agriculture Organization (FAO) of the United Nations (Reeuwijk and Houba 1998): "*A Standard Operating Procedure is a document which describes the regularly recurring operations relevant to the quality of the investigation. The purpose of a SOP is to carry out the operations correctly and always in the same manner.*" Key goals of this specific SOP are to standardize data collection and interpretation for development of ERSSs, and to assure the credibility of resulting reports for transparency and repeatability. In addition, following this SOP closely and documenting the steps in the process allows for the development of a high quality administrative record.

How the ERSS Process Works

The rapid risk screening process uses international and regional databases, scientific literature, and climate matching to classify the risk of invasiveness of a species if introduced within the United States outside its native range. ERSS assessors collect, summarize, and synthesize information on the introduction history and documented impacts of introduction of the species, as well as information on species distribution, biology, and ecology. Assessors also conduct a climate matching analysis using a peer-reviewed model to quantify climate similarity between the target region of the United States and locations where the species is currently established. The synthesis of introduction and impact history and the results of the climate matching analysis lead the assessor to the classification of species risk as either high, low, or uncertain. This process is founded on the work of Hayes and Barry (2008), who identify climate, history of invasive success, and propagule pressure as non-taxon-specific predictors of introduced species establishment success (for further detail, see "Background and Justification for Ecological Risk Screening Summaries"). The ERSS report produced through the rapid risk screening process can be provided to government, industry, and other stakeholders to highlight species' risk of invasiveness and more efficiently protect the biosecurity of the United States through either regulatory or non-regulatory risk management actions, or identify species for which additional risk assessment is needed. One or more levels of review of each ERSS report provide quality assurance and quality control prior to release of the document to stakeholders.

Link to the FISRAM

When the overall risk posed by a freshwater fish species is classified as uncertain, it may be further evaluated using the Freshwater Fish Injurious Species Risk Assessment Model (FISRAM), a peer-reviewed tool developed by the Service. FISRAM is a Bayesian network risk assessment model for predicting invasiveness based on the known and projected characteristics of the species. FISRAM, however, is not part of the ERSS

process, but rather is a next step in the risk assessment process (see figure 1), conducted in response to an external or internal request, and is not covered in this document. A model diagram, FISRAM SOP, and a journal article describing the development of FISRAM are available on the Service's web page at: https://www.fws.gov/fisheries/ANS/erss_supporting_documents.html.

Standard methods for further evaluation of other taxa classified as Uncertain Risk are not currently available from the Service, although a Bayesian network risk assessment model to predict invasiveness of crayfish species is under development. Additional risk assessment and risk screening tools for various taxa are available from other sources, such as Fisk Invasiveness Screening Kit (see Hill and Lawson (2015) and Hill et al. (2017)), Aquatic Species Invasiveness Screening Kit (Copp et al. 2016), and Weed Risk Assessment (see USDA (2019)).

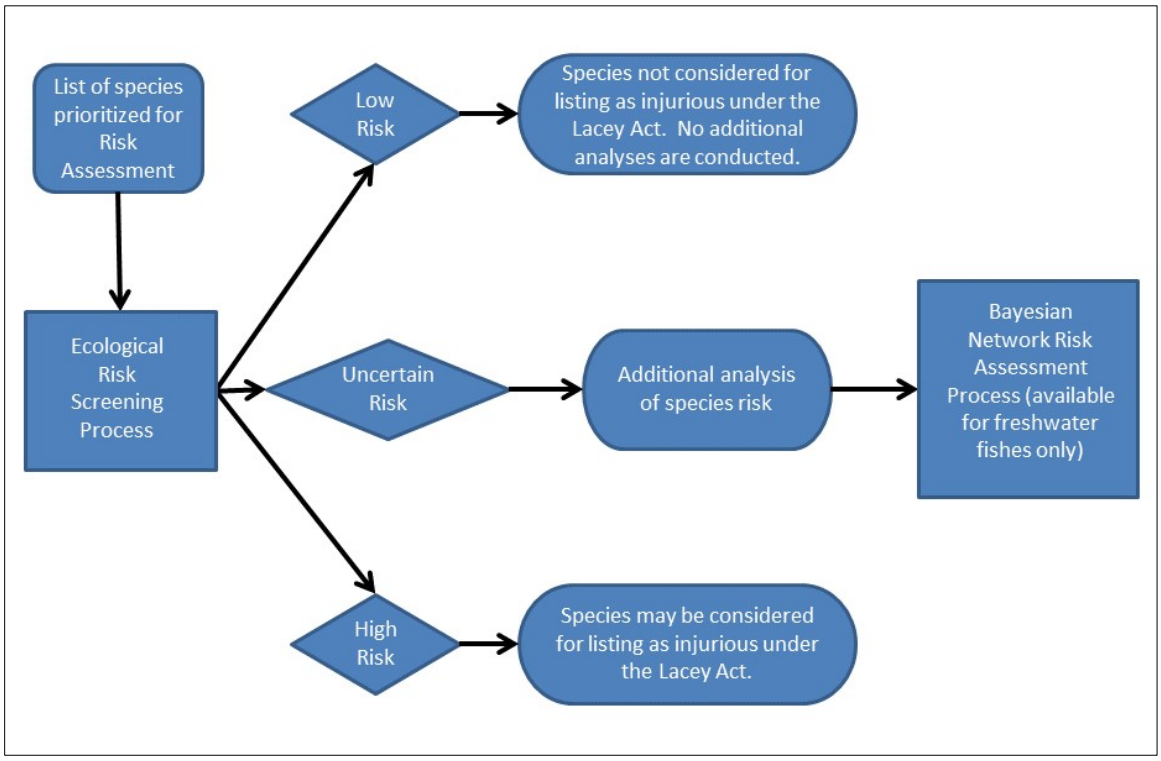

Figure 1. The ERSS process and its resulting species risk classification outputs. When freshwater fishes are classified as Uncertain Risk, FISRAM may be used.

Using the ERSS Reports

The completed ERSSs are intended to identify species for which preventative measures could be taken, in three ways: 1) to inform the injurious wildlife listing process; 2) to inform our co-managers (such as other Federal agencies, the States, and Tribes), the public (such as hobbyists) and private sectors (such as importers of live animals) of the risks of importation, transportation, or establishment of certain species; and 3) in the event of a new detection, provide stakeholders with information needed in the evaluation

and rapid response process. ERSSs that have gone through full internal Service review will be posted on the Service's web page at: https://www.fws.gov/fisheries/ANS/species_erss_reports.html.

Species found by the ERSS process to be a high or uncertain risk may be further reviewed for potential injurious wildlife listings under Title 18 of the Lacey Act. It is important to clarify that a species that has gone through the ERSS process is not exempt in any way from all of the required steps in the injurious wildlife listing process, including opportunities for public comment; the ERSS process is a screening process that simply helps prioritize species for further scrutiny.

To help inform co-managers and the public, completed ERSSs are posted on the Service website to let the public know the high and uncertain risk species they may choose to voluntarily avoid importing or transporting and the low risk species to consider as more responsible alternatives. Live-animal and plant importers could use the results to facilitate responsible decision-making in the importation and movement of live organisms. The completed ERSSs could also assist States in determining regulatory, legislative, or other measures (targeted prevention efforts, developing watch lists and monitoring programs, decision-making in potential rapid response scenarios, etc.) that prevent the introduction or establishment of species in their jurisdictions.

For more information on injurious wildlife, please visit the Service's web page at: www.fws.gov/injuriouswildlife/ and https://www.fws.gov/fisheries/ANS/prevention.html.

PART 2:
GUIDELINES FOR CONDUCTING AN ECOLOGICAL RISK SCREENING SUMMARY

Assessor Qualifications

It is recommended that the preparation of an ERSS be conducted by a single individual with subject matter expertise, preferably with a specific background in the taxon or species being assessed or, at a minimum, a background in biology, ecology, or invasive species. The assessor should at least be fully conversant with this SOP and should, as needed, consult the peer-reviewed literature outlined both in this document and in the companion Background and Justification document referred to in the notes on page "i". Additionally, assessors should be competent at conducting thorough literature searches and critically evaluating information sources. Available information on species occurrences, biology, and impacts may be of varying quality. The assessor should be able to apply the data quality standards described below to discern what information is valid to use in justifying the species assessment.

Development Process

Conducting an ERSS in a group setting is not recommended because the clear formula for data gathering and assessment make collaborative assessment inefficient. However, a hierarchical review process allows for a high degree of quality assurance and quality control in the final product. The recommended development process for conducting an ERSS occurs in a series of stages as follows[2]:

Original Assessor → Technical Reviewer → Editorial and Policy Reviewer

Whenever possible, as a form of quality control, the individuals assigned to the three roles in the process above should not be the same. The original assessor compiles data from literature and database searches, cites and records all references incorporated into the administrative record, completes the climate matching analysis, and produces an ERSS incorporating all of this information. The reviewers assess the accuracy and completeness of the ERSS and its accompanying administrative record. Although their duties overlap, the technical reviewer should focus primarily on the accuracy and completeness of the information presented in the ERSS, while the editorial and policy reviewer should primarily focus on internal consistency of the report, compliance with this SOP, and accessibility of the report to diverse audiences.

[2] While this description of the stages of the ERSS development process is our preference for how they will be developed, we can't unequivocally commit to this approach and bind the agency's capabilities in the future. Rather, we will balance the fiscal and staffing realities of the agency in delivering its conservation mission with the benefit of keeping these roles differentiated.

Data Quality Standards

The ERSS should be a compilation of facts, peer-reviewed data, and actual occurrences of species impacts, instead of hypothetical circumstances. A risk assessor's primary source of information will be from expert-validated native and invasive species information systems listed in appendix A and peer-reviewed scientific literature. Information from white papers and other gray literature can be used and noted, but should not be used as the sole basis for assessing risk in an ERSS.

It is important to note that even peer-reviewed scientific journal articles and book chapters contain conjecture. That conjecture can be informative, but it cannot be used as evidence of history of invasiveness, which is described in detail later in this SOP.

How Much is Enough?

One of the main difficulties in developing an ERSS is that for many species the information being sought is typically either very general (because that is typically all the information that is available) or nonexistent, which makes it very difficult to set data thresholds and limits. The risk assessors are expected to review multiple sources for each section, select and compile the most reliable, credible, clear, and convincing information, and add new relevant information from other sources if it exists.

Although a risk assessor may feel inclined to stop after finding information in the first few databases they consult, they should not do so and should consult as many of the databases listed within appendix A as possible within a reasonable time. Experience has shown that further investigation beyond initial findings sometimes reveals that a species' status is not as clear as initially thought. If all websites recommended in appendix A of this SOP are visited, including searching for peer-reviewed literature, and little information has been found, and new sources are consulted that may have become available since appendix A was last updated, then the lack of data should be noted, and searching can stop. Conversely, the assessor should keep in mind that the ERSS is intended as a rapid assessment, and should not take more than a couple of days to write, even for the most complicated species. If information is abundant, it can be useful to ask the question, "What information would a manager want to know about this species?" in determining what information to include and what to exclude. Ultimately, what is desired for each section of an ERSS is the best available information that can be derived from the recommended information sources.

As part of ERSS process, and to help reviewers understand how much research was completed and which databases were and were not used, the risk assessor should also complete the Record of Online Data Searches (RODS) to help clarify exactly what databases were, and were not, used for the ERSS.

General Notes

The development of an ERSS report consists mainly of copying and pasting large amounts of quoted material from various websites and scientific journals. Because the layout of the ERSS report is based, in part, on the most popular information sources for aquatic invasive species, it is possible that quoted material from a single source could appear under multiple headings within the ERSS template. When this occurs, the reference for the quoted material should be repeated for each new heading. This is to prevent confusion and make apparent the source of the quoted material. The following requirements must be adhered to at all times when gathering information for an ERSS:

1) The following guidelines must be followed to copy and paste large amounts of quoted material from either websites or scientific journals.

    a) Surround all copy-pasted materials with quotation marks.

    b) Quotation marks must only be used when the information quoted is an exact quotation (text copied and pasted without alteration).

    c) Sometimes a paragraph from a quoted source that is being used for one section will contain some information that is more appropriate for a different section (for example, information on human uses contained in a paragraph that otherwise belongs in biology). Break apart the paragraph and insert each part of the paragraph in the appropriate section.

    d) Use brackets within quoted material to designate material that has been added to a quotation. This should only be done when the meaning of the original material is unclear. For example, add the country where a river is located, or add the full scientific name of a species if an abbreviation of the name is not defined elsewhere in the report. Example: “Species is present in the Song Da [Black River, Vietnam].”

    e) If errors are discovered within quoted source material, include the error as written in the quotation followed by “[sic]”, to indicate the error was part of the original quotation.

    f) When deleting extraneous, non-vital information from within quoted material, use an ellipsis (three periods in a row) in brackets (like this “[...]”) to show that the ellipsis was not part of the original passage.

    g) Re-read the quotation to make sure letters and symbols copied correctly.

2) Carefully document and credit sources for pictures and figures using the following formats:

    a) Photo: [Author]. Licensed under [license information]. Available: [website]. ([date accessed]).

b) Figure [X]. [Description of figure] from [Author(s)] ([year]; [license information]).

3) Be sure to confirm images can be used within the ERSS without seeking permission from the author or creator. If unable to confirm ability to re-use, do not use the image.

4) ERSSs must be compliant with Section 508 of the Rehabilitation Act of 1973 (29 U.S.C. 794d; standards on electronic accessibility). The following are a few reminders applicable to ERSSs. For additional details see DOI guidance on 508 compliance (375 DM 8, Section 508 Program and Responsibilities and Accessible Electronic Document Community of Practice Section 508 Basic Authoring and Testing Guide; https://www.doi.gov/ocio/policy-mgmt-support/information-and-records-management/section-508-policies, https://www.section508.gov/create/documents).

   a) The ERSS Template is already Section 508 compliant. **Do not make changes to the structure or formatting of the template.**

   b) In Microsoft Word, designate the species name with "Title", each section heading with the style "Heading 1", each subsection heading with "Heading 2", each sub-subsection with "Heading 3", and author information with "Heading 4". If headings are designated but not properly formatted and the template file is available, navigate to Developer Tab > Document Template. Choose "Attach" on the "Templates" tab, navigate to and select "ERSS template_2019.dotx", and check the "Automatic update" box.

   c) Insert alt text for all photos, images, tables, and maps. Alt text should describe what is displayed for those using a screen reader. Alt text should not repeat the caption because screen readers will read the caption. Do not include citations in alt text. Access alt text by right-clicking on the image and selecting "Format picture."

   d) In "File Properties", insert document title (such as, "Electric Eel (*Electrophorus electricus*) ERSS") and change the author to "USFWS."

   e) For tables:

      i) Do not split or merge cells.

      ii) On Layout tab, select "repeat header row" for the table header row(s).

      iii) Right-click within the table to access the Table Properties dialog box. In the "Row" tab, make sure "allow row to break across pages" is unchecked and in the "Alt Text" tab, provide a brief description of the table.

      iv) Paraphrase small tables and other information that cannot be directly quoted. If you have a hard time following what the information means while looking

at the quote, a screen reader will have a harder time. It's best to paraphrase and cite appropriately in that situation.

5) Follow the GPO style manual (https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf), including:

   a) Spell out "United States" when it is used as a noun (for example, contiguous United States) and use the abbreviation "U.S." when it is an adjective (for example, U.S. territories).

   b) Capitalize "State" when referring to one or any of the 50 United States.

   c) Capitalize "Federal" when used as an adjective describing a proper noun (for example, Federal Government), but not when used as an adjective in a general sense or as an adverb (for example, federally listed species).

6) Remember to watch for material that uses a numeric citation system and be sure to replace the numeric system with Journal of Fish and Wildlife Management Style formatted citations in brackets.

Creating an Administrative Record

The assessor should file a detailed administrative record with each completed and reviewed ERSS. The administrative record should include a saved PDF of all source information cited (articles, databases, reports, screenshots) at the time they are accessed, as well as the RODS (see appendix B). Google Chrome contains a built in option to print a webpage to a PDF within the browser. When a distribution map is taken from a webpage, save a PDF of the entire webpage, in addition to an image file of the map.

These files should be saved in a single location and sent to ERSS reviewers along with the completed ERSS. Anyone reviewing an ERSS should be able to access a saved copy of all source information, as it appeared at the time it was cited. This level of documentation is required for the administrative record for injurious wildlife listings and improves public transparency of the ERSS.

PART 3:
STANDARD OPERATING PROCEDURES FOR ECOLOGICAL RISK SCREENING SUMMARIES

The following information is intended to guide the reader through the steps necessary to complete an ERSS. Each of the following sections, which are organized to match the required flow of an ERSS report, contain descriptions of the data needed, specific data sources in some cases, and special instructions.

General Guidelines

- Provide as much relevant information as possible for each of the ERSS subheadings in parts 3A – 3D below without unnecessary repetition.
- The source of the quoted material should be repeated for each new subheading.

An empty ERSS template is provided in Appendix I, and an example of a completed ERSS is provided in appendix J.

3A: ERSS Title Page Header Information

1) **Title page header –** An ERSS title page header should contain the following items:

    a) Common and scientific name of the species,

    b) Details on the assessor and reviewers and date of each version of the ERSS document,

    c) Organism Type and Overall Risk Assessment Category, and

    d) A properly credited photograph or drawing (if available) of the species being evaluated.

2) **Specific instructions –** Use the specific instructions below to create the information necessary for the title page header information.

    a) **Common and scientific names –** Search for the common and valid scientific names for the assessed species.

i) Common names

(1) For fish species - The American Fisheries Society (AFS) common name is the preferred common name. The current AFS name list may be checked here: https://fisheries.org/books-journals/writing-tools/names-of-fishes-searchable-version/.

(a) If no AFS common name is available, then the FAO name may be used.

(b) If neither an AFS nor FAO common name is available, then use the most common English name present in the literature, with preference for names used in expert-validated databases and peer-reviewed literature over trade names.

(2) For other species - Use the common name provided by the Integrated Taxonomic Information System (ITIS). If no common name is available, then use the most common English name present in the literature, with preference for names used in expert-validated databases and peer-reviewed literature over trade names.

(3) If the species has no English common name, provide a familiar name for the taxon (for example: carp, catfish, cichlid, tilapia, clam, mussel, snail, amphipod, crayfish, shrimp) and state that there is no common name (example: "*Cyprinus barbatus* (a carp, no common name)")

ii) Scientific names

(1) Note: The full taxonomy for the species is included in section 2 of the ERSS (see part 3C of this SOP).

(2) For fish species - Use the following sources (written here in order of reliability and updates):

(a) Eschmeyer's Catalog of Fishes – http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (preferred source for current valid fish names); then

(b) The AFS Name Book (if the species occurs in North America) – https://fisheries.org/books-journals/writing-tools/names-of-fishes-searchable-version/; then

(c) FishBase – www.fishbase.org/; and then finally,

(d) ITIS – www.itis.gov/.

(3) For plant species –

(a) World Flora Online – www.worldfloraonline.org (preferred source for current accepted plant names); then

(b) If World Flora Online provides no accepted name, then you may use other databases such as ITIS or an associated name in the scientific literature.

(4) For other species - Use World Register of Marine Species (WoRMS) – http://www.marinespecies.org. Although 'marine' is in the database name, it does contain information on non-marine species under the least restrictive search parameters.

(a) Use the genus and species names in the header, but note that the entire taxonomic hierarchy is used in Section 2 of an ERSS.

(b) If the subject species is not a fish or plant, and WoRMS provides no scientific name, then use the name either associated in scientific literature or from other databases listed in Appendix A (or elsewhere), and ensure that the source(s) is documented.

b) **Preparer and version details –** Include details on the preparer and version of the ERSS document.

i) The assessor of an ERSS must put their name and the month and year of the ERSS report below the species name in a right justified format (Author Line style). See examples in appendices I and J.

ii) The technical reviewer must add their name and the month and year of review beneath the original author's name.

iii) When an ERSS has gone through its technical and policy reviews and is ready for posting on the Service website, the author's and reviewer's names are replaced with:

U.S. Fish & Wildlife Service, draft month and year
Revised, revision month and year
Web Version, date of final edits

iv) If updating a previously published web version, start the author list the same way as for a new document. An ERSS may be updated for a variety of reasons, including incorporating new or improved science and techniques, or due to new information that may result in a change in the ORAC.

c) **Photograph**s **–** Search for photograph(s) of the assessed species, carefully documenting and crediting any images used.

i) Citing photographs – Like all other resources used for the development of an ERSS, images must also be cited, even if the image is in the public domain. All images must have a citation. If the assessor created the image, an appropriate attribution must be used. When citing images, as much of the following information as possible should be included within the caption:

(1) Creator name
(2) License information
(3) Repository information (museum, library, or other owning institution)
(4) Image source (database, website, book, etc.)
(5) Date accessed

ii) Responsible use of digital images – Be aware that some photos posted on websites cannot be re-posted or copied without permission from the author. Always check the website for guidance on use of images. The University of Washington Library (2014) summarizes the issue very well: "*Digital images are electronic resources that need to be used responsibly and with an awareness of copyright and ethical use best practices. Most databases and websites provide information about how their images can be used. It is important to read this information carefully, and comply with all usage guidelines. Usage guidelines can vary considerably, so be alert to differences and details.*"

(1) License issues – Some databases automatically gather images from the web. It is not uncommon for license information associated with the image to be gathered incorrectly. It is good practice to trace the image back to the original source to obtain the correct license information. If there is uncertainty about the correct license do not use the image.

(2) All images, species photos, and figures from journal articles need to be licensed for re-use. You may need to check a journal's main information page if you cannot find clear license information in the article.

iii) Graphic standards – Though not mandatory due to the general lack of images for many of these species, whenever possible, photographs should be color and should adhere to the following standards:

(1) Resolution – 300 dpi
(2) Size – 4" x 6" or 6" x 4"
(3) File formats – JPEG or PNG

iv) When no photographs are available a drawing or sketch may be used with the same citation and licensing considerations as for photographs.

v) If no images at all are available, place an image of a camera where the image should be and state: "No photo available." Alt text should read: "Image of camera indicating no photo available." There is an image of a camera with "No photo available" text included in the ERSS template.

vi) Images should be formatted as "In line with text."

3B: ERSS Section 1 - Native Range and Status in the United States

1) **Data description –** For section 1 of an ERSS, search for information about the Native Range, Status in the United States, Means of Introduction to the United States, and Remarks using data sources and specific instructions in number 2 below.

   a) **Native Range –** The native distribution of the species; the description may include countries, States, regions, and geographic areas such as a specific river basin or specific mountain range. When the quotation provides only names of waterbodies, provide State or country in brackets; when a waterbody spans multiple States or countries, indicate which are part of the species' range, if known.

   b) **Status in the United States –** Whether the species has been reported in the United States and if so, where, including both native and nonindigenous occurrences. If possible, identify which occurrences represent established populations. Established population data is often limited to State-level data but may include more detailed occurrence information. If the species has not been reported in the United States, clearly state so. In addition to whether the species has been found in the United States, this is also the place to mention:

      i) Whether or not the species is in trade within the United States. It is acceptable to include information from a pet or trade site to document trade. For clarity, if no data on trade or status can be found, the ERSS should clearly state that fact so that readers know that an attempt was made to find this information.

      ii) If the species has any special Federal or State regulatory status, such as being banned for importation into the State, listed as a State-designated noxious weed or invasive species, or if the species is listed as injurious under the Lacey Act or as a noxious weed.

      iii) If a species was stocked, indicate period of time stocking occurred. If historical or current status of stocking is unknown, indicate as such.

   c) **Means of Introduction into the United States –** How the species was introduced to and spread within the United States. This should include, when known, both the pathways and vectors. Although these terms can sometimes be difficult to

separate, the pathway is generally regarded as the reason why a species is transported (the activity that facilitates the movement), whether accidentally or deliberately, and the vector is exactly how a species is transported (the physical things the species move on, in, or with). For example, commercial shipping is a pathway, and ballast water, hull fouling, and stowaways are all vectors associated with commercial shipping. If no information was found for this section or the species has not been reported in the United States, clearly state so.

d) **Remarks –** Determine whether there are any special circumstances or additional information that is key to the overall interpretation of the ERSS that should be highlighted. This may include:

   i) Contradictory information on the range of the species.

   ii) Recent taxonomic changes.

   iii) The taxonomic names used to search for information for the ERSS (i.e. the valid name and a recent synonym).

   iv) Other common names applied to the species; state when a common name is used for multiple species.

   v) Difficulty in correctly identifying this species.

   vi) Information on hybridization or varieties. Mention the ability to hybridize in Remarks but any detailed information about hybridization (i.e. fertile or non-fertile offspring) should be included in the Biology (or Impacts of Introduction) section.

   vii) If working on a species with an unusual genetic situation (such as, diploid or triploid grass carp), additional clarifications may be needed in this section (consult with your Regional Lead).

   viii) If the ERSS was previously published and if the valid scientific name has changed since that publication.

   ix) Any other information that the assessor deems pertinent to the ERSS but does not fit in any other subsection.

2) **Specific instructions –** Using the specific instructions below and data sources in appendix A, search for the information necessary to describe the native range and status information relevant to the species being assessed. Risk assessors are not limited to the data sources in appendix A. Any additional sources should be evaluated for scientific credibility. If a species is not covered in the databases and websites listed in appendix A, expand the search to other databases and primary literature to determine native range, nonindigenous occurrences, and how the introductions

occurred. If a risk assessor has checked all the appropriate sources and limited information was found, then the lack of data should be noted, and searching can stop.

a) **Status in the United States -** If a species has both native and nonnative occurrences within the contiguous United States this needs to be clearly explained. If available, a map clearly showing the native and nonnative range of the species should be included here.

b) Remarks – Some standardized text has been developed for a few specific situations that may occur:

i) If there is no information for this section, state: "No additional remarks."

ii) For species that are native in all or most of the contiguous United States but are of interest to noncontiguous areas it must be stated that an ERSS must be completed before a climate supplement (see appendix G) can be prepared. The text should read: "Although [*Species name*] is native to [much, most, or all] of the contiguous United States, it is [considered invasive in *or* of concern to] [noncontiguous area]. As per the Service ERSS standard operating procedures, to determine the full extent of the [taxa]'s risk to [noncontiguous area], an ERSS for the contiguous United States is completed before a more specific climate match can be completed for [noncontiguous area]."

iii) If a fish species has been or may be intentionally stocked in a nonnative area within the United States for fishery management objectives the following language needs to be added: "[*Species name*] has been intentionally stocked [add "outside its native range" if applicable] within the United States by State fishery managers to achieve fishery management objectives. State fish and wildlife management agencies are responsible for balancing multiple fish and wildlife management objectives. The potential for a species to become invasive is now one important consideration when balancing multiple management objectives and advancing sound, science-based management of fish and wildlife and their habitat in the public interest."

3C: ERSS Section 2 - Biology and Ecology

1) **Data description –** For section 2 of an ERSS, search for information for the following 11 data fields, using specific instructions in number 2 below and information sources in appendix A. Each of the data fields should be placed as a subheading within section 2 of an ERSS (see template, appendix I). The headings in section 2 of an ERSS were designed to correspond with many of the major headings in FishBase.

a) **Taxonomic Hierarchy and Taxonomic Standing –** The complete taxonomic hierarchy for the valid name of the organism including the kingdom, phylum,

class, order, family, genus, and species. The descriptors and taxonomic authorities that often occur after the scientific names are not needed.

i) May also include subgroups such as infraclass, superorder, etc.

ii) Other scientific names applied to the species. This may include any recent synonyms or if much of the literature about the species was published using a name that is no longer valid.

b) **Size, Weight, and Age Range –** The length or age at maturity, size range, maximum length, common length, maximum weight, and maximum age as available. Define any taxon-specific measurement abbreviations that appear in quoted material.

c) **Environment –** A basic description of the physical conditions necessary for survival of the species, not including climate. For an aquatic organism, for example, this may include water temperature (**note: air temperature goes under Climate**), salinity, pH, dissolved oxygen content, depth range, turbidity, or water velocity. If found, elevation should be included, especially if it is a high elevation species. If the species spends part of it lifecycle in a marine environment, see appendix F (ERSS Writing for Species Not Restricted to Freshwater). Biological associations should be listed under Biology and not Environment. If the reported water temperature range is for aquarium settings, it should be noted. If the water temperature is an outdoor temperature, then the author should state this. If the water temperature is from a thermal spring or other source that stays fairly constant year-round despite seasonal variations in temperature, (such as a cave), state so.

d) **Climate–** The general climate (temperate, tropical, etc.), air temperature range (**note: water temperature goes under Environment**), and latitude range where the species can survive.

e) **Distribution Outside the United States**

i) **Native –** The native range of the organism outside the United States. Often the same as "Native Range" in section 1 of the ERSS. If the species is native to any or all of the United States, do not repeat the information pertaining to the United States from section 1, instead state: "Part of the native range for this species is within the United States, see section 1 for a complete description of the native range." Repeat the information on the native range outside of the United States.

ii) **Introduced –** The introduced range of the organism outside the United States. If possible, include whether the species is known to be established in each location.

f) **Means of Introduction Outside the United States –** How the species was introduced to a new range outside of the United States. This includes pathways and vectors (see part 3B(1)(c) above for description of pathways and vectors). If possible, provide a general summary of historical information on introduction, transport routes, and spread.

g) **Short Description –** A physical description of the species. Focus on information that may be used for identification purposes.

h) **Biology –** The basic biology of the species. May include information on habitat use, feeding, reproduction, development, genetics, activity patterns (such as, migration, hibernation), adaptations for survival, patterns in population size or density, as available.

i) **Human Uses –** Actual and potential human uses of the species and its current status in trade. May include information related to consumption by humans, use in the pet trade, ornamental uses, use for materials, use as bait, etc.

    i) United States trade information should be reiterated from "Status in the United States" in section 1 of the ERSS.

    ii) If possible, include specific information on the duration and volume of the species in trade.

j) **Diseases –** Pathogens and parasites known to be carried by the species. For vertebrate and macroinvertebrate species, the initial statement should be whether species is reported to carry any diseases that are on the World Organisation for Animal Health's list of notifiable diseases (known as "OIE-listed"[3]) with the appropriate citation for the disease list. This statement should be in bold. OIE does not list diseases for which the hosts are exclusively microinvertebrate species or plant species.

k) **Threat to Humans –** Characteristics of the species that pose a threat to humans. May include that the species is venomous, poisonous, traumatogenic (causes bodily injury), a potential pest, carries a zoonotic disease (animal to human transmission), etc. This information can come from the native or invaded range of the species.

    i) The distinction between this subheading and the Impacts of Introductions section below is that this section is for threats to humans, regardless of whether there is evidence of those threats actually having an impact in an invaded area. If there is documentation of the threat having an impact in the *invaded* range, the information should also be included in the Impacts of Introductions section (see part 3D).

[3] The World Organisation for Animal Health was formerly known as the Office International des Epizootics (OIE); despite the name change, they have kept the "OIE" acronym.

ii) Information on threats to humans from the genus (for example, envenomation from freshwater stingrays or shock from electric fish) may go in this section regardless of whether the specific species is identified.

2) **Specific instructions –** For section 2 of an ERSS, search for information for all of the 11 biology and ecology subheadings listed above, and consider the specific instructions below relevant to the species being assessed.

a) Taxonomic Hierarchy

i) See part 3A(2) for details on identifying the current valid scientific name.

ii) If the species has recently (within the last 50 years) undergone a change in valid name or was known by a synonym for a significant time (that is, several years' worth of literature about the species may be published using the synonym) list those names in this section as well and use them to search for information. Only list synonyms that were also used to search for information.

b) For all other subheadings in section 2 of an ERSS, search all appropriate sources listed in appendix A to document as much biological and ecological information regarding the species as possible, placing the information under the appropriate subheadings within the ERSS template.

c) If a species is not covered in the databases and websites listed in appendix A, expand the search to other databases and primary literature to determine native range, nonindigenous occurrences, and how the introductions occurred. If a risk assessor has checked all the appropriate sources, then the lack of data should be noted, and searching can stop.

3D: ERSS Section 3 - Impacts of Introductions

1) **Data description –** Based on the data description below, search for information on documented impacts of introduction for the species being assessed, using data sources in appendix A and specific instructions in number 2 below.

a) **Impacts of Introduction** – Include all information on the documented effects of the assessed species within a nonnative habitat, including those affecting native species, the environment, the economy, or human health. Information on impacts to other nonnative species may be included if needed to document an impact to human health or the economy. Pay special attention to those impacts related to criteria under the Lacey Act, including impacts to human beings, to the interests of agriculture, horticultural, forestry, or to wildlife or the wildlife resources of the United States. Details that may be useful include:

i) The specific ecological, social, or economic constructs or functions were affected,

ii) The magnitude of the impacts, and

iii) If the species is listed on international, Federal, or State invasive, prohibited, or restricted lists. The jurisdictions that promulgated rules to restrict possession, trade, or transport should be provided. This statement should repeat any information on regulations presented in "Status in the United States", see part 3B(1)(b).

2) **Specific instructions –** Search for information on documented impacts of introduction that are relevant to the species being assessed. Use peer-reviewed literature when available.

a) **Important notes -** It is most important to seek peer-reviewed literature documenting details of assessed and documented impacts, and to copy from, and cite, that literature. Provide as much relevant information on impacts as possible without unnecessary repetition. While *potential* impacts can certainly be reported, they cannot be used as the sole basis on which a species is assessed. Any potential impacts must be clearly identified as potential and not documented impacts.

b) Good sources for accessible peer-reviewed literature are: Web of Science (http://apps.webofknowledge.com) and Google Scholar (https://scholar.google.com/).

c) For Service personnel, the Service's Conservation Library can be useful in finding full text copies of articles not otherwise available. The catalog of available full text journals can be found here: https://fwslibrary.on.worldcat.org/atoztitles/. If the article cannot be accessed via the catalog, an email requesting a copy can be sent to library@fws.gov. Be sure to send the full citation and indicate which program the request originates from (i.e. FAC, Refuges).

3E: ERSS Section 4 – History of Invasiveness

1) **Data description** – Based on the information gathered on introductions and impacts of introduction for the assessed species, the assessor should assign a history of invasiveness (HOI) category and corroborate that category with a supporting narrative.

2) **Specific instructions –** Summarize the clear, convincing, and scientifically reliable and credible evidence in sections 1 through 3 of the ERSS relating to the species' history of invasiveness and explain how the information fulfills the criteria for the HOI category (see below). Pay particular attention to the differences between the definitions of Low, Data Deficient, and No Known

Nonnative Population HOI categories when assessing a species without documented adverse impacts of introduction. Summarize information on introductions, establishment, impacts, existing regulations, and trade. If trade data are available for a limited period (days, months, or a single year), clearly state that when extrapolating data for comparison with the threshold of "substantial trade [millions of organisms] for substantial time [10 or more years]."

a. **High –** Species is established outside its native range, and one or more sources provide clear, convincing, and scientifically credible, reliable, and defensible documentation of negative impacts of introduction. Pertinent information is quoted in section 3, Impacts of Introduction, and cited in the Literature Cited sections (sections 10 and 11). As per part 3D of this SOP, impacts of introduction are defined as the effects of the assessed species, within a nonnative habitat, including those affecting native species, the environment, the economy, or human health (such as impacts to human beings; to the interests of agriculture, horticultural, forestry; or to wildlife or the wildlife resources of the United States).

b. **Low -**

    i. The species is established outside of its native range, but scientifically defensible studies conclude that there are no significant negative impacts of introduction (as per part 3D, see above) that are attributable to the subject species; or

    ii. The species has been transported beyond its native range due to substantial trade [millions of organisms] for substantial time [10 or more years][4] with no or very little evidence of establishment outside its native range.

c. **Data Deficient –**The species is established beyond its native range, and

    i. There was no evidence found of negative impacts, no evidence found of lack of negative impacts (see 2(b)(i) above), or no evidence found of substantial trade for at least 10 years as defined in 2(b)(ii) above; or

    ii. There is information available indicating possible negative impacts or possible lack of negative impacts. However, this information fails to meet the requirements for scientifically defensible studies or "preponderance of evidence" that would qualify the species as having "High" or "Low" HOI.

[4] The bracketed materials provide only the Service's frame of reference, instead of a precise amount of propagule pressure and time period.

d. **No Known Nonnative Population**

i. No evidence was found of the species having ever been transported (through trade or other mechanisms) outside its native range, so presumably the species has had no opportunity to become established and exhibit any negative impacts of introduction; or

ii. The species is cryptogenic (status as a native or nonnative species is unknown); or

iii. The species' distribution is unknown (including whether it has been introduced outside its native range); or

iv. There is evidence of the species having been introduced beyond its native range, but no evidence of establishment in the wild and there was no evidence of substantial trade for at least 10 years as defined in 2(b)(ii) above.

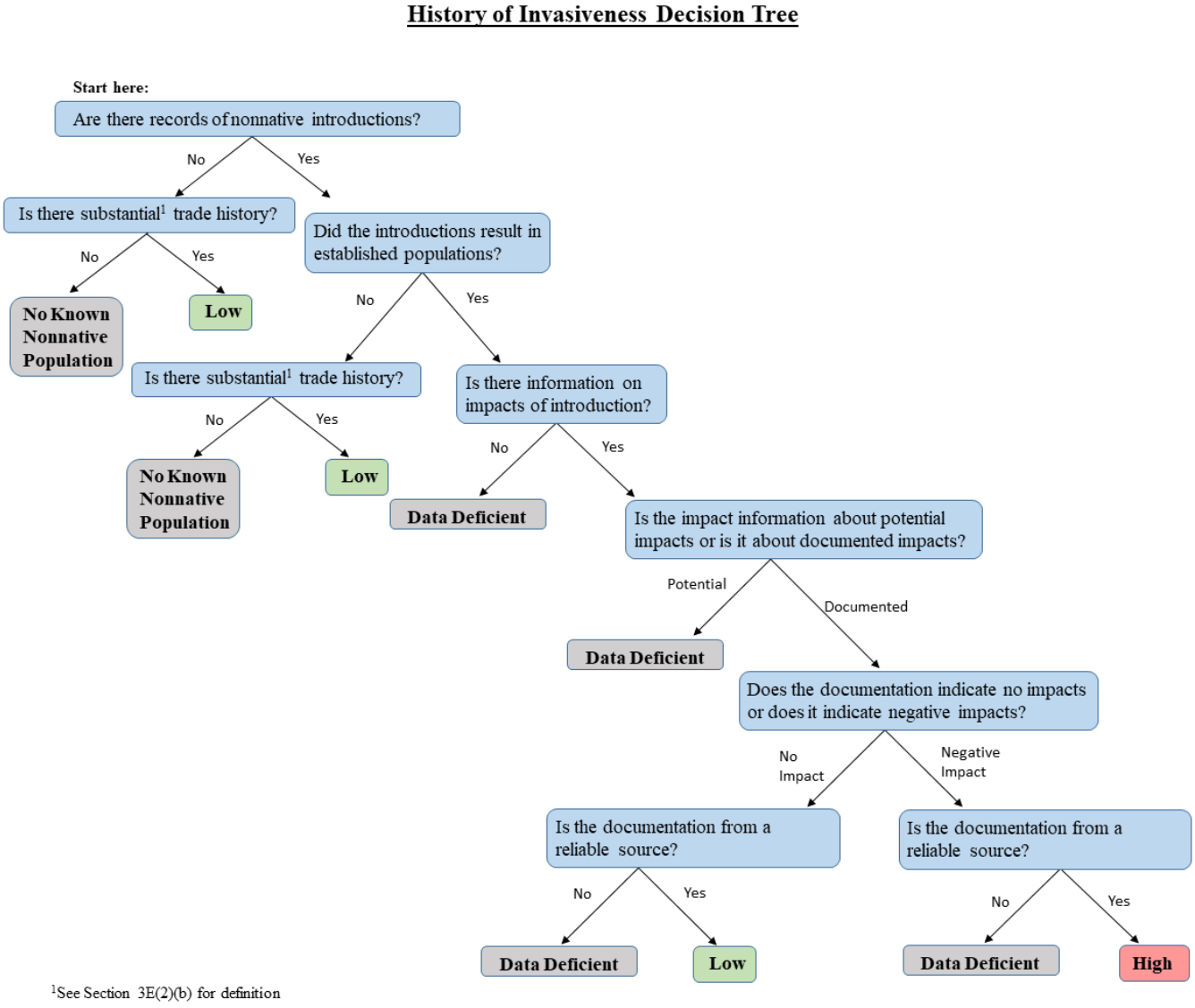

Figure 2. A decision tree to assist assessors with selecting the correct HOI category based on the information in the ERSS. Use the narrative explanations (see part 3E(2)a through d) to confirm or revise the result of the decision tree.

3F: ERSS Section 5 - Global Distribution

1) **Data description –** Based on the data description below, search for geographically referenced information, preferably in map form, on the global distribution of the species being assessed, using data sources in appendix A and specific instructions in number 2 below.

   a) Global Distribution – Geographically referenced observations of the species displayed on one or more maps. Maps must:

      i) Include a caption and, where applicable, a legend. The caption should state the countries (or general regions of the world in the case of a large distribution) where points are located.

      ii) Include at least a little bit of coastline or country borders so it is possible to identify where the data points are located. Do not zoom in so close that it is not possible to recognize the location. If the map does not have zoom capabilities and does not contain coastline or country borders, describe the location in the figure caption.

   b) For parts of the range missing from the maps, state that there is a lack of georeferenced occurrences in the missing parts of the range. In cases where this may affect the climate match results, say so in section 7, and if severe, repeat in sections 8 and 9.

2) **Specific instructions –** Search for the information on global distribution, considering the specific instructions below relevant to the species being assessed.

   a) Include maps showing the species' distribution in the world

      i) Start by searching the Global Biodiversity Information Facility (GBIF) and including any maps for the species. Use of GBIF is integrated into RAMP (Risk Assessment Mapping Program, see appendix E) so it is important to include any distribution maps that GBIF contains for the species.

      ii) If there are no points in GBIF or other mapping databases, and it is possible to generate a distribution map based on species location descriptions cited in sections 1 and 2 or coordinates given in an article, a map may be generated using Google Maps, Google Earth, or ArcGIS with appropriate credit given to that software.

         (1) If specific coordinates or locations are listed in the literature those can be used to plot the observations.

         (2) If only general locations are listed in the literature (i.e. a lake or river basin) find a map of that location(s) with appropriate usage rights. Clearly

state that the locations represent the range of the species and that source points for the climate match were chosen to represent the lake, basin, or region.

iii) Maps from other databases and literature may be used provided they are published under a re-use license.

b) Search for outliers and anomalies – When viewing the GBIF map or other distribution data, it is important to distinguish between established population locations and other types of occurrences. Only established population locations will be used to select source points for the climate match. Any points that will not be used to select source points should be clearly indicated in figure captions in section 5. The general process for identifying locations that may not represent established populations is below and can be used for any database. Specific and more detailed instructions using GBIF as a model can be found in appendix D.

i) Check for internal consistency in the document regarding the species range. Compare the map to the known native range, introduced range, and other information regarding the established range. If range information in sections 1 and 2 is not consistent with maps in section 5, evaluate the differences, as described below, to determine if points on maps are legitimate.

ii) Access the record information for any outlier points. Within the provided information on the record, be sure that:

(1) The longitude and latitude are correct for the provided collection location,

(2) The map location makes sense (such as, a fish species captured from an aquatic environment not dry land or a freshwater species in a marine environment),

(3) The collector or collecting organization has not simply provided a location for its library or catalogue (this seems to occur more frequently in Scandinavia and Germany),

(4) For aquatic species, the location is not a thermal spring or other environment where the water remains at a constant or warmer temperature despite the seasonal changes in air temperature. If so, the location should not be used for the climate match as the climate matching programs cannot account for the different ambient water conditions present at those locations and will likely bias risk of establishment based on climate match analyses. The location should, however, be mentioned under “Remarks”, noting that the species has survived or established in the thermal springs, and

(5) The specimen was obtained in the wild. Some records will be the result of market collections, pet shops confiscations, aquarium or laboratory specimens, greenhouse locations, etc. which do not represent established wild populations.

iii) If the record appears genuine and representative of an established population, it may be included, if not, note that the point will not be used to select source points for the climate match in the caption of the map and the reason it is not included. Perform the climate match without it.

c) Save and insert the map in the ERSS, noting any data points that will not be used (see above). Save both an image file (JPG or PNG) of the map for incorporation into the ERSS and a PDF of the webpage in the administrative file.

i) Caption formatting for global distribution map (usually figure 1) should read: "Figure [X]. Known global distribution of [scientific name] reported from [countries or regions]. Map from [citation]."

ii) Note in the caption for the map any points that will not be used to select source locations for the climate match and why. Group points by the reason they will not be used. For example: "Locations in France and the Atlantic Ocean were not used to select source points for the climate match because the listed coordinates do not match the collection location." and "Locations in India and South Africa were not used to select source points for the climate match because the specimens were not collected from the wild."

iii) It may also be helpful to note in the caption why an outlier point was determined to be valid and used to select source locations for the climate match.

iv) Also, in text below the map(s), note any locations where the species is reported from that are not represented on the map(s).

Figure 3. Example of a species distribution map from GBIF.

3G: ERSS Section 6 - Distribution Within the United States

1) **Data description –** Based on the data description below, search for geographically referenced information on the distribution within the United States and its territories of the species being assessed, using data sources in appendix A and specific instructions in number 2 below.

    a) **Distribution Within the United States –** Maps displaying the distribution of the species within the United States and its territories (if the species is present in the United States).

        i) The map(s) should include a caption and, if provided by the source, a legend (such as, when the points are in multiple colors or symbols).

        ii) Maps should always include at least a little bit of coastline or State borders so it is possible to identify where the data points are located. Do not zoom in so close that it is not possible to recognize the location. If the map does not have zoom capabilities and does not contain coastline or State borders, describe the location in the figure caption.

        iii) For parts of the range missing from the maps, state that there is a lack of georeferenced occurrences in the missing parts of the range. In cases where this may affect the climate match results, say so in section 7, and if severe, repeat in sections 8 and 9.

        iv) If the species has not been reported in the wild in the United States, then simply state: "This species has not been reported in the wild in the United States."

2) Specific instructions – Search for the information on the United States distribution using the specific instructions below and data sources in appendix A that are relevant to the species being assessed.

    a) Access maps showing distribution in the United States.

    b) Search for outliers and anomalies using the same methods as outlined in part 3F(2)(b).

    a) United States distribution map caption should read: "Figure [X]. Distribution of [scientific name] in the United States reported from [States or if too many, regions]. Map from [citation]." Note in the caption any points not used to select source points for the climate match and why. Also, note in text below the map(s) any locations where the species is reported from that are not represented on the map(s). See examples in part 3F(2)(c)(ii).

Figure 4. Example of a United States distribution map acquired from the NAS database.

3H: ERSS Section 7 - Climate Matching

The climate matching component of an ERSS is completed using the Service's Risk Assessment Matching Program (RAMP; Sanders et al. 2018)[5]. RAMP was peer reviewed under Office of Management and Budget criteria for influential science (OMB 2004); peer review documentation may be found at: https://www.fws.gov/fisheries/ANS/erss_supporting_documents.html. If a risk assessor outside of the Service is licensed to use ArcGIS and wishes to use RAMP, then a request for the program can be made by sending a message to preventinvasives@fws.gov. The RAMP program is accompanied by an SOP (https://www.fws.gov/fisheries/ANS/pdf_files/RAMP-SOP.pdf; also found in appendix E) that provides detailed instructions on using RAMP to conduct climate matching.

1) **Data descriptions -** Climate matching - In section 7, the maps in ERSS sections 5 and 6 (parts 3F and 3G, above) are used to run a climate match for the assessed species. The RAMP SOP is included within this SOP as an embedded PDF in appendix E.

   a) **Source map -** A map displaying the source points selected for the climate match (see figure 5). The map should include a caption. The caption should clearly state the overall geographic area of the map. The countries or States with selected source points should be identified in the caption. The overall distribution of the points should be described in the alt text.

   b) **United States climate match map -** A map displaying the climate match results for the contiguous United States (see figure 6). The map should include a caption and alt text. The climate match in the ERSS is run for the contiguous United States, but if an assessment is needed for a noncontiguous area, a climate match

[5] If the ERSS process is being applied outside of the Service and the use of RAMP is not feasible (see above on requirements and obtaining a copy), then the Australian Bureau of Rural Science's Climatch program (Australian Bureau of Rural Sciences 2010) is an acceptable alternative. See appendix E for information on Climatch and the Climatch User Manual.

supplement (see appendix G) can be done that includes Alaska, Hawaii, and U.S. territories.

c) **Climate Match Summary –** Section 7 should begin with a summary of the results of the climate match and include information regarding:

   i) Climate match – The similarity between the source climate and the target region climate. The climate match can be described in terms of areas of high, medium, or low match within the contiguous United States. Target point scores of 0-3 (blue and dark green) are considered low, 4-6 (light green to yellow) as medium, and 7-10 (orange and red) as high. The target point score is the similarity of the climate variables at the target point with the climate variables at the sources points. Each target point is assigned a score of 0 – 10, where a score of 10 is a perfect climate match between the source locations and the target point and a score of 0 is no match.

   ii) Climate 6 score - ((Count of target points with target point scores 6-10)/(Count of all target points)) – Used to determine the overall high, medium, or low category of the climate match. RAMP will automatically calculate the Climate 6 score for the target region[6].

   iii) Overall climate match category - The Climate 6 score is used to determine the overall climate match category (High, Medium, Low) for the target region. See table 1. If the target region is the contiguous United States, RAMP will also calculate the Climate 6 score for each State and list which States fall in each climate match category at the bottom of the results map.

   iv) Example of a Climate Match Summary: "The climate match for [*Species name*] was generally low for the contiguous United States with small areas of medium and high climate match. Peninsular Florida has a high climate match and there were areas of medium climate match along the Gulf Coast. Everywhere else had a low climate match. The overall Climate 6 score was 0.002, low (scores between 0.000 and 0.005, inclusive, are classified as low). Florida had a high individual Climate 6 score, and Louisiana, Mississippi, and Texas had medium individual Climate 6 scores."

d) **Table of Climate Match Scores –** A table including the count of target points for each target point score (0–10), and the Climate 6 score are automatically generated on the climate match map when using RAMP (found in the lower left corner of the map)[7].

[6] If Climatch is used instead of RAMP, the Climate 6 score will need to be calculated manually based on the table of values provided as part of the Climatch output.
[7] If Climatch is used instead of RAMP, a table that includes the count of target points for each target point score (0–10) and the Climate 6 score must be created and included.

2) **Specific instructions**

a) Technical instructions are available in the RAMP SOP (https://www.fws.gov/fisheries/ANS/pdf_files/RAMP-SOP.pdf); the SOP is also embedded as a PDF in appendix E.

b) Selecting source points – Choose the source points to represent locations where the assessed species is established (both its native range and its introduced range).

i) Stations selected should be those representing established populations only. Check for consistency between points designated as established and the species' range described in sections 1 and 2. Please see the important note in part 3F(2)(b) above on searching for outliers and anomalies. Add or remove points as necessary.

ii) Save source map. This is automatically done when 'Step 3' is run in RAMP[8]. Insert the map into section 7 in the ERSS.

(1) Caption for the source map should read: "RAMP (Sanders et al. 2018) source map showing weather stations in [geographic area] selected as source locations (red; [list countries with selected source points]) and non-source locations (gray) for [scientific name] climate matching. Source locations from [citation]. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves."

(2) Example alt text for the source map: "Map of the world showing selected source locations for *Achatina fulica* climate matching. Locations are concentrated in the southern hemisphere in South America, Africa, and Asia."

[8] If using Climatch the source point map needs to be saved manually.

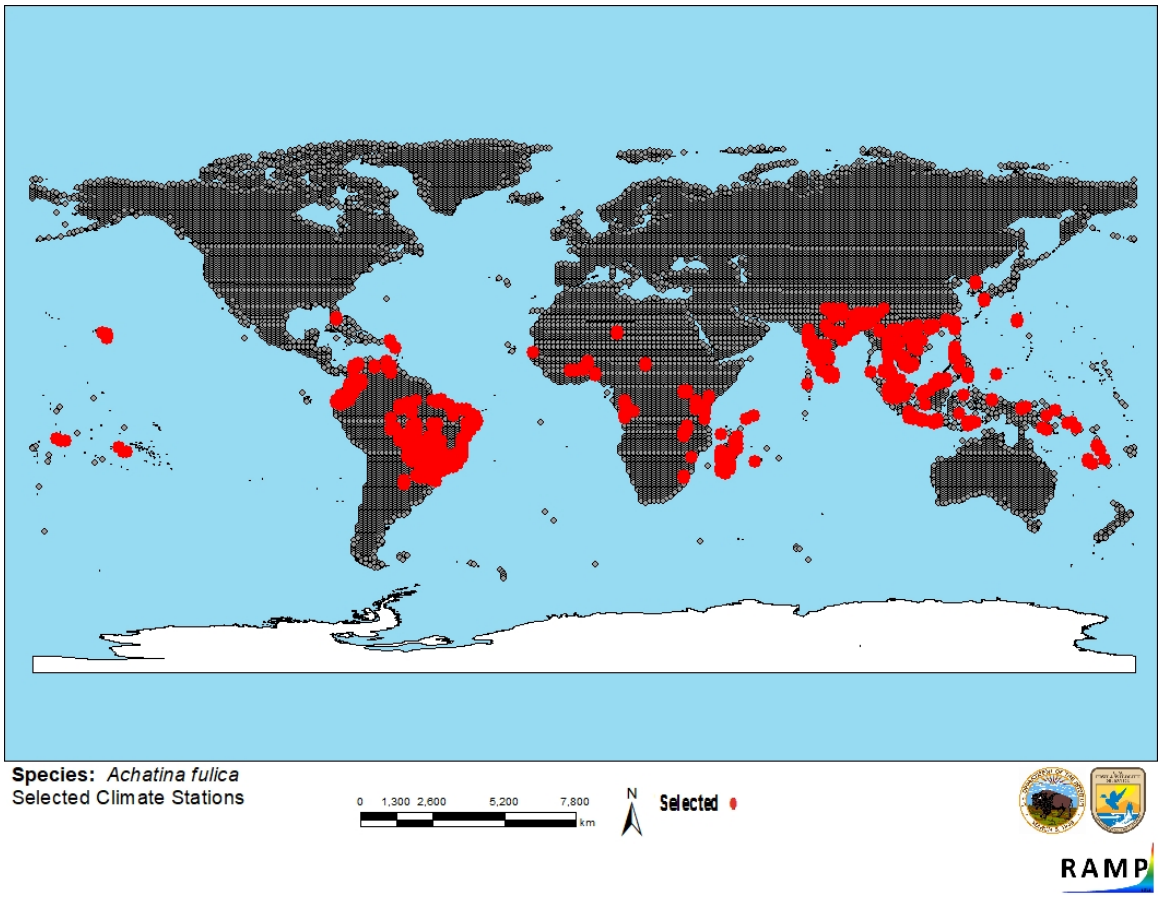

Figure 5. RAMP source map showing weather stations used in the climate matching process.

c) Designating target region– In this step, identify the target region for the climate match. Refer to the user manual (link provided above) for specific instructions.

d) Run the climate match. Save results map and place in section 7. All results files are automatically saved while running the climate match step in RAMP[9].

e) Incorporate climate matching results into ERSS - The United States climate match map must be inserted into the ERSS in section 7.

(1) Caption for the United States Climate Match Map should read: "Map of RAMP (Sanders et al. 2018) climate matches for [scientific name] in the contiguous United States [or appropriate region] based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match."

(2) Example alt text: "Map of the contiguous United States showing results of climate match for *Achatina fulica*. A text description of the results was provided at the beginning of section 7."

[9] If using Climatch all files must be saved manually.

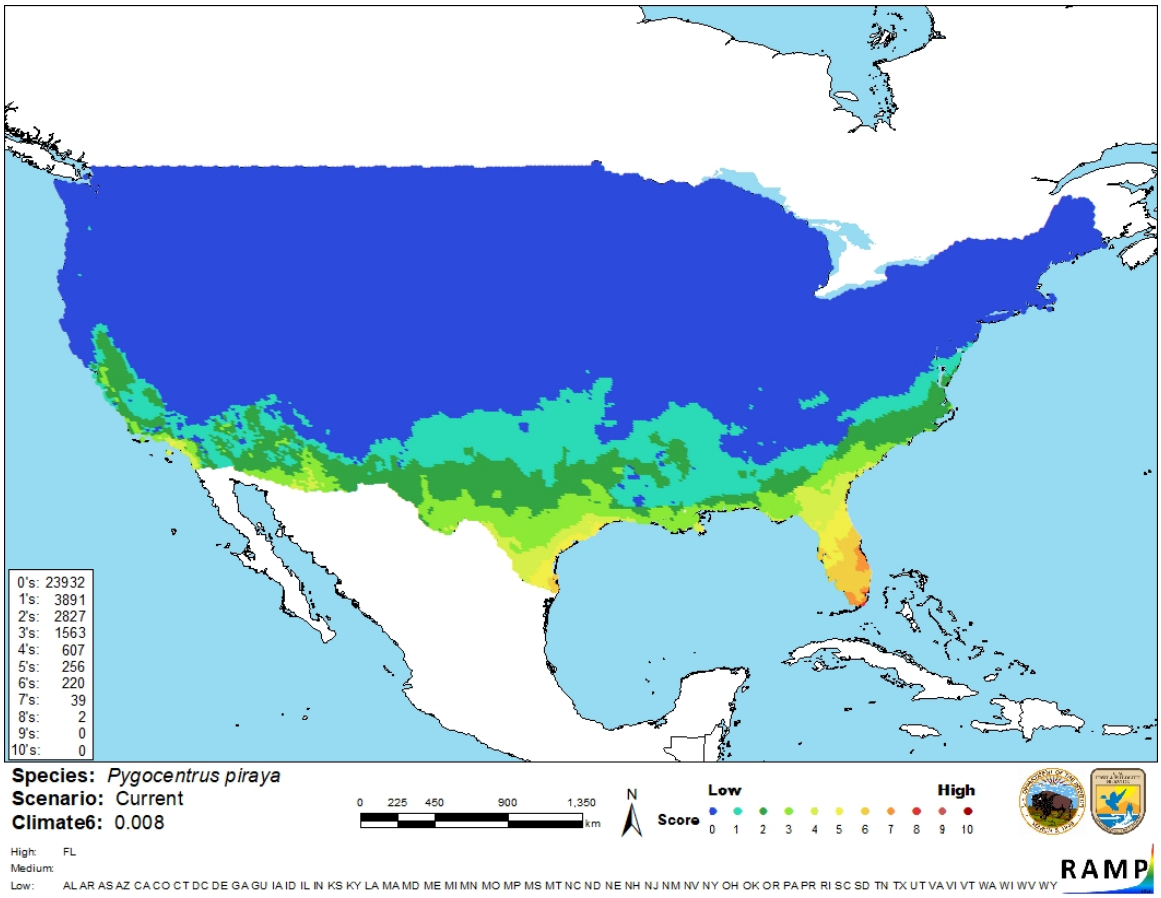

Figure 6. Example of a United States climate match map from RAMP.

f) Climate 6 score calculations

i) RAMP automatically calculates the Climate 6 score[10] and it is included at the bottom left in the in the climate match map.

ii) Use the Climate 6 score to categorize the score (high, medium, low).

[10] If using Climatch, calculate Climate 6 score ((Count of target points with target climate scores 6-10)/(Count of all target points)) and provide it in a table within section 7 of the ERSS along with the counts of each target point score.

Table 1. Climate 6 scores and associated overall climate match category. These relationships were based on analysis of data for 255 species established in 10 countries (Bomford 2008). See appendix H for more details about how the climate match categories were derived.

Climate 6: (Count of target points with target climate scores 6-10)/(Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

g) Climate Match Summary – If a species is native to part or most of the contiguous United States, clearly differentiate the climate match results between the native and nonnative areas. For example: "The climate match for *Sander vitreus* was generally very high in its native range in the Great Lakes and Mississippi River basins. However, it was also high across much of the rest of the contiguous United States." Or "*Elodea nuttallii* is native to most of the contiguous United States and the corresponding climate match was mostly high."

3I: ERSS Section 8 - Certainty of Assessment

1) **Data definition -** Based on the quality and quantity of the information for the assessed species, the assessor should assign a level of certainty to the ERSS and corroborate that certainty level with a supporting narrative.

    a. **Certainty of Assessment –** For section 8, use the information generated in the previous 7 sections to describe the amount and quality of information available regarding the species, its distribution, and its adverse impacts, to help determine a level of certainty for the overall risk assessment category (ORAC) of the species. This is most important in relation to scientific documentation of impacts of introduction (that is, history of invasiveness), and the information necessary to document the species distribution, which is used to match climate variables throughout its established range to climate variables in the United States. Other sources of uncertainty may include large gaps in georeferenced locations, partial marine range, need to extrapolate trade data, and taxonomic confusion.

2) **Specific instructions–** The assessor should assign a level of certainty to the ERSS based on the certainty categories below.

    a) **Certainty categories**

        i) **High certainty –** The risk assessor is highly certain of ERSS overall risk categorization, which is based on existing evidence that is provided and referenced within the ERSS. High certainty means that clear, convincing, and

scientifically credible and defensible information and associated syntheses are being used to draw conclusions about the subject species' history of invasiveness and climate match with the United States.

(1) One could conclude High certainty when abundant, clear, and convincing information is available about the subject species' distribution and negative impacts of introduction from peer-reviewed, scientific literature.

(2) One could conclude High certainty when abundant, clear, and convincing information is available about the subject species' distribution and if the subject species is documented as established outside of its native range, and one or more credible and reliable scientific studies concluded that no significant impacts of introduction resulted from establishment of the subject species.

(3) One could conclude High certainty when abundant, clear, and convincing information is available about the subject species' distribution and if the subject species is not documented as established outside of its native range, and one or more credible and reliable sources provide trade data showing millions of individuals in trade over at least 10 years.

ii) **Medium certainty –** Medium certainty means that there is a "preponderance of evidence" (Weiss 2003) relating to the history of invasiveness and the species distribution and that the certainty of the assessment is neither High (see part 3I(2)(a)(i) above) nor Low (see part 3I(2)(a)(iii) below). Examples of when the risk assessor may conclude Medium certainty, include: when most of the data and information about the subject species history of invasiveness and distribution are available only from gray literature; when some peer reviewed studies conclude there are impacts, while others find no impacts; when otherwise credible trade data cannot be compared directly to the threshold time period established for Low history of invasiveness (see part 3E(2)(b) above) and must be extrapolated from a shorter time period; and when key studies are not available in English for review beyond the abstract.

iii) **Low certainty–** The risk assessor is uncertain of the ERSS risk categorization. In this case, very limited or no information regarding the species' history of invasiveness or distribution is available. The information, particularly regarding history of invasiveness, is not scientifically defensible or the distribution information is so incomplete that the climate matching with the United States will not provide scientifically defensible results.

b) **Narrative** – The certainty category should be accompanied by a narrative that clearly explains the reasons for the risk assessor's choice. Topics that should be discussed here include the quality and quantity of the data (including the relative abundance of peer-reviewed studies indicating impacts or lack thereof), taxonomic issues, distribution issues, whether the species is cryptogenic (status as

a native or nonnative species is unknown), if part of the species range is marine (and therefore not included in the climate match), and anything else that the risk assessor feels affects the certainty of the ERSS.

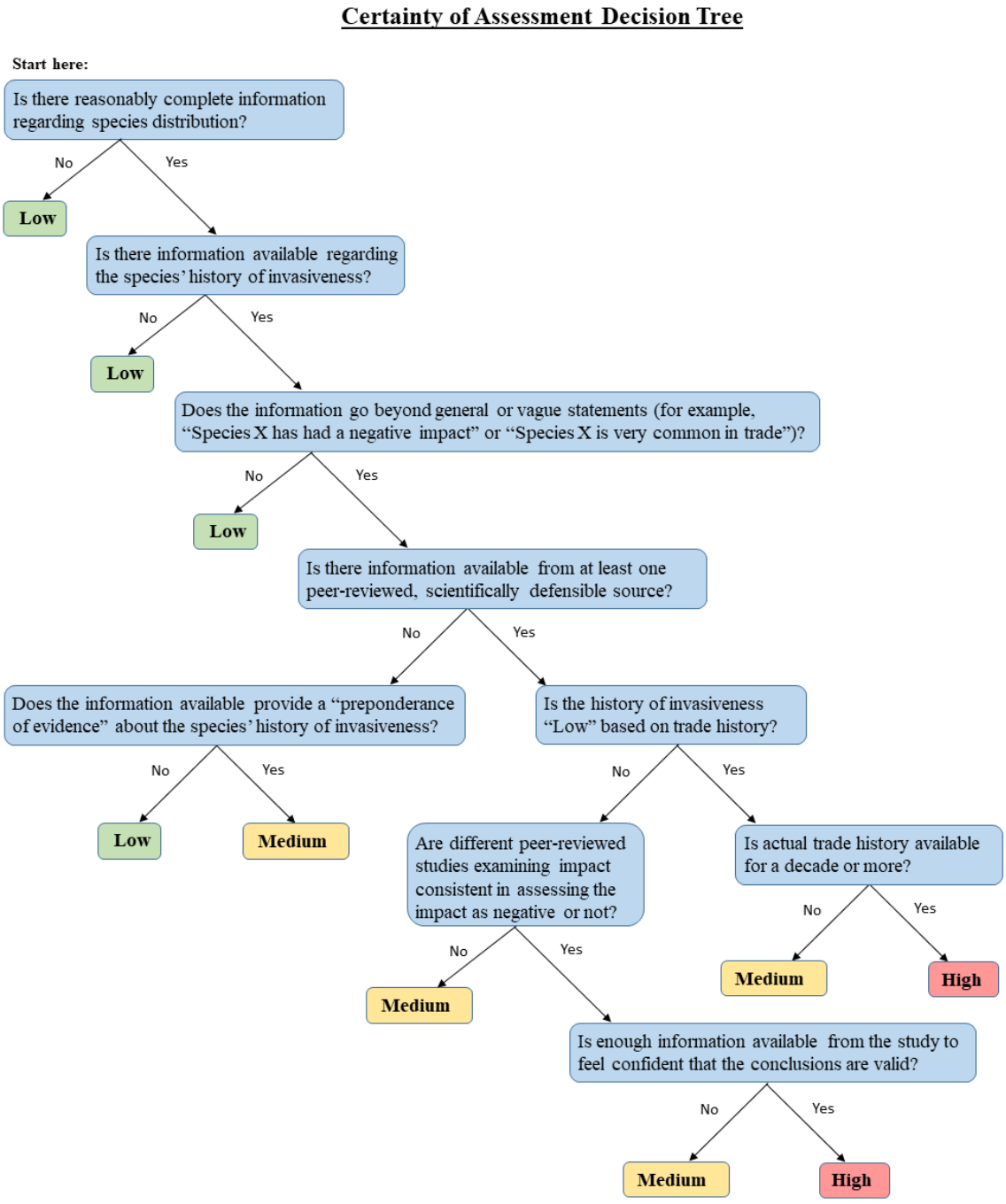

Figure 7. A decision tree to assist assessors with selecting the correct certainty of assessment category based on the information in the ERSS. Use the narrative explanations above to confirm or revise the result of the decision tree.

3J: ERSS Section 9 - Risk Assessment

1) **Data definitions –** For section 9, summarize the information from the preceding sections of the ERSS along with the categories assigned to the assessment elements (history of invasiveness and climate match). Follow the format in recent ERSS examples. Be sure all of the information in this section was mentioned in a previous section of the ERSS; no new information should be introduced in this section.

   a) **Summary of Risk to the United States –** This is a narrative summary and synthesis of the entire ERSS document. Included in this summary are, at a minimum, important information on the biology and ecology (such as OIE-reportable diseases), distribution, impacts, uses, and threats posed by the species. Especially important are a summary and synthesis of the history of invasiveness, climate match with the United States, the certainty of the assessment, and the ORAC for the species.

   b) **Assessment Elements –** The categories for each element of the risk assessment, as determined using the guidelines in the SOP, are presented in bulleted form (figure 8).

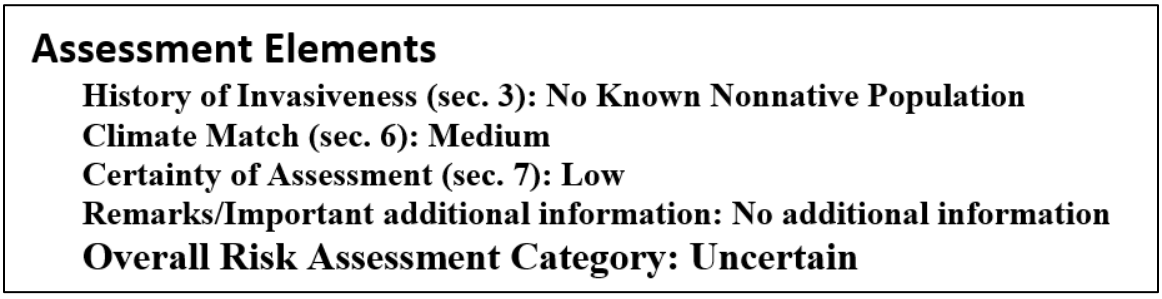

Figure 8. Example of the assessment elements list from an ERSS.

2) **Specific instructions**

   a) **Summary of Risk to the United States**

      i) The risk assessor should summarize the information within the ERSS that has led them to their ORAC. Include information important to evaluating risk – known impacts, if in trade, where climate match with the United States is high. Do not introduce new information in this section.

         (1) Begin with a general statement about what the organism is and where it lives. For example: "Jumbie Teta (*Ancistrus cirrhosis*) is an armored catfish that is native to South America (Brazil, Paraguay, Argentina and Uruguay)." Note if any States regulate possession or trade of the species. State the HOI category and summarize the justification. State the overall climate match category and summarize any regions of the country with a high climate match, especially if the species has a low or medium climate

match overall. State the certainty category and summarize the justification. The summary paragraph should end with a statement of the ORAC (see part 3J(2)(b)(v), below).

(a) If part of the species' range is marine, note that the marine portion of the distribution is not included in the climate match.

(b) If the source points for the climate match were only a general representation of the range of the species, state this and explains how it impacts the results of the climate match.

(c) If the species is native to part of the contiguous United States, clearly indicate where the climate match results represent the native range of the species and the results for remainder of the contiguous United States. For example: "The overall climate match is high, both in its native range in the Great Lakes and Mississippi River basins, and in areas outside its native range." Or "The climate match is high for most of the contiguous United States, where the plant is native."

(d) If a species has been or may be introduced within the United States for fishery management purposes state so.

(2) Example summary paragraph: "Splash Tetra (*Copella arnoldi*) is a South American freshwater fish that is native to Brazil, Colombia, French Guiana, Guyana, Suriname, Venezuela, and Trinidad. It is used in the aquarium trade outside of the United States. The history of invasiveness is Data Deficient. It has been introduced in Trinidad and Tobago and established a population. No studies on impacts from that introduction were found. The overall climate match for the contiguous United States was Low with all States having a low individual Climate 6 score, except Florida which had a medium individual score. The certainty of assessment is Low because of a lack of information. The overall risk assessment category is Uncertain."

(3) See other examples in the sample of a completed ERSS in appendix J and in existing ERSS reports located on the Service's ERSS Reports web page at: https://www.fws.gov/fisheries/ANS/species_erss_reports.html.

b) **Overall Risk Assessment Category** – This final piece of information is a rating of Low, High, or Uncertain based on the information below. See table 2 for a summary of all the combinations of Overall Climate Match Category and History of Invasiveness. The summary paragraph in section 9 should end with this information and it is also listed in the Assessment Elements.

(1) **High –** To receive an overall risk of High, a species must have both of the following:

(a) Medium or High Overall Climate Match Category; and

(b) High History of Invasiveness (scientific evidence is clear, convincing, and scientifically credible, reliable, and defensible).

(2) **Low –** To receive an overall risk of Low, a species must have both of the following:

(a) Low Overall Climate Match Category; and

(b) Low History of Invasiveness (see 2(b) in this section).

(3) **Uncertain** – A species is given an overall risk of Uncertain, for any of the following conditions:

(a) Climate 6 score is Low and history of invasiveness is High, or

(b) Climate 6 score is High or Medium and history of invasiveness is Low, or

(c) Climate 6 score is Low, Medium, or High and history of invasiveness is Data Deficient, or

(d) Climate 6 score is Low, Medium, or High and history of invasiveness is Uncertain, or

(e) If the species cannot reproduce in non-marine environments because the climate match for marine reproduction cannot be assessed in an ERSS.

Table 2. Overall risk categories determined by combining the overall climate match category (high, medium, or low) with the history of invasiveness category (high, low, data deficient, no known nonnative population).

History of Invasiveness	High Climate Match	Medium Climate Match	Low Climate Match
High	**High**	**High**	Uncertain
Low	Uncertain	Uncertain	**Low**
Data Deficient	Uncertain	Uncertain	Uncertain
No Known Nonnative Population	Uncertain	Uncertain	Uncertain

c) **Assessment Elements**

i) **History of Invasiveness** - List the categorical result (High, Low, Data Deficient, or No Known Nonnative Population) as determined in part 3E (ERSS section 4).

ii) **Overall Climate Match Category** –List the categorical result (High, Medium, or Low) as determined in part 3H (ERSS section 7).

iii) **Certainty of Assessment** – List the categorical result (High, Medium, or Low) as determined in part 3I (ERSS section 8).

iv) Remarks/Important additional information - This section, in the assessment elements, is used to note any important issues, such as disease, uncertainty as a result of reproduction in marine environments, if the species has survived or established in thermal springs, problems with type specimen (juvenile, came from fish market), if it is native to part of the contiguous United States, stocked for fishery management purposes, or carries a threat to humans. This information should already be stated elsewhere in the ERSS and also be included in the summary paragraph at the beginning of section 9. No new information should be listed here. If there are no additional remarks the assessment elements list should state so.

v) Overall Risk Assessment Category – List the ORAC as determined from the HOI and overall climate match category.

d) Organism Type and ORAC in Title Page Header - Now that the ORAC is known, fill in the organism type and the ORAC fields in the header information on the first page of the ERSS.

3K: ERSS Sections 10 and 11 – Literature Cited

1) **Data description –** All sources, peer-reviewed literature, other scientific sources, or supplemental sources, cited within the ERSS must be included in one of the two literature cited sections, sections 10 and 11.

a) **Section 10 – Literature Cited –** This section is for citations that were directly accessed by the risk assessor; these sources were quoted or paraphrased within the ERSS.

b) **Section 11 – Literature Cited within Quoted Material –** This section is for citations that occur within quoted material, but that were not accessed by the risk assessor. If a source cited within quoted material was also accessed by the risk assessor (as in it is already listed in section 10) then it should not be listed a second time in section 11.

2) **Specific instructions**

a) All references should use standard Journal of Fish and Wildlife Management formatting (see appendix C for examples). The current Journal of Fish and Wildlife Management Style Guide can be found here: https://www.fws.gov/science/guideforauthors.html#StyleGuide. Correct citations for commonly used databases can be found in appendix A. For Service employees, the "ERSS Database Manual" shared document contains the information found in appendix A and any updates since the last publication of the appendix. Ask your Regional Lead for access to the shared document.

b) Remember to italicize scientific names within references.

c) When citing online references, the date for the citation should be the publication date of the page or date of last edit, if available, or if not available, the date the site was accessed. The month and year of access should be included at the end of the reference. Example: Froese R, Pauly D, editors. 2019. *Alburnus alburnus*. FishBase. Available: www.fishbase.us/summary/Alburnus-alburnus.html (March 2019).

d) When a primary source accessed by the risk assessor fails to include all or part of the information for a citation in section 11, add the following after the available information: "[Source material did not give full citation for this reference.]"

e) Although the rapidity in which an ERSS is prepared often makes it difficult to use personal communications, it is certainly acceptable to do so, provided the risk assessor has sufficient time to seek out the assistance of experts in the appropriate fields of study. Personal communications should follow Journal of Fish and Wildlife Management style. Personal communications within quoted material do not need to be cited in section 11. However, if available, identifying information such as type of communication or the person's affiliation should be added to the quoted text in brackets. Example: (A. Berzins, [Dixie State College,] personal communication).

PART 4:
FINAL NOTE

Final Note

After all the steps in part 3 have been completed, the risk assessor should have a completed ERSS ready for technical review. The final step in the ERSS process is to use the RODS and the QA/QC Checklist (appendix B) to ensure that all parts of the ERSS have been thoroughly completed, and the research and administrative path is clearly documented. Remember that all documentation used to build the ERSS, including the RODS and QA/QC Checklist, should be kept in PDF or Word format to be used as part of the administrative record, particularly if the results of the ERSS are ultimately used to pursue an injurious wildlife listing for the species. It is recommended that the RODS be completed by the risk assessor while completing the ERSS. The technical reviewer will complete the QA/QC Checklist. When updating an already existing ERSS, a new RODS and QA/QC Checklist need to be completed. The RODS will be filled out by the assessor updating the information. The comments sections in the QA/QC Checklist should be filled in by the risk assessor when completing an update of an existing ERSS in order to document what changes were made between the previously published ERSS and the update. The technical reviewer will complete the QA/QC Checklist.

As previously mentioned, species ERSSs with an ORAC of "High" or "Uncertain" may contribute useful information for injurious wildlife listings under Title 18 of the Lacey Act. It is important to emphasize, however, that a species that has gone through the ERSS process is not exempt in any way from all of the required steps in the injurious wildlife process, including opportunities for public comment. The ERSS process is a screening process that simply helps the Service prioritize species for further scrutiny.

PART 5:
LITERATURE CITED

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PART 6:
APPENDICES

List of Appendices

Appendix A:
Data Sources

Important Note

The purpose of this appendix is to provide a centralized location in the SOP to document the different databases most frequently used in drafting ERSSs. This is an effort to standardize the usage of databases between different assessors and provide a support tool to new assessors. Assessors are not limited to the databases listed; other databases may be used. It is important to remember to check the scientific quality of any new database before using.

Structure of the Appendix

The database names are in **bold** and are followed by the link to the appropriate home or search page where the instructions start.

The next few lines are an example citation in Journal of Fish and Wildlife Management format for that database. The information in [brackets] is specific to the page being accessed and should be replaced with the correct information for each ERSS. When properly formatted, no part of the citation will be underlined. There may be an additional few lines describing where to find information specific to the page being accessed that is needed for the citation.

Following the citation information, there may be a few lines detailing what sort of information is available in the database or any other key information needed to use the database appropriately.

The instructions for each database are preceded by 'TO USE:'. These instructions will cover the basic information search and any techniques used to determine accuracy and quality of information. As databases update structures and user interfaces these specific instructions may no longer apply.

General Tips

Find Command: To use this, press the 'Ctrl' and 'F' key simultaneously. This brings up a search box in the top right corner of the page. Type all or part of the species name into this box. It will automatically search and highlight instances of the search term on the page. Use the arrow keys in the box or the 'Enter' key to toggle between instances of the search term.

Print Screen: Some databases do not have the built in function to save maps as images. In this case use the 'Print Screen' key on the keyboard to make a copy of the current monitor display. Paste this into any program that allows the manipulation of images. Use a crop function to select only the map and then save that as an image for use in the ERSS.

Table A-1: Taxa covered by each database.

Database	Aquatic	Terrestrial	Algae	Amphibians	Birds	Fish	Invertebrates	Mammals	Plants	Reptiles
AKEPIC	Yes	Yes	No	No	No	No	No	No	Yes	No
AlgaeBase	Yes	No	Yes	No	No	No	No	No	No	No
AmphibiaWeb	Yes	Yes	No	Yes	No	No	No	No	No	No
AquaNIS	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No
APASD	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No
BISON	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BugGuide	No	Yes	No	No	No	No	Yes	No	No	No
CABI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Catalog of Fishes	Yes	No	No	No	No	Yes	No	No	No	No
FAO	Yes	No	No	No	No	Yes	Yes	No	Yes	No
EASIN	Yes	Yes	No	No	No	Yes	No	No	Yes	No
EDDMapS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FishBase	Yes	No	No	No	No	Yes	No	No	No	No
GBIF	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GLANSIS	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No
GISD	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GRIIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GloBI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IBIS	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes
iMapInvasives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
India Biodiversity Portal	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Invasive Plant Atlas	Yes	Yes	No	No	No	No	No	No	Yes	No
Invasive Species of Japan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ITIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IUCN Red List	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Database	Aquatic	Terrestrial	Algae	Amphibians	Birds	Fish	Invertebrates	Mammals	Plants	Reptiles
MyBIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NatureServe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USGS NAS	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
NEMESIS	Yes	No	Yes	No	No	Yes	Yes	No	No	No
NOBANIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SeaLifeBase	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes
USDA PLANTS	Yes	Yes	No	No	No	No	No	No	Yes	No
VertNet	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
World Flora Online	Yes	Yes	No	No	No	No	No	No	Yes	No
WoRMS	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Table A-2: Databases where different types of information may be found.

Database	Taxonomy	Images	Range	Maps	Biology	Introductions	Impacts
AKEPIC	No	No	Yes	Yes	Yes	Yes	Yes
AlgaeBase	Yes	No	Yes	No	Yes	No	No
AmphibiaWeb	No	No	Yes	Yes	Yes	No	No
AquaNIS	Yes	No	Yes	No	Yes	No	No
APASD	No	No	Yes	No	Yes	Yes	Yes
BISON	No	No	Yes	Yes	No	No	No
BugGuide	Yes	Yes	Yes	No	Yes	Yes	No
CABI	Yes	Yes	Yes	No	Yes	Yes	Yes
Catalog of Fishes	Yes	No	Yes	No	No	No	No
FAO	No	No	No	No	No	Yes	No
EASIN	Yes	No	No	Yes	Yes	Yes	Yes
EDDMapS	Yes	Yes	Yes	Yes	Yes	Yes	No
FishBase	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GBIF	Yes	Yes	No	Yes	No	No	No
GLANSIS	No	No	Yes	Yes	Yes	Yes	Yes
GISD	No	No	Yes	No	Yes	Yes	Yes
GRIIS	No	No	No	No	No	Yes	No
GloBI	No	No	No	No	Yes	No	No
IBIS	Yes	No	No	Yes	No	Yes	Yes
iMapInvasives	No	No	No	Yes	No	Yes	No
India Biodiversity Portal	Yes	Yes	Yes	Yes	Yes	No	No
Invasive Plant Atlas	No	Yes	Yes	Yes	Yes	Yes	Yes
Invasive Species of Japan	No	No	Yes	Yes	Yes	Yes	Yes
ITIS	Yes	No	No	No	No	No	No
IUCN Red List	Yes	No	No	No	Yes	Yes	No
MyBIS	Yes	No	No	Yes	Yes	Yes	No
NatureServe	Yes	No	Yes	No	Yes	Yes	Yes
USGS NAS	No	Yes	Yes	Yes	Yes	Yes	Yes
NEMESIS	Yes	No	Yes	No	Yes	Yes	Yes
NOBANIS	No	No	Yes	No	Yes	Yes	Yes
SeaLifeBase	Yes	No	Yes	No	Yes	Yes	Yes
USDA PLANTS	Yes	Yes	No	Yes	No	Yes	No
VertNet	No	No	No	Yes	No	No	No

Database	Taxonomy	Images	Range	Maps	Biology	Introductions	Impacts
World Flora Online	Yes	Yes	Yes	No	Yes	No	No
WoRMS	Yes	No	Yes	No	Yes	No	No

List of Databases

Alaska Exotic Plant Mapping Project (AKEPIC)

http://aknhp.uaa.alaska.edu/apps/akepic/

Alaska Center for Conservation Science. 2016. Alaska Exotic Plant Mapping Project (AKEPIC). Anchorage: University of Alaska. Available: http://aknhp.uaa.alaska.edu/apps/akepic/ ([month and year of access]).

TO USE: This is a mapping application. Agree to the terms of use. The main screen shows a composite map for all nonnative plant species. To view a single species map, enter a species name in the search box in the middle of the legend. When you click on a species name in the results below the search box, a map of occurrences for just the selected species opens in an inset window. You can view the date of the occurrence record and the size of the infestation by scrolling over individual occurrence points.

One or more icons may appear on the right side of the results table. These icons allow you to download the occurrence data, species profile, risk assessment, or taxonomic information.

AlgaeBase

http://www.algaebase.org/

Guiry MD, Guiry GM. [year of access]. AlgaeBase. Galway: National University of Ireland. Available: http://www.algaebase.org ([month and year of access]).

TO USE: Type the genus or species name into the appropriate search box on the left and click the arrow button to search. Select the appropriate species from the results list to access the species page.

AmphibiaWeb

https://amphibiaweb.org/

AmphibiaWeb. [year of access]. [page title]. AmphibiaWeb. Berkeley: University of California. Available: [URL for species page] ([month and year of access]).

TO USE: Click on “Search the Database” and then type the genus or species name into the appropriate search box and click the “Search” button to search.

AquaNIS – Information system on aquatic non-indigenous and cryptogenic species

http://www.corpi.ku.lt/databases/index.php/aquanis/species/open

[page author(s)]. [year of access]. [page title]. AquaNIS: information system on aquatic non-indigenous and cryptogenic species. AquaNIS editorial board. Available: [page URL] ([month and year of access]).

The author's name can be found at the bottom of the species page. If there is a specific reference for a piece of information in AquaNIS, it is at the bottom of the information box. Place these references in [brackets] at the end of the quoted statements in the ERSS, and include the full citations in Section 10 of the ERSS.

TO USE: Select the starting letter of the species name. Use the Find command to search the page for the species. If species is included in the database, click on the species name to access the page.

Asian-Pacific Alien Species Database (APASD)
http://www.naro.affrc.go.jp/archive/niaes/techdoc/apasd/

National Institute for Agro-Environmental Sciences. 2007. [page title]. Asian-Pacific Alien Species Database. Available: [page URL] ([month and year of access]).

TO USE: From the homepage, click on "Enter APASD" to begin. Choose the appropriate taxon. There is no built-in option to sort or search the list of species for each taxon, so use the Find command to search the page for the species. If the species is included in the database, click on the species name to access the page. Note that if the species is present in multiple countries, there will be links for each country. In this case, cite the database as a whole rather than a single species page.

BISON – Biodiversity Serving Our Nation
https://bison.usgs.gov/#home

BISON. [year of access]. Biodiversity Information Serving Our Nation. U.S. Geological Survey. Available: https://bison.usgs.gov ([month and year of access]).

BISON will show any species occurrences in the United States. This is a good source for maps for Section 5.

TO USE: In the drop down box to the left of the search box, select the type of search to perform. ITIS refers to a taxonomic database described further on in the document. If a species is not listed in that database, make sure to choose 'Non ITIS Enabled Search by Scientific Name'. Once the appropriate search type is selected, type the species name into the search box and click 'Search'.

If there are species locations, use the tabs at the top right of the map to show the points layer and disable the heatmap layers. Use the controls to pan and zoom the map to explore the points. Use the Print Screen function to save the map.

To evaluate any points that do not match other distribution information found click on the point in question and details of that location record will pop up. If further information is needed, click on 'Show Details' in blue at the bottom of the box. It may help to zoom in so that only the point in question is highlighted by the click.

BugGuide - List of Non-native Arthropods in North America
https://bugguide.net/node/view/32329

Iowa State University. 2018. List of non-native arthropods in North America. BugGuide. Ames: Iowa State University Department of Entomology. Available: [page URL] ([month and year of access]).

TO USE: Use the Find function to search for a species by scientific name, then click on the hyperlinked name to view the species page.

CABI Invasive Species Compendium
http://www.cabi.org/isc/

[CABI] CABI International. [year of last page revision]. [page title] [original text by [page contributor(s)]]. CABI Invasive Species Compendium. Wallingford, United Kingdom: CAB International. Available: [page URL] ([month and year of access]).

CABI contains species datasheets as well as abstracts and some full text articles. The above citation is for datasheets found within CABI. Any articles accessed should be cited as normal. The author(s) of the original text is found toward the bottom of the datasheet under the heading 'Contributors'. The copyright year is found at the bottom of the page.

TO USE: Type the species name in the green search box and click 'Search'. There are options to refine search results on the right of the page if needed. Click on the appropriate search result to access the datasheets or articles.

Catalog of Fishes
http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp

Before September 4, 2018, the Catalog of Fishes should have been cited as:

Eschmeyer WN, Fricke R, van der Laan R, editors. [year of access]. Catalog of fishes: genera, species, references. California Academy of Science. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp ([month and year of access]).

As of September 4, 2018, the Catalog of Fishes should be cited as:

Fricke R, Eschmeyer WN, van der Laan R, editors. [year of access]. Catalog of fishes: genera, species, references. California Academy of Science. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp ([month and year of access]).

As of January 30, 2019, the Catalog of Fishes should be cited as:

Fricke R, Eschmeyer WN, van der Laan R, editors. [year of access]. Eschmeyer's catalog of fishes: genera, species, references. California Academy of Science. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp ([month and year of access]).

Catalog of Fishes is the ultimate authority on fish scientific names for the ERSS. If the scientific name differs between Catalog of Fishes and ITIS or other databases, the one listed in Catalog of Fishes is to be used for the ERSS. Make notations about the differences in valid scientific name between the databases in the Remarks subsection of the ERSS.

TO USE: Type the species name in the search box. Make sure the 'SPECIES' radio button is selected. Click 'Search'. This will provide a list of results. Use the Find command to search for the species name, looking for the entry where it is the original name (indicated in bold italics), at one point the 'Valid as' name, or the currently valid name.

Alternatively, access this database through FishBase by clicking on 'sp.' next to 'Catalog of Fishes' under the 'Classification / Names' heading on a species page. Accessing Catalog of Fishes this way returns only the entry for which the species name is the currently valid scientific name.

Database on Introductions of Aquatic Species (FAO)
http://www.fao.org/fishery/introsp/search/en

[FAO] Fisheries and Agriculture Organization of the United Nations. [year of access]. Database on introductions of aquatic species. Rome: FAO. Available: http://www.fao.org/fishery/introsp/search/en ([month and year of access]).

This database lists recorded introductions and many have some further information on means of introduction.

TO USE: Type the species name in the green search box and click 'Search'. This will generate a list of records. Save the list of records as a PDF. Click on each record to access the details. Save these detail pages to the PDF.

Use quotations around the target species name to limit the results to only records pertaining to the target species, otherwise the search results may include species that are taxonomically related to the target species or species that have similar names.

EASIN – European Alien Species Information Network
http://alien.jrc.ec.europa.eu/SpeciesMapper

European Commission – Joint Research Centre. 2017. European Alien Species Information Network. Available: https://easin.jrc.ec.europa.eu/ ([month and year of access]).

This website contains a mapping application showing distributions of nonnative species in Europe. It may also contain information on introductions to Europe and pathways of introduction, as well as links to other factsheets on the species.

TO USE: To run a Basic Search, type the species name into the search box. To run an Advanced Search (filtering species by taxonomy or pathway), select the taxonomic group(s) or pathway(s) of interest from the checklist. After starting with either search type, look at the table below the search tools for the species name. Information on the species can be accessed by clicking the green button next to the species name.

The species distribution map can be accessed by checking the box to the left of the name, then click on 'Show Map' just above the table. To view the species distribution in more detail, be sure to choose the 'Grid 10x10 km' radio button from the list of EASIN Layers in the top right corner of the map.

EDDMapS – Early Detection & Distribution Mapping System
http://www.eddmaps.org/distribution/
https://www.eddmaps.org/Species/

EDDMapS. [year of access]. Early Detection and Distribution Mapping System. Tifton: University of Georgia, Center for Invasive Species and Ecosystem Health. Available: http://www.eddmaps.org/ ([month and year of access]).

TO USE: Type the all or part of the species name in the search box on the right. The database will automatically filter the species as text is entered. If there is information for the species of interest, select the desired type of map. This will bring up the corresponding map. There are tabs along the top left of the map that can be used to toggle between the different types.

To evaluate any specific point, click on that point to zoom in until a list of observations is shown. Clicking on the 'Record ID' will pull up a detailed observation record with the information needed to evaluate the observation. Save any record details accessed to the PDF.

The Species Information functions the same way as the Distribution Maps. Type all or part of the species name into the search box and select the species name to go to the species information page.

FishBase
http://www.fishbase.org/search.php

Froese R, Pauly D, editors. [year of access]. [page title]. FishBase. Available: [page URL] ([month and year of access]).

FishBase contains basic information about fish species. The ERSS subsections were structured with many of the same headings as the subsections of the FishBase.

If the main FishBase page is down, try one of the many mirror sites.

TO USE: There are many ways to search FishBase. Type just the genus name into the 'Genus' search box, the specific epithet into the 'Species' search box or the entire species name into the 'Genus + Species' search box. If using the 'Genus' or 'Species' searches, a list of matching species will be provided. Click on the appropriate species name to access the species page. If using the 'Genus + Species' search box, this will go directly to the species page or provide a list of possible matches if a direct match does not exist.

Within the species page, there are links to the right of the main headings that can be used to access further information. There are also links to further information at the bottom of the page. If accessing any of those links, save the pages to the PDF.

The references can be found by clicking on the 'References' link. Save this page to the PDF. The reference numbers in the quoted material must be replaced by the correct reference in Journal of Fish and Wildlife Management style. The replacement information must be placed within [brackets] in the ERSS.

On the main species page, click on 'Common names' to access the list of common names for the species. Look for the American Fisheries Society accepted name, it will be labeled with 'AFS' in the 'Type' column. If an AFS name is not available, use an FAO accepted name, and if that is not available the most common English common name.

GBIF – Global Biodiversity Information Facility
https://www.gbif.org/species/search

GBIF Secretariat. [year of access]. GBIF backbone taxonomy: [page title]. Copenhagen: Global Biodiversity Information Facility. Available: [page URL] ([month and year of access]).

GBIF contains aggregated world occurrences. This is the database from which RAMP automatically draws source points, and is typically the source of the map for Section 4 of the ERSS.

The publication year for the site is available near the bottom of the species page, where the citation is given. Note that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

TO USE: Type the species name in the white box in the top left that says 'Search for species', then click the magnifying glass. If there is more than one possible match, a list will appear in the main part of the page; click on the appropriate species. GBIF will place the closest match at the top of the list.

To evaluate points: Maneuver the map by zooming in and dragging the focus so that the point of interest is the only one visible, then click the 'Explore Area' button at the bottom right of the map. This will bring up a list of the occurrences located in the current map view. Click on an occurrence to view the details. If the point is included or excluded in the climate match for any reason found in the details page, make sure to save the details page to the GBIF PDF.

GLANSIS – Great Lakes Aquatic Nonindigenous Species Information System
https://www.glerl.noaa.gov/glansis/nisListGen.php

[name of author(s)]. [year of access]. [page title]. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database, and Ann Arbor, Michigan: NOAA Great Lakes Aquatic Nonindigenous Species Information System. Available: [page URL] ([month and year of access]).

Citation information for these pages are found at the bottom of each individual species account, but note that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

GLANSIS contains biological, ecological, distribution, introduction, and impact information for invasive species found in the Great Lakes or that may be found in the Great Lakes. Many times this is the same information as is available in NAS but they do contain different species lists.

TO USE: Enter the genus name in the 'Genus' box; enter the species name in the 'Species' box. Both names are not needed; searches can be conducted by genus, species, or common name or any combination of those. If the species is not known to be in the Great Lakes currently, change the species category from its default to 'Watchlist Species'. Click the 'Submit' button. If there is only one possible match it will go directly to that species page. If there is more than one possible match there will be a list of species to choose from. Select the 'Factsheet' option for the correct species.

Global Invasive Species Database (GISD)
http://www.iucngisd.org/gisd/

[GISD] Global Invasive Species Database. 2017. Species profile: [page title]. Gland, Switzerland: Invasive Species Specialist Group. Available: [page URL] ([month and year of access]).

Citation information for these pages are found at the bottom of each individual species account, but note that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

This database contains comprehensive information on the included invasive species.

TO USE: There are two ways to search for a species. 1. Type the species name into the search box in the middle of the page and click 'Search'. This generates a results list; click on the appropriate species name. 2. Click 'Advanced Search Options', then click the arrow (not the box) next to appropriate classification until a list of species is displayed. This tree search will only include taxonomy for species contained in the database. (TIP: Use the taxonomy from ITIS to do a tree search). Click on the species name to access the species information page.

The 'How To Use' link at the top of each page has instructions for navigating within the species account.

Global Register of Introduced and Invasive Species (GRIIS)
http://www.griis.org/

Pagad S, Genovesi P, Carnevali L, Schigel D, McGeoch MA. 2018. Introducing the Global Register of Introduced and Invasive Species. Scientific Data 5:170202. DOI: https://doi.org/10.1038/sdata.2017.202.

GRIIS provides annotated and verified country level introduced and invasive species inventories. Attached to each record is the source information with links to the database or article if available. These links can be followed to find further detailed information about the species.

TO USE: On the home page, type the species scientific name in the box at the top of the page and click 'Search'. If so desired there are search criteria below the search box that can be used to limit the results of the search. If the species is present in the database, a table will populate showing available records. Click on the green button with the + sign at the end of the record to see information on the sources for that record. To the right of the results table are options to modify or clear search criteria.

GloBI (Global Biotic Interactions)
https://www.globalbioticinteractions.org/

Poelen JH, Simons JD, Mungall CJ. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

GloBI provides information on organism interactions that are sourced from peer reviewed papers, published datasets, and other scholarly sources. This is a good source for information on food items and parasites.

TO USE: Type the species name into the 'some organism' box directly before the drop down list. Click the 'Enter' key to search. The results will appear in table format. The second column indicates the type of relationship. The ones that say 'host of' indicate that the species listed in the third column is a parasite or disease of the species of interest.

Due to the format of the information presented, it is most easily communicated in a paraphrased manner instead of a direct quote. For example: "Poelen et al. (2014) lists species 1, species 2, disease 1, … as parasites [and/or diseases] of [target species]." However, accessing the cited reference(s) directly to learn more about the interaction and citing from those sources is encouraged.

Google Scholar
https://scholar.google.com/

Directly cite any articles used in Journal of Fish and Wildlife Management format.

TO USE: Type the species name and any other search terms into the search bar. Use quotation marks around the species name to indicate that the terms must be present together in that order.
Save copies of all articles used. There is no need to save a PDF of the search results list.

IBIS - Island Biodiversity and Invasive Species
http://ibis.fos.auckland.ac.nz/

[ISSG] Invasive Species Specialist Group. 2015. Island Biodiversity and Invasive Species Database, version 2015.1. Available: http://ibis.fos.auckland.ac.nz/ ([month and year of access]).

TO USE: Click the "Invasive Species Search" button and then follow the directions to type a species name into the search box.

iMapInvasives
https://imapinvasives.natureserve.org/imap/login.jsp

iMapInvasives. [year of access]. iMapInvasives: NatureServe's online data system supporting strategic invasive species management. NatureServe. Available: http://www.imapinvasives.org ([month and year of access]).

TO USE: You will need a log in for this database. Use the 'Sign Up' form on the log in page. Once on the map, click on 'Filter Records' to be able to type a species name in. Toggle off the 'Species List' to search the entire database instead of just your primary jurisdiction. Click 'Filter' and only observations for that species will show on the map. To export data for use in selecting source points for the climate match, click on the 'Export' tool then follow the directions to download the data. Data is available from

participating states and provinces. As of July 2019 the participants were Arizona, Florida, Maine, New York, Oregon, Pennsylvania, Saskatchewan, Vermont, and Virginia.

India Biodiversity Portal
http://indiabiodiversity.org/

India Biodiversity Portal. [year of publication or "No date"]. [page title]. India Biodiversity Portal, species page. Available: [page URL] ([month and year of access]).

TO USE: Type the species name in the top of the page. Click the magnifying glass. Choose the correct species from the list of results.

Critically evaluate the locations on the maps, some may represent a centralized location for a species list rather than actual collection points.

Invasive Plant Atlas of the United States
https://www.invasiveplantatlas.org/distribution.html

Swearingen J, Bargeron C. 2016. Invasive Plant Atlas of the United States. University of Georgia Center for Invasive Species and Ecosystem Health. Available: http://www.invasiveplantatlas.org/ ([month and year of access]).

TO USE: Use the Find command to search the page for the species name. Click on the appropriate species name to access the information page.

Invasive Species of Japan
http://www.nies.go.jp/biodiversity/invasive/index_en.html

[NIES] National Institute for Environmental Studies. [year of access]. [page title]. Invasive species of Japan. Tsukuba, Japan: National Research and Development Agency, National Institute for Environmental Studies. Available: [page URL] ([month and year of access]).

This database contains information on the presence, distribution, and impact of invasive species in Japan.

TO USE: Click on the appropriate Taxon button. Use the Find command to search the list for the species name. Click on the species name to access the information page. Alternatively, enter the species name in the search box and click 'Google Custom Search'. Select the link with the appropriate species name to access the information page.

ITIS (Integrated Taxonomic Information System)
https://www.itis.gov/

[ITIS] Integrated Taxonomic Information System. [year of access]. [page title]. Reston, Virginia: Integrated Taxonomic Information System. Available: [page URL] ([month and year of access]).

This website is the main source for information for the 'Taxonomic Hierarchy and Taxonomic Standing' section. NOTE: If the valid name according to ITIS is different from the one listed in Catalog of Fishes, the one in Catalog of Fishes takes precedence for the ERSS.

TO USE: Type the species name in the search box and hit 'Search'. This opens a search results page; click on the appropriate species name to access the species page. If there are no results, try different spellings or just searching by the genus. If there are still no results, the species is not included in the database and the taxonomic information must be found elsewhere.

There is always a search box at the bottom of each page to start a new search.

IUCN Red List of Threatened Species
http://www.iucnredlist.org/

[name of author(s)]. [year of publication]. [page title]. The IUCN Red List of Threatened Species [IUCN list year and version]. Available: [page URL] ([month and year of access]).

Citation information for these pages are found at the bottom of each individual species account, but note that the citation format given on the website is not exactly the same as the Journal of Fish and Wildlife Management format required for an ERSS.

The IUCN Red List database contains distribution, biology and habitat information. Do not use the distribution maps provided in the ERSS; they are generalized at best.

TO USE: In the top left, type the species name into the box that contains the text 'Enter Red List search term(s)' and click the 'GO' button. If there is a match, a results list will show. Click on the appropriate species name. The search box remains at the top of each page.

When using the species page, make sure to click the 'Full Account' tab at the end of the tab row before saving to PDF. This puts all the information on a single webpage.

MyBIS – Malaysia Biodiversity Information System
http://www.mybis.gov.my/one/discover.php

[MyBIS] Malaysia Biodiversity Information System. [year of access]. [page title]. Available: [page URL] ([month and year of access]).

TO USE: Type the species name in the search box at the left of the page. Click the yellow 'Search' button and a list of results will appear to the right. Click on the appropriate species to access the species page.

National Invasive Species Information Center
https://www.invasivespeciesinfo.gov/index.shtml

Follow the links on the species page and directly cite any sources used in Journal of Fish and Wildlife Management format.

TO USE: In the blue boxes on the left, select the correct category under 'Browse by Subject'. Type the species name into the Google search box and click the search button with the magnifying glass. A window with the search results will appear. Select the appropriate result to access the information.

NatureServe
http://explorer.natureserve.org/

NatureServe. [year of access]. NatureServe Explorer: an online encyclopedia of life. [NatureServe version number]. Arlington, Virginia: NatureServe. Available: http://explorer.natureserve.org ([month and year of access]).

NatureServe contains United States distribution by State, native status by State, and some ecological information.

TO USE: Type the species name in the 'Species Quick Search' box and click 'Go'. This will bring up a search results page that will either list any potential species matches or return no results. Click on the appropriate species name to access the species page. Halfway down the page is a white check box to expand all sections; check it before saving a PDF.

NAS – Nonindigenous Aquatic Species
https://nas.er.usgs.gov/queries/SpSimpleSearch.aspx

[name of author(s)]. [publication year]. [page title]. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: [page URL] ([month and year of access]).

Citation information for these pages are found at the bottom of each factsheet, but note that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

NAS contains biological, ecological, distribution, introduction, and impact information for invasive species found in the United States or that may be found in the United States.

TO USE: Enter the genus name in the 'Genus' box; enter the species name in the 'Species' box. Both names are not needed; searches can be conducted by genus, species, or common name or any combination of those. Click the 'Submit' button. If there is only one possible match it will go directly to that species page. If there is more than one possible match there will be a list of species to choose from. Select the 'Factsheet' option to view a narrative about the species and its introduction history in the United States; select the 'Point Map' option to view a map of reported species occurrences in the United States.

Use the browser back button to return to the search screen or hover over 'Database & Queries' then 'NAS Database' then click on 'Text Queries' to get back to the main search page.

NEMESIS – National Exotic Marine and Estuarine Species Information System
http://invasions.si.edu/nemesis/browseDB/searchTaxa.jsp

Fofonoff PW, Ruiz GM, Steves B, Simkanin C, Carlton JT. [year of access]. [page title]. National Exotic Marine and Estuarine Species Information System. Edgewater Maryland: Smithsonian Environmental Research Center. Available: [page URL] ([month and year of access]).

This database contains information on invertebrates and algae.

TO USE: Type the species name into the search box at the bottom of the Taxonomic Group listing. Click the 'Search' button. Search results will appear under the search box. Click the appropriate species name to access the species information. On the species pages, there are tabs along the top of the information box in the middle that will display different information. Each tab view used, including References, should be included in the administrative record as a PDF.

NOBANIS – European Network on Invasive Alien Species
https://www.nobanis.org/search-alien-species/

NOBANIS. [year of access]. [page title]. European Network on Invasive Alien Species. Available: [page URL] ([month and year of access]).

If downloading a factsheet from a species page, use the following citation format instead:

Gollasch S. 2011. NOBANIS – invasive alien species fact sheet – [species name]. Online database of the European Network on Invasive Alien Species – NOBANIS. Available: [factsheet URL] ([month and year of access]).

Citation information for these factsheets are found at the top of each factsheet, but note that the citation format given is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

TO USE: Type the species name into the 'Species' search box, click on the magnifying glass button. The results page will look just like the search pages, with the search results at the bottom. Click on the appropriate species.

SeaLifeBase
http://www.sealifebase.org/search.php

Palomares MLD, Pauly D, editors. [year of access]. [page title]. SeaLifeBase. Available: [page URL] ([month and year of access]).

SeaLifeBase is similar to FishBase but it is not limited to fish species.

TO USE: There are many ways to search SeaLifeBase. Type just the genus name into the 'Genus' search box, the specific epithet into the 'Species' search box or the entire species name into the 'Genus + Species' search box. If using the 'Genus' or 'Species' searches, a list of matching species will be provided. Click on the appropriate species to access the species page. If using the 'Genus + Species' search box, this will go directly to the species page or provide a list of possible matches if a direct match does not exist.

Within the species page, there are small headings to the right of the main headings that can be used to access further information. There are also links to further information at the bottom of the page. If accessing any of those links, save the pages to the PDF.

The references can be found by clicking on the 'References' link. Save this page as a PDF. The reference numbers in the quoted material must be replaced by the correct reference in AFS style. The replacement information must be placed within [brackets] in the ERSS.

USDA PLANTS
https://plants.usda.gov/java/

USDA, NRCS. [year of access]. [page title]. The PLANTS database. Greensboro, North Carolina: National Plant Data Team. Available: [page URL] ([month and year of access]).

USDA Plants has general taxonomic and distribution information. The species pages may also contain helpful links to further information.

TO USE: At the top left of the homepage is a search box. Type the scientific name here. Make sure there are no misspellings otherwise it will not return any search results. Also, make sure the box below says 'Scientific Name'. Then hit 'Go'. This search function remains on the left of every page.

The species pages are made up of different tabs, either use the 'Show All' button on the right of the page before converting to PDF or remember to save each tab to a PDF.

USFWS Conservation Library
https://fwslibrary.on.worldcat.org/atoztitles/search#journal

Directly cite any articles used in Journal of Fish and Wildlife Management format.

If the full text of an article is not accessible through Google Scholar or Web of Science, it may be found through the Conservation Library.

TO USE: On the Search tab, type the journal title or ISSN into the appropriate search box and click 'Search'. This will provide any journals that match the search terms. Click on the appropriate journal and follow the links to access the article in question.

Alternatively, on the Browse tab, select the first letter of the journal. The option then exists to select the second and then third letters in the journal name. If the journal is listed, click on the journal name and follow the links to access the article.

If a full text copy of the article cannot be obtained through the catalog, Service employees may email library@fws.gov with the full citation and their program to request a full text copy.

VertNet
http://www.vertnet.org/index.html

VertNet. [year of access]. VertNet. Available: http://www.vertnet.org/index.html ([month and year of access]).

TO USE: Type the species name in the search box at the bottom left of the page. Click the 'Search Now' button. This will bring up a table with any species occurrences matching the species name. Click the 'Map' tab at the top of the table. If there are more than 100 occurrences, click the blue 'Load more…' button in the top right of the map until the map displays all points. Use the Print Screen function to save a copy of the map for the ERSS.

The search box responds to Boolean operators if you find you need to filter the results by location, for example.

Web of Science
http://apps.webofknowledge.com/UA_GeneralSearch_input.do?product=UA&search_mode=GeneralSearch

Directly cite any articles used in Journal of Fish and Wildlife Management format.

TO USE: Use the drop down box next to 'Select a database' to choose 'All Databases'. Type the species name in quotations into the search box; make sure the drop down box to the right of the search box is set to 'Topic'. Click '+ Add Another Field' to add additional search terms as needed, or use Boolean operators to add search terms into the same field as the species name. Click the 'Search' button. On the search results page there are filters on the left to help refine the results if needed.

Note that Web of Science requires a subscription, so you must be connected to a USFWS network to use it.

World Flora Online
http://www.worldfloraonline.org/

World Flora Online. [year of access]. World Flora Online – a project of the World Flora Online Consortium. Available: www.worldfloraonline.org ([month and year of access]).

TO USE: Type the species scientific or common name in the search box and hit 'Enter'. This will give a list of names, look for the name identified as 'accepted'. Click on the species name to access the individual page. This is the database to use when looking for the accepted scientific name of plant species.

WoRMS – World Register of Marine Species
http://www.marinespecies.org/aphia.php?p=search

[name of author(s)]. [publication year]. [page title]. World Register of Marine Species. Available: [page URL] ([month and year of access]).

The author's name and date can be found at the bottom of the species page.

This database contains taxonomic and potentially other information, not strictly limited to marine species.

TO USE: Uncheck the 'marine taxa' box. Type the species name into the search bar and click 'Search'. The results page will show all potential matches, including any synonyms in the database. Click on the appropriate name to view the species page.

Appendix B:
Record of Online Data Searches and ERSS QA/QC Checklist

This appendix includes two checklists that help improve the quality of both the final ERSS reports and the administrative record necessary if an injurious wildlife listing is pursued for a species.

PART ONE – Record of Online Data Searches – This table allows a risk assessor to show which online resources were and were not used in an ERSS. This table should be included as part of the administrative record for a completed ERSS.

PART TWO – QA/QC Checklist – This checklist allows a risk assessor and the reviewers to determine if all aspects of the ERSS have been completed properly.

PART ONE – RECORD OF ONLINE DATA SEARCHES

The citations for the quoted scientific information within an ERSS help the reader understand the origins of the material that goes into the final ERSS for a species. It is also important, however, to document exactly how much research was conducted for an ERSS, including online resources consulted, whether data were found, and whether those data were used within an ERSS. Documenting online resources that both were and were not used:

- Contributes to a better understanding of the validity of an ERSS;
- Allows for a quicker review of an ERSS; and
- Facilitates updating of an ERSS in the future.

In the table on the next page, indicate which databases were and were not used for the ERSS. Important items to consider include:

- Has all information used from the databases consulted below been properly cited and referenced?
- Have copies of all information quoted from the online databases consulted been saved as PDFs for the administrative record?
- For the table cell labelled "Justification/Web Site:" copy and paste internet addresses when appropriate, or give details on why a web site was not consulted, search terms used, or data not used.

Record of Online Data Searches for ERSS of:
Online Databases and Information Sources for ERSS Development (Most commonly used listed first)
FishBase Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
ITIS (Integrated Taxonomic Identification System) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Catalog of Fishes Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
GBIF (Global Biodiversity Information Facility) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
USGS Nonindigenous Aquatic Species) Database Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
CABI (Invasive Species Compendium) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
GISD (Global Invasive Species Database) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Alien non-marine snails and slugs of priority quarantine importance in the United States (PDF) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
BISON Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Comprehensive List of Non-native Species (USGS) (Downloadable .xlsx or .txt file) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:

DAISIE (Delivering Alien Invasive Species Inventories for Europe) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
EDDMaps Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
FAO (Database on Introductions of Aquatic Species) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Federal Noxious Weed List (PDF) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
GloBI (Global Biotic Interactions) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
iMap Invasives Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Invasive Alien Species in Japan Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Invasive Plant Atlas of the United States Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
IUCN Red List (Maps have known inaccuracies – do not use) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Nature Serve Explorer Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
NEMESIS (National Estuarine and Marine Exotic Species Information System) (contains some freshwater species) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
NOBANIS (European Network on Invasive Alien Species) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:

The Crayfish and Lobster Taxonomy Browser Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
USDA PLANTS (Introduced/Invasive/Noxious Plants) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
VertNet Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
WoRMS Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
USFWS List of Injurious Wildlife (PDF) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Google Scholar Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Web of Science Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Additional Database (add lines as needed): Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Additional Database (add lines as needed): Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:

PART TWO – QA/QC CHECKLIST

The following pages are designed to be a checklist to help the ERSS assessor and technical reviewer determine if an ERSS is complete, follows the SOP, and meets data standards.

Subject Species Scientific Name:
Subject Species Common Name:

Name of Reviewer:
Date Reviewed:

General Questions
Has an administrative record for the ERSS been included? ☐ Yes ☐ No
Has the Record of Online Data Searches been completed? ☐ Yes ☐ No
Was a search done on all synonyms listed? If not, was justification given? ☐ Yes ☐ No
Has the format of the ERSS Template been followed? ☐ Yes ☐ No
Are there citations at the beginning of each subheading? ☐ Yes ☐ No (Sources for quoted material that spans multiple subheadings must be cited at each relevant subheading for clarity)
Is the document internally consistent? ☐ Yes ☐ No (Does the range provided in Sections 1 and 2 match the range displayed in Sections 5 and 6? If not, is an explanation provided?)
Comments:

Title Page Header
Was the scientific name obtained via a database appropriate for the taxon? ☐ Yes ☐ No Indicate where the info was obtained:
Was the common name obtained via a database appropriate for the taxon? ☐ Yes ☐ No Indicate where the info was obtained:
Are the preparer and version details complete? ☐ Yes ☐ No
Is the organism type and overall risk assessment category listed? ☐ Yes ☐ No
Are any species photographs or artwork properly cited? ☐ Yes ☐ No

Have we verified re-use license information for any photographs or artwork used? ☐ Yes ☐ No
Comments:

Section 1 – Native Range and Status in the United States
Was information sought, from multiple sources in the list of online databases, for all 4 headings in Section 1? - Native Range ☐ Yes ☐ No - Status in the United States ☐ Yes ☐ No - Means of Introduction ☐ Yes ☐ No - Remarks ☐ Yes ☐ No
Have State and Federal regulations been checked for this species? ☐ Yes ☐ No
Is it clear what countries or States the species range encompasses? ☐ Yes ☐ No
Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 2 – Biological and Ecological Information
Was information sought, from multiple sources in the list on online databases, for all 11 headings in Section 2? - Taxonomy Hierarchy and Standing ☐ Yes ☐ No - Size, Weight, Age Range ☐ Yes ☐ No - Environment ☐ Yes ☐ No - Climate ☐ Yes ☐ No - Distribution Outside the United States ☐ Yes ☐ No - Means of Introduction Outside the United States ☐ Yes ☐ No - Short Description ☐ Yes ☐ No - Biology ☐ Yes ☐ No - Human Uses ☐ Yes ☐ No - Diseases ☐ Yes ☐ No - Threats to Humans ☐ Yes ☐ No
Were any OIE-reportable diseases documented for the assessed species? ☐ Yes ☐ No
Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 3 – Impacts of Introduction
Was information sought from multiple sources for Impacts of Introduction? ☐ Yes ☐ No
Are the impacts listed specific to areas where the species is nonnative? ☐ Yes ☐ No
For any impacts involving a second species, is that species native to the area where the impacts are occurring? ☐ Yes ☐ No
Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 4 – History of Invasiveness
Has the History of Invasiveness been adequately explained, considering records of introductions, establishment, volume of trade, and documented impacts? ☐ Yes ☐ No
Comments:

Section 5 – Global Distribution
Was GBIF consulted for global distribution? ☐ Yes ☐ No Indicate any additional sources where info was obtained:
Were the data for global distribution reviewed for outliers and anomalies? ☐ Yes ☐ No
Is an explanation provided for any differences in range between Sections 1 and 2 and Section 5? ☐ Yes ☐ No
Was the map(s) used for this section saved for the administrative record? ☐ Yes ☐ No
Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 6 – United States Distribution
Was the USGS NAS Database used for U.S. distribution? ☐ Yes ☐ No Indicate any additional sources where info was obtained:
Were the data for United States distribution reviewed for outliers and anomalies? ☐ Yes ☐ No
Is an explanation provided for any differences in range between Sections 1 and 2 and Section 6? ☐ Yes ☐ No
Was the map(s) used for this section saved for the administrative record? ☐ Yes ☐ No

Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 7 – Climate Matching
Was RAMP used for the climate match? ☐ Yes ☐ No - If so, was the species folder saved for the administrative record? ☐ Yes ☐ No Indicate RAMP version:
If Climatch was used, then was the ".clm" file generated within Climatch saved for the administrative record? ☐ Yes ☐ No
Was the United States Climate Match map saved for the administrative record? ☐ Yes ☐ No
Has the Climate 6 score been double-checked for accuracy? ☐ Yes ☐ No
If georeferenced locations were not available for a large portion of the range or the range of the species is uncertain, is this noted in the Section 7 summary text as potentially causing uncertainty in the climate match? ☐ Yes ☐ No
Comments:

Section 8 – Certainty of Assessment
Has the Certainty of the Assessment been adequately explained, considering amount and quality of data on introductions, impacts, range, and taxonomy? ☐ Yes ☐ No
Comments:

Section 9 – Risk Assessment
Does this section begin with a sentence stating what the species is and where it is found? ☐ Yes ☐ No
Does the section have summarize pertinent details from the risk assessment? ☐ Yes ☐ No
Have each of the elements of the risk assessment (history of invasiveness; climate match) been adequately explained? ☐ Yes ☐ No
Comments:

Section 10 – Literature Cited
Has all of the quoted material within the ERSS been properly cited in Section 10 using Journal of Fish and Wildlife Management guidelines? ☐ Yes ☐ No
Comments:

Section 11 – Literature Cited in Quoted Material
Have all of the references in the ERSS within quoted material that were not accessed by the ERSS assessor been properly cited in Section 11 using Journal of Fish and Wildlife Management guidelines? ☐ Yes ☐ No
Comments:

Appendix C:
Examples of Standard Formatting for References

The following information is taken from the Journal of Fish and Wildlife Management Guide for Authors. The full guide may be found at https://www.fws.gov/science/guideforauthors.html#StyleGuide.

In-text citations use the name-year format and may take one of two forms:

"Johnson (1995), Jones and Smith (1996, 1998), Rice et al. (1997) and Berger (in press) found walleyes in Lake Pollock."
"Walleyes occur in Lake Pollock (Johnson 1995; Jones and Smith 1996, 1998; Rice et al. 1997; Berger, in press)"

Cite both authors if there are only two authors of the publication, if there are three or more authors, give the first author followed by "et al." Citations in text should be arranged chronologically.

If an institution is the author and the name is very long the name may be abbreviated.

"APHA et al. (1992)" in the text would then be in the reference list as "[APHA] American Public Health Association, American Water Works Association, and Water Environment Federation. 1992."

Journal Article
Author(s). Year. Article title. Journal title volume number (issue number only if each starts with page 1): inclusive pages.

Examples:

Crawshaw LI, Lemons DE, Palmer M, Messing JM. 1982. Behavioral and metabolic aspects of low-temperature dormancy in the brown bullhead, *Ictalurus nebulosus*. Journal of Comparative Physiology B 148:41–47.

Hochachka PW. 1990. Scope for survival: a conceptual "mirror" to Fry's scope for activity. Transactions of the American Fisheries Society 119:622–628.

Kennedy VS. 1990. Anticipated effects of climate change on estuarine and coastal fisheries. Fisheries 15(6):16–24.

Kent ML, Traxler GS, Kieser D, Richard J, Dawe SC, Shaw RW, Prosperi-Porta G, Ketcheson J, Evelyn TPT. 1998. Survey of salmonid pathogens in ocean-caught fishes in British Columbia, Canada. Journal of Aquatic Animal Health 10:211–219.

Petersen MR, Weir DN, Dick MH. 1991. Birds of the Kilbuck and Ahklun Mountain Region, Alaska. North American Fauna. 76:1–158. doi: 10.3996/nafa.76.0001

Book
Author(s). Year. Title. Edition (other than 1st) or Volume (if part of a series). City, State, Province, or Country (only if needed to locate city): Publisher. Other identifying information. Omit the number of pages.

Examples:

[APHA] American Public Health Association, American Water Works Association, and Water Environment Federation. 1992. Standard methods for the examination of water and wastewater. 18th edition. Washington, D.C.: APHA.

Hoar WS, Randall DJ, editors. 1988. Fish physiology. Volume 11, part B. New York: Academic Press.

Rheinheimer, G. 1985. Aquatic microbiology. 3rd edition. New York: Wiley.

Article in a Book (including those in the AFS book series – Special Publications, Symposia, and Monographs, and conference proceedings)
Author(s). Year. Article title. Inclusive pages in editor(s). Book title. City, State, or Province, or Country (only if needed to locate city): Publisher. Other identifying information.

For conference proceedings, identify by year of publication (not year of meeting), and give publisher's name and location (not the location of the meeting).

Examples:

Adams SM, Breck JE. 1990. Bioenergetics. Pages 389–415 in Schreck CB, Moyle PB, editors. Methods for fish biology. Bethesda, Maryland: American Fisheries Society.

Campton DE. 1995. Genetic effects of hatchery fish on wild populations of Pacific salmon and steelhead: what do we really know? Pages 337–353 in Schramm HL Jr, Piper RG, editors. Uses and effects of cultured fishes in aquatic ecosystems. Bethesda, Maryland: American Fisheries Society. Symposium 15.

Livingstone AC, Rabeni CF. 1991. Food-habitat relations of underyearling smallmouth bass in an Ozark stream. Pages 76–83 in Jackson DC, editor. The first international smallmouth bass symposium. Bethesda, Maryland: American Fisheries Society.

Thesis or Dissertation

Author. Year. Title. Master's thesis or Doctoral dissertation. City, State, Province, or Country (only if needed to locate city): University. Omit State after city if included in the university name.

Examples:

Chitwood JB. 1976. The effects of threadfin shad as a forage species for largemouth bass in combination with bluegill, redear, and other forage species. Master's thesis. Auburn, Alabama: Auburn University.

Hartman KJ. 1993. Striped bass, bluefish, and weakfish in the Chesapeake Bay: energetics, trophic linkages, and bioenergetics model applications. Doctoral dissertation. College Park: University of Maryland.

Government Publication

Author(s) or agency. Year. Title. City, State, Province, or Country (only if needed to locate city): Agency. Type and number of publication. Omit State or province after city if included in the agency name.

Examples:

[EPA] U.S. Environmental Protection Agency. 1986. Quality criteria for water. Washington, D.C.: EPA. Report 440/5-86-001.

Gimbarzevsky P. 1988. Mass wasting on the Queen Charlotte Islands: a regional inventory. Victoria: British Columbia Ministry of Forests and Lands. Land Management Report 29.

Contract Report

Author(s). Year. Title. Organization that issued the report (if different from the author) to Organization that received the report, Receiver's city, State, province, or country (only if needed to locate city).

Examples:

Smith AB. 1986. Turbine-induced fish mortality at Highrise Dam, 1985. Report of Robertson Consultants to Prairie Utilities, Jonesville, Alberta.

Webpages

Author(s) or agency. Year [of last page revision]. Title. Publisher or Publication. [volume: page numbers]. Available: URL (month and year accessed). [DOI:] Items in brackets are optional.

See Appendix I for citations for databases and pages commonly used in ERSSs.

Examples:

Baldwin NA, Saalfield RW, Dochoda MR, Buettner HJ, Eshenroder RL. 2000. Commercial fish production in the Great Lakes 1867–1996. Great Lakes Fishery Commission. Available: www.glfc.org/databases/commercial/commerc.php (September 2000).

Villeneuve DL, Wang RL, Bencic DC, Biales AD, Martinovic D, Lazorchak JM, Toth G, Ankley GT. 2009. Altered gene expression in the brain and ovaries of zebrafish (*Danio rerio*) exposed to the aromatase inhibitor fadrozole: microarray analysis and hypothesis generation. Environmental Toxicology and Chemistry 28:1767–1782. Available: www.setacjournals.org/perlserv/?request=get-abstract&doi=10.1897%2F08-653.1&ct=1 (October 2009). DOI: 10.1897/08-653.1

Appendix D:
Detecting Outlier Data Points

As one inspects geo-referenced location data for collected specimens with the intent to create a climate map for evaluating risk, sometimes there will be points on the map that may seem out of place. Perhaps they fall outside the described range, or maybe they appear to be outside the type of habitat expected for the species, or maybe they just don't feel "right". These points are called outliers. Whatever the reason, these points need to be carefully examined in order for the risk assessor to decide to include or exclude them from the data. One outlying point in a climate matching scenario can change the outcome! This appendix is meant to be a starting guide only to help seek out and identify outliers when performing a climate match.

A few sideboards:

- Use of the Global Biodiversity Information Facility (GBIF) and the Google Chrome internet browser will be assumed, although this SOP can be used for identifying outliers using other systems with geo-referenced points.

- Points on GBIF maps within the established native range of the species are assumed to be correct.

- Remember we are trying to map only ESTABLISHED population records.

Follow these steps to evaluate georeferenced observations for use in selecting source points for the climate match.

1. To begin, open GBIF (https://www.gbif.org/species/search).

2. Enter the species name in the search area (for this example, *Perca flavescens* will be used; figure D-1) and click the "Enter" button:

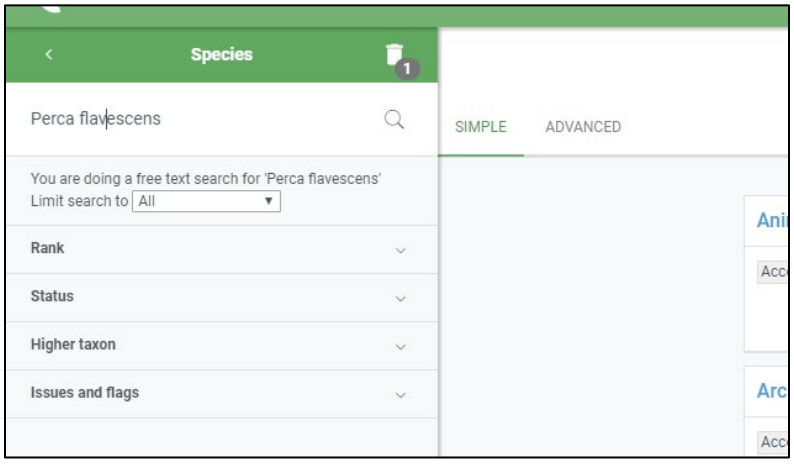


Figure D-1. Image of the GBIF species data search box.

3. The results should look something like what is pictured below in figure D-2. Select the option that is labeled as the accepted species. In this case, it is the first result listed:

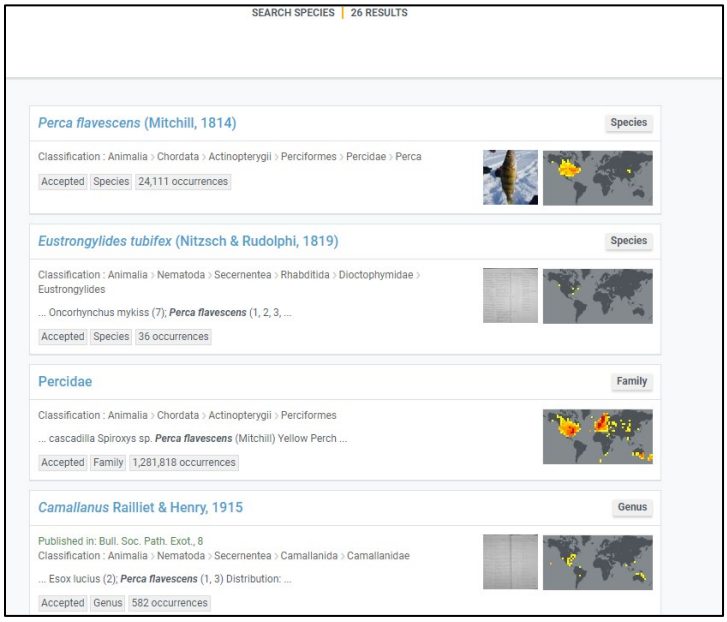


Figure D-2. Screen shot of GBIF search results.

4. The map below (figure D-3) is the resulting map showing the global distribution data within GBIF. Notice the few locations in China and Mongolia that lie far outside most of the data points. The red circle below was added to highlight the outlier:

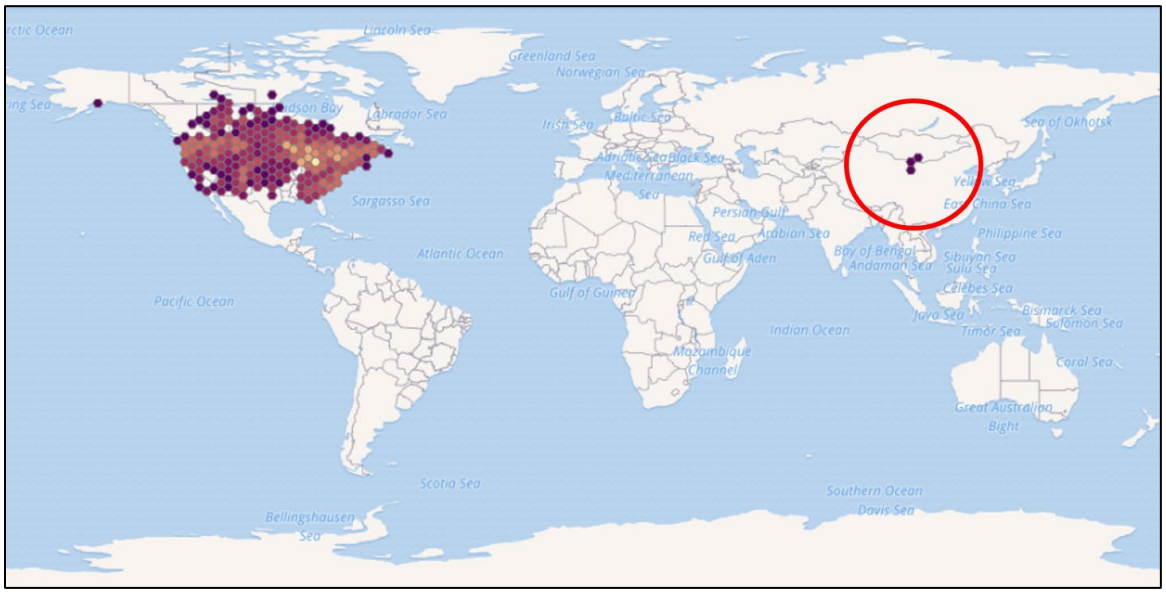


Figure D-3. Map of the global distribution of *Perca flavescens* from GBIF showing potential outlier points.

5. At this point it is important to have a source that references the known distribution of this species. For example, FishBase lists the following distribution for this species: "North America: Atlantic, Arctic, Great Lakes, and Mississippi River basins from Nova Scotia to Mackenzie River drainage, Northwest Territories in Canada, and south to Ohio, Illinois and Nebraska in the USA; south in Atlantic drainages to Savannah River in Georgia, USA." Fishbase also lists the following countries as having populations of this species: United States and Canada. For this species all points fall within that described range with the exception of the few points located in China and Mongolia.

   These points should be further investigated as potential outliers. These particular outliers were noticed because they are so far outside of the described range for this species. However, outliers can occur for many reasons, some of those reasons will be seen as this outlier is investigated (proper habitat nearby, coordinate error, etc.). In the end, whether to include a point or not may come down to risk assessor discretion, and this appendix will help to make that decision.

6. Zoom in on the map until the only points viewable on the map are the potential outliers, it should look like this (figure D-4):

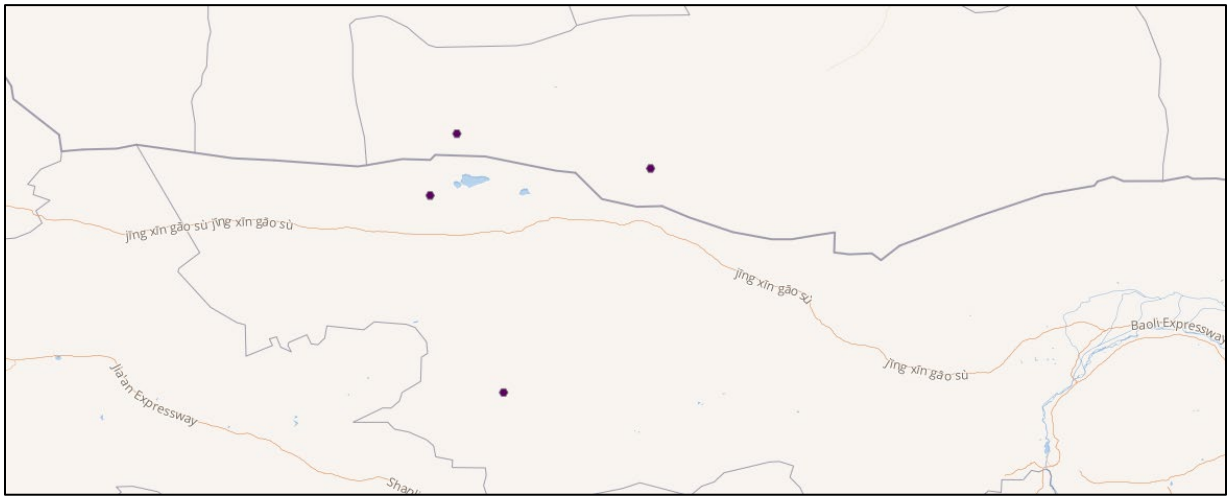


Figure D-4. A map focused in on the potential outlier points in Mongolia and China.

At this point click on the gray "EXPLORE" under the map.

7. The button will take one to a records page (figure D-5). Sometimes there can be many records at a single location. This is often a good indication that the point in question may NOT be an outlier, because many records at a single location are a good indicator of establishment. Often, however, there is only one record at a single location, while this is not a definitive indication that this location is an outlier that should be excluded, it is the first clue that points towards exclusion. In this case, the records page looks like:

TABLE GALLERY MAP TAXONOMY METRICS DOWNLOAD

Scientific name	Country or area	Coordinates	Month & year	Basis of record	Dataset
Perca flavescens (Mitchill, 1814)	Mongolia	42.9N, 100.5E	2008 July	Preserved specimen	FHSM Fish Collecti
Perca flavescens (Mitchill, 1814)	Mongolia	42.5N, 102.6E	2008 July	Preserved specimen	FHSM Fish Collecti
Perca flavescens (Mitchill, 1814)	China	42.2N, 100.3E	2008 August	Preserved specimen	FHSM Fish Collecti

Figure D-5. Image of the list of records shown after clicking on the 'EXPLORE' button under the GBIF map.

Click on the first *Perca flavescens* (Mitchill, 1814) to view more information on this record.

8. GBIF presents a map with more physical features of the landscape around the record in question and several pieces of information about the record itself. First, zoom in on the map and if you are dealing with a fish species or other species that requires an aquatic habitat, ensure that there is an acceptable body of water near the geo-referenced record. Our example looks like this:

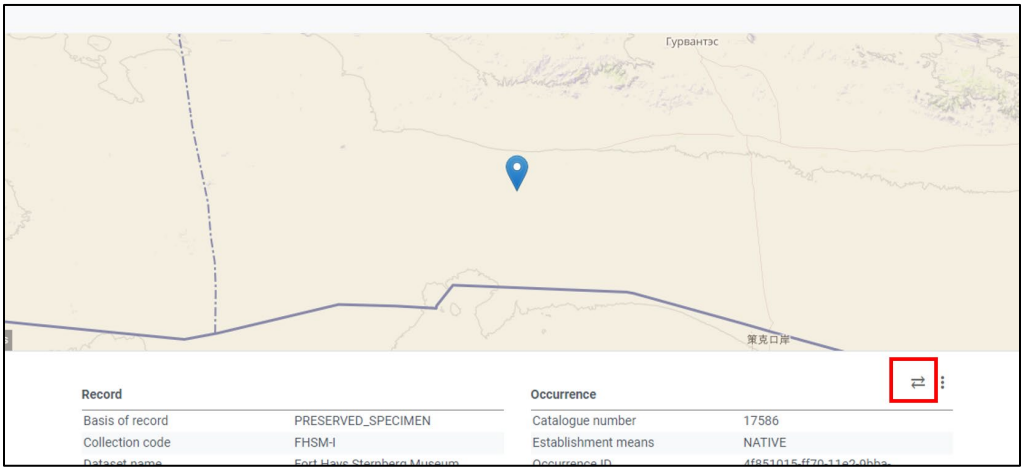
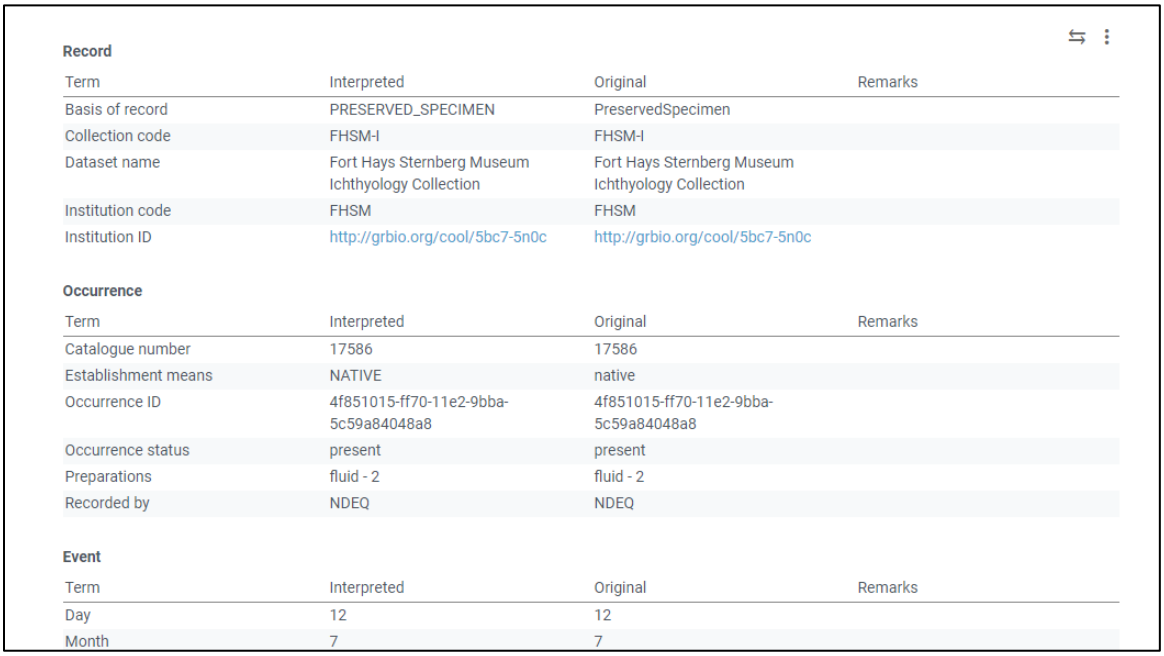


Figure D-6. Topographic map of the specimen location. Red box highlights the button that will display the original record information beside the GBIF interpretation of that information.

In this case there does not seem to be a body of water nearby; this is another clue that the record may not be valid. Below the map is the record information. There is also a double arrow icon (highlighted in red in figure D-6) that will display the original record information and the GBIF interpretation of the information side by side. Scroll down the page to look at the record details.



Record

Term	Interpreted	Original	Remarks
Basis of record	PRESERVED_SPECIMEN	PreservedSpecimen	
Collection code	FHSM-I	FHSM-I	
Dataset name	Fort Hays Sternberg Museum Ichthyology Collection	Fort Hays Sternberg Museum Ichthyology Collection	
Institution code	FHSM	FHSM	
Institution ID	http://grbio.org/cool/5bc7-5n0c	http://grbio.org/cool/5bc7-5n0c	

Occurrence

Term	Interpreted	Original	Remarks
Catalogue number	17586	17586	
Establishment means	NATIVE	native	
Occurrence ID	4f851015-ff70-11e2-9bba-5c59a84048a8	4f851015-ff70-11e2-9bba-5c59a84048a8	
Occurrence status	present	present	
Preparations	fluid - 2	fluid - 2	
Recorded by	NDEQ	NDEQ	

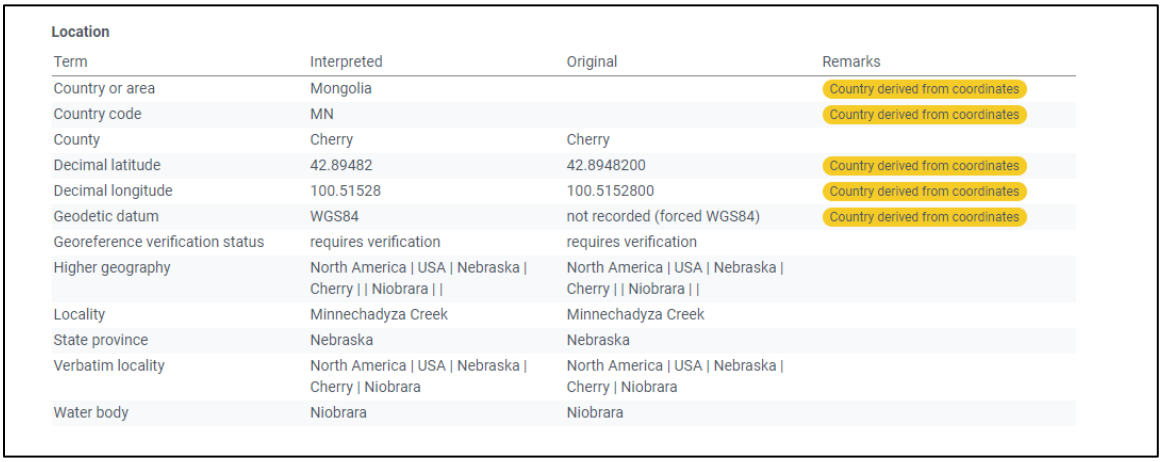
Event

Term	Interpreted	Original	Remarks
Day	12	12	
Month	7	7	

Figure D-7. The detailed record information for a potential outlier data point.
In this case it is somewhat suspicious that the data set is from a United States military base for a location in China. Again, this is not a definitive indication of an occurrence that should be excluded, but it is suspicious.

The details list the basis of record as “PRESERVED_SPECIMEN” that does not indicate whether or not this record should be excluded. There is only one gathering date, which again is another clue that points towards exclusion, since an established species would likely be able to be gathered many times near the same location, but is not definitive.

Significantly, the collection location given in the original record location is Nebraska (figure D-8). The country is not given in the original information but was derived from the coordinates by GBIF. The discrepancy is due to inaccurate recording and transmittal of the coordinates; the longitude is missing the “-” sign indicating the western hemisphere. It can sometimes be helpful to check the coordinates and change the signs to see if adding or removing a “-” from one coordinate then puts the point in the corresponding collection location.



Location

Term	Interpreted	Original	Remarks
Country or area	Mongolia		Country derived from coordinates
Country code	MN		Country derived from coordinates
County	Cherry	Cherry	
Decimal latitude	42.89482	42.8948200	Country derived from coordinates
Decimal longitude	100.51528	100.5152800	Country derived from coordinates
Geodetic datum	WGS84	not recorded (forced WGS84)	Country derived from coordinates
Georeference verification status	requires verification	requires verification	
Higher geography	North America | USA | Nebraska | Cherry | | Niobrara | |	North America | USA | Nebraska | Cherry | | Niobrara | |	
Locality	Minnechadyza Creek	Minnechadyza Creek	
State province	Nebraska	Nebraska	
Verbatim locality	North America | USA | Nebraska | Cherry | Niobrara	North America | USA | Nebraska | Cherry | Niobrara	
Water body	Niobrara	Niobrara	

Figure D-8. The location section of a record detail for the potential outlier data point.

9. The original version of the record is as descriptive as the record is going to get. At this point, if there is still no further information that is helpful in determining whether or not to exclude the occurrence record best judgment will need to be used and a justification will need to be written into the ERSS.

   So, to review what has been discovered about this record:
   - The species was not listed as a live specimen ("live specimen" is the typical designation when a species is recorded in an area where it was not previously known to exist),
   - The record does not seem to be located near a body of water,
   - The record is a single record, and
   - The collection location is listed as Nebraska while the coordinates are for a location in Mongolia.

Based on the above points, the risk assessor concluded that this record should be excluded from the climate matching process. (The other outlier points indicated at the beginning of the example were also collected in Nebraska.)

Experienced users of GBIF have noted there are two locations where outliers seem to be more common: data points in Germany and near Oslo, Norway. Both locations seem to be data entered by museums and/or botanical gardens. Data points in these locations should be viewed with extra care.

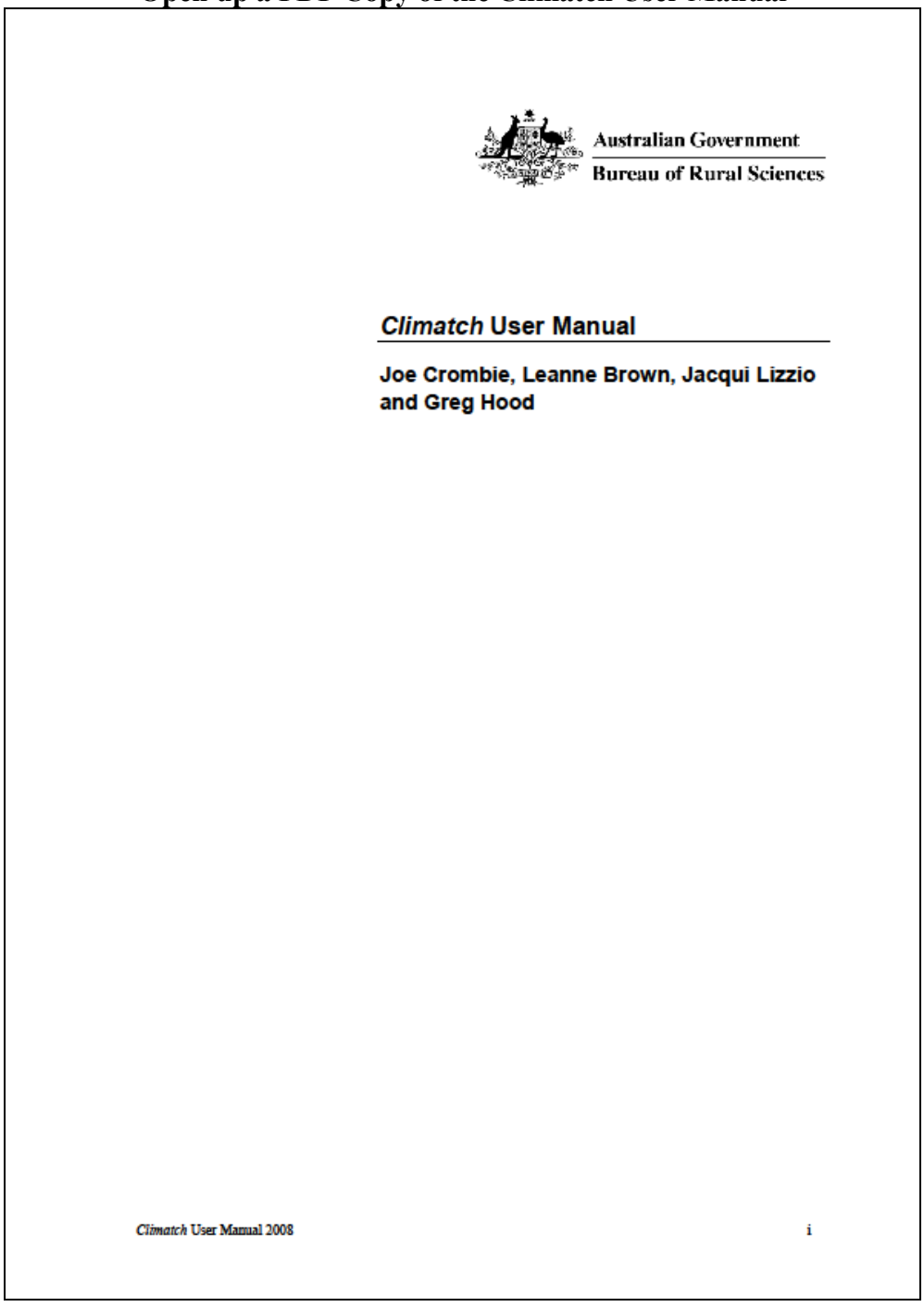
Appendix E:
RAMP SOP and Climatch User Manual

This appendix includes a full copy of the RAMP SOP and Climatch User Manual as embedded PDF documents. They are provided to give the reader a more complete understanding of the climate matching process. On the next page the reader should see a graphic resembling the first page of the Climatch User Manual followed by brief instructions on how to run a climate match using Climatch. The last item in the appendix is a graphic resembling the first page of the RAMP SOP. Double clicking on the graphics should open a full copy of the manual. **Readers should also note that the internet address for the Climatch web site has changed since the user manual was written and has not been updated within the manual.** The correct address for both the Climatch online program and the user manual are below.

- The citation for Climatch is: Australian Bureau of Rural Sciences. 2010. Climatch. Available: https://climatch.cp1.agriculture.gov.au/climatch.jsp. (March 2019).

- The user manual and a quick start guide can be found here: https://climatch.cp1.agriculture.gov.au/climatch.jsp

Double-Click on the Graphic Below to
Open up a PDF Copy of the Climatch User Manual



Australian Government
Bureau of Rural Sciences

***Climatch* User Manual**

Joe Crombie, Leanne Brown, Jacqui Lizzio and Greg Hood

Climatch User Manual 2008 i

Abbreviated directions for Climatch:

1) Manually select source points. Save the source map ".clm" file. If the climate match needs to be run again, the user can upload the ".clm" file instead of selecting all the points again.

2) Manually select target points. After you have selected the contiguous United States stations, then save the file as a ".clm" file. You can then load that file for future climate matches instead of reselecting points each time.

3) Run climate match. Click the "Run Match" button. The results include both a table on the left that displays the match classes and accompanying match counts and a map on the right side showing the distribution of the climate matches. Save the results map and the results table.

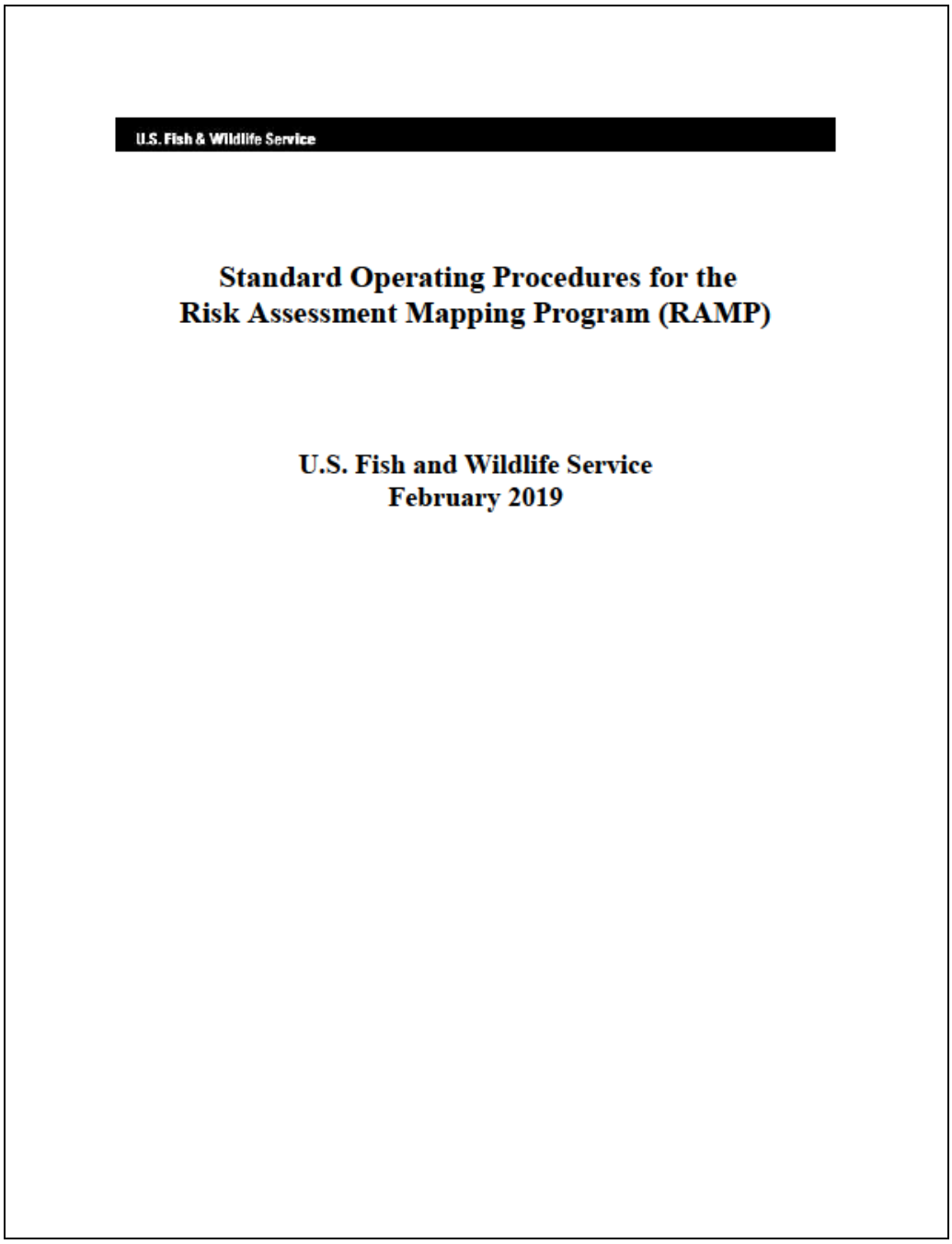
4) Climate 6 score calculations. Calculate Climate 6 score ((Count of target points with target climate scores 6-10)/(Count of all target points)) and provide a table within section 7 of the ERSS report with the target point scores.

   Caption for table of target point scores: "Table [X]. Climatch (Australian Bureau of Rural Science 2010) target point scores for [scientific name] for [region of the United States]. Climate 6 Score = Count of Climate Scores 6-10 / Count of Total Climate Scores = [insert Climate 6 score] ([insert Overall Climate Match Category, High, Medium, or Low])"

Table E-1. Example of a table of target point scores and the Climate 6 calculations for insertion into an ERSS report. See above for recommended caption.

Climate Match	0	1	2	3	4	5	6	7	8	9	10
Count	1	0	3	1	3	7	88	275	614	283	721

Double-Click on the Graphic Below to Open up a PDF Copy of the RAMP SOP



Appendix F:
ERSS Writing for Species Not Restricted to Freshwater

General Note
Source locations for climate matching should include only those located in freshwater and brackish water environments to minimize the influence of salinity dependent temperature tolerances (Todd and Dehnel 1960; Kinne and Kinne 1962). Add the following line to map captions in sections 5 and 6 if marine occurrences were excluded from the source locations for climate matching: "Because the climate matching analysis (section 7) is not valid for marine waters, no marine occurrences were used in the climate matching analysis."

Use the following key to determine whether and how to assess a species based on its salinity tolerance:

1) Can the species survive in fresh and/or brackish water (<35 ppt salinity)?
   a) YES – go to 2.
   b) NO – An ERSS should not be written or reviewed. Choose an alternate tool for assessing the risk posed by marine species.

2) Can the species reproduce in freshwater?
   a) YES – go to 3.
   b) NO – The ERSS (particularly section 3 and beyond) should focus on the non-marine parts of the lifecycle:
      i) The assessor should state in the climate matching summary in section 7 that the climate match refers only to where the species can survive and not necessarily to where it can reproduce.
      ii) The assessor should restate the limitations of the climate match in sections 8 and 9, and downgrade the certainty of the assessment accordingly.
      iii) The ORAC should be characterized as Uncertain if the species cannot reproduce in freshwater environments.

3) Is the species an obligate migrant between marine (≥35 ppt salinity) and non-marine (<35 ppt salinity) environments (i.e., either obligatory anadromous or catadromous)?
   a) YES – The ERSS (particularly section 3 and beyond) should focus on the non-marine parts of the lifecycle.
      i) Add the following line to the climate summary in section 7: "The climate match presented here refers only to where the species can survive in freshwater and brackish environments and not in marine environments."
      ii) Add the following line to sections 8 and 9: "This species migrates between marine and non-marine environments. Because not all locations in the United States are conducive to such migration, inland establishment of this species may be limited according to the existing connectivity between marine and non-marine environments."
   b) NO – No modifications to the ERSS are necessary other than what is outlined in the general note, above.

Literature Cited

Kinne O, Kinne EM. 1962. Rates of development in embryos of a cyprinodont fish exposed to different temperature-salinity-oxygen combinations. Canadian Journal of Zoology 40(2):231–253.

Todd ME, Dehnel PA. 1960. Effect of temperature and salinity on heat tolerance in two grapsoid crabs, *Hemigrapsus nudus* and *Hemigrapsus oregonensis*. Biological Bulletin 118(1):150–172.

Appendix G:
Climate Supplements

General Information

Upon request, the Service can prepare two different climate supplements to expand on the climate matching information provided in an ERSS. The first is for the noncontiguous United States and the second is for future climate scenarios. An ERSS must be completed before either climate supplement can be written. Below are directions and templates for the climate supplements. RAMP must be used to complete climate supplements.

ERSS Supplement for the Noncontiguous United States

Directions -

1) Run the climate match for each target noncontiguous area.
   a) Make sure that, wherever the RAMP files are stored on your computer, the Species folder contains the climate matching folder for the species of interest (named following the format "Genus_species"). This folder was created as part of RAMP Step 1 for the ERSS. Do not repeat RAMP Step 1 now.
   b) Run Step 2 in RAMP, selecting the option to "Use Previous Selection". This option selects the same climate station as those used in the ERSS to perform climate matching with the contiguous United States.
   c) For Step 3, select "Individual State" as the "Region." Then select the postal code abbreviation of a noncontiguous area under "State" and run the match.
   d) Repeat a) and b) until you have results maps for all of seven of the noncontiguous areas.

2) Use the steps below to complete sections 1 through 7 of the climate supplement.
   a) Write a climate match summary (see part 3H(1)(c) of this document for details on how to write the summary). For sections 3-7 of the climate supplement (covering target areas other than Alaska and Hawaii), if the overall climate match is High, please insert the following language: "The small number of target points will give any single point a large influence over the Climate 6 score." This sentence should appear immediately after the sentence defining the range of Climate 6 score classified as High match. No special language is needed for Medium or Low overall climate matches.
   b) Insert the climate match results map with an appropriate caption, including citation of the data sources from the ERSS. Example: "Figure 1. Map of RAMP (Sander et al. 2018) climate match for [*Species name*] in Alaska based on source locations reported by GBIF Secretariat (2019). 0/Blue = Lowest match, 10/Red = Highest match."
   c) Copy the Certainty of Assessment summary paragraph from the ERSS (section 8). Revise the text as needed if the climate matching analysis affects certainty in a different way for the noncontiguous area relative to the contiguous United States. In particular, for High overall climate matches in areas other than Alaska and Hawaii, insert the following language: "The certainty of the interpretation of the

Climate 6 score for High matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as High match." Downgrade the certainty of assessment accordingly; Commonwealths and territories with High match should not have High certainty in that match.

d) Copy the Summary of Risk paragraph from the ERSS (section 9). Revise the text to be applicable to the noncontiguous area, including replacing the information on climate match for the contiguous United States with information on climate match for the noncontiguous area. If you downgraded the certainty of assessment for a noncontiguous area because it had a High overall climate match, give "uncertainty in Climate 6 score interpretation" as a reason for the chosen level of certainty.
e) Fill in the Assessment Elements list based on the information in the Summary of Climate Matching Analysis, Certainty of Assessment, and Summary of Risk for the noncontiguous area.

3) Place the global source point map and information on the references used to select the source points in section 8 of the climate supplement.
   a) State: "All climate matches were based on source locations reported by [list references used, can be obtained from section 7 of the ERSS]."
   b) Example map caption: "Figure 8. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; [name countries or States containing source locations]) and non-source locations (gray) for [*Species name*] climate matching. Source locations from [citations]. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves. [Add any needed text about outlier locations either used or not used, can be obtained from sections 5 through 7 of the ERSS.]"

4) List references used to select source points in the literature cited section. The citations should be copied from the ERSS.

Template–

U.S. Fish & Wildlife Service

Common Name (*Scientific Name*)

ERSS Supplement for the Noncontiguous United States

Author Name, Month Year

1 Alaska

Summary of Climate Matching Analysis for Alaska

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for Alaska was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 1). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of Alaska.

[Insert Alaska RAMP match map here] Alt text: "Map of Alaska showing results of climate matching for [species name]. Description of results in preceding paragraph."
Figure 1. Map of RAMP (Sanders et al. 2018) climate match for [species name] in Alaska based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for Alaska

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS.

Summary of Risk to Alaska

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [*species name*] in Alaska is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

2 Hawaii

Summary of Climate Matching Analysis for Hawaii

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for Hawaii was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 2). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of Hawaii.

[Insert Hawaii RAMP match map here] Alt text: "Map of Hawaii showing results of climate matching for [species name]. Description of results in preceding paragraph."
Figure 2. Map of RAMP (Sanders et al. 2018) climate match for [species name] in Hawaii based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for Hawaii

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a high climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for high matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as high match."

Summary of Risk to Hawaii

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in Hawaii is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

3 American Samoa

Summary of Climate Matching Analysis for American Samoa

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for American Samoa was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 3). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Only if the climate match was High, next insert: "The small number of target points will give any single point a large influence over the Climate 6 score." Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of American Samoa.

[Insert American Samoa RAMP match map here] Alt text: "Map of American Samoa showing results of climate matching for [species name]. Description of results in preceding paragraph"
Figure 3. Map of RAMP (Sanders et al. 2018) climate match for [species name] in American Samoa based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for American Samoa

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a high climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for high matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as high match."

Summary of Risk to American Samoa

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in American Samoa is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

4 Guam

Summary of Climate Matching Analysis for Guam

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for Guam was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 4). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Only if the climate match was High, next insert: "The small number of target points will give any single point a large influence over the Climate 6 score." Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of Guam.

[Insert Guam RAMP match map here] Alt text: "Map of Guam showing results of climate matching for [species name]. Description of results in preceding paragraph"
Figure 4. Map of RAMP (Sanders et al. 2018) climate match for [species name] in Guam based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for Guam

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a high climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for high matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as high match."

Summary of Risk to Guam

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in Guam is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

5 Northern Mariana Islands

Summary of Climate Matching Analysis for the Northern Mariana Islands

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the Northern Mariana Islands was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 5). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Only if the climate match was High, next insert: "The small number of target points will give any single point a large influence over the Climate 6 score." Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of the Northern Mariana Islands.

[Insert Northern Mariana Islands RAMP match map here] Alt text: "Map of the Northern Mariana Islands showing results of climate matching for [species name]. Description of results in preceding paragraph"
Figure 5. Map of RAMP (Sanders et al. 2018) climate match for [species name] in the Northern Mariana Islands based on source locations reported by [citation].
0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for the Northern Mariana Islands

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a High climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for High matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as High match."

Summary of Risk to the Northern Mariana Islands

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in the Northern Mariana Islands is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

6 Puerto Rico

Summary of Climate Matching Analysis for Puerto Rico

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for Puerto Rico was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 6). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Only if the climate match was High, next insert: "The small number of target points will give any single point a large influence over the Climate 6 score." Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of Puerto Rico.

[Insert Puerto Rico RAMP match map here] Alt text: "Map of Puerto Rico showing results of climate matching for [species name]. Description of results in preceding paragraph."
Figure 6. Map of RAMP (Sanders et al. 2018) climate match for [species name] in Puerto Rico based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for Puerto Rico

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a High climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for High matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as High match."

Summary of Risk to Puerto Rico

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in Puerto Rico is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

7 U.S. Virgin Islands

Summary of Climate Matching Analysis for the U.S. Virgin Islands

Describe the results of the climate matching analysis in 3-4 sentences. Begin with: "The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the U.S. Virgin Islands was [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low] (figure 7). (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Only if the climate match was High, next insert: "The small number of target points will give any single point a large influence over the Climate 6 score." Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of the U.S. Virgin Islands.

[Insert U.S. Virgin Islands RAMP match map here] Alt text: "Map of the U.S. Virgin Islands showing results of climate matching for [species name]. Description of results in preceding paragraph."
Figure 7. Map of RAMP (Sanders et al. 2018) climate match for [species name] in the U.S. Virgin Islands based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

Certainty of Assessment for the U.S. Virgin Islands

Summarize how much information is available on the species and determine the certainty of the assessment. Refer to the ERSS. Reduced certainty in the assessment is warranted when there is a small total number of target points and a High climate match. If this is the case, downgrade the certainty relative to the ERSS and insert: "The certainty of the interpretation of the Climate 6 score for High matches is reduced because of the low number of target points and the broad range of Climate 6 scores classified as High match."

Summary of Risk to the U.S. Virgin Islands

Summarize and describe the assessment elements from assessment elements below. History of invasiveness should be the same as for the contiguous United States. Copy the summary paragraph in section 9 of the species' ERSS. Edit the paragraph as needed for the specific geographic region. End with: "The overall risk assessment category for [species name] in the U.S. Virgin Islands is [ORAC]."

Assessment Elements

- **History of Invasiveness (sec. 3): [High, Low, Data Deficient, or No Known Nonnative Population]**
- **Climate Match (sec. 6): [High, Medium, or Low]**
- **Certainty of Assessment (sec. 7): [High, Medium, or Low]**
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

8 Source Locations for Climate Matching

All climate matches were based on source locations reported by [Citation: sources used for climate match, can obtain from section 7 of ERSS document] (figure 8).

[Insert RAMP Source Map here] Alt text: "Source map of [region] showing selected source locations for [species name] climate match. [Describe where in the world the source points are.]"
Figure 8. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; [name countries or States containing selected source points]) and non-source locations (gray) for [Species name] climate matching. Source locations from [citation]. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves. [Add text explaining any additions or deletions in the source points, take the appropriate text from Sections 4 through 6 of the ERSS]

The "High", "Medium", and "Low" climate match categories are based on the following table:

Climate 6: (Count of Climate Scores 6-10) / (Count of total Climate Scores)	Overall Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

9 Literature Cited

[References used as source points or to evaluate the source points used in the climate match; can be copied from the ERSS].

Sanders S, Castiglione C, Hoff M. 2018. Risk Assessment Mapping Program: RAMP. Version 3.1. U.S. Fish and Wildlife Service.

ERSS Supplement for Climate Change Projections

RAMP has the capability to match the climate variables in a species current range with the estimated variables under three different potential future trajectories for radiative forcing. Each scenario is projected at two time intervals, 2050 and 2070. More information is available in "Standard Operating Procedures for the Risk Assessment Mapping Program" (see appendix E). An example with the contiguous United States is shown below, but the climate supplement can be completed for individual States, Commonwealths, or territories, as well.

Directions -

1) Run the climate match for each of the six climate projections (each of the three scenarios at both the 2050 and 2070 time steps).
   a) Make sure that, wherever the RAMP files are stored on your computer, the species folder contains the climate matching folder for the species of interest (named following the format "Genus_species"). This folder was created as part of RAMP Step 1 for the ERSS. Do not repeat RAMP Step 1 now.
   b) Run Step 2 in RAMP, selecting the option to "Use Previous Selection." This option selects the same climate stations as those used in the ERSS to perform current climate matching.
   c) Run Step 3 and select one of the six projections under "Climate Scenario".
   d) Repeat a) and b) until you have results maps for all six of the climate projections.

2) Use the steps below to complete the climate supplement.
   a) Write two climate match summaries (see part 3H(1)(c) for details on how to write the summary).
      i) The first summary will be for the current climate scenario. This and the current scenario results map can be taken from section 7 of the ERSS.
      ii) The second summary will be for the results of the future scenarios.
   b) Place the results maps in the supplement with appropriate captions.
      i) The current climate map is figure 1.
         (1) Example caption: "Map of RAMP (Sanders et al. 2018) climate matches under current climate conditions for *Zizania palustris* in the contiguous United States based on source locations reported by BONAP (2014) and GBIF Secretariat (2016). 0/Blue = Lowest match, 10/Red = Highest match."
         (2) Example alt text: "Map of the contiguous United States showing the climate matching results for [*species name*] under current climate conditions. Description of results is provided in the beginning summary paragraph, above."
      ii) The future climate results maps should be arranged in tabular format for figure 2 (see example below, figure G-1) and then added as full page figures within an appendix at the end of the document. Appropriate captions should be placed with each instance.
         (1) Example caption for tabular figure: "Map of RAMP (Sanders et al. 2018) climate matches under potential future climate conditions for *Zizania palustris* in the contiguous United States based on source locations

reported by BONAP (2014) and GBIF Secretariat (2016). Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. RCPs used: 2.6, 4.5, and 8.5. Generations: 2050 and 2070. 0/Blue = Lowest match, 10/Red = Highest match. See appendix for larger versions of the maps contained in this figure."

(2) Example alt text: "Six maps of the contiguous United States showing the climate matching results for [*species name*] for two time steps and three potential future climate conditions. The top row of maps is for the earlier time step, the bottom row of maps is for the later time step. Description of results is provided in the second summary paragraph, above."

(3) Example caption for larger future scenario results maps: "Map of RAMP (Sanders et al. 2018) projected climate matches for *Zizania palustris* in the contiguous United States in 2050 under RCP 2.6. Climate matches are based on source locations reported by BONAP (2014) and GBIF Secretariat (2016). Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. 0/Blue = Lowest match, 10/Red = Highest match."

(4) Example alt text for larger future scenario results maps: "Map of the contiguous United States showing the climate matching results for [*species name*] under RCP 2.6 in the year 2050. Description of results is provided in the beginning summary paragraph, above."

c) Place the source point map with appropriate caption.

i) Example caption: "RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; [name countries or States containing source locations]) and non-source locations (gray) for *Zizania palustris* climate matching. Source locations from BONAP (2014) and GBIF Secretariat (2016). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves. GBIF Secretariat (2016) source locations in Australia and New Zealand were not included in climate matching because the New Zealand population has been extirpated (Champion et al. 2014) and establishment in Australia could not be confirmed."

ii) Example alt text: "Map of the world showing selected source points for *Zizania palustris* climate matching. Source points are concentrated in northern North America with a few source points in western Asia."

d) List references used to select source points in the literature cited section.

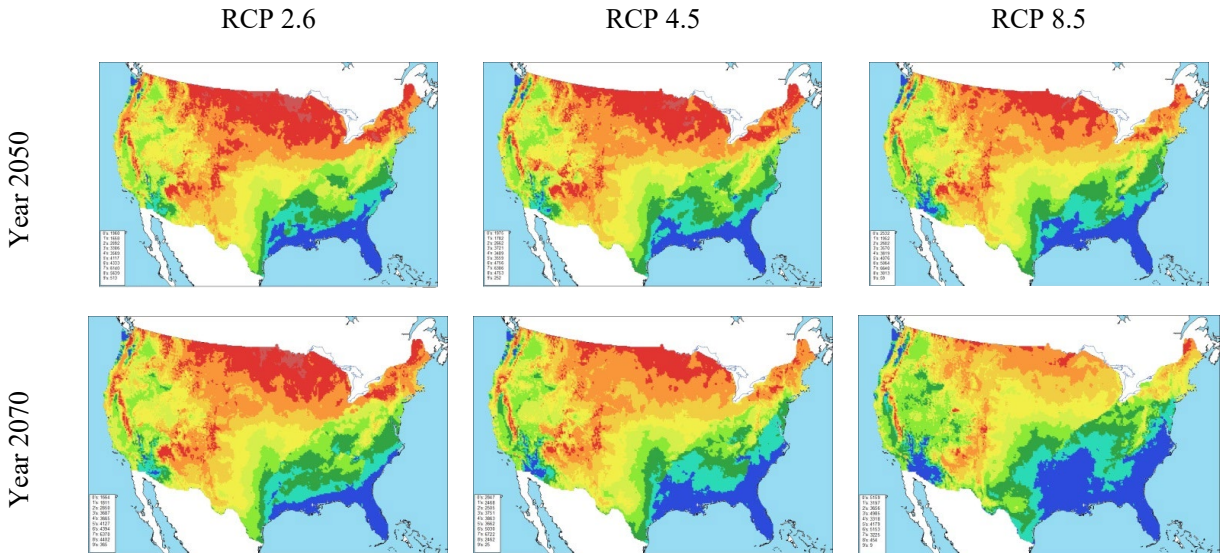


Figure G-1. Example of future climate scenario results maps in tabular form.

Template –

U.S. Fish & Wildlife Service

Common Name (*Scientific Name*)

Climate Change Projection Supplement

Author Name, Month Year

Summary of Climate Matching Analysis

Begin with: "Under current climate conditions (figure 1), the Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for [target region] is [insert the Climate 6 score, and state whether that score is classified as High, Medium, or Low]. (Scores of [insert range of scores from table 1 containing the Climate 6 score] are classified as [insert overall climate match category].)" Finish the paragraph with a brief description of where high, medium, and low matches were found within the boundaries of the target region.

Under future climate conditions (figure 2), the highest climate match is projected to occur in [geographic areas] in [target region]. [Describe how regions of high, medium, and low match will change under different scenarios and time steps.]

Current and future climate matches were all based on source locations reported by [Citation: sources used for Climate match, can obtain from section 7 of ERSS document]. Future climate scenarios are from the Representative Concentration Pathways (RCP) developed by the Intergovernmental Panel on Climate Change for the 5th Assessment in

2014 (IPCC 2014). The three scenarios used are RCP 8.5 in which assumes that radiative forcing rises through the next century, RCP 4.5 in which radiative forcing continues to rise until mid-century then decline, and RCP 2.6 in which radiative forcing has already peaked and will start to decline.

[Insert United States RAMP Match Map here] Alt text: "Map of the contiguous United States [or appropriate region] showing results of climate matching for [species name]. Description of results can be found at beginning of section."
Figure 1. Map of RAMP (Sanders et al. 2018) climate matches under current climate conditions for [*Scientific Name*] in the contiguous United States [or appropriate region] based on source locations reported by [citation]. 0/Blue = Lowest match, 10/Red = Highest match.

[Insert six image panel of future scenarios. Three across, two down. Top row is time step 2050, starting at right RCP 2.6, RCP 4.5, RCP 8.5. Bottom row is time step 2070 with RCPs in same order.] Each image should have alt text: "Map of the contiguous United States [or appropriate region] showing results of future scenario [appropriate RCP and time step] climate matching for [species name]. Description of results can be found at beginning of section."
Figure 2. Map of RAMP (Sanders et al. 2018) climate matches under potential future climate conditions for [*Species name*] in the contiguous United States [or appropriate region] based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. RCPs used: 2.6, 4.5, and 8.5 (Hijmans et al. 2005). Generations: 2050 and 2070. 0/Blue = Lowest match, 10/Red = Highest match. See appendix for larger versions of the maps contained in this figure.

[Insert RAMP Source Map here] Alt text: "Source map of [region] showing selected source locations for [species name] climate match. [Describe the location of source points.]"
Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; [list countries or States containing selected source points]) and non-source locations (gray) for [*Species name*] climate matching. Source locations from [citation]. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves. [Add text explaining any additions or deletions in the source points, take and appropriate text from sections 4 through 6 of the ERSS]

Literature Cited

[Those references used as source points or to evaluate the source points used in the climate match; can be copied from the ERSS].

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A. 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25:1965–1978.

[IPCC] Intergovernmental Panel on Climate Change. 2014. Climate change 2014: synthesis report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: IPCC.

Sanders S, Castiglione C, Hoff M. 2018. Risk Assessment Mapping Program: RAMP. Version 3.1. U.S. Fish and Wildlife Service.

[**Each image in the appendix should be on its own landscape formatted page. In interest of saving space in this document, all the captions will be listed directly after the previous with only single lines in between.]

Appendix

The following pages present enlarged versions of climate match maps from figure 2 to allow the reader to examine the results in more detail.

[Insert RAMP Match Map for RCP 2.6, time step 2050] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 2.6 in 2050 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A1. Map of RAMP (Sanders et al. 2018) projected climate matches for [*Species name*] in the contiguous United States [or appropriate region] in 2050 under RCP 2.6. Climate matches are based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. 0/Blue = Lowest match, 10/Red = Highest match.

[Insert RAMP Match Map for RCP 4.5, time step 2050] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 4.5 in 2050 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A2. Map of RAMP (Sanders et al. 2018) projected climate matches for [species name] in the contiguous United States in 2050 under RCP 4.5. Climate matches are based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. 0/Blue = Lowest match, 10/Red = Highest match.

[Insert RAMP Match Map for RCP 8.5, time step 2050] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 8.5 in 2050 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A3. Map of RAMP (Sanders et al. 2018) projected climate matches for [species name] in the contiguous United States in 2050 under RCP 8.5. Climate matches are based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model. 0/Blue = Lowest match, 10/Red = Highest match.

[Insert RAMP Match Map for RCP 2.6, time step 2070] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 2.6 in 2070 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A4. Map of RAMP (Sanders et al. 2018) projected climate matches for [species name] in the contiguous United States in 2070 under RCP 2.6. Climate matches are based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model.
0/Blue = Lowest match, 10/Red = Highest match.

[Insert RAMP Match Map for RCP 4.5, time step 2070] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 4.5 in 2070 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A5. Map of RAMP (Sanders et al. 2018) projected climate matches for [species name] in the contiguous United States in 2070 under RCP 4.5. Climate matches are based on source locations reported by [citation]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model.
0/Blue = Lowest match, 10/Red = Highest match.

[Insert RAMP Match Map for RCP 8.5, time step 2070] Alt text: "A larger version of the map of the contiguous United States [or appropriate region] showing results of future scenario RCP 8.5 in 2070 climate matching for [species name]. Description of results can be found at beginning of the document."
Figure A6. Map of RAMP (Sanders et al. 2018) projected climate matches for [species name] in the contiguous United States in 2070 under RCP 8.5. Climate matches are based on source locations reported by [citations]. Climate source data provided by Worldclim using the Geophysical Fluid Dynamic Laboratory Couple Physical Model.
0/Blue = Lowest match, 10/Red = Highest match.

Appendix H:
Derivation of Climate Match Categories

For the ERSS process, the results of the climate match are used to generate a Climate 6 score (Bomford 2008), which is calculated as the number of target points with climate scores 6 to 10 divided by the total number of target points. That resulting Climate 6 score then falls into one of three Overall Climate Match Categories (Low, Medium, High – see table H-1 below). The Service believes that the categorical system provided by generating and using the Climate 6 score is the most effective for our current needs. Climate categories were developed based on the most comprehensive dataset available (Bomford 2008). A more detailed description of the Climate 6 scoring approach follows.

Table H-1: Climate 6 score and its relationship with Overall Climate Match Category. These relationships were based on an analysis of data for 255 species established in 10 countries (Bomford 2008).

Climate 6 score: (Count of Climate Scores 6-10) / (Count of total Climate Scores)	Overall Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

The Overall Climate Match categories (Low, Medium, High) were based on an analysis of data for 255 species established in 10 countries (Bomford 2008). The analysis showed that even species with Climate 6 scores near zero could occasionally become established. The Service used *a priori* statistical categories to determine the range of Climate 6 scores defining each category. The *a priori* statistical categories were: 1) Low: rejection of 95% of the established populations, those Climate 6 scores where 5% or less of the species became established; 2) Medium: rejection of 80% of the established populations, those Climate 6 scores where less than 20% but more than 5% of the species became established; and 3) High: those Climate 6 scores where 20% or more of the species became established (table H-1, statistical thresholds depicted in figure H-1).

The statistical categories were applied after sorting the Climate 6 score data from Bomford (2008) in tabular form. Data in that table, along with the predetermined statistical levels used to separate Overall Climate Match Categories, determined the ranges of Climate 6 scores that fell within each Overall Climate Match Category (table H-1).

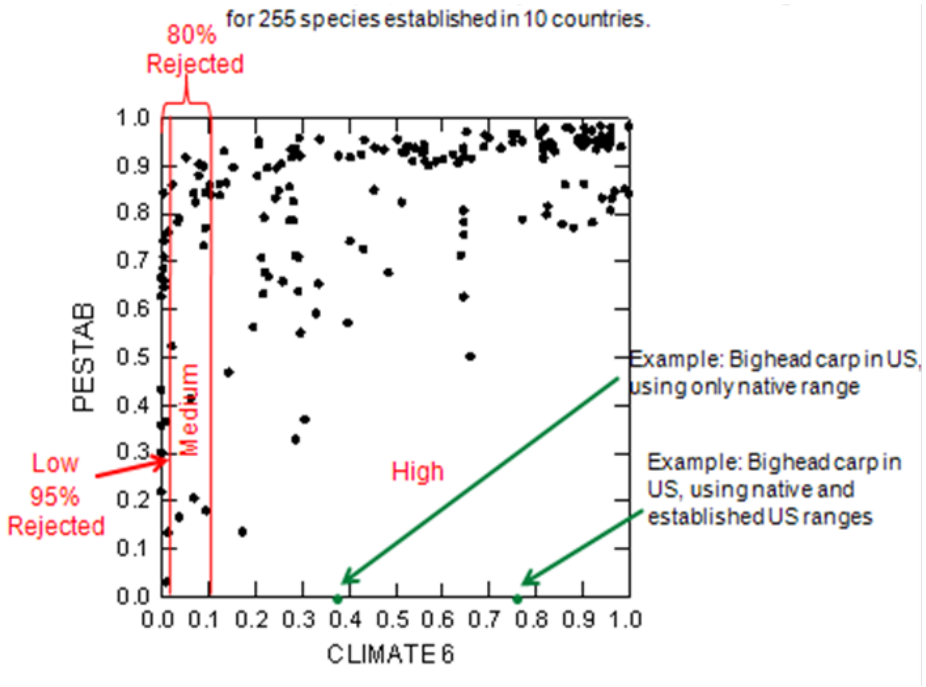


Figure H-1. Probability of establishment (PESTAB) and Climate 6 scores for 255 species in 10 countries (Bomford 2008), and relationship to Service-developed Overall Climate Match Categories. An example for Bighead Carp is shown; one with the climate match based only on the native range and the second with the climate match based on the native range and the established populations in the United States. This graph is for visual representation of the statistical categories only and was not used to develop those categories.

Appendix I:
A Template for Completing Ecological Risk Screening Summaries

This appendix contains a template that should be used in conjunction with the Standard Operating Procedures to complete an Ecological Risk Screening Summary.

The template refers to RAMP in the climate match sections. If Climatch is used instead, replace references to RAMP with the corresponding information for Climatch.

Australian Bureau of Rural Sciences. 2010. Climatch. Available: https://climatch.cp1.agriculture.gov.au/climatch.jsp.

U.S. Fish & Wildlife Service

Common Name (*Scientific name*)

Ecological Risk Screening Summary

When no common name exists, state species group and no common name (such as: a catfish, no common name).

Author, (affiliation only if not USFWS), Month Year

Organism Type: [Fish, Plant, Crayfish, etc.]
Overall Risk Assessment Category: [High, Low, or Uncertain; fill in once ERSS is complete]

In place of the camera, insert an image above if available. Include credit ("Photo: [Author]. Licensed under [re-use license, e.g., CC BY-SA]. Available: [website]. ([Date accessed])."). To improve accessibility, add a text description of image using right-click > format object > alt text, and type "Photo of [species name]."
Change "Photo" to "Image" when using an illustration.

1 Native Range and Status in the United States

Provide information for as many of the headings as possible, replacing the explanatory text below under each heading.

Note: Development of ERSS reports often includes copying and pasting large amounts of quoted material from various websites or scientific journals. Because this template was based, in part, from the most popular sources for aquatic invasive species, it is possible that quoted material could span multiple headings within the ERSS template. When this occurs, the reference for the quoted material should be repeated for each new heading.

This is to prevent confusion and make the source of the quoted material more readily apparent.

Native Range

The native distribution of the species. May include countries, States, regions, and geographic areas such as a specific river basin or specific habitats. If not provided in the quote, be sure to indicate in brackets the countries or States included in range.

Status in the United States

Whether the species has been reported in the United States and if so, where. Often limited to State-level data but may include more detailed occurrence information. In addition to whether the species has been found in the United States, this is also the place to mention: (1) if the species is in trade within the United States; and (2) if the species has any special status in a State, such as being banned for importation into the State, or listed as a State-designated noxious weed or invasive species, or if the species is a federally listed noxious weed or injurious species. If possible, state if introductions resulted in established populations or not.

Note: For clarity, if no data on trade or status can be found, the ERSS should clearly state that so users know that an attempt was made to find this information.

Means of Introductions within the United States

How the species was introduced to and spread within the United States. This should include, when known, both the pathways and vectors. Although these terms can sometimes be difficult to separate, the pathway is generally regarded as the reason why a species is transported (whether accidentally or deliberately), and the vector is exactly how a species is transported (i.e., on, in, or with what?). For example, commercial shipping is a pathway, and ballast water, hull fouling, and stowaways are all vectors associated with commercial shipping.

Remarks

Determine whether there are any special circumstances or additional information that is key to the overall interpretation of the ERSS that should be highlighted. Include any additional information that is important to the reader's understanding of the ERSS. This may include: (1) contradictory information on the range of the species, (2) recent taxonomic changes, (3) other commonly used names, (4) difficulty in correctly identifying this species, or (5) information on congeners and hybridization.

This is also the location to state which names were used for information searches or if the common name refers to more than one species.

Examples include things such as: "Species is commonly confused with the congener P. miles so the available information often includes both species;" or "This species is

also commonly referred to as the Peacock Bass;" or "The population in Florida is now believed to be extirpated, although studies have not confirmed this information."

If the ERSS is an update for a previously published version add: "This ERSS was previously published in [month and year of Web Version date] under [previous scientific name] (if there was a change in valid name between previous publication and update.)"

2 Biology and Ecology

Provide information for as many of the headings as possible. References for the quoted material should be repeated for each new heading (see note above).

Taxonomic Hierarchy and Taxonomic Standing

The complete taxonomic hierarchy for the organism including at least the kingdom, phylum, class, order, family, genus, and species. The descriptors and taxonomic authorities that often occur after the scientific names are not needed.

May also include subgroups, such as infraclass, superorder, etc. Include whether the taxonomy is considered valid. If available, note any recent taxonomic revisions, related species and races, hybrids and varieties.

Size, Weight, and Age Range

The length or age at maturity, size range, maximum length, common length, maximum weight, and maximum age as available.

Environment

A basic description of the physical conditions necessary for survival of the species, not including air temperature (air temperature should be listed in Climate). For an aquatic organism, for example, this may include water temperature, salinity, pH, dissolved oxygen content, depth range, turbidity, velocity, etc. If possible, specify if the water temperature is from nature or an aquarium setting.

Climate

The general climate (temperate, tropical, etc.), air temperature range, and latitude range where the species can survive as available.

Distribution Outside the United States

Native

The native range of the organism outside the United States. Often the same as "Native Range" in section 1 of the ERSS. If not provided in the quote, be sure to indicate in brackets the countries included in range.

If all or part of the native range is within the United States: "Native range of Species name is [entirely or partially] within the United States, see Native Range in section 1." Include the portions not in the United States in this section.

Introduced

The introduced range of the organism outside the United States. If possible, include whether the species is known to be established in each location.

Means of Introduction Outside the United States

How the species was introduced to its new range outside of the United States. This includes pathways and vectors (see part 3B(1)(c) of the ERSS SOP for description of pathways and vectors). If possible, provide a general summary of historical information on introduction, transport routes, and spread.

Short Description

A physical description of the species that may be used for identification purposes.

Biology

The basic biology of the species. May include information on habitat use, feeding, reproduction, development, genetics, activity patterns (e.g., migration, hibernation), adaptations for survival, patterns in population size or density, etc. as available.

Human Uses

Actual and potential human uses of the species and its current status in trade. May include information related to consumption by humans, use in the pet trade, ornamental uses, use for materials, use as bait, etc. United States trade should be reiterated from "Status in the United States" above.

Diseases

Pathogens and parasites known to be carried by the species. Make note of those which are OIE-reportable. If no records of OIE-reportable diseases were found, state this.

Threat to Humans

Characteristics of the species that pose a threat to humans. May include that the species is venomous, poisonous (toxic), traumatogenic (causes injury), a potential pest, carries a zoonotic disease, etc. Threats to agriculture, horticulture, or forestry should also be highlighted.

3 Impacts of Introductions

This section is extremely important; document as much information as possible on impacts. Include all information on the effects of the assessed species due to its introduction in a nonnative habitat including those affecting native species, the

environment, the economy, or human health. Details that may be useful include: Specifically what ecological, social, or economic constructs or functions were impacted? What was or were the magnitude of the impact(s)? Is the species listed on international, Federal, or State invasive, prohibited, or restricted lists? If so, then provide the jurisdictions that promulgated rules to restrict possession, trade, or transport.

If only information on potential impacts is found, that information can be added in this section with clear indication that the information is about potential impacts and not documented impacts.

4 History of Invasiveness

Summarize information on introductions, establishment, impacts, existing regulations, and trade. If actual, or extrapolated, trade volume and duration are known then specify if it is considered "substantial trade" as outlined in the description for a "Low" History of Invasiveness. Determine the History of Invasiveness category (High, Low, Data Deficient, or No Known Nonnative Population) and explain how the known information meets the criteria for the category as outlined in the ERSS SOP.

5 Global Distribution

[Insert Global Distribution Map here.] Add alt text using right-click > format object > alt text, and type "Map of [geographic area] showing locations where [species name] has been reported. [Give brief description of where the locations are.]"
Figure [X]. Known global distribution of [scientific name]. Observations reported from [countries or regions]. Map from [citation]. [Note here any points that appear on the map that do not represent established populations.]

More than one Global Distribution map may be used as long as each map adds needed information to the ERSS.

Be sure map(s) includes enough of the landmass and coastline to determine location. Check for and note any discrepancies between map and range descriptions in sections 1 and 2. Clearly state why any of the observations in the figures were not used to select source points for the climate match.

6 Distribution Within the United States

[Insert United States Distribution Map here.] Add alt text using right-click > format object > alt text, and type "Map of [geographic area] showing locations where [species name] has been reported. [Give brief description of where the locations are.]"
Figure [X]. Known distribution of [scientific name] in the United States. Observations reported from [states, or if too many to list, regions]. Map from [citation]. [Note here any points that appear on the map that do not represent established populations.]

More than one United States distribution map may be used as long as each map adds needed information to the ERSS.
Check for and note any discrepancies between map(s) and range descriptions in section 1. Clearly state why any of the observations in the figures were not used to select source points for the climate match.

7 Climate Matching

Summary of Climate Matching Analysis

Describe the results of the climate matching analysis in 3-6 sentences: where were highest matches found, where were medium or low matches found, etc.

[Describe areas of the map that have high, medium, and low matches.] The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was [insert the Climate 6 score, and state whether that score is categorically high, medium, and low] (scores between [XXX] and [XXX], [inclusive or exclusive], are classified as [classification]). The following States had [high, medium, low] individual Climate 6 scores: [list States in the high category from the bottom of the RAMP results map or those that are different from the overall climate score].

[Insert RAMP source map here.] Alt text: "Source map of [region] showing selected source locations for [species name] climate match. [Describe locations of source points.]"
Caption:
Figure [X]. RAMP (Sanders et al. 2018) source map showing weather stations in [general geographic area] selected as source locations (red; [list countries containing selected source points]) and non-source locations (gray) for [*scientific name*] climate matching. Source locations from [citation]. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

[Insert United States RAMP match map here.] Alt text: "Map of the contiguous United States [or appropriate region] showing results of climate matching for [species name]. A text description of the results was provided at the beginning of section 7."
Caption:
Figure [X]. Map of RAMP (Sanders et al. 2018) climate matches for [scientific name] in the contiguous United States [or appropriate region] based on source locations reported by [citation]. Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with target climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

Summarize how much information is available on species, especially impacts and determine the certainty of the assessment. Also include, if needed, climate match certainty is reduced (large portions of range without georeferenced locations or that is marine; taxonomic confusion impacting data quality).

9 Risk Assessment

Summary of Risk to the Contiguous United States

Summarize and describe the information contained in the ERSS. Specifically, how does that information meet the criteria for the assessment elements below? The summary should start with a general statement about what the organism is and where it lives (For example: Ancistrus cirrhosis, the Jumbie Teta, is an armored catfish that is native to South America (Brazil, Paraguay, Argentina and Uruguay)). Mention human uses because they can be important pathways. Note if the species is listed on international, Federal, or State invasive, prohibited, or restricted lists. Summarize evidence supporting the HOI category. State overall climate match and note any areas in the United States with a high climate match (especially if the Overall Climate Match Category is low). State certainty category and summarize why and conclude with a statement of the Overall Risk Assessment Category.

Assessment Elements

History of Invasiveness (sec. 4): [High, Low, Data Deficient, or No Known Nonnative Population]

Overall Climate Match Category (sec. 7): [High, Medium, or Low]

Certainty of Assessment (sec. 8): [High, Medium, or Low]

Remarks, Important additional information: [parthenogenic, genetically modified, human health impacts, etc.]

Overall Risk Assessment Category: [High, Low, or Uncertain]

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

See ERSS Database Manual on the google drive or appendices A and C of the SOP for correct citation formats.

[OIE] World Organisation for Animal Health. [year of access]. OIE-listed diseases, infections and infestations in force in 2019. Available: http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2019/ [month and year of access].

Sanders S, Castiglione C, Hoff M. 2018. Risk Assessment Mapping Program: RAMP. Version 3.1. U.S. Fish and Wildlife Service.

11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

References not accessed by risk assessor but occurring within quoted material go here. If there are no citations to be listed in this section, state: No references in this section.

Note if complete citation was not provided in source document. If any necessary details are missing in the citation given, add [Source material did not give full citation for this reference.] after the given information.

Appendix J:
Example of a Completed Ecological Risk Screening Summary

This appendix is an example of a completed Ecological Risk Screening Summary. Additional examples can be found on the Service's ERSS Reports web page, at: https://www.fws.gov/fisheries/ANS/species_erss_reports.html.

Some ERSSs provided on the USFWS website were completed before the finalization (and 2020 update) of this SOP. Where there are differences in formatting, the current version of the ERSS SOP should be regarded as the final word on ERSS content, structure, and layout.

U.S. Fish & Wildlife Service

Tigerfish (*Hydrocynus vittatus*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, August 2011
Revised, December 2018, February 2019
Web Version, 4/26/2019

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

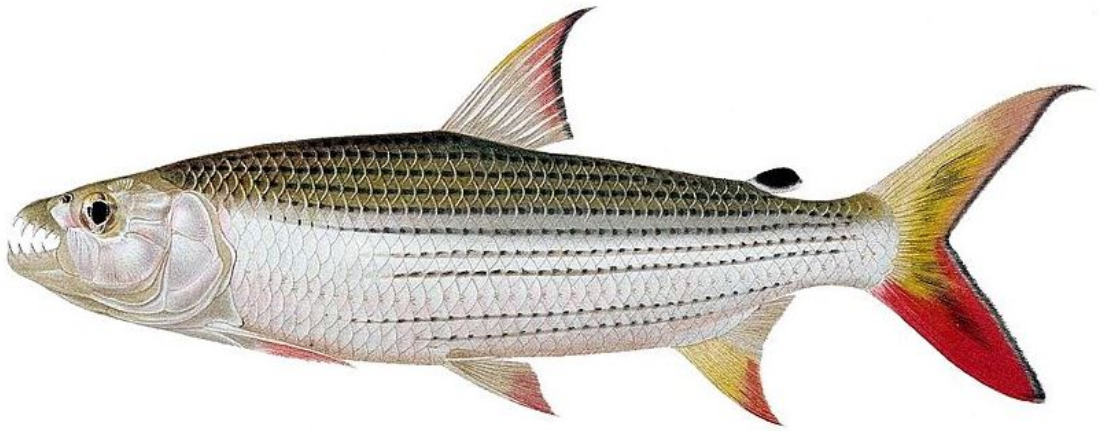


Photo by: Biodiversity Heritage Library. Licensed under Creative Commons Attribution 2.0 Genetic. Available: https://commons.wikimedia.org/wiki/File:Hydrocynus_vittatus_The_fishes_of_the_Nile_(Pl._XVII)_(6961607491).jpg. (December 2018).

1 Native Range and Status in the United States

Native Range

From Azeroual et al. (2010):

"*Hydrocynus vittatus* is known from most of sub-Saharan Africa from Senegal to Ethiopia, and south to South Africa."

"Central Africa: *Hydrocynus vittatus* is found throughout the Congo River basin [Angola, Burundi, Cameroon, Central African Republic, Democratic Republic of the Congo, South

Sudan, Tanzania, Zambia]. In Lower Guinea, it is found in the Cross and Sanaga basins [Cameroon, Nigeria]."

"Eastern Africa: This species is known from Lake Tanganyika [Burundi, Democratic Republic of the Congo, Tanzania, Zambia] and major affluent rivers, including Malagarasi river [Tanzania], as well as Lake Albert [Democratic Republic of the Congo, Uganda] and Murchison Nile [Uganda], Lake Turkana [Kenya] [Seegers et al. 2003] and Lake Rukwa [Tanzania]. It is also present in the Lower Shire river [Malawi, Mozambique], Rufigi and Ruaha Rivers [Tanzania]. According to Hopson and Hopson (1982) in the Turkana Basin [Kenya, Uganda, South Sudan] this species is principally riverine and ecological changes in the lake level have tended to inhibit incursions of *H. vittatus* into the lake. However, an erroneous identification by Worthington and Ricardo (1936) for *H. forskahlii* is also possible. In the latter case *H. vittatus* most likely does not occur in Kenya [Seegers et al. 2004]."

"Northeast Africa: It is present in the Ghazal and Jebel systems [South Sudan], White and Blue Niles [Sudan, South Sudan, Tanzania, Uganda, Democratic Republic of the Congo], and Nile to Lake Nasser (also known as Lake Nubia) [Sudan, South Sudan, Ethiopia, Uganda, Democratic Republic of the Congo, Kenya, Tanzania, Burundi]."

"Southern Africa: It occurs in the Zambezi [Zambia, Angola, Namibia, Botswana, Zimbabwe, Mozambique] and Okavango [Angola, Namibia, Botswana] (but not the Kafue [Zambia] or Lake Malawi [Malawi, Mozambique, Tanzania]), south to the Save [Zimbabwe, Mozambique], Limpopo [South Africa, Botswana, Zimbabwe, Mozambique] and Phongolo [South Africa, Mozambique] systems [Skelton 2001]. It has also been found in Lake Kariba [Zimbabwe, Zambia] [Losse 1998]."

"Western Africa: In West Africa, this species occurs in the basins of the Chad [Cameroon, Central African Republic, Chad, Niger, Nigeria, Sudan], Niger/Benue [Guinea, Mali, Niger, Benin, Nigeria, Burkina Faso], Ouémé [Benin, Nigeria], and Senegal [Senegal, Mali]."

In addition to the countries listed above, Azeroual et al. (2010) lists *Hydrocynus vittatus* as native in Ghana, Swaziland, and Togo.

Status in the United States

Hydrocynus vittatus has not been reported as introduced or established anywhere in the United States. *H. vittatus* is found in the aquarium trade in the United States.

From Aqua Imports (2018):

"AFRICAN TIGER FISH (HYDROCYNUS VITTATUS)

$119.99

One of the largest and most fearsome predatory fish species found in Africa's freshwater rivers and lakes, the African Tigerfish is a challenging fish to keep both due to its huge adult size and somewhat delicate temperament. They require clean, well-oxygenated water and will do best with moderate to high water flow. Recommended only for experienced fishkeepers with the largest home aquariums."

Means of Introductions within the United States

No introductions in the wild in the United States were found.

Remarks

Hoplias microlepis is also known by the common name Tigerfish.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2018):

"**Current status:** Valid as *Hydrocynus vittatus* Castelnau 1861."

From ITIS (2018):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Characiformes
Family Alestiidae
Genus *Hydrocynus*
Species *Hydrocynus vittatus* Castelnau, 1861"

Size, Weight, and Age Range

From Froese and Pauly (2018):

"Maturity: L_m 39.8 […]
Max length : 105 cm FL male/unsexed; [IGFA 2001]; 74.0 cm FL (female); max. published weight: 28.0 kg [IGFA 2001]; max. reported age: 8 years [Griffith 1975]"

Environment

From Froese and Pauly (2018):

"Freshwater; demersal; potamodromous [Riede 2004]. […] 22°C - 28°C [Baensch and Riehl 1995] [assumed to be recommended aquarium temperature]"

Climate

From Froese and Pauly (2018):

"Tropical;"

Distribution Outside the United States

Native

From Azeroual et al. (2010):

"*Hydrocynus vittatus* is known from most of sub-Saharan Africa from Senegal to Ethiopia, and south to South Africa."

"Central Africa: *Hydrocynus vittatus* is found throughout the Congo River basin. In Lower Guinea, it is found in the Cross and Sanaga basins."

"Eastern Africa: This species is known from Lake Tanganyika and major affluent rivers, including Malagarasi river, as well as Lake Albert and Murchison Nile, Lake Turkana [Seegers et al. 2003] and Lake Rukwa. It is also present in the Lower Shire river, Rufigi and Ruaha Rivers. According to Hopson and Hopson (1982) in the Turkana Basin this species is principally riverine and ecological changes in the lake level have tended to inhibit incursions of *H. vittatus* into the lake. However, an erroneous identification by Worthington and Ricardo (1936) for *H. forskahlii* is also possible. In the latter case *H. vittatus* most likely does not occur in Kenya [Seegers et al. 2004]."

"Northeast Africa: It is present in the Ghazal and Jebel systems, White and Blue Niles, and Nile to Lake Nasser (also known as Lake Nubia)."

"Southern Africa: It occurs in the Zambezi and Okavango (but not the Kafue or Lake Malawi), south to the Save, Limpopo and Phongolo systems [Skelton 2001]. It has also been found in Lake Kariba [Losse 1998]."

"Western Africa: In West Africa, this species occurs in the basins of the Chad, Niger/Benue, Ouémé, and Senegal."

Introduced

Hydrocynus vittatus has not been reported as introduced or established anywhere in the world outside of its native range.

Means of Introduction Outside the United States

Hydrocynus vittatus has not been reported as introduced or established anywhere in the world outside of its native range.

Short Description

From Froese and Pauly (2018):

"Dorsal spines (total): 0; Dorsal soft rays (total): 10; Anal spines: 0; Anal soft rays: 15. Diagnosis: 2 scale rows between lateral line and scaly process at pelvic-fin bases; eye < 70% of interorbital space [Paugy 1990, 2003]. Dorsal-fin origin at about same level as pelvic-fin insertions; tips of adipose and dorsal fins black; forked edge of caudal fin black [Paugy 1990, 2003; Paugy and Schaefer 2007]."

Biology

From Froese and Pauly (2018):

"Prefers warm, well-oxygenated water, mainly larger rivers and lakes; all but the largest form roving schools of like-sized fish; aptly described as fierce and voracious; feeds on whatever prey is most abundant but *Brycinus*, *Micralestes*, *Barbus*, and *Limnothrissa* are favored [Skelton 1993]. Useful food fish in some areas [Eccles 1992]."

From Azeroual et al. (2010):

"Breeding takes pace [sic] on a very few days each year, when the first good rains have swollen rivers and streams, usually in December and January at which time it undertakes a spawning migration up rivers and into small streams [Jackson 1961]. The females spawn a great number of eggs in very shallow water, among the stems of grasses and other submerged and partly submerged vegetation and here the young live until the falling of the flood water forces them out of this refuge [Jackson 1961]."

Human Uses

From Froese and Pauly (2018):

"Fisheries: commercial; gamefish: yes"

Hydrocynus vittatus is found in the aquarium trade.

From Aqua Imports (2018):

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adult size and somewhat delicate temperament. They require clean, well-oxygenated water and will do best with moderate to high water flow. Recommended only for experienced fishkeepers with the largest home aquariums."

Diseases

No records of OIE- reportable diseases (OIE 2019) were found for *Hydrocynus vittatus*.

No information on diseases was found.

Threat to Humans

From Froese and Pauly (2018):

"Harmless"

3 Impacts of Introductions

Hydrocynus vittatus has not been reported as introduced or established anywhere in the world outside of its native range; therefore there is no information on impacts of introduction.

4 History of Invasiveness

No reports of introductions of *Hydrocynus vittatus* outside its native range were found. Therefore, the history of invasiveness is No Known Nonnative Population.

5 Global Distribution

Figure 1. Known global distribution of *Hydrocynus vittatus*. Locations are in Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, The Democratic Republic of the Congo, Ghana, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Senegal, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Map from GBIF Secretariat (2018). Georeferenced locations were not available in Ethiopia, Guinea, Kenya, and South Sudan.

6 Distribution Within the United States

Hydrocynus vittatus has not been reported as introduced or established anywhere in the United States.

7 Climate Matching

Summary of Climate Matching Analysis

Most of the contiguous United States had a low climate match. The southern border with Mexico had a medium to high match. Peninsular Florida also had a medium to high match. The northern United States had a low match. The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.019, medium (scores between 0.005 and 0.103, exclusive, are categorized as medium). Most States had low individual Climate 6 scores except for Florida and Texas, which had high individual Climate 6 scores; and Arizona, which had a medium score.

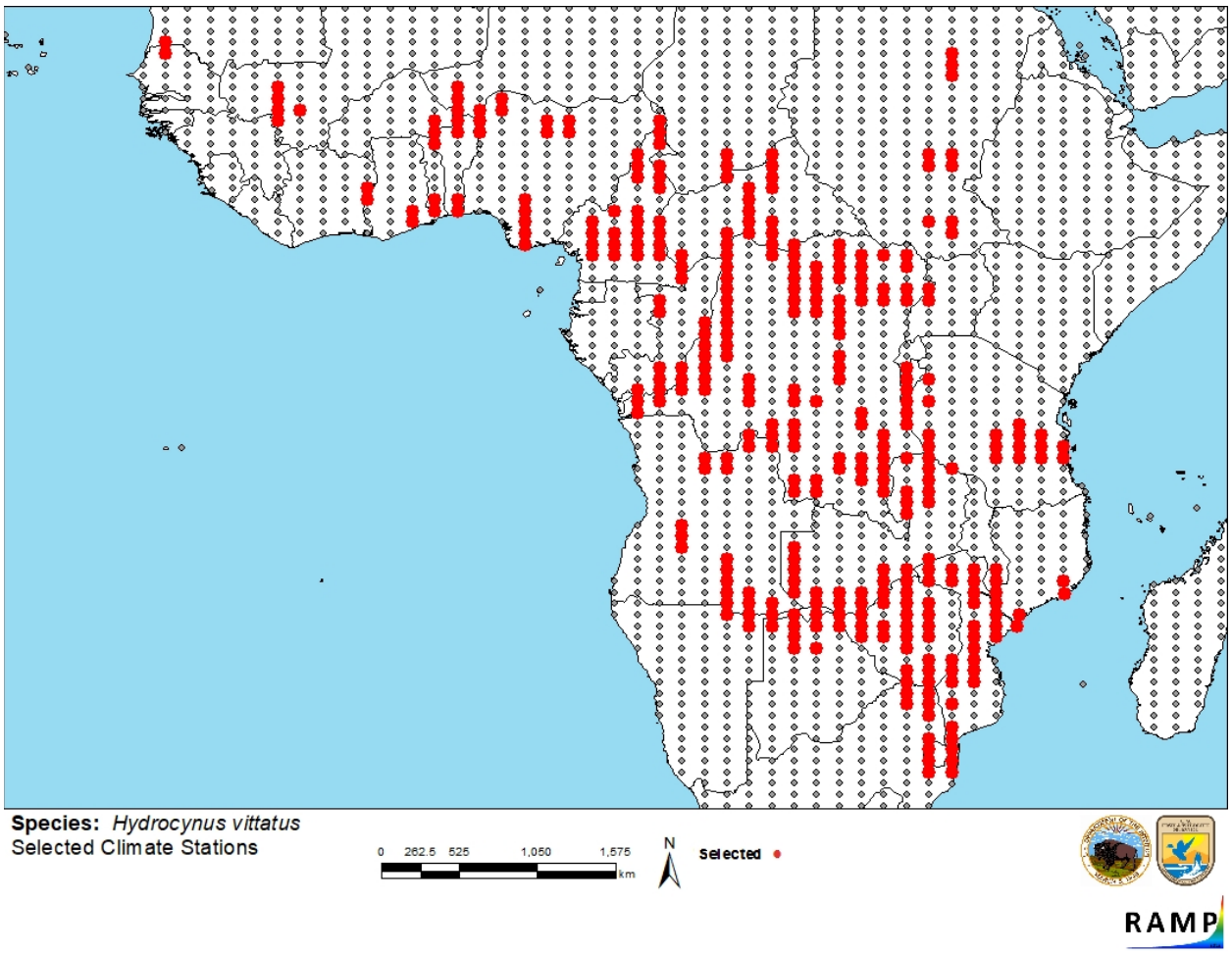

Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations in Angola, Benin, Botswana, Burundi, Cameroon, Central African Republic, Chad, Congo, The Democratic Republic of the Congo, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Senegal, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe selected as source locations (red) and non-source locations (gray) for *Hydrocynus vittatus* climate matching. Source locations from GBIF Secretariat (2018). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

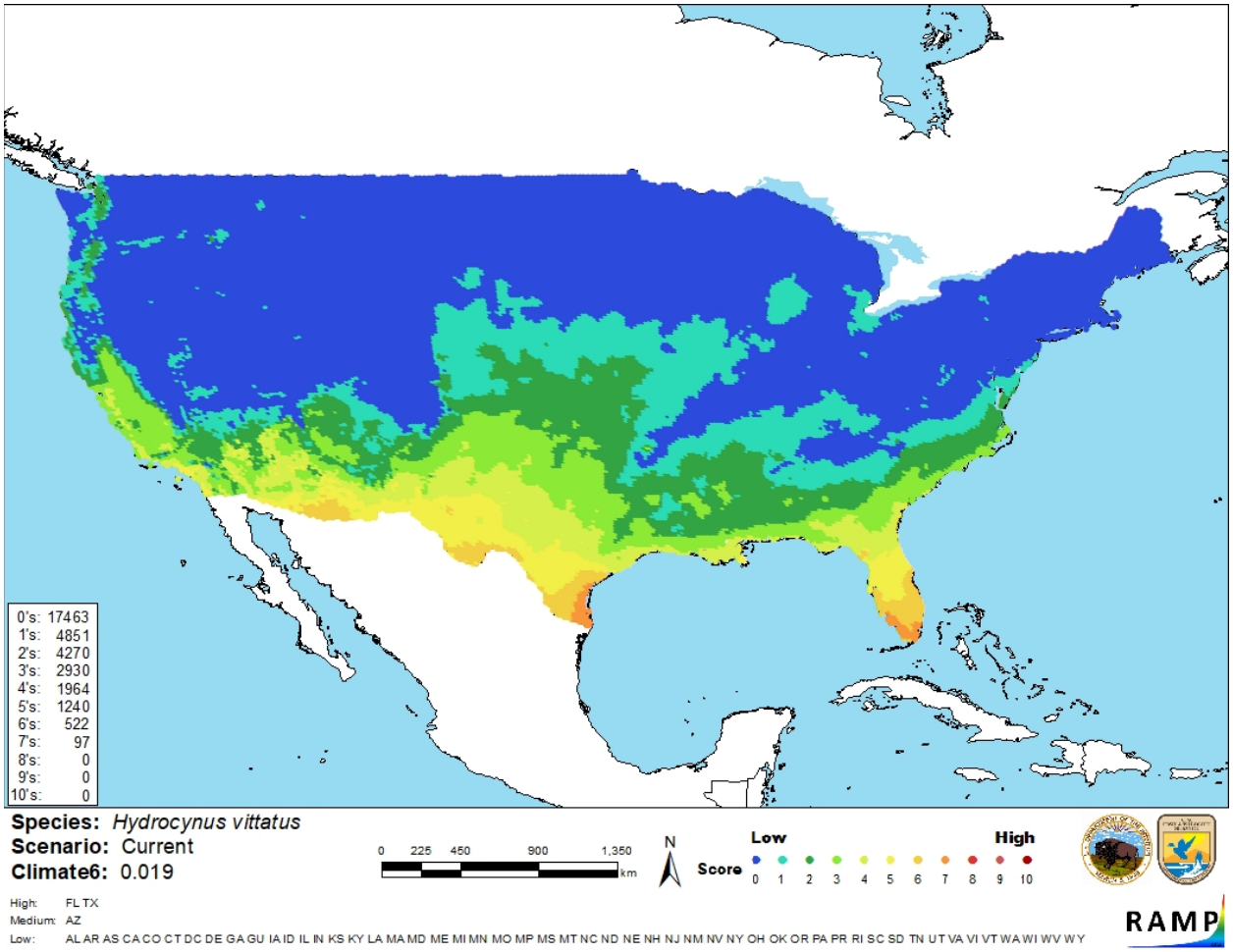

Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Hydrocynus vittatus* in the contiguous United States based on source locations reported by GBIF Secretariat (2018). 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of Climate Scores 6-10) / (Count of total Climate Scores)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

Hydrocynus vittatus has not been recorded anywhere in the world outside of its native range. With no information on history of invasiveness or impacts of introduction, the certainty of assessment is low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Tigerfish (*Hydrocynus vittatus*), is a freshwater predator native to much of sub-Saharan Africa. This species is a popular game fish in its native range and sold commercially for food and within the aquarium trade. *Hydrocynus vittatus* has not been reported anywhere outside of its native distribution, resulting in a history of invasiveness of No Known Nonnative Population. The climate match for the contiguous United States is Medium. The majority of the contiguous United States had a low match with areas of medium to high match found in southern areas from southern California to southern Florida. The certainty of assessment is Low due to a lack of information. The overall risk assessment category for *Hydrocynus vittatus* is Uncertain.

Assessment Elements

History of Invasiveness (sec. 3): No Known Nonnative Population
Climate Match (sec. 6): Medium
Certainty of Assessment (sec. 7): Low
Remarks/Important additional information: No additional information
Overall Risk Assessment Category: Uncertain

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

Aqua Imports. 2018. African tiger fish (*Hydrocynus vittatus*). Available: https://www.aqua-imports.com/shop/product/african-tiger-fish-hydrocynus-vittatus/ (December 2018).

[References abbreviated for this document.]

10 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Baensch HA, Riehl R. 1995. Aquarien atlas. Band 4. Melle, Germany: Mergus Verlag GmbH, Verlag für Natur-und Heimtierkunde.

Brewster B. 1986. A review of the genus *Hydrocynus* Cuvier 1819 (Teleostei: Characiformes). Bulletin of the British Museum (Natural History). Zoology 50(3):163–206.

[References abbreviated for this document.]