U.S. Fish & Wildlife Service

Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge

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Anaho Island National Wildlife Refuge
Inventory and Monitoring Plan

1 Signatures

Inventory and Monitoring Plan

For: Anaho Island National Wildlife Refuge

Prepared By:	Orien Richmond (lead), Wildlife Biologist, Region 8 Inventory and Monitoring Initiative Nancy Hoffman, Project Leader, Stillwater National Wildlife Refuge Complex Donna Withers, Wildlife Refuge Specialist, Stillwater National Wildlife Refuge Complex Giselle Block, Zone Biologist, Region 8 Inventory and Monitoring Initiative Sharon Dulava, Biological Technician, Region 8 Inventory and Monitoring Initiative Patrick Ward, Ecologist, National Inventory & Monitoring Initiative
Reviewed By:	Karen Laing , Region 8 Inventory and Monitoring Coordinator Curtis McCasland, Refuge Supervisor Mark Pelz, Chief, Natural Resources Division
Submitted By:	Nancy Hoffman, Project Leader, Stillwater National Wildlife Refuge Complex — Date: 3/16/2015
Approved By:	Polly Wheeler, Refuge Assistant Regional Director — Date: 3.17.15

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2 Introduction

Anaho Island National Wildlife Refuge (hereafter "refuge") is one of three refuges in the Stillwater National Wildlife Refuge Complex (NWRC). The refuge is located ½ mile west of the eastern shore of Pyramid Lake in Washoe County, Nevada, within the Pyramid Lake Paiute Reservation. Pyramid Lake is 30 miles northeast of Reno, Nevada, and 60 miles northwest of Stillwater NWRC headquarters in Fallon, Nevada. Anaho Island rises from the waters of Pyramid Lake, which is within the Truckee River watershed and Great Basin physiographic region.

The refuge was established in 1913 by Executive Order 1819 as a "…preserve and breeding ground for native birds." P.L. 101-618 §210(b)(2) more narrowly defined the purpose of the refuge, stating that it was to be managed and administered " …for the benefit and protection of colonial nesting species and other migratory birds." P.L. 101-618 also recognized that Anaho Island is part of the Pyramid Lake Indian Reservation, but it is to be managed and administered by the Service as a component of the Refuge System. A memorandum of understanding between the Service and the Pyramid Lake Paiute Tribe was signed in March 1992 that described the terms of the Service's management and administration of the island.

Anaho Island was proposed for wilderness designation as a roadless island in 1974 and is managed to preserve its wilderness character. Although the Service exercises primary jurisdiction over the island, no major deviations from current management practices will occur without the consent of and coordination with the Pyramid Lake Paiute Tribe, as per Resolution No. 19-90 of the Pyramid Lake Paiute Tribal Council and P.L. 101-618. (see also Section 3.2.2.1.6).

The Inventory and Monitoring Plan (IMP) identifies the surveys that a refuge intends to conduct over the next 15 years and briefly describes the purpose, management context, and partnerships involved in those surveys. A survey is defined as: "a specific data-collection effort to complete an inventory or conduct monitoring of biotic or abiotic resources (701 FW 2)." We expand the definition of survey here to include research. Survey information is also maintained in the Planning and Review of Inventory and Monitoring on Refuges (PRIMR) database. The IMP provides the rationale for the ranking and selection of surveys. Due to budget and personnel constraints, it is necessary for refuge management to prioritize surveys in light of their importance for informing management decisions, addressing treaty and policy obligations, and assessing progress toward meeting refuge goals, objectives and purposes.

The IMP provides guidance, transparency and continuity for the biological program and assists managers with budget allocation decisions. The IMP will be revisited annually by refuge staff to ensure that the current surveys are relevant, the refuge has the resources to conduct them and new issues and/or constraints are considered. The addition of new surveys or deletion of old surveys will require IMP revision and approval. An IMP can be approved before protocols have been developed or approved for each survey. A protocol consists of the detailed instructions for conducting a survey, including information on sampling procedures, data collection, management and analysis and reporting of results (see the Survey Protocol Handbook for more

details; U.S. Fish & Wildlife Service 2013). In lieu of complete protocols, refuge and I&M staff completed initial survey instructions for four high-priority surveys in this IMP (Appendices G-I). 'Initial survey instructions' is a term used to describe the initial phase of survey protocol development in Service policy (701 FW 2). These instructions consist of notes or other materials describing survey objectives or some of the procedures used to conduct a Refuge System survey. Following approval of this IMP, refuge and I&M staff will work collaboratively to develop complete protocols for each survey. Updating protocols requires IMP amendment and does not require approval.

This plan documents the prioritization process and results for those surveys that are currently and expected to be conducted at Anaho Island NWR from FY2015 to FY2030. This document was developed in collaboration with the Service's Inventory and Monitoring (I&M) Initiative and in accordance with the revised U.S. Fish and Wildlife Service policy 701 FW 2.

The Anaho Island NWR IMP is tightly linked to the Anaho Island NWR Natural Resource Management Plan (NRMP) (U.S. Fish & Wildlife Service 2014*a*), which is a step-down management plan from the Comprehensive Conservation Plan (CCP) for the refuge (U.S. Fish & Wildlife Service 2000). The NRMP was developed using the Open Standards for the Practice of Conservation, a systematic approach for planning, implementing, and monitoring conservation initiatives developed by a suite of professional conservation organizations (The Conservation Measures Partnership 2013). Surveys in this IMP are linked with numbered goals, objectives and strategies from the NRMP. The terms 'conservation target,' 'goal,' 'objective' and 'strategy' have specific definitions in the Open Standards Framework (The Conservation Measures Partnership 2013), provided below:

- A <u>conservation target</u> is a specific species, community or ecosystem that is selected by the refuge as a focus for management.
- A <u>goal</u> represents the desired status of a conservation target over the long term. A good goal meets the criteria of being linked to targets, impact oriented, measurable, time limited, and specific.
- An <u>objective</u> is a formal statement of the desired change that you believe is necessary to attain a goal. Objectives specify the desired changes in the factors (direct and indirect threats and opportunities) that you would like to achieve in the short and medium-term. A good objective meets the criteria of being results oriented, measurable, time limited, specific, and practical.
- A <u>strategy</u> is a set of actions with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, integrating opportunities and limiting constraints. These can include a broad array of conservation actions such as habitat restoration, land protection, policy change, or education.

The NRMP identifies three conservation targets for Anaho Island NWR: (1) colonial nesting waterbirds; (2) colonial nesting waterbird foraging areas and (3) the island ecosystem. Information generated from surveys is used to assess conservation progress and will inform natural resource management decisions and strategies. In addition, survey information will enhance accountability, credibility and transparency with policymakers and the public. Surveys were developed to address various temporal and spatial scales; e.g., to identify key threats to

management of natural resources, build landscape conservation partnerships and strategies and address climate change.

3 Methods

Surveys were prioritized and selected during a workshop held January 14-16, 2014, at the Stillwater NWRC office in Fallon, Nevada. The workshop was attended by Stillwater NWRC staff (Project Leader Nancy Hoffman and Wildlife Refuge Specialist Donna Withers), staff from the Region 8 I&M Initiative (Biologist Orien Richmond, Zone Biologist Giselle Block and Biological Technician Sharon Dulava) and one staff person from the Natural Resource Program Center (NRPC), Fort Collins, CO (Ecologist Patrick Ward). Because the workshop occurred after the development of much of the Anaho Island NWR NRMP, information about conservation targets, goals and objectives were readily available for use in prioritizing and selecting surveys for this IMP. Refuge staff made the evaluations and decisions leading to survey selection, while NRPC and I&M staff facilitated the process.

3.1 Development of Comprehensive List of Surveys

The group reviewed elements of the draft Anaho Island NWR NRMP (goals, objectives and proposed surveys) and existing refuge surveys in the PRIMR database. Refuge staff then compiled a comprehensive list of surveys comprised of five existing surveys and thirty-one potential surveys identified in the NRMP process. A variety of survey types were considered, including:

1) *Inventories* – Surveys to estimate a resource at a particular time;
2) *Monitoring* – Surveys repeated through time;
3) *Research* – Surveys to improve knowledge and understanding of system function; and
4) *Management milestones* – Surveys to assess progress toward reaching goals and objectives that do not involve on-the-ground data collection.

Nine management milestones were identified in the NRMP but were not ranked during the IMP process because they did not involve field data collection and thus did not require protocols. A table of management milestones is reproduced from the NRMP in Appendix A, Table A1.

The remaining survey types (inventories, monitoring and research, N = 27) were ranked during the IMP process. Newly identified surveys were added to the PRIMR database, and the information about existing surveys was updated.

3.2 Prioritization of Surveys

Refuge and I&M staff reviewed a new National Wildlife Refuge System survey prioritization tool (U.S. Fish & Wildlife Service 2014*b*; version 2.1) for evaluating and scoring proposed refuge surveys that is comprised of 24 criteria. After discussing a variety of methods that could be used to rank surveys, refuge staff decided to use the new survey prioritization tool.

Refuge and I&M staff reviewed the survey ranking criteria and selected 13 of the original 24 criteria for use in ranking the surveys (Appendix B). Four of the criteria were modified slightly for clarity or to reflect language in the NRMP. As the criteria differed in scope and importance to refuge staff, they were ranked on a scale of one to thirteen using the survey prioritization tool

(one being the most important and thirteen being the least). Each criterion was then assigned a weight from zero to 100, zero being the lowest rating and 100 being the highest, using a direct rating process (Goodwin and Wright 2011) that collectively reflected the refuge's priorities.

Refuge staff then worked together to evaluate and assign a collectively agreed upon score for each criterion to every survey in the comprehensive list of surveys. Notes were compiled to briefly document the scoring rationale. Survey scores were reviewed and discussed to make sure that they made sense. Once all surveys were evaluated, the survey prioritization tool was used to calculate a priority score for each survey (Appendix C, Table C1). A sorted list of surveys (high to low) and a figure (Appendix C, Figure C1) of final priority scores were reviewed and used as a reference for selecting surveys.

3.3 Selection of Surveys

The surveys were first bracketed into three groups—high, medium and low priority—based on the final priority scores from the survey prioritization tool (Appendix C: Figure C1). These groupings provided a starting reference for assigning the surveys into one of three tiers that considered refuge capacity (time, personnel, and money) to do the survey in addition to priority level. Tier definitions followed those given in the revised I&M Policy (701 FW 2: Exhibit 1, Section 4) and are provided below:

- Tier 1 – The highest priority surveys that the Project Leader estimates can be conducted with existing staffing and costs;
- Tier 2 – Surveys that the Project Leader sees as second priority for the refuge, or high priority surveys that would require an increase in staffing or costs; and
- Tier 3 – Lower priority surveys that are currently being conducted or are anticipated, but would require the major reallocation of staff or funds.

The final step in the selection process was to assign each survey a status of 'Current', 'Expected', 'Future', or 'Historical' as defined in the revised PRIMR User's Guide (U.S. Fish & Wildlife Service 2012; Appendix C, Table C1) and provided below. Selected surveys for the IMP were identified as those with a Current or Expected status; non-selected surveys were those assigned a Future or Historical status.

1) *Selected*
    a. *Current* – Surveys that are either continued from previous years or scheduled to begin in the year of IMP development because they are high priorities and because personnel time and funding will be available to conduct the survey; and
    b. *Expected* – Surveys that have not been started but have a good chance of being conducted during the span of the IMP because they are moderate to high priority, and, although resources may not be currently available, there is a good chance that they can be acquired. A starting year must be approximated for these surveys.
2) *Non-selected*
    a. *Future* – Surveys that have been prioritized and have a very low chance of being conducted during the span of the IMP because of low priority and/or the resources to conduct the survey are not likely to be acquired; and
    b. *Historical* – Surveys that have been completed.

The first three of these status categories usually corresponded to the respective Tiers I, II, and III, but could differ when priority or refuge capacity suggested a lower or higher status should be designated. For example, a low priority survey (Tier III) that was easy (less expensive) to conduct could be elevated from Future to Current survey status.

The Stillwater NWRC Project Leader and Wildlife Refuge Specialist estimated FWS staff requirements, staff salary costs, and other non-staff costs associated with each current survey by reviewing staff involvement and expenditures over the last 8 years (2006-2013; Appendix D, Table D1). Staff requirements were categorized by refuge positions expected to lead or conduct the survey, primarily Wildlife Refuge Specialist (GS- 485) and Maintenance Worker (WG-4749 or WG-5716). For each survey, the average annual staff requirement for each position was estimated in total hours per year, converted into Full Time Equivalents (FTE; 2080 hrs. = 1 FTE) and multiplied by the average FTE cost for that position to obtain an estimated staff salary cost. Staff salary costs from all positions participating in the survey were summed to provide a total estimated staff salary cost for the survey. Other non-staff costs included transportation (fuel, vehicle maintenance, etc.), equipment, and other costs (e.g., volunteers). To date, volunteers have not assisted with the current surveys. For surveys that are expected to be completed in the near future, the Stillwater NWRC Project Leader estimated staff requirements, staff costs, and other costs associated with the future surveys by reviewing costs for similar surveys and discussing survey costs with peers who had completed similar surveys (Appendix D, Table D2). All cost estimates were developed in FY 2014 and do not account for inflation into the future. Stillwater NWRC staff documented the current data management system that is used to manage survey data collected on the refuge and identified action items to improve data management (Appendix E). Finally, Stillwater NWRC staff developed a timeline for survey completion (Appendix F).

4 Results

Twenty-seven potential surveys were evaluated in the prioritization process (Appendix C, Table B1). Most (24) were inventory or monitoring activities. Three were cooperative research projects that will require active participation and capacity by refuge staff for design and potentially implementation.

The prioritization process resulted in the selection of 16 surveys to be implemented over the anticipated span of the IMP (FY2015—FY2030; Table 1, Appendix C). Five of the selected surveys can be implemented with current refuge capacity and were given a survey status of Current. The other 11 selected surveys can be implemented only with additional capacity that the refuge staff believes can be obtained over the span of the IMP. These surveys were classified as Expected. Additional details about the selected surveys are provided in Section 5, Survey Narratives. Each narrative identifies the refuge management objectives that the survey directly supports. Other refuge management objectives that are indirectly supported by the survey, if applicable, are also provided.

Eleven surveys included in the prioritization process, bulleted below, were not selected for implementation. These surveys were given a status of 'Future' (Appendix C) and are not included in Table 1 of the IMP.

- Colonial Nesting Waterbird Breeding Range Shifts Study
- Caspian Tern Reproductive Success
- Double-crested Cormorant Reproductive Success
- Great Blue Heron Reproductive Success
- California Gull Reproductive Success
- Black-crowned Night Heron Reproductive Success
- Snowy Egret Reproductive Success
- Invertebrate Species Richness Monitoring
- Reptile Species Richness Monitoring
- Mammal Species Richness Monitoring
- Plant Species Richness Monitoring

No previously conducted ongoing surveys were terminated and given a status of 'Historical'.

Table 1. Summary of 16 selected surveys to be implemented in FY2015-FY2030 for Anaho Island National Wildlife Refuge.

Survey Priority[1]	Survey ID Number[2]	Survey Name/(Type)[3]	Survey Status[4]	Goal, Objective, Strategy Id[5]	Survey Area[6]	Staff Time (FTE)[7]	Avg. Ann Cost (OPR)[8]	Survey Timing[9]	Survey Length[10]	Survey Coordinator[11]	Protocol Citation[12]	Protocol Status[13]
1	FF08RANH00-043	Anaho Island Isolation Study (CR)	Current	NRMP G3.3, O06, S05-S07,S09,S12	Regional	N/A	$0.00	TBD/ Occurs one time only	2014- 2017	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	N/A; research plan in development.
2	FF08RANH00-005	American White Pelican Fledging Success (M)	Current	NRMP G1.2	Entire station	FWS: 0.1	$750.00	March-September/ Recurring -- every year	1984- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
3.1	FF08RANH00-041	Pyramid Lake Water Elevation Monitoring (M)	Current	NRMP G3.3, O06, S05-S07,S09,S12	Regional	FWS: 0.0	$0.00	TBD/ Recurring -- every year	2014- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
3.2	FF08RANH00-015	Anaho Island Isolation Monitoring (M)	Current	NRMP G3.3, O06, S05-S07,S09,S12	Regional	FWS: 0.01	$50.00	TBD/ Recurring -- every year	2014- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
4	FF08RANH00-012	Colonial Nesting Waterbird Species Richness (M)	Current	NRMP G1.1	Entire station	FWS: 0.12	$5,750.00	TBD/ Recurring -- every year	1984- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
5	FF08RANH00-013	Colonial Nesting Waterbird Foraging Areas (M)	Expected	NRMP G2.1, O07,S09,S12	Regional	FWS: 0.02	$100.00	TBD/	2015- Indefinite	Nancy Hoffman, Project Leader: Stillwater NWR Complex	(none)	Initial Survey Instructions
6	FF08RANH00-042	Colonial Nesting Waterbird Threats Study (CR)	Expected	NRMP S10	Regional	N/A	$0.00	TBD/ Occurs one time only	2018- 2019	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	N/A; research plan in development.
7	FF08RANH00-024	Bird Species Inventory (I)	Expected	NRMP G3.2, S01-S04	Entire station	N/A	$0.00	TBD/ Occurs one time only	2015- 2016	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions

[1] The rank for each survey listed in order of priority (e.g., numeric, tiered, alpha-numeric, or combination of these).
[2] A unique identification number consisting of the refuge code and computer assigned sequential number. The refuge code comes from the FBMS cost center identifier. The computer assigned sequential number comes from PRIMR
[3] Short titles for the survey name, preferably the same name used in refuge work plans. Also include the PRIMR code for survey type in parentheses. These are: Inventory (I), Cooperative Baseline Monitoring (CB), Monitoring to Inform Management (M), Cooperative Monitoring to Inform Management (CM), Research (R), and Cooperative Research (CR).
[4] Surveys selected for the timespan of this IMP. Current surveys can be implemented with the current capacity of the refuge. Expected surveys can be implemented but only with additional capacity.
[5] The management goals and objectives that justify the selected survey and related management strategies. References to the NRMP include goals (G), objectives (O) and strategies (S).
[6] The broadest spatial scale of the area for which the survey results are intended. May include refuge management unit names, entire refuge, or names of other landscape units.
[7] Estimates of Service (FWS) and non-Service (Other) staff time needed to complete the survey (1 work year = 2080 hours = 1 FTE).
[8] Estimates of average annual operations cost for conducting the survey during the years it is conducted (e.g., equipment, contracts, travel) but not including staff time.
[9] Timing and frequency of survey field activities. TBD = to be determined.
[10] The years during which the survey is conducted.
[11] The name and position of the survey coordinator (the Refuge Biologist or other designated Service employee) for each survey.
[12] Title, author, and version of the survey protocol (if there is no protocol to cite, enter None).
[13] Stage of approval of the survey protocol (Initial Survey Instructions, Complete Draft, In Review, or Approved).

Table 1 continued.

Survey Priority	Survey ID Number	Survey Name/(Type)	Survey Status	Mgmt. Objective Id	Survey Area	Staff Time (FTE)	Avg. Ann Cost (OPR)	Survey Timing	Survey Length	Survey Coordinator	Protocol Citation	Protocol Status
8	FF08RANH00-021	Invertebrate Species Inventory (I)	Expected	NRMP S01-S04	Entire station	N/A	$0.00	TBD/ Occurs one time only	2015- 2020	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
9	FF08RANH00-023	Mammal Species Inventory (I)	Expected	NRMP S01-S04	Entire station	N/A	$0.00	TBD/ Occurs one time only	2015- 2020	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
10	FF08RANH00-025	Reptile Species Inventory (I)	Expected	NRMP S01-S04	Entire station	N/A	$0.00	TBD/ Occurs one time only	2015- 2020	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
11	FF08RANH00-030	Invasive/Nuisance Plant Management Effectiveness Monitoring (M)	Expected	NRMP O12, S06, S08	Entire station	FWS: 0.02	$0.00	TBD/	2018- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
12	FF08RANH00-031	Invasive/Nuisance Animal Management Effectiveness Monitoring (M)	Expected	NRMP O13, S06, S08	Entire station	FWS: 0.02	$0.00	TBD/	2018- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
13	FF08RANH00-037	Invasive/Nuisance Species Early Detection (M)	Expected	NRMP O11, O13, S06, S08	Entire station	FWS: 0.04	$0.00	TBD/	2018- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
14	FF08RANH00-019	Bird Species Richness Monitoring (M)	Expected	NRMP G3.2	Entire station	FWS: 0.08	$0.00	TBD/	2017- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions
15	FF08RANH00-014	Vegetation Cover and Composition (M)	Expected	NRMP G3.1	Entire station	FWS: 0.04	$250.00	TBD/	2016- Indefinite	Donna Withers, Wildlife Refuge Specialist: Stillwater NWR Complex	(none)	Initial Survey Instructions

5 Narratives of Selected Surveys

5.1 Surveys Implemented with Current Refuge Capacity

1.0 Anaho Island Isolation Study (PRIMR ID: FF08RANH00-043)

1) What is the population or attribute of interest, what will be measured, and when?
Staff carrying out this cooperative research study will: (1) model the relationship between Pyramid Lake water levels and bathymetry; (2) evaluate past and future trends in Pyramid Lake water levels (e.g., climate change, water use, land bridge formation); (3) determine the primary threats to Pyramid Lake water levels (e.g., climate change, economic development); (4) identify Pyramid Lake water level thresholds for mammalian access to Anaho Island; and (5) identify points where mammalian crossings are likely to occur. The study will utilize existing data including Pyramid Lake bathymetry data, Truckee River flow data and water surface elevation data to develop an Anaho Island Isolation model (NRMP Strategy 05). Initial review of the existing bathymetry data began in 2013. Development of the model began in FY2014 and is targeted for completion by the end of FY2015. The model will be tested in FY2016 and updated or modified as necessary and appropriate.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: A.1, A.2, B.1
NRMP Goals: 3.3
NRMP Objective: 06
NRMP Strategies: 05, 06, 07, 09, 12

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Water supply to Pyramid Lake is critical to preventing formation of a land bridge and preserving Anaho Island biodiversity. If Pyramid Lake water levels continue to decline, the risk of novel predators and nuisance species (e.g., coyotes, horses, cows) introductions increase. These introductions will result in significant changes to colonial nesting waterbirds and the island ecosystem. Increased understanding of the status and trend of Pyramid Lake water levels and the relationship to critical threats (e.g., invasive species) will provide the refuge and its partners with a basis for taking action and improving water supply to Pyramid Lake. Information generated by this strategy will be used by the refuge to prevent or control new invasive introductions (NRMP Strategy 06), coordinate with the Pyramid Lake Paiute Tribe relative to the Memorandum of Understanding governing management of Anaho Island NWR (NRMP Strategy S07), improve water conservation and management in the project scope (NRMP Strategy 09) and ultimately contribute to the conservation of colonial nesting waterbirds and the Anaho Island ecosystem. Completing this study may trigger a management response if Pyramid Lake water elevation levels are reduced below 1,166 m (NRMP Goal 3.3).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this is a cooperative research study. The USFWS will work with the Pyramid Lake Paiute Tribe, The U.S. Geological Survey (USGS), the U.S. Natural Resources Conservation Service (NRCS), other USFWS offices, the Truckee River Operating Forum and others.

5) Protocol status?

The research plan for this survey is under development and will be completed by the end of FY2015.

2.0 American White Pelican Fledging Success (PRIMR ID: FF08RANH00-005)

1) What is the population or attribute of interest, what will be measured, and when?
This survey provides an estimate of the annual reproductive success of American white pelicans (*Pelecanus erythrorhynchos*) on Anaho Island NWR. The indicator or metric for reproductive success is *annual fledging success*, defined as the number of pelican fledglings divided by the number of active nests in a given year. *Fledglings* are defined as juvenile pelicans present in sub-colonies on the island prior to dispersal away from the sub-colony and prior to becoming flight-capable and leaving the island (which usually occurs between July and September). *Active nests* are defined as pelican nests that contain one or more pelican eggs or fledglings or with at least one adult in direct attendance, either incubating or standing directly on a nest. This survey is expected to be conducted annually between FY2015-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A
CCP Objectives: A.3
NRMP Goals: 1.2

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
This survey enables managers to assess whether the refuge is meeting its purpose of providing suitable breeding habitat for one of its priority colonial nesting waterbird species, American white pelicans. Specifically, the survey directly informs managers about meeting NRMP Goal 1.2: Over the next 15 years, annual American white pelican fledging success at Anaho Island is ≥ 0.3 juvenile pelicans fledged per active nest. If fledging success drops below the threshold of 0.3 juveniles fledged per active nest, management actions may be triggered such as increased efforts to improve foraging habitat. Potential threats that might reduce fledging success include availability of forage resources, predation, disturbance, etc. The Colonial Nesting Waterbird Threats Study (PRIMR ID: FF08RANH00-042) will help identify and evaluate potential threats.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions have been developed (Appendix G). A site-specific protocol is needed.

3.1 Pyramid Lake Water Elevation Monitoring (PRIMR ID: FF08RANH00-041)

1) What is the population or attribute of interest, what will be measured, and when?
This survey documents the monthly surface water elevation of Pyramid Lake. Refuge staff incorporate water elevation data collected monthly by USGS into a refuge database for use in the Anaho Island Isolation Study (PRIMR ID: FF08RANH00-043). The survey is expected to be conducted annually between FY2015-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: A.1, A.2, B.1
NRMP Goals: 3.3
NRMP Objectives: 06
NRMP Strategies: 05, 06, 07, 09, 12

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Maintaining Anaho Island as an island is vitally important for conserving sensitive colonial nesting waterbirds and other native species. Based on bathymetric data, the potential exists for a land bridge to form on the eastern side of the island if Pyramid Lake water levels continue to decline. The formation of a land bridge, or even the formation of a shallow-water zone, could allow mammalian predators (e.g., coyote, bobcat, fox, cat, etc.) to access the island and would increase colonization potential by a range of other native and nonnative species. Mammalian predators could decimate colonial nesting waterbird populations; colonization of the island by mainland native or nonnative species could threaten uniquely-evolved island populations of plants, reptiles and invertebrates. This survey directly informs managers about whether they are meeting NRMP Goal 3.3: Over the next 50 years, the water surface elevation of Pyramid Lake is ≥1,166-m in order to maintain island isolation and preserve island biodiversity. The monthly Pyramid Lake water elevation data will be used to develop an island isolation model as part of the Anaho Island Isolation Study (PRIMR ID: FF08RANH00-043). The Anaho Island Isolation Study will estimate the size of Anaho Island and the distance between the island and the eastern shoreline of Pyramid Lake under current and predicted future water levels. Staff will compare the results generated by the model with the thresholds established in the Integrated Pest Management Plan (NRMP Strategy 06), which will outline actions to be taken if water levels drop below prescribed thresholds.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this is a cooperative survey. Water elevation data are collected by USGS. SNWRC staff query the National Water Information System online database (NWISWeb) to obtain the data.

5) Protocol status?
Initial survey instructions have been developed (Appendix H). A site-specific protocol is needed.

3.2 Anaho Island Isolation Monitoring (PRIMR ID: FF08RANH00-015)

1) What is the population or attribute of interest, what will be measured, and when?
This survey documents the horizontal distance between the easternmost shore of Anaho Island and the mainland. The island-mainland distance is currently calculated from aerial imagery on an annual basis or whenever new imagery is available. In the future (2015 or 2016), a bathymetric model will be used to calculate the monthly island-mainland distance and generate an annual depth profile of the lake between the easternmost shore of Anaho Island and the mainland (Anaho Island Isolation Study, PRIMR ID: FF08RANH00-043). The survey is expected to be conducted annually between FY2015-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: A.1, A.2, B.1
NRMP Goals: 3.3
NRMP Objectives: 06
NRMP Strategies: 05, 06, 07, 09, 12

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Continued aquatic isolation is key to preserving the biological diversity of Anaho Island. The unique biological community of interacting organisms at Anaho Island has been shaped in large part by its aquatic isolation and associated lack of terrestrial predators (e.g., coyotes). The degree of island isolation is a function of the surface elevation of Pyramid Lake, the topography of Anaho Island and the uplands surrounding Pyramid Lake, and the bathymetry of Pyramid Lake. As Pyramid Lake water levels decrease, the distance and depth of the water between Anaho Island and the mainland decreases, and the risk of invasive/nuisance plant and animal species introductions to Anaho Island increases. Staff will compare the results from the survey with the island-mainland distance thresholds established in the Integrated Pest Management Plan (NRMP Strategy 06), which will outline actions to be taken if the island-mainland distance drops below prescribed thresholds.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions have been developed (Appendix I). A site-specific protocol is needed.

4.0 Colonial Nesting Waterbird Species Richness (PRIMR ID: FF08ANH00-012)

1) What is the population or attribute of interest, what will be measured, and when?
This survey documents the annual species richness of colonial nesting waterbirds at Anaho Island. Targeted species include: *Ardea herodias* (Great Blue Heron); *Egretta thula* (Snowy Egret); *Pelecanus erythrorhynchos* (American White Pelican); *Nycticorax nycticorax* (Black-crowned Night-Heron); *Larus californicus* (California Gull); *Hydroprogne caspia* (Caspian Tern); and *Phalacrocorax auritus* (Double-crested Cormorant). Mainland surveys from the east shore of Pyramid Lake begin in mid-February and are conducted approximately every 2 weeks until at least 200 pelicans have established active nests on the island, after which on-island surveys are initiated. On-island surveys are conducted at least three times from May-July. The survey is expected to be conducted annually, in conjunction with Survey 2.0 American White Pelican Fledging Success (PRIMR ID: FF08RANH00-005), between FY2015-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A
CCP Objectives: A.1, A.3
NRMP Goals: 1.1

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
This survey enables refuge managers to assess the ability of Anaho Island NWR to meet its purpose of providing habitat for colonial nesting waterbirds. Colonial nesting waterbirds are a priority resource of concern for the refuge. This survey directly informs managers about whether they are meeting NRMP Goal 1.1: Over the next 15 years, Anaho Island continues to support breeding populations of at least five colonial nesting waterbird species annually. Waterbird abundance will be incorporated into this goal in the future following development of methods to estimate waterbird abundance. Data collected during this survey will be shared with other organizations compiling data to assess the status of colonial waterbird species on a State or regional level (such as the Great Basin Bird Observatory's Nevada Aquatic Bird Count and the Pacific Flyway's American White Pelican and Double crested cormorant monitoring strategies). Survey results may trigger a management response if there are significant declines in colonial nesting waterbird diversity and/or abundance. Threshold values for triggering management responses relative to abundance and species diversity still need to be developed based on existing refuge and regional data. Causal reasons for declines will need to be identified and will be informed by completion of other priority surveys identified in this IMP.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions have been developed (Appendix G). A site-specific protocol is needed.

5.2 Surveys Implemented with Expected Additional Capacity

5.0 Colonial Nesting Waterbird Foraging Areas (PRIMR ID: FF08RANH00-013)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will document the acreage of waterbodies within the defined scope of the Anaho Island NRMP (approximately 160 km, or 100 mi, from Anaho Island) on an annual basis. Waterbody surface area is assumed to be positively correlated with aquatic food availability and waterbird reproductive success. The survey is expected to be conducted annually between FY2015-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A
CCP Objectives: A.4
NRMP Goals: 2.1
NRMP Objective: 07
NRMP Strategies: 09, 12

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Anaho Island's colonial nesting waterbird species are dependent upon aquatic food resources (e.g., fish, invertebrates) during the breeding season. This is especially true for American White Pelicans, double-crested cormorants and Caspian terns. Aquatic food resources are found in Pyramid Lake and surrounding waterbodies (lakes, rivers and wetlands) of the NRMP project scope. Declining water supply as a result of human use (agriculture, domestic/public) and climate change can negatively impact the abundance, distribution and characteristics (e.g., depth, food web) of waterbodies. Reduced aquatic food availability, in turn, can result in lowered reproductive success for fish-dependent waterbird species. Climate change and resulting declines in precipitation and snowpack are expected to exacerbate existing water supply and distribution threats in the project scope. This survey directly informs managers about whether they are meeting NRMP Goal 2.1: Over the next 30 years, waterbody surface area (ha) within the project scope is greater than 2013 levels in order to sustain Anaho Island colonial nesting waterbird populations. The data from the survey will be combined with data from Survey 2.0 American White Pelican Fledging Success (PRIMR ID: FF08RANH00-005) and Survey 4.0 Colonial Nesting Waterbird Species Richness (PRIMR ID: FF08ANH00-012) to determine if food availability may be a threat to colonial waterbirds on Anaho Island (NRMP Strategies 10 and 11).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions will be developed by the end of FY2015. A protocol is needed.

6.0 Colonial Nesting Waterbird Threats Study (PRIMR ID: FF08RANH00-042)

1) What is the population or attribute of interest, what will be measured, and when?
This cooperative research study will identify and prioritize all threats that may be currently impacting colonial waterbird species richness, abundance, and reproductive success on Anaho Island NWR, such as but not limited to, forage availability, contaminants, predation and human disturbance. The study is scheduled to be initiated in 2018. This research study is expected to be conducted between FY2018-FY2019.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A
CCP Objectives: A.1, A.4
NRMP Strategies: 10

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
This research study will provide a better understanding of the threats that may be currently impacting the colonial waterbirds on Anaho Island so that refuge managers can determine which threats warrant the expenditure of funds to minimize/eliminate their impacts. Current and projected threats of greatest concern to Anaho Island waterbirds are climate change, water management and use and invasive animal species. Climate change and resulting declines in precipitation and snowpack are expected to exacerbate existing water supply and distribution threats in the project scope, resulting in decreased aquatic food production (e.g., fisheries). Aquatic food availability is considered the main driver of waterbird reproductive success. The potential for introduction of novel mammalian predators and nuisance species is a critical concern for Anaho Island waterbirds (species richness, abundance, reproductive success). If Pyramid Lake water levels continue to decline, the risk of invasive animal introductions is almost certain. Such introductions would likely increase waterbird mortality rates across all species and life stages (e.g., eggs, chicks, adults) and result in reproductive failure or loss of waterbird species. Information gained from this study would be used to refine Anaho Island NRMP threat rankings, strategies and objectives.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this is a cooperative research study. Partners have not been identified to date.

5) Protocol status?
A research plan will be developed by the end of FY2015.

7.0 Bird Species Inventory (PRIMR ID: FF08ANH00-024)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will provide a baseline inventory of all bird species that occur on Anaho Island throughout the annual cycle (fall, winter, spring and summer). Surveyors will use a combination of complete area searches and automated recorder stations to document bird species that occur on the island. Surveys are expected to begin in winter 2014-15 and extend through fall 2015.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: B.2
NRMP Goals: 3.2
NRMP Strategies: 01, 02, 03, 04

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Currently the refuge has limited species occurrence information, especially for birds other than waterbirds. A bird inventory will increase refuge understanding of current bird species richness, inform trends in bird species richness (e.g., comparison with available legacy data), support development of refuge management strategies (preservation/restoration, pest management) and provide a baseline for evaluating bird response to management actions and anticipated long-term threats (e.g., climate change). The collection and utilization of bird inventory data will contribute to long-term conservation of Anaho Island biodiversity. This survey will inform managers about whether they are meeting NRMP Goal 3.2: Over the next 30 years, >80% of native bird and plant species documented on Anaho Island (since first records in the late 1800's) continue to persist. Inventory results will also inform the development and refinement of natural resource management strategies, including the development of an Anaho Island Biodiversity Preservation/Restoration Strategy (NRMP Strategy 2.0), development of an Integrated Pest Management Plan (Strategy 6.0) and refinement of Anaho Island priority resources of concern (NRMP Strategy 03).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this is a cooperative survey. The Service and Great Basin Bird Observatory (GBBO) will cooperatively design and carry out the bird inventory.

5) Protocol status?
A Scope of Work (SOW) for a cooperative agreement between the Service and GBBO is currently under development. The SOW directs GBBO to develop initial survey instructions for the survey. A protocol is needed.

8.0 Invertebrate Species Inventory (PRIMR ID: FF08RANH00-0021)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will provide a baseline inventory of the invertebrate species or genera that occur on Anaho Island. The inventory is expected to be conducted between FY2016-FY2020.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: B
CCP Objectives: B.2
NRMP Strategies: 01, 02, 03, 04

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Currently the refuge has limited species occurrence information, especially for invertebrates. An invertebrate inventory will increase refuge understanding of current invertebrate diversity, inform trends in invertebrate diversity (e.g., comparison with available legacy data), support development of refuge management strategies (preservation/restoration, pest management) and provide a baseline for evaluating invertebrate response to management actions and anticipated long-term threats (e.g., climate change). The collection and utilization of invertebrate inventory data will ultimately contribute to long-term conservation of conservation targets. Inventory results will inform the development and refinement of natural resource management strategies, including the development of an Anaho Island Biodiversity Preservation/Restoration Strategy (NRMP Strategy 2.0), development of an Integrated Pest Management Plan (Strategy 6.0) and refinement of Anaho Island priority resources of concern in the NRMP.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this will likely be a cooperative survey.

5) Protocol status?
Initial survey instructions will be developed by the end of FY2016. A protocol is needed.

9.0 Mammal Species Inventory (PRIMR ID: FF08RANH00-023)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will provide a baseline inventory of all mammal species that occur on Anaho Island. The inventory will target both terrestrial small mammals and bats. The inventory is expected to be conducted between FY2016-FY2020.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: B
CCP Objectives: B.2
NRMP Strategies: 01, 02, 03, 04

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Currently the refuge has limited species occurrence information. A mammal inventory will increase refuge understanding of current mammal species richness, inform trends in mammal species richness (e.g., comparison with available legacy data), support development of refuge management strategies (preservation/restoration, pest management) and provide a baseline for evaluating mammalian response to management actions and anticipated long-term threats (e.g., climate change). The collection and utilization of mammal inventory data will ultimately contribute to long-term conservation of conservation targets. Inventory results will inform the development and refinement of natural resource management strategies, including the development of an Anaho Island Biodiversity Preservation/Restoration Strategy (NRMP Strategy 2.0), development of an Integrated Pest Management Plan (Strategy 6.0) and refinement of Anaho Island priority resources of concern in the NRMP.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this will likely be a cooperative survey.

5) Protocol status?
Initial survey instructions will be developed by the end of FY2016. A protocol is needed.

10.0 Reptile Species Inventory (PRIMR ID: FF08RANH00-025)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will provide a baseline inventory of all reptile species that occur on Anaho Island. The inventory is expected to be conducted between FY2016-FY2020.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: B
CCP Objectives: B.2
NRMP Strategies: 01, 02, 03, 04

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Currently the refuge has limited species occurrence information. A reptile inventory will increase refuge understanding of current reptile species richness, inform trends in reptile species richness (e.g., comparison with available legacy data), support development of refuge management strategies (preservation/restoration, pest management) and provide a baseline for evaluating reptile response to management actions and anticipated long-term threats (e.g., climate change). The collection and utilization of reptile inventory data will ultimately contribute to long-term conservation of conservation targets. Inventory results will inform the development and refinement of natural resource management strategies, including the development of an Anaho Island Biodiversity Preservation/Restoration Strategy (NRMP Strategy 2.0), development of an Integrated Pest Management Plan (NRMP Strategy 6.0) and refinement of Anaho Island priority resources of concern in the NRMP.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes, this will likely be a cooperative survey.

5) Protocol status?
Initial survey instructions will be developed by the end of FY2016. A protocol is needed.

11.0 Invasive/Nuisance Plant Management Effectiveness Monitoring (PRIMR ID: FF08RANH00-030)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will document the effectiveness of invasive/nuisance plant management actions implemented in accordance with the Anaho Island Integrated Pest Management Plan (NRMP Strategies 06 and 08). Monitoring will occur as directed in the plan. The Integrated Pest Management Plan is expected to be developed in FY2015-2017. The survey is expected to be conducted between FY2018-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: A.1, B.2
NRMP Objectives: 12
NRMP Strategies: 06, 08

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Invasive species pose a critical threat to Anaho Island biota. Introduction of new invasive plants or expansion of existing invasive plant populations are expected to negatively impact Anaho Island biota. Although there is little evidence, we assume invasive plants are already negatively impacting native Anaho Island biota, especially native plants. Currently the refuge does not have an IPM plan or a clear understanding of which invasive species should be a focus of management and what actions to take to prevent or control invasive species. Development and implementation of IPM plan (NRMP Strategies 06 and 08) would lead to a better understanding of priority invasive threats, result in knowledge about the status of threats (e.g., inventory) and provide a framework for adaptive management of invasive species. Successful implementation of the IPM plan is expected to prevent new invasions and successfully reduce existing invasive populations. Prevention and reduction of invasive threats will reduce current stress on native plant/wildlife habitats, prevent future stress and ultimately contribute to conservation of Anaho Island biota.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions for this survey will be developed as part of the Intergrated Pest Management Plan. A protocol is needed.

12.0 Invasive/Nuisance Animal Management Effectiveness Monitoring (PRIMR ID: FF08RANH00-031)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will document the effectiveness of invasive/nuisance animal management actions implemented in accordance with the Anaho Island Integrated Pest Management Plan (NRMP Strategies 06 and 08). Monitoring will occur as directed in the plan. The Integrated Pest Management Plan is expected to be developed in FY2015-2017. The survey is expected to be conducted between FY2018-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform? CCP Goals: A, B
CCP Objectives: A.1, B.2
NRMP Objectives: 13
NRMP Strategies: 06, 08

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Invasive species pose a critical threat to Anaho Island biota. Introduction of invasive or nuisance animals (e.g., coyotes, dogs) could significantly alter wildlife reproductive success and survival. Currently the refuge does not have an IPM plan or a clear understanding of which invasive species should be a focus of management and what actions to take to prevent or control invasive species. Development and implementation of IPM plan (NRMP Strategies 06 and 08) would lead to a better understanding of priority invasive threats, result in knowledge about the status of threats (e.g., inventory) and provide a framework for adaptive management of invasive species. Successful implementation of the IPM plan is expected to prevent new invasions and successfully reduce existing invasive populations. Prevention and reduction of invasive threats will reduce current stress on native plant/wildlife habitats, prevent future stress and ultimately contribute to conservation of Anaho Island biota.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions for this survey will be developed as part of the Integrated Pest Management Plan.

13.0 Invasive/Nuisance Species Early Detection (PRIMR ID: FF08RANH00-037)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will document the presence of priority invasive/nuisance species that become established on Anaho Island in accordance with the Anaho Island Integrated Pest Management Plan (NRMP Strategies 06 and 08). Monitoring will occur as directed in the plan. The Integrated Pest Management Plan is expected to be developed in FY2015-2017. The survey is expected to be conducted between FY2018-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: A.1, B.2
NRMP Objectives: 11, 13
NRMP Strategies: 06, 08

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Invasive species pose a critical threat to Anaho Island biota. Introduction of invasive or nuisance animals (e.g., coyotes, dogs) could significantly alter wildlife reproductive success and survival. Introduction of new invasive plants or expansion of existing invasive plant populations are expected to negatively impact Anaho Island biota. Although there is little evidence, we assume invasive plants are already negatively impacting native Anaho Island biota, especially native plants. This survey will document the presence of high priority invasive/noxious species on Anaho Island as soon after establishment as possible, so that actions identified in the Integrated Pest Management Plan (NRMP Strategies 06 and 08) can be undertaken as early as possible and with the least cost and greatest effectiveness.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions for this survey will be developed as part of the Integrated Pest Management Plan.

14.0 Bird Species Richness Monitoring (PRIMR ID: FF08RANH00-019)

1) What is the population or attribute of interest, what will be measured, and when?
This survey will document the number of bird species that occur on Anaho Island on a periodic basis. The exact methodology and timing of the survey will be determined after Survey 7 Bird Species Inventory (PRIMR ID FF08RANH00-024) has been completed. The survey is expected to be conducted between FY2017-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform?
CCP Goals: A, B
CCP Objectives: B.2
NRMP Goals: 3.2

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Biodiversity was recognized in the NRMP as a key ecological indicator of the Anaho Island Ecosystem. Biodiversity on Anaho Island includes several taxa, including invertebrates, plants, birds, mammals and reptiles. Bird species richness was selected in the NRMP as an initial indicator for island biodiversity. Birds were chosen because: (1) they are responsive to environmental changes (locally and at larger landscape scales); (2) they can be feasibly measured; (3) bird data are available from local and larger landscape scales (e.g., Avian Knowledge Network) and (4) birds are commonly used to indicate changes in environmental health at larger landscape scales (e.g., climate change effects). Species richness (the number of species in a given area) represents a single but important metric that is valuable as a common currency of biodiversity. In the future, bird species richness will be integrated with other metrics to more fully capture biodiversity (e.g., genetic variability, distribution) of Anaho Island. Baseline levels of bird species richness at Anaho Island will be determined via Survey 7 Bird Species Inventory (PRIMR ID FF08RANH00-024). Results from this survey will be compared with the results of the Bird Species Inventory to track changes in diversity over time and assess the effects of management actions (e.g., implementation of the Integrated Pest Management Plan, NRMP Strategy 08).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
To be determined.

5) Protocol status?
Initial survey instructions for this survey will be developed as part of Survey 7 Bird Species Inventory (PRIMR ID FF08RANH00-024). A protocol is needed.

15.0 Vegetation Cover and Composition (PRIMR ID: FF08RANH00-014)

1) What is the population or attribute of interest, what will be measured, and when?
The vegetation on Anaho Island will be monitored to determine species composition and percent cover. The survey is expected to be conducted between FY2016-FY2030.

2) What refuge management goals and objective(s) does the survey support? Is/are the goal(s) or objective(s) derived from the CCP, interim objectives, an HMP, or other? What strategy or strategies does the survey directly inform? CCP Goals: B
CCP Objectives: B.1, B.2
NRMP Goals: 3.1

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Landcover diversity was recognized in the NRMP as a key ecological indicator of the Anaho Island Ecosystem. Landcover diversity at Anaho Island is indicated by the proportion of the island that is vegetated and native plant composition (% cover). The amount and composition of vegetation cover is assumed to have a strong influence on the biodiversity of Anaho Island. Recent vegetation surveys (2009-2011) suggest 20% of the island is vegetated and 50% of the vegetative cover is comprised of native species. This survey will directly contribute to baseline knowledge that will inform managers about whether they are meeting NRMP Goal 3.1: By the end of FY 2030, Anaho Island vegetation covers is ≤20% of the island and >50% of the vegetation is composed of native plant species.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
No, this is not a cooperative survey.

5) Protocol status?
Initial survey instructions will be developed by the end of FY2015. A protocol is needed.

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6 Appendices

Appendix A. Management Milestones

Table A1. Management milestones identified in the Anaho Island NRMP (U.S. Fish & Wildlife Service 2014*a*). Management milestones inform progress towards attaining conservation target goals and threat-reduction objectives or informing management strategies. A management milestone does not require a field survey to assess conservation progress but instead represents completion of a management strategy or related activity.

NRMP Strategy	NRMP Threat-Reduction Objective	Indicator
Strategy 02: Develop Anaho Island biodiversity preservation/restoration strategy	Objective 14: By FY 2020, priority natural resource preservation and restoration needs at Anaho Island have been identified and documented (Strategy 02).	% completion of preservation/restoration plan
Strategy 06, 08: Develop (S06) and implement (S08) an Anaho Island Integrated Pest Management Plan	Objective 08: By FY 2018, the USFWS identifies priority invasive animal and plant threats to Anaho Island biodiversity and develops optimal strategies to prevent, eradicate or mitigate their impacts.	Invasive priorities identified (% completed); IPM plan prepared (% completed)
Strategy 06, 08: Develop (S06) and implement (S08) an Anaho Island Integrated Pest Management Plan	Objective 09: By FY 2018, spatially referenced data on the distribution and abundance of priority invasive or nuisance plant species on Anaho Island are collected, summarized and shared with the Pyramid Lake Paiute Tribe.	Invasive plant inventory completed (% completion)
Strategy 06, 08: Develop (S06) and implement (S08) an Anaho Island Integrated Pest Management Plan	Objective 10: Over the next 15 years, the Pyramid Lake Paiute Tribe continues to monitor human activity within the Anaho Island buffer zone.	Pyramid Lake Paiute tribe monitors human activity within the Anaho Island buffer zone (yes/no)
Strategy 09, 12: Identify (S09) and implement (S12) optimal strategies to conserve important waterbodies within the project scope	Objective 01: By FY 2016, the USFWS identifies priority waterbody preservation/conservation actions within the Truckee River Basin and Carson River Basin waterbird foraging areas.	Priority waterbody preservation/ conservation actions within the Truckee River Basin and Carson River Basin are identified and documented (Measure: % Completed).
Strategy S09, S12: Identify (S09) and implement (S12) optimal strategies to conserve important waterbodies within the project scope	Objective 02: By FY 2016, the USFWS identifies priority waterbody preservation/conservation actions within the Humboldt River drainage basin.	Priority waterbody preservation/ conservation actions within the Humboldt River drainage basin are identified and documented (% Completed).
Strategy S09, S12: Identify (S09) and implement (S12) optimal strategies to conserve important waterbodies within the project scope	Objective 03: By FY 2017, the USFWS identifies priority waterbody preservation/conservation actions within the Walker River drainage basin.	Priority waterbody preservation/ conservation actions within the Walker River drainage basin are identified and documented (Measure: % Completed).
Strategy S09, S12: Identify (S09) and implement (S12) optimal strategies to conserve important waterbodies within the project scope	Objective 04: By FY 2018, the USFWS identifies priority waterbody preservation/conservation actions within the California portion of the Anaho Island Natural Resource Management Plan scope.	Priority waterbody preservation/ conservation actions within the California portion of the Anaho Island Natural Resource Management Plan scope are identified and documented (Measure: % Completed).
Strategy S09, S12: Identify (S09) and implement (S12) optimal strategies to conserve important waterbodies within the project scope	Objective 05: By 2018, the Stillwater National Wildlife Refuge Complex is coordinating water management and use (on lands adjacent to the Complex) with at least two of the following partners: Fallon Paiute Shoshone Tribe (FPST), Canvasback Club, Naval Air Station Fallon, and the City of Fallon.	% of total water rights users Stillwater NWR Complex is coordinating with.

Appendix B. Criteria and Terms for Prioritizing Surveys

This section describes the 13 criteria that were used in conjunction with a SMART Tool (U.S. Fish & Wildlife Service 2014*b*) to help refuge staff prioritize surveys. Each criterion is grouped under a theme that describes a survey's general contribution to a refuge's or broader needs. Rating values (1-2, 1-3, or 1-4) that are used to score each survey are also given for each criterion.

1. Refuge Priorities and Management Needs

A. Refuge Purpose

Does the survey provide information to evaluate if the refuge is achieving its purpose(s)?

Note: Surveys that provide information to either directly evaluate or serve as indicators of refuge purpose(s) can be considered as meeting this criterion. Refuge purposes are generally those defined under the Refuge's founding legislation (e.g., Executive Order). A survey addressing wilderness character addresses purpose for a refuge with proposed or designed wilderness. Example: Anaho Island NWR was founded to protect breeding colonial waterbirds. An American white pelican survey directly relates to this purpose.

1. No
2. Yes, one purpose
3. Yes, two purposes.
4. Yes, three or more purposes.

2. Partner Priorities and Management Needs

A. FWS Programs

Does the survey provide information that directly contributes to evaluating the status and trends of resources for another FWS regional or national program (e.g., Migratory Birds, Fisheries, Water Resources/Hydrology *other than ESA species*)?

Example 1: North American Breeding Bird Survey, North American Amphibian Monitoring Program, Mid-Winter Waterfowl Survey, and Circumpolar Biodiversity Monitoring Network are priority surveys for regional or national FWS programs.

1. Does not address an identified FWS regional or national program or initiative.
2. Addresses 1 identified FWS regional or national program or initiative.
3. Addresses 2 identified FWS regional or national program or initiatives.
4. Addresses ≥3 FWS regional or national programs or initiatives.

B. FWS Partners

Does the survey address an identified priority of a conservation partner, such as a Landscape Conservation Cooperative(s) (LCC), state agencies, or other conservation partner?

These priorities should be obtained from documents such as State Wildlife Action and Joint Venture plans. The staff should document where they obtained these priorities and if they were high- or medium-level priorities. The refuge itself does not count as a partner.

1. Does not address an identified conservation partner program or initiative (e.g., LCC, state agency, Tribe, Audubon, etc.).
2. Addresses 1 identified conservation partner program or initiative (e.g., LCC, state agency, Tribe, Audubon, etc.).
3. Addresses 2 identified conservation partner programs or initiatives (e.g., LCC, state agency, Tribe, Audubon, etc.).
4. Addresses three or more identified conservation partner programs or initiatives (e.g., LCC, state agency, Tribe, Audubon, etc.).

3. Ecological Applications

B. Refuge Processes

Does the survey focus on an ecological process (e.g., fire, water temperature, climate) that is changing at a rate that is important to the refuge or an indicator species associated with that process?

1. No.
2. Yes, one significant ecological process or species.
3. Yes, two or more significant ecological processes or species.

4. Additional Legal Mandates

A. Listed species or vegetation communities

Is the objective of the survey a species or vegetation community federally listed under ESA, state listed (threatened or endangered only), ranked by the state's natural heritage program (S1 or S2 rank only), globally ranked by NatureServe (G1 or G2 rank only), or globally listed on the IUCN Red List of Threatened Species (Critically Endangered, Endangered, or Vulnerable only)?

1. Not state, federally or globally ranked.
2. Yes, state listed or ranked by state's natural heritage program.
3. Yes, globally listed by NatureServe or IUCN.
4. Yes ,federally listed under the ESA as threatened or endangered.

B. Legal Mandate(s)

Is the survey required to meet a legal mandate that is a requirement by legislation other than the federal ESA or those that stipulated refuge priorities or management needs (Item 1, above)?

1. No.
2. Yes, one mandate.
3. Yes, more than one mandate.

5. Immediacy of Need

A. Controversy

Does the survey support decision-making to address a controversial action or management decision related to refuge resources?

Note: Document why the refuge staff knows or suspects an action is controversial because the interpretation can vary from person to person. Controversy can be associated with the general public, specific interest group(s) (e.g., animal rights activist, cooperative farmers), or one or more conversation partners. This criterion is focused on a high level of controversy from outside interests where the Service could be litigated, refuge actions that could result in a precedent setting action, or severely damage a working relationship with the state or other conversation partner. This criterion does not pertain to suspected or known issues among refuge staff members and/or other FWS employees. Examples of controversy include changes to predator control, and changes to water allocation.

1. Not controversial and little to no potential for controversy.
2. Not currently controversial, but potentially or suspected of controversy.
3. Known controversy, but data or immediate management action is not currently needed but may be in the near future.
4. Pressing controversy; data required to support immediate management action.
5.

B. Threat

Does the survey support decision-making to monitor and mitigate a known or suspected threat to refuge resources?

Note: This criterion scores surveys addressing known or suspected threats as identified in the Natural Resources Management Plan. It does not apply to baseline monitoring intended to detect new (i.e., unknown) threats or changes. Examples of threats may include invasive species, pollutants or toxins, and climate change.

1. No, the survey does not relate to threat reduction strategies.
2. Yes, supports decision making to address a threat reduction strategy with a score of 2.5.
3. Yes, supports decision making to support a threat reduction strategy with a score of 3.0.
4. Yes, supports decision making to support a threat reduction strategy with a score of 3.5.

6. Scope and Scale

A. Baseline data

Does the survey provide high-priority information that contributes to baseline data needs? Example: Inventories of species guilds (e.g., invertebrates, plants, reptiles) or abiotic parameters (soils, waters).

1. No.
2. Yes.

B. Survey Scope

What proportion (%) of the species', subspecies', or communities' (i.e., vegetation) geographic range under U.S. jurisdiction will be covered by the survey on the refuge?

Example 1: 75% of Laysan Albatross population nest on Midway NWR. Conducting a survey to monitor the breeding population size on the refuge would cover >10% of the entire species' population and score 3.

Note: Surveys of abiotic factors affecting these species or vegetation communities should also be considered for this criterion. Example 2: 60% of the wintering waterfowl in the Pacific Flyway use wetlands in the Central Valley of California including the San Luis NWRC. Monitoring water levels by reading staff gauges weekly from October to March in managed wetlands is an important abiotic survey to indicate if there are sufficient acres of suitable foraging habitat to support 60% of the wintering waterfowl. Because water is essential to maintain refuge wetlands for wintering waterfowl, "survey coverage" would equate to waterfowl population surveys and score 3.

1. Not significant = <10% of the regional population (Great Basin LCC) of the species depends on the refuge for one or more stages of its lifecycle or <10% of the regional area of the ecosystem/vegetation community occurs on the refuge.
2. Regionally significant for the Great Basin LCC = >10% of the regional population of the species depends on the refuge for one or more stages of its lifecycle or >10% of the regional area of the ecosystem/vegetation community occurs on the refuge.
3. Nationally significant = >10% of the national population of the species depends on the refuge for one or more stages of its lifecycle or >10% of the national area of the ecosystem/vegetation community occurs on the refuge.
4. Globally/continentally significant = >10% of the global/continental population of the species depends on the refuge for one or more stages of its lifecycle or >10% of the global area of the ecosystem/vegetation community occurs on the refuge.

C. Spatial Scale

What is the largest scale at which survey results will be applied for resource management?

Note: Only surveys with a protocol that establishes methods for data management and analysis are scored higher than a 1. The area of inference for larger-scale surveys (e.g., A Monitoring Strategy for the Western Population of American White Pelicans within the Pacific Flyway) will be considered small scale unless the refuge actually sends in their data to a coordinating entity that performs analyses at larger spatial scales than the refuge. This criterion is applicable to surveys covering areas on and adjacent to the refuge. Examples: If a refuge participates in and contributes data to a regional survey involving neighboring US Forest Service lands, then this would be considered a medium scale survey. If a refuge conducts a Christmas Bird Count but doesn't send their data in to Auduon, then this would be considered a small scale survey.

1. Small scale: Applicable to only a single refuge.
2. Medium scale: Applicable to a few refuges, a refuge complex, or includes the refuge and an area beyond the refuge boundary (e.g., area of the NRMP scope).
3. Large scale: Applicable to multiple refuges/complexes across an entire ecoregion, LCC, or region (here we are using the Great Basin LCC/Pacific Flyway).
4. Continental scale: Component of a large landscape level survey (e.g., North American Breeding Bird Survey, North American Amphibian Monitoring Program, and Circumpolar Biodiversity Monitoring Network).

D. Integration

Are survey results used to inform one or more priority management strategies identified in the NRMP? (Refer to NRMP results chains).

1. No.
2. Yes, the survey results are used to inform one priority management strategy identified in the NRMP
3. Yes, the survey results are used to inform more than one priority management strategy identified in the NRMP.

8. Cost

C. Security/Source of Funding

How is this survey funded or how would it be?

Note: *If selection is based on assignment of survey status that factors in a refuge's capacity after the prioritization process, then evaluators may wish to assign 0 ratings to this criterion to avoid overemphasizing refuge capacity.*

1. Require full support from a non-refuge funding source for completion, and source has not been identified or is not secure.
2. Requires partial support from a non-refuge funding source that is not secure and reliable.
3. Requires partial support from a non-refuge funding source, but the funding source is consistent and secure for the expected duration of the survey (high level of confidence that funding will remain).
4. Could be fully supported using refuge base funds, or has no monetary cost to the refuge.

Appendix C. Survey Prioritization Scoring Results

Table C1. Results of the survey prioritization and selection process. Final prioritization scores were arrived at using a SMART tool (U.S. Fish & Wildlife Service 2014*b*). Selected surveys were determined using the final prioritization score and consideration of the refuge's capacity (staff time and operations cost) to conduct a survey. Surveys selected and reported in Table 1 of the IMP were assigned a survey priority number.

Survey Priority	Survey Name	Final Prioritization Score	Final Prioritization Rank	Survey[a] Status
1.0	Anaho Island Isolation Study	0.556	1	Current
2.0	American White Pelican Fledging Success	0.436	4	Current
3.1	Pyramid Lake Water Elevation Monitoring	0.292	8	Current
3.2	Anaho Island Isolation Monitoring	0.270	15	Current
4.0	Colonial Nesting Waterbird Species Richness	0.198	16	Current
5.0	Colonial Nesting Waterbird Foraging Areas	0.454	2	Expected
6.0	Colonial Nesting Waterbird Threats Study	0.444	3	Expected
7.0	Bird Species Inventory	0.410	5	Expected
8.0	Invertebrate Species Inventory	0.307	7	Expected
9.0	Mammal Species Inventory	0.288	9	Expected
10.0	Reptile Species Inventory	0.288	10	Expected
11.0	Invasive/Nuisance Plant Management Effectiveness Monitoring	0.288	11	Expected
12.0	Invasive/Nuisance Animal Management Effectiveness Monitoring	0.288	12	Expected
13.0	Invasive/Nuisance Species Early Detection	0.288	13	Expected
14.0	Bird Species Richness Monitoring	0.162	18	Expected
15.0	Vegetation Cover and Composition Monitoring	0.127	23	Expected
	Colonial Nesting Waterbird Breeding Range Shifts Study	0.339	6	Future
	Double-crested Cormorant Reproductive Success	0.273	14	Future
	Caspian Tern Reproductive Success	0.196	17	Future
	Great Blue Heron Reproductive Success	0.162	19	Future
	California Gull Reproductive Success	0.162	20	Future
	Black-crowned Night Heron Reproductive Success	0.162	21	Future
	Snowy Egret Reproductive Success	0.139	22	Future
	Invertebrate Species Richness Monitoring	0.037	24	Future
	Reptile Species Richness Monitoring	0.018	25	Future
	Mammal Species Richness Monitoring	0.018	26	Future
	Plant Species Richness Monitoring	0.018	27	Future

[a] **Current**— surveys that are either continued or scheduled to begin in the year of IMP development because the survey is high priority and because it is reasonably certain that the capacity will be available to conduct the survey (e.g., surveys conducted with operational or other FWS funds); **Expected**— new surveys or previously conducted surveys that have a likely chance of being conducted during the span of an IMP because of moderate to high priority and because the capacity to conduct the survey comes from less certain sources (e.g., from partners or through grants); **Future**— surveys that have been prioritized but have low chance of being conducted during the span of the IMP because of low priority or because the capacity to conduct the survey will be difficult to secure. **Historical**—surveys that have been completed. Though typically not included in an IMP, a previously ongoing survey could be rated low enough in priority that refuge staff decide to end the survey and assign it a Historical status.

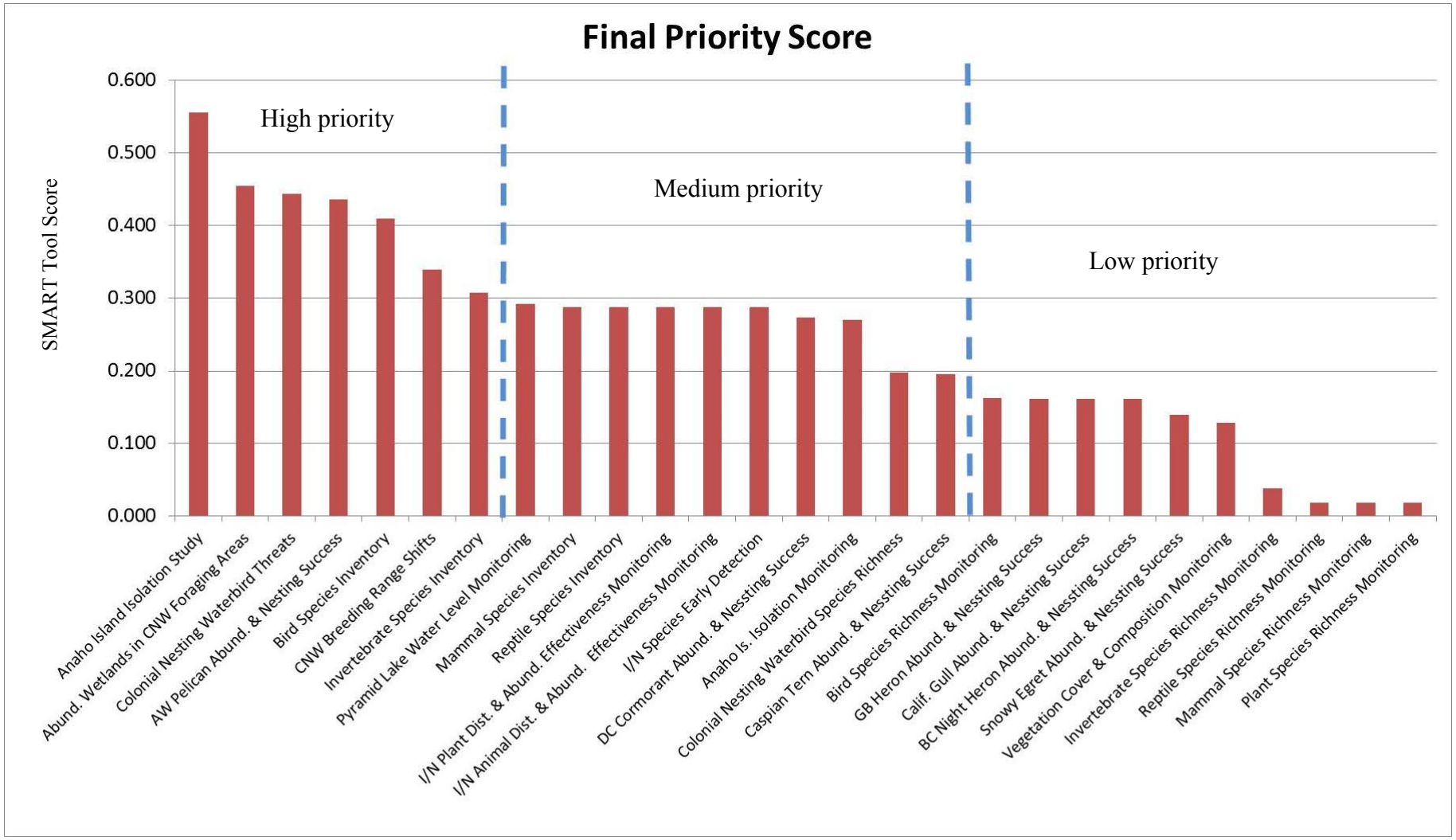


Figure C1. Final priority scores for 27 potential surveys at Anaho Island National Wildlife Refuge. Blue dashed lines show the brackets for high, medium, and low priority surveys used as a reference to assign Tiers and eventually select surveys for implementation.

Appendix D. Estimated Annual Survey Costs.

Table D1. Survey priority and estimated annual surveys costs for Current Surveys.

Survey Name	Survey Priority[1]	Average Annual Staff Time, FWS (hrs)[2]	FWS Staff Total ($)[3]	Average Annual Volunteer Time (hrs)	Average Annual Operations Cost ($)[4]	Total Cost
Anaho Island Isolation Study	1	-	-	-	-	-
American White Pelican Fledging Success	2	200	$6,692	0	$750	$7,442
Pyramid Lake Water Elevation Monitoring	3.1	6	$216	0	0	$216
Anaho Island Isolation Monitoring	3.2	8	$288	0	0	$288
Colonial Nesting Waterbird Species Richness	4	240	$8,135	0	$5,750	$13,885

[1] The lower the number, the higher the survey priority
[2] Includes permanent and seasonal FWS staff time
[3] Total costs are being calculated by dividing the Average Annual Staff Time (entered as hours) by 2080 (1FTE = 2080 hours) and then multiplying by the Average FTE Cost
[4] Includes transportation costs, field equipment and any other estimated costs

Table D2. Survey priority and estimated annual surveys costs for Expected Surveys.

Survey Name	Survey Priority[1]	Average Annual Staff Time, FWS (hrs)[2]	FWS Staff Total ($)[3]	Average Annual Volunteer Time (hrs)	Average Annual Operations Cost ($)[4]	Total Cost
Colonial Nesting Waterbird Foraging Areas	5	40	$1,505	0	$100	$1605
Colonial Nesting Waterbird Threats Study	6	-	-	-	-	-
Bird Species Inventory	7	-	-	-	-	-
Invertebrate Species Inventory	8	-	-	-	-	-
Mammal Species Inventory	9	-	-	-	-	-
Reptile Species Inventory	10	-	-	-	-	-
Invasive/Nuisance Plant Management Effectiveness Monitoring	11	40	$1,452	0	0	$1,452

Survey Name	Survey Priority[1]	Average Annual Staff Time, FWS (hrs)[2]	FWS Staff Total ($)[3]	Average Annual Volunteer Time (hrs)	Average Annual Operations Cost ($)[4]	Total Cost
Invasive/Nuisance Animal Management Effectiveness Monitoring	12	40	$1,452	0	0	$1,452
Invasive/Nuisance Species Early Detection	13	80	$2,904	0	0	$2,904
Bird Species Richness Monitoring	15	160	$5,808	0	0	$5,808
Vegetation Cover and Composition	16	80	$2,596	0	$250	$2,846

[1] The lower the number, the higher the survey priority
[2] Includes permanent and seasonal FWS staff time
[3] Total costs are being calculated by dividing the Average Annual Staff Time (entered as hours) by 2080 (1FTE = 2080 hours) and then multiplying by the Average FTE Cost
[4] Includes transportation costs, field equipment and any other estimated costs

Appendix E. Data Management.

Current system

There is currently no written protocol, system or framework which identifies staff responsibilities for biological data record storage, security and archiving at the Stillwater NWRC. Each wildlife biologist, biological technician, or wildlife refuge specialist has had the implied responsibility for management of their current projects, as well as legacy projects within their respective program area. Project data may be recorded in paper and/or electronic data forms. Metadata are generally lacking for most data. Paper records are generally organized and stored at individual staff members' desks based on their personal organizational systems. Similarly, electronic data are primarily stored on the hard drives of staff members' desktop computers or on the common drive within the office computer network. Currently, all Stillwater NWRC computers are connected via a network. Files saved to a network drive are stored on a RAID 5 disk array for redundancy (in case one hard drive fails, the system will still function and data are backed up). A full backup of all data and differential backups are completed every day until the 3TB external hard drives fill up. At that time, that external hard drive is exchanged for another external hard drive. All files stored on the first external hard drive are deleted so that it is ready to replace the second external hard drive when it is full. One external hard drive usually stores files for 4 to 5 months before it needs to be replaced. There is currently no protocol established for permanent, long term storage of electronic data files.

Databases

MS Excel is used to store most refuge biological datasets. Use of relational databases, such as MS Access, will be used in the future to facilitate better data management. Technical support and training of refuge staff will be obtained to facilitate this transition.

GIS

Spatial data associated with biological data collected on Anaho Island NWR either by staff or by others under cooperative agreements have been inconsistently stored and managed. The majority of the spatial data are stored on the Wildlife Refuge Specialist's drive within the Stillwater NWRC server, with incomplete or missing metadata. Some shapefiles created by refuge staff or volunteers are stored on the GIS drive within the Stillwater NWRC server, but in inconsistently labeled files. The Nevada FWS Geographer, with the assistance of a local volunteer, has initiated the restructuring of the GIS files on the Stillwater NWRC server. With additional guidance from the Region 8 I&M database manager, refuge staff will begin populating the new GIS file structure with existing spatial data once that data has been verified.

Action Items

Refuge staff will take the following steps to improve data management:

1) Ensure that all existing and future data sets (or at least a class of similar data sets) have documentation that comply with a minimum metadata standard. A key component of any data management system is good documentation of data and procedures. In order to enable compliance with the open data policies, all data sets will be using the parameters described in our basic metadata form (http://ifw7fair-web/im/fw7_metadata_form.pdf). This will ensure compliance with the "Common Core Metadata" (http://project-open-data.github.io/schema/) requirements of the open data policy.

2) Establish a written protocol for data management, including, but not limited to, a paper and electronic file system structure, and electronic file backup protocol. Ensure all backups and working file system structure is documented.
3) Ensure all existing and future spatial data (and its metadata) associated with Anaho Island biological data are appropriately stored within the GIS drive on the Stillwater NWR Complex server. Establish spatial data management protocol.

Appendix F. Estimated Annual Schedule for Surveys.

Table E1. Estimated annual schedule for selected Current and Expected Surveys. Green shading indicates the fiscal years that a survey is expected to be active.

Survey Name	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
Anaho Island Isolation Study																
American White Pelican Fledging Success																
Pyramid Lake Water Elevation Monitoring																
Anaho Island Isolation Monitoring																
Colonial Nesting Waterbird Species Richness																
Colonial Nesting Waterbird Foraging Areas																
Colonial Nesting Waterbird Threats Study																
Bird Species Inventory																
Invertebrate Species Inventory																
Mammal Species Inventory																
Reptile Species Inventory																
Invasive/Nuisance Plant Management Effectiveness Monitoring																

Survey Name	**FY15**	**FY16**	**FY17**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**
Invasive/Nuisance Animal Management Effectiveness Monitoring																
Invasive/Nuisance Species Early Detection																
Bird Species Richness Monitoring																
Vegetation Cover and Composition Monitoring																

Appendix G. Initial Survey Instructions for Colonial Nesting Waterbird Species Richness and American White Pelican Fledging Success

Survey Name:

Colonial Nesting Waterbird Species Richness and American White Pelican Fledging Success

Survey ID Number(s):

A unique identification number generated by PRIMR consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.

FF08RANH00-012 and FF08ANH00-005

Refuge Name(s):

Anaho Island NWR

Natural Resource Management Plan:

Natural Resource Management Plan (NRMP) associated with the survey.

Natural Resource Management Plan, Anaho Island National Wildlife Refuge, Pyramid Lake, Nevada (U.S. Fish & Wildlife Service 2014a)

Inventory and Monitoring Plan:

Inventory and Monitoring Plan (IMP) associated with the survey.

Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge (U.S. Fish & Wildlife Service 2014b)

Submitted By and Contact Information:

Donna Withers, Wildlife Refuge Specialist
Stillwater NWR Complex, Fallon, Nevada
775-423-5128 ext 231; donna_withers@fws.gov

Background Information:

This survey enables refuge managers to assess the ability of Anaho Island National Wildlife Refuge (NWR) to meet its purpose of providing breeding habitat for colonial waterbirds, one of three conservation targets identified in the Natural Resource Management Plan (NRMP) for Anaho Island NWR (U.S. Fish & Wildlife Service 2014a). Anaho Island supports some of the largest concentrations of colonial waterbirds in Nevada, including a long persistent breeding colony of American white pelicans, *Pelecanus erythrorhynchos* (hereafter AWPE; Intermountain West Joint Venture 2013). This survey documents the annual species richness of breeding colonial waterbirds on Anaho Island and provides an estimate of AWPE annual fledging success (for survey metric definitions see Section 3. Survey Methods, below). A Wildlife Inventory Plan developed in 1984 for Anaho Island NWR (Loth 1984) established the survey methods for monitoring colonial waterbirds nesting on Anaho Island, including but not limited to AWPE; black-crowned night-heron, *Nycticorax nycticorax* (hereafter BCNH); California gull, *Larus californicus* (hereafter CAGU); Caspian tern, *Hydroprogne caspia* (hereacter CATE), double-crested cormorant, *Phalacrocorax auritus* (hereafter DCCO); great blue heron, *Ardea*

herodias (hereafter GBHE); and snowy egret, *Egretta thula* (hereafter SNEG). These initial survey instructions further refine the survey methods established in 1984 and identify additional work that needs to be completed to develop a survey protocol. Currently, surveys consist of a combination of mainland surveys (remote observation using spotting scopes) and on-island surveys (ground observations from fixed vantage points). In addition, the refuge desires to test the efficacy of aerial surveys over the next several years.

Mainland Surveys

Surveys from the mainland (on the east shore of Pyramid Lake) are conducted to determine: (1) when on-island surveys should start at the beginning of the waterbird breeding season; and (2) when on-island surveys should end at the conclusion of the breeding season. A threshold of 200 active AWPE nests was selected as a trigger for the initiation of on-island surveys at the beginning of the breeding season because it generally coincided with the start of the breeding season for pelicans and the other colonial nesting waterbird species. If a boat is not available for on-island surveys or weather prohibits access to the lake, mainland surveys are sometimes used to assess the approximate number of nesting waterbird species and stage of reproduction (i.e., adults on nests, relative size of juvenile birds). However, due to the distance and angle of viewing from the mainland, only rough estimates can be determined. These estimates are not included in the annual species richness or fledging success reporting, but are used to plan efficient and effective on-island surveys.

Beginning in 2015, the refuge plans to begin a transition to aerial surveys of colonial nesting birds on Anaho Island (see below). Mainland and on-island surveys will continue during the transition to aerial surveys. Mainland surveys will continue after the transition to help inform the timing of flights.

On-Island Surveys

From 1984-2014, on-island surveys were generally conducted from March-August from three fixed locations on the island that afford a view of the majority of the AWPE sub-colonies. On-island surveys have consisted of counts of adult AWPE, counts of active AWPE nests and counts of AWPE young that survived until near fledging, in addition to counts of active nests of the other colonial nesting waterbirds when weather or staffing permitted. During on-island surveys, the location of the colony areas were marked on maps or photographs were taken of the colony areas from each of the three ground count locations.

Beginning in 2015, the refuge plans to transition to aerial surveys of colonial nesting birds (see below). However, in years when aerial surveys aren't possible, on-island ground surveys will continue to be conducted to determine the number of active AWPE nests and number of AWPE young that survive until near fledging, in addition to counts of active nests of the other colonial nesting waterbirds when weather and/or staffing permits. Adult AWPE counts will no longer be conducted because these include non-breeding birds, and the size of the breeding population is the main parameter of interest. Counting active nests, from which the number of breeding adults can be estimated, is consistent with the methods recommended in the monitoring strategy for the western population of AWPE within the Pacific Flyway (Pacific Flyway Council 2013a). During on-island surveys, photographs will continue to be taken of the colony areas from each of the three ground count locations.

Aerial Surveys

Beginning in 2015, the refuge plans to incorporate aerial surveys of colonial nesting birds. Low-level aerial photography followed by photo interpretation to enumerate nesting birds is recommended as an alternative or complementary method for monitoring Anaho Island's waterbirds by the Western Colonial Waterbird Survey (Jones 2008) and the Pacific Flyway Council's monitoring strategies for AWPE (Pacific Flyway Council 2013a) and DCCO (Pacific Flyway Council 2013b). In 2014, counts from aerial imagery taken from fixed-wing aircraft

were conducted and will be compared to on-island observation data. In 2015, counts from aerial imagery taken from Unmanned Aircraft Systems (UAS) will also be compared to on-island observation data. It is hoped that aerial surveys will provide more accurate estimates of active AWPE nests and AWPE young because some nests are obscured by the island's topography and rocks, shrubs, etc during ground counts. Once enough paired ground- and air-based counts are available, a correction factor will be developed to improve the estimates of active nests and young from ground counts. It is unknown if accurate estimates of AWPE young and/or the presence of active nests of the other colonial nesting waterbird species can be obtained from aerial imagery. Continued testing of the aerial survey method is needed. Once testing is complete, the refuge will decide to what degree aerial surveys will be used in combination with mainland and on-island surveys for long-term monitoring.

Section 1. Survey Targets & Objectives

Target Species/Taxa/Community:

Any colonial waterbird species breeding on the island, including but not limited to: AWPE, BCNH, CAGU, CATE, DCCO, GBHE and SNEG.

Target Habitat(s) (*if applicable*):

Currently and in the recent past, the colonial waterbirds nest on the eastern and southeastern portions of the island, often in mixed-species colonies, although the location of individual nests and extent of sub-colony areas varies annually. Refuge records indicate that historically, mixed colonies were not as common and additional sub-colony areas were utilized that are not currently active, but the majority of the nesting activity was on the east side of the island.

Management Objectives:

Management objectives are clearly articulated descriptions of a measureable standard, desired state, threshold value, amount of change or trend that you are striving to achieve for a particular population or indicator. Each objective requires six components: (1) species or indicator; (2) location; (3) attribute; e.g., size, distance, density, cover; (4) action; e.g., increase, decrease, maintain; (5) quantity/status; e.g., measureable state or degree of change for the attribute; and (6) time frame (Elzinga et al. 2001).

I. Natural Resource Management Plan (NRMP) Goal 1.1: Over the next 15 years, Anaho Island continues to support breeding populations of at least five colonial nesting waterbird species annually (U.S. Fish & Wildlife Service 2014a).
II. NRMP Goal 1.2: Over the next 15 years, annual AWPE fledging success at Anaho Island is ≥ 0.3 juvenile AWPEs fledged per active nest (U.S. Fish & Wildlife Service 2014a).

Sampling Objectives:

Sampling objectives are included whenever monitoring involves sampling procedures. The sampling objectives include information on target levels of precision, power, the magnitude of change you are hoping to detect and acceptable false-change and missed-change error rates. For monitoring that does not involve sampling, the ability to assess success should be obvious from the management objectives themselves without the need to specify additional information (Elzinga et al. 2001).

N/A

Section 2. Survey Design

Is this part of a collaborative State, Regional, or National survey? Yes

If yes please fill out the items in the gray box below, if no (i.e., local refuge only) skip the gray box.

Coordinating organization(s):

2014-2023 Pacific Flyway Council – Monitoring strategy for the western population of American white pelicans within the Pacific Flyway (2013a)
2014-2023 Pacific Flyway Council – Monitoring strategy for the western population of double-crested cormorants within the Pacific Flyway (2013b)

Are there recommended survey methods for the survey? Yes

Is there a Service-approved protocol framework for the survey? No

Are there refuge-specific elements of implementation? Yes

If yes please specify refuge-specific elements of the survey in sections 2 thru 6 below.
If no please skip to the data management section 4 below.

Year of survey origin:

Add year of survey modification below origin if applicable.

1984
2014 – transition to aerial surveys

Are specific sampling units identified? Yes

If no skip to "Describe sampling strategy" below.

Select type of sampling unit (sampling geometry): Other

Other (describe):

Sampling units consist of portions of the island visible from observation points; the sampled region was selected by convenience sampling (non-probabilistic sampling).

Do sampling units remain fixed (i.e., same location from year to year)? Yes

Describe sampling design:

By "design" we mean detailed elements of survey design - study area or population of interest, whether the survey is a census (complete count) or a sample, how sampling units were selected (e.g., randomly, arbitrarily, grid), how samples were stratified, sample size, etc.

Mainland Surveys

The study area of interest is the entire surface of Anaho Island. Convenience sampling (non-probabilistic sampling) was used to select the sampled region, which consists of the eastern portion of the island that is visible from a fixed observation point near a rock outcrop on the east shore of Pyramid Lake (Figure 1).

On-Island Surveys

The study area of interest is the entire surface of Anaho Island. Convenience sampling (non-probabilistic sampling) was used to select the sampled region, which consists of the portions of the island occupied by colonial nesting waterbirds that are visible from fixed observation points (estimated at >90% of the total sub-colony area; Figure 2). The observation points were selected to provide the optimal vantage point for observing the birds without causing disturbance to the birds. Additional observation points can be established as needed to provide a vantage point from which to view new sub-colonies that establish outside the viewing area of the existing three observation points.

Describe survey timing:

Examples of survey timing include # repeat visits each year, months, season, time of day, etc.

Mainland Surveys

Currently, the east shore of Pyramid Lake is closed to the public. A Pyramid Lake Tribal Council waiver will be needed to authorize refuge staff access to this area in order to conduct the mainland survey. Pending issuance of the waiver to access the east side of Pyramid Lake, mainland surveys begin in mid-February and are conducted approximately every 2 weeks until at least 200 active AWPE nests are present on Anaho Island, after which on-island surveys are initiated. Mainland surveys are also conducted whenever an observation is needed and a boat is not available or weather prohibits access to the lake, as well as in late August or early September to verify that the colonial birds are no longer returning to the island.

On-Island Surveys

In accordance with the 1984 inventory methodology (Loth 1984), at least three on-island surveys are conducted per year—one each month in May, June and July. Each count is conducted on a single day and begins by 9:00 am. The count is conducted in the morning before heat shimmer distorts the observer's view and birds begin to return from feeding areas (usually between 11:00 am and 1:00 pm). Generally, summer weather conditions for boat access to Anaho Island are more favorable in the morning, before wind speeds increase in the afternoon. Staff availability and weather conditions may affect the actual timing of on-island surveys.

The Pacific Flyway Council AWPE monitoring strategy (2013a) recommends a single count of active nests in early to mid-May for determining the annual breeding population of AWPE at Anaho Island and other colonies in the west. Due to the prolonged period of AWPE nest initiation (March – July), a more accurate reflection of the total annual breeding population of AWPE at Anaho Island is provided by counting the number of active nests throughout the nesting season. Counts of juvenile AWPE are made while they are still near the nest, prior to dispersal away from the sub-colony and prior to becoming flight-capable and leaving the island, which usually occurs between July and September.

The frequency of on-island surveys will vary year to year due to the availability of staff and boat operators. In recent years, attempts have been made to conduct on-island surveys every two weeks between early March and late August to better document AWPE sub-colony dynamics. Ideally, counts are spaced no more than 3 weeks apart beginning with the arrival of the birds in the spring to their departure in late summer/early Fall.

Section 3. Survey Methods

Primary metrics collected:

Mainland Surveys

Survey to determine when on-island surveys should be initiated

-**Metric: Number of active AWPE nests**. When the number of active nests is greater than 200, on-island surveys are initiated. The definition of active nest follows that of Jones (2008): "active nests are nests with eggs or chicks, incubating or brooding adults, nests that have fledged chicks present, or nests that are otherwise being tended by adults, such as being constructed or repaired." It is not known if renesting occurs after clutch loss in AWPE; here we assume that it does not occur. Thus, the number of active nests can be multiplied by two to estimate the number of adult breeding AWPE.

-Photographs are taken to document bird presence and the general condition of the island.

On-Island Surveys

Regular survey during the waterbird breeding season

-**Metric: Number of colonial waterbird species breeding on Anaho Island**. This is defined as the number of colonial waterbird species with active nests.

-**Metric: Number of active AWPE nests**. See the definition of 'active nest' above.

-**Metric: Number of juvenile AWPE**. These young are defined as post-nestling AWPE present in sub-colonies on the island prior to dispersal away from the sub-colony and prior to becoming flight-capable and leaving the island (which usually occurs between July and September); this can also be interpreted as the number of young that survive to fledging or near fledging. Further refinement of this definition will be needed when the full survey protocol is developed.

-Photographs are taken to document the condition of the colonies and for use in verifying the count data.

-**Optional Metric: Number of active nests of the other colonial waterbird species**. From these counts, the number of breeding adults can be inferred. Only carried out if weather permits additional time to be spent on the island and/or there is additional staff to assist. This is a lower priority than counting active AWPE nests and is not required.

Last survey of the waterbird breeding season

In addition to the above metrics, the following is collected:

-**Metric: Number of dead adult AWPE and AWPE young of near fledging size observed in all subcolonies**.

-Photographs are taken to document the condition of the colonies and for use in verifying the count data.

Annual AWPE fledging success is calculated by dividing the number of juvenile AWPE by the number of active AWPE nests.

Aerial Surveys

Metrics for aerial surveys are under development but will likely include:

-**Metric: Number of colonial waterbird species breeding on Anaho Island**. This is defined as the number of colonial waterbird species with active nests.

-**Metric: Number of active AWPE nests**.

-**Metric: Number of juvenile AWPE**. These young are defined as post-nestling AWPE present in sub-colonies on the island prior to dispersal away from the sub-colony and prior to becoming flight-capable and leaving the island (which usually occurs between July and September); this can also be interpreted as the number of young that survive to fledging or near fledging. Further refinement of this definition will be needed when the full survey protocol is developed.

How are sites marked?

Examples include GPS waypoints, flagging, etc.

Mainland Surveys

If a Tribal waiver is obtained to authorize access, the mainland surveys are made from near a rock outcrop on the east shore of Pyramid Lake (Figure 1). The observation location is recorded as a GPS waypoint.

On-Island Surveys

The boat is launched from Pelican Point Boat Launch Ramp (Figure 3) on the west side of Pyramid Lake and beached in a sandy cove on the northwest side of the island (Figures 2,3). Refuge staff follow an established route (Figure 2; saved as a "track" within the GPS unit) and hike approximately ½ mile (400 feet vertical gain from lake level to ~4,200 feet) up to the Observation Points (Figure 2) in the rocks above the colonies. Observation Point 4 was established in 2012 when AWPE nested to the west of South Slope but were not visible from Observation Point 3. The observation points are recorded as GPS waypoints. Additional observation points are established if needed to provide unobstructed view of the sub-colonies. Because more than one survey point is needed to survey some of the sub-colonies, unique rock formations are used to define the portions of each sub colony surveyed from each point.

GPS Waypoints for Observation Points and Boat Access Points
ifw8stlw-fs1 GISData (G:) SNWRC_Wildlife/AnahoIslandNWR/Biological/Observations (ArcGIS 10 shapefiles)
Projection: NAD 1983, UTM Zone 11 North

	Latitude (decimal degrees)	Longitude (decimal degrees)
East Pyramid Lake Observation Point	39.9559	-119.4845
Pelican Point Boat Launch Ramp	39.9854	-119.6191
Anaho Island Northwest Boat Beach	39.9579	-119.5196
Anaho Island Observation Point 1	39.9528	-119.5141
Anaho Island Observation Point 2	39.9524	-119.5133
Anaho Island Observation Point 3	39.9515	-119.5128
Anaho Island Observation Point 4 (alternate observation point)	39.9501	-119.5127
Anaho Island Observation Access Route	Saved as a "track" to load into GPS Unit.	

Describe preparatory requirements for the survey:

Examples include permits, training, contracts, other logistics…

Mainland Surveys

A waiver from Pyramid Lake Paiute Tribal Council authorizing refuge staff access the observation site must be obtained. A four-wheel drive vehicle is required because sections of the dirt road are prone to developing areas of deep, drifting sand if it hasn't been maintained recently. Use caution on the dirt road as there are several blind curves.

On day of visit, notify Pyramid Lake Ranger station (775-476-1155), or if there is no answer leave a message. Also call the Nixon Police Department (775-574-1014) to inform them about the trip. This road is closed to the public but open to tribal members. Provide the approximate time of the trip, type & color of the vehicle, expected length of visit (usually less than 1 hour), and contact cell phone number. Call again when you leave the area.

On-Island Surveys

Access to the island is provided by Stillwater National Wildlife Refuge Complex's 21-ft Boston Whaler outboard motorboat operated by FWS certified boat operators. Boat Operators must ensure their Motorboat Operators Certification is up-to-date. Prior to the survey, the survey date(s) must be coordinated with the boat operator and refuge staff conducting the count. Refuge maintenance staff conduct and document preventative maintenance and pre-trip safety checks on the boat, boat trailer, and vehicle used to haul the boat. A float plan is created for each trip; a copy of the float plan is posted in the refuge office and reviewed with office personnel the day of the trip.

Refuge staff check the Pyramid Lake weather forecast http://www.wrh.noaa.gov and Pyramid Lake wind forecast available at http://www.wrh.noaa.gov/rev/lakefcst/?area=pyramid. Real-time weather conditions for Anaho Island from the Anaho Island weather station are available http://www.wrh.noaa.gov/rev/remotedata/anaho.php and for Sutcliff, Nevada (west shore of Pyramid Lake) http://www.wrh.noaa.gov/rev/remotedata/rnosutobs.php. Scheduling and accomplishing counts is limited by favorable weather with safe wind conditions at Pyramid Lake, which do not preclude boat access to island. Trips are not initiated if the weather forecast includes sustained winds of 10-15 mph or winds building through the day to greater than 15 mph by the end of the planned day.

SNWRC boat procedures (currently unwritten) have specified that a boat operator is in charge of and stays with the boat while other staff conduct biological or other activities on the island. In this way, the operator is always able to quickly reposition the boat should the winds rapidly change (as they commonly do). North winds quickly travel the length of the lake, building substantial waves before reaching Anaho Island. Unique conditions at Pyramid Lake often create non-directional waves, which create challenging boating conditions. The number of people traveling in the boat affects the weather-related decision regarding wind speed. The more people, the more caution should be used in decisions to attempt island access. Boat operator and on-island staff continually watch for environmental cues that the winds are building (i.e., dust rising off the playa to the north; waves beginning to build on the lake). If the wind is building out of the south, staff on north side of the island may not notice because the island mass blocks the wind, and similarly if the wind blows from the north, staff on the south side of the island may not notice.

The boat operator and on-island staff communicate with each other and Pyramid Lake Ranger Station/Nixon Police Department) via cellular phone, hand held radio or marine band radio. All phones/radios must have batteries fully charged. The boat operator must be able to notice in-coming calls while operating the boat (i.e. volume must be set on high to be heard over engine noise and wind). There are "dead zones" on the island where a radio transmission or cellular phone signal cannot be obtained. Verizon has a tower on Marble Bluff, southeast of Anaho Island near the southern end of Pyramid Lake, but the signal can be blocked on north-facing slopes.

Staff who will be conducting the count, should familiarize themselves with the count methodology, verify that binoculars/spotting scope, GPS unit and camera are in working order, and understand how to operate the GPS unit and camera. Waypoints for Observation Points and Track for path to Observation Points should be downloaded into GPS unit. Staff who are unfamiliar with Anaho Island and the sub-colonies should review and print photographs from previous counts to use as reference for the location of the sub-colonies once on the island.

Describe equipment used during the survey:

<u>Mainland Surveys</u>
-4 wheel drive vehicle
-Cellular phone with fully charged battery
-GPS unit with extra batteries (staff currently use Garmin GPSmap76CSx handheld GPS unit)
-High-quality binoculars (staff currently use Swarovski SLC 10x42WB binoculars) or a spotting scope
-Digital camera with extra batteries (staff currently use Canon Powershot SX40HS digital camera; 12.1 mega pixels; 35mm optical zoom capability; full HD)
-Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1)
-Pen or pencil
-Tally clicker counters

<u>On-Island Surveys</u>
-Truck, and Boston Whaler motor boat on boat trailer
-Personal floatation devices for each person on boat, plus extras
-Cellular phones/hand held two-way radios with fully charged batteries; 1 each for boat operator and survey staff
-GPS unit with extra batteries (staff currently use Garmin GPSmap76CSx handheld GPS unit); waypoints provided for Observation Points and track provided for path to observation points.
-High-quality binoculars (staff currently use Swarovski SLC 10x42WB binoculars) or spotting scope (Questar Field Model was used in 2014)
-Digital camera with extra batteries (staff currently use Canon Powershot SX40HS digital camera; 12.1 mega pixels; 35mm optical zoom capability; full HD)
- Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1)
-Pen or pencil
-Tally clicker counters

Describe detailed methodology (field and lab procedures):

You can upload any additional related documents describing methods to the ServCat record.

Mainland Surveys (Pending issuance of waiver from Pyramid Lake Paiute Tribal Council to access the observation site, which is closed to the public)

Directions to East Lake Observation Site (Figure 1): Approximately 1 hour drive time from Fallon, NV one way. From Nixon, Nevada, follow State Route 447 (north toward Gerlach, Nevada) approximately 8.8 miles, turn left onto dirt road Pyramid Lake Tribal Route 5. Follow dirt road approximately 6.25 miles, turn left onto dirt road toward rock outcrop overlooking lake (approx. 0.15 mile). Park in open area overlooking lake and Anaho Island.

From the East Lake Observation Point (parking area or a vantage point on the rock outcrop), the observer can view the east side of Anaho Island using high quality binoculars or spotting scope. An estimate is made of the number of adult birds on nests, and the estimate is recorded on the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1). Additional comments such as species in observed flight, on the water, and on the island but not on nests, or observations on stage of reproduction are included.
Photographs are taken to document bird presence and general condition of island. One photo is taken of the entire eastern side of the island, and overlapping photos are taken using the zoom feature on the camera. The capability of the camera used will determine the extent of the zoom appropriate to capture images which are sharp and clear. With the current camera (Canon Powershot SX40HS digital camera), zoom to 300mm mark on the lens and take photos with approximately 30% overlap to cover the eastern side of the island from southeastern tip to northern tip.

On-Island Surveys

The boat is launched at the Pelican Point Boat Launch Ramp (Figure 3), approximately 4 miles north of the community of Sutcliff, Nevada. Anaho Island is approximately 5.5 miles southeast of Pelican Point Boat Launch Ramp. Under calm winds (<5 mph), it takes approximately 20 minutes to cross the lake and reach the island. This time can triple under high wind and rough water conditions.

Travel to the island is planned so that counts can begin between 9:00 AM and 10:00 AM, especially during the heat of summer, to avoid surface heating that causes shimmering and affects the viewing of the birds. Refuge staff usually depart Fallon by 7:00 AM. It usually takes 1 ½ hours to drive to the boat launch, 30 minutes to launch and reach the island, and 20-30 minutes to hike to the first observation point.

Upon arriving by boat at the island, a trip can be made around the island to observe the general location of the nesting birds and allow staff to make final plans for the count by knowing where the birds are. If the initial boat cruise around the island reveals birds nesting in areas outside the traditional sub-colonies, new observation sites may need to be established.

The primary boat beach used during the nesting season is located on the west side of the island (Figures 2, 3). Once on the island, observers must use caution to avoid turned ankles on the uneven, rocky terrain and to be alert for rattlesnakes. Snake guard coverings for the lower leg are stored in the boat console.

Observers follow the established route (Figure 2) and hike approximately ½ mile (400 feet vertical gain from lake level to ~4,200 feet) up to the Observation Points (Figure 2) in the rocks above the colonies. The observation points were selected to provide the optimal vantage point for observing the birds without

causing disturbance to the birds. Additional observation points can be established as needed to provide a vantage point from which to view new sub-colonies which may establish outside the viewing area of the existing observation points.

Care must be taken not to duplicate counting birds when changing locations. Figure 2 illustrates the approximate areas observed from each location.

Observation Point 1 is used for monitoring Sub-colonies C, D, B, and Bluff North. Observation Point 2 is used for monitoring Sub-colonies A, Bluff South, Ridge, and portions of Saddle and South Slope. Observation Point 3 provides a complete view of Saddle and South Slope, and is the preferred location if large numbers of birds are using these sub-colonies. Observation Point 4 was established in 2012 when AWPE nested to the west of South Slope but were not visible from Observation Point 3. If new observation sites need to be established, the optimum site is located and its coordinates are determined using a GPS Unit (currently using Garmin GPSmap76CSx). The coordinates are recorded on the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1), and a waypoint is created in the GPS Unit.

Upon first arriving at the observation location, the observer takes a few minutes to scan each sub-colony viewable from that location (Figure 2) to note species present, age class of bird present, stage of breeding (i.e. copulation, single bird at nest, eggs visible, chicks visible, etc.).

Photographs are taken to document the condition of the sub-colony and for use in verifying the count data. One photo is taken of the sub-colony, and then overlapping photographs are taken. The capability of the camera used will determine the extent of the zoom appropriate to capture images which are sharp and clear. With the current camera (Canon Powershot SX40HS digital camera), zoom to 300mm mark on the lens and take photos with approximately 30% overlap to cover each sub-colony.

The observer surveys one sub-colony at a time, beginning with a count of AWPE active nests and unattended AWPE young. Then the observer documents the presence of any other colonial waterbird species with active nests within the same sub-colony. If staff and weather conditions allow, counts of active nests of the other species can be made. The observer then repeats the process for all other sub-colonies, moving to the other observation locations as necessary. If multiple observers are present, the tasks can be divided by sub-colony or by species. For example, one observer counts all birds of all species in the assigned sub-colonies or one observer counts only one species within all sub-colonies. Clicker counters can be used to capture count tallies. Data are entered into the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1). Notes are made regarding the presence of eggs or hatchlings at nests tended by an adult. Young AWPE are counted when they are unattended by adults.

The observer should note if the data recorded represents a total count or an estimate of the number of birds present in the sub-colony. Generally, the observation distance and the high number of AWPE present in some of the sub-colonies preclude counting each individual bird, so an estimate is made. The observer should calibrate by counting 50 or 100 individuals and fixing a mental image of the area covered by that number of birds. Then the observer “counts” the number of areas with similar densities of birds and multiplies the number of areas by the number of birds in the sample area. The process is repeated for each species present in the sub-colony and for each sub-colony.

Because only active AWPE nests are counted, the observer must understand how to interpret what is seen, especially early in the nesting season. The definition of active nest follows that of Jones (2008): “active nests

are nests with eggs or chicks, incubating or brooding adults, nests that have fledged chicks present, or nests that are otherwise being tended by adults, such as being constructed or repaired." Appendix F contains photographs to provide examples. If a group of birds is present within a sub-colony but do not appear as pairs, the entire group is probably in the early stages of pair bonding, but have not yet begun to nest, so no active nests are recorded. If a pair is exhibiting mating behavior, no active nest is recorded until incubation begins. During incubation (30 days), the adult AWPE will sit on the nest at a time, but will rise to stretch or turn the egg, so an active nest is counted. Later in the incubation or chick rearing stages, both parents may be in attendance while switching nest tending duty, but an egg or nestling will be present, so an active nest is recorded. If one adult is sitting on the nest, and the other is standing immediately next to the nest, one active nest is recorded. After hatching, the adult may stand over the chick to shade it or feed it, but an active nest is recorded. As the nesting season progresses usually only one adult is at the nest, except briefly during the exchange of incubation or chick tending duty. Occasionally the adult AWPE tending the nest may leave the nest before its mate returns. A nest with unattended eggs and hatchling is counted as an active nest, even though the egg or nestling may not survive until the adult returns, if it does.

Getting an accurate count of juvenile AWPEs is complicated by determining what qualifies as a juvenile, asynchronous breeding in different subcolonies and the behavior of juveniles. AWPE adults incubate eggs for 30 days and then tend to the nestling(s) from hatching until they are about 18 days old. When the AWPE chick is 18-25 days old, it is covered by downy feathers, and the adults no longer provide constant care, but only return to feed the chick until it fledges at approximately 70 days old. At this stage, the unattended young are counted as juvenile AWPE. Because the unattended AWPE young will gather into tight groups (crèche), counting can be a challenge. Unattended young are counted during each survey, but as they grow notes are made to indicate the stage of feather development (i.e., downy, flight feathers) and relative size to be able to estimate time of fledging. Young nearing fledging are fully feathered and almost adult sized but have smaller bills. Due to the extended nesting period (March – July) and often asynchronous timing of nesting, a sub-colony may contain incubating adult AWPE as well as young AWPE near fledging. Variation in nesting chronology also occurs between sub-colonies. Notations made during surveys regarding the presence of eggs, hatchlings, and creched juveniles provide indicators as to the variation within and between sub-colonies. Photographs of different AWPE life stages are provided in Figures 4-8. Counts of juvenile AWPE do not take into account imperfect detection. The method to reach an accurate estimate of juvenile AWPE will be refined during protocol development.

At the end of the breeding season, when juveniles have fledged and neither adults nor juveniles are returning to the island, a walk through each sub-colony is conducted to count the number of dead adults and dead pre-fledge juvenile birds. The path of the walk will be determined each year based on the location of the nests, to provide visual coverage of each sub-colony. A GPS unit will be utilized to track the path taken. Data are recorded on the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1). Notes are made as well on the relative abundance of dead nestlings and eggs exhibiting signs of predation (i.e., hole in egg), or any other unusual observations that may indicate low or extremely low reproductive success. The estimate of dead juvenile and adult AWPE does not take into account imperfect detection. In addition, the rates of decomposition of dead AWPE juveniles and/or scavenging or predation that results in birds and/or carcasses being removed from the island or otherwise not available to be counted are unknown. The method to reach an accurate estimate of dead adult and juvenile AWPE will be refined during protocol development.

<u>Back In the office</u>

Currently, raw data are transferred from the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1) to the Anaho Island Colonial Bird Monitoring Data Entry Microsoft Excel Spreadsheet on the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/ANWR_Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_DataEntry_YYYY.xlsx.

The Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1) is scanned into .pdf format and saved to the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_FieldDataForm_YYYYMMDD.pdf.

Photographic images are transferred from the camera to the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ANWR_ColonialBirdMonitoring_YYYY/ANWR_ColonialBirdMonitoring_Images_YYYYMMDD/IMG_XXXX.jpg.

Overlapping photos are merged using the panoramic feature in Adobe Photoshop Elements 10 and the resulting merged image is saved to (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_Images_YYYYMMDD/"ANWR_(description of merged image)_YYYYMMDD".jpg. Merged images can be used to verify the data recorded on the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1).

New observation point waypoint and track data are downloaded from the GPS unit using DNRGPS (copyright held by Minnesota Department of Natural Resources; www.mndnr.gov) and saved as ArcGIS compatible shapefiles with projection of NAD_1983_UTM_Zone_11N. to the Stillwater NWRC Server ifw8stlw-fs1 GISData (G:) SNWRC_Wildlife/AnahoIslandNWR/Biological/Observations

Staff Conducting Surveys:

Include interns, contractors, etc. if primary surveyors.

Mainland Surveys

Mainland surveys were conducted by Donna Withers, Wildlife Refuge Specialist from 1999-2013.

On-Island Surveys

On-island surveys have been conducted by various refuge staff over the years. Donna Withers, Wildlife Refuge Specialist, conducted the counts from 1999-2013. Nancy Hoffman, Refuge Manager, conducted the counts in 2014.

Section 4. Data Management

Specify data entry file format(s):

Examples include MS Excel, MS Access, GIS, web dbs (e.g., SQL), etc...

MS Excel 2010

Specify data storage/archive location (hardcopy and electronic):

Provide file names and locations here if applicable. You can upload any additional related documents to the ServCat record.

The original Anaho Island NWR Colonial Bird Monitoring Field Data Forms (Form 1) with raw data are maintained within the file system at the Stillwater NWR Complex office in 3 ring binders by year at Donna Withers' desk. The forms are also scanned into .pdf format and saved to the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_FieldDataForm_YYYYMMDD.pdf.

Data are transferred from the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1) to the Anaho Island Colonial Bird Monitoring Data Entry Microsoft Excel Spreadsheet on the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_DataEntry_YYYY.xlsx.

Images are transferred from the camera to the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ANWR_ColonialBirdMonitoring_YYYY/ANWR_ColonialBirdMonitoring_Images_YYYYMMDD/IMG_XXXX.jpg. Overlapping photos are merged using the panoramic feature in Adobe Photoshop Elements 10 and the resulting merged image is saved to(//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_Images_YYYYMMDD/"ANWR_(description of merged image)_YYYYMMDD".jpg.

When birds are enumerated using merged images in ArcGIS 10 or other software, the resulting file is saved on the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_ImageData_YYYYMMDD/ ANWR_(description of merged image)_YYYYMMDD.mxd.

GPS waypoint and track data are downloaded from the unit using DNRGPS Version 6.1.0.4 (May 5, 2014) (copyright held by Minnesota Department of Natural Resources; www.mndnr.gov) and saved as ArcGIS compatible shapefiles with projection of NAD_1983_UTM_Zone_11N to the Stillwater NWRC Server ifw8stlw-fs1 GISData (G:) SNWRC_Wildlife/AnahoIslandNWR/Biological/Observations

Describe procedure for verifying/checking/securing the data:

Data recorded on the Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1) and then entered into the Microsoft Excel spreadsheet is checked for data entry errors.
Count data can be verified by enumerating birds in the photos.

Describe methods/software used in data analysis:

Mainland Surveys

None; data are not analyzed, but only referred to for planning purposes.

On-Island Surveys

Anaho Island NWR colonial bird monitoring data are utilized to derive the annual values for colonial waterbird species richness and AWPE fledging success. A determination of the number of active AWPE nests and the number of juvenile AWPE is necessary to determine AWPE fledging success. If staff and weather conditions allow, the number of active nests for other colonial waterbird species will also be counted.

Anaho Island NWR Nesting Colonial Waterbird Richness: Number of colonial waterbird species with active nests on Anaho Island NWR each year. If a species is observed but active nests are not documented, the species is noted as occurring on the island and added to or maintained on the species list for the refuge, but not included in the Nesting Colonial Waterbird Richness tally. A list of colonial bird species with active nests is created from the annual bird inventory data, and then the number of species in the list is determined.

Anaho Island NWR AWPE Fledging Success: AWPE fledging success is determined by dividing the number of juvenile AWPE by the number of active AWPE nests. The number of juvenile AWPE found dead on the island is subtracted from the total juvenile AWPE count before dividing by the number of active nests.

Anaho Island NWR Colonial Nesting Waterbird Abundance: The number of adult birds of each colonial waterbird species actively nesting on Anaho Island NWR is calculated if data are available. The abundance for each species is determined by multiplying the number of active nests by 2 to account for both the male and female birds of the pair. It is not known if re-nesting occurs after clutch loss, so here we assume that it does not occur.

Prior to 2015, inconsistent and undocumented methodologies have been used to analyze the annual survey data to determine the number of active AWPE nests and juvenile AWPE. The AWPE data are analyzed by sub-colony and across the various survey days, taking into consideration the span of time between surveys and the average nesting chronology time frames, to determine the maximum total number of active nests and number of young for each sub-colony. These numbers are then added together for the refuge total. The number and location of active nests is compared from one survey date to the next.

The following example provides insight into the thought process currently used for estimating the number of AWPE fledglings:

(1) For a give sub-colony during the first on-island survey, 100 incubating adults are present; the assumption is made that eggs were laid anytime from that day to 30 days prior; 100 active nests are recorded.
(2) During the second survey 30 days later, there are 50 adults tending nests (nestlings are observed in some of the nests) and 40 unattended young; 50 active nests and 40 young are recorded.
(3) During the third survey 45 days later, there are 0 adults and 60 unattended young; 60 young are recorded
(4) After the birds have left, 3 dead fledging-sized young are recorded. For this sub-colony, the total estimated number of active nests would be 100 because the transition in number of adults present decreased during the second or third count, following the expected progression for synchronous nesting within this sub-colony. To determine the number of juvenile AWPE, it is assumed that young counted on the 2nd count fledged before the 3rd count, given the length of time between the 2nd and 3rd count, so the number of young from the 2nd and 3rd counts are

added together, for a total of 100, then the number of dead is subtracted for a grand total of 97. Fledging success for this sub-colony would be 97%.

When new pairs initiate nesting within a sub-colony weeks later than the others, there will be more variety in the age of the unattended chicks from survey to survey then in this example. If surveys can be conducted every two weeks, it is easier to track the changes in sub-colony dynamics and develop better estimates, but this increases survey cost. The methods for analyzing the juvenile AWPE count data will be refined during protocol development.

Photo Interpretation

Counts of active nests can be verified by enumerating birds and nests in photos. Overlapping photos of each sub-colony are merged using the panoramic feature in Adobe Photoshop Elements 10. The procedure outlined in Stephensen et al. (2012) is currently being utilized to enumerate nesting birds. The merged .jpg image for a sub-colony is added to a blank project in ArcGIS 10. The "create point shape" feature in ArcGIS 10 is used to mark individual nesting birds as individual points, and the attribute table tallies the number of nests. Zooming into the image allows easier differentiation of nests. The total is entered into a Anaho Island NWR Colonial Bird Monitoring Field Data Form (Form 1), with the Observation Location noted as "Photo Interpretation". Although the .jpg file is not geo-referenced, the distribution and number of the points on specific count days can be compared to document changes in nest number and distribution since the photos are taken approximately the same way each count day, following the procedure outlined in Stephensen et al. (2012). The ArcGIS .mxd file is saved on the Stillwater NWR Complex office server (//ifw8stlw=fs1) dwithers$ (U:) MyFiles/Anaho Island NWR/ANWR_Colonial Bird Monitoring/ ANWR_ColonialBirdMonitoring_YYYY/ ANWR_ColonialBirdMonitoring_ImageData_YYYYMMDD/ ANWR_(description of merged image)_YYYYMMDD.mxd.

Beginning in 2015, another program "Image J" will also be utilized to enumerate nesting birds from photographs as a comparison to the ArcGIS 10 method.

Aerial imagery

Beginning in 2014, aerial photography may be utilized to determine the number of AWPE nesting on Anaho Island NWR, in support of the Pacific Flyway Council's monitoring strategy for the western population (Pacific Flyway Council 2013a). This strategy recommends the use of photographs taken during a single aerial flight (at flight altitudes of 150-400 meters above the colony) during the peak of the breeding season to monitor AWPE breeding colonies. Aerial photographs can either be: (1) a single photograph of an entire island or nesting colony (50mm lens recommended), or (2) overlapping close-up photographs of the colony (200mm or 300mm lens recommended). Nests are then be enumerated from the photographs by at least two independent counts of the image. The strategy recommends the aerial photographs be taken at Anaho Island in early to mid-May.

A contract ($3,700.00) was issued to Spencer B. Gross of Nevada, Inc. (Andy Daniels, President; 1010 Caughlin Crossing, Suite #3, Reno, Nevada 89519; 775-826-4240; www.sbgreno.com) to provide ortho-rectified imagery of Anaho Island taken during May 2014.

In order to compare the viability of this technique compared to current on-the-ground count techniques, a count of the nesting AWPE using the existing on-the-ground technique was conducted the week after the aerial images were taken. Weather conditions and staff scheduling conflicts precluded access to the island the same day as the flight.

The use of Unmanned Aircraft Systems (UAS) to obtain aerial imagery from which to enumerate nesting birds is also being investigated. In 2014, the U.S. Geological Survey's Unmanned Aircraft Systems project office approved a Proof-of-Concept project at Anaho Island NWR to utilize a UAS to obtain aerial imagery, and the flight has been scheduled for May 4-8, 2015. This Proof-of-Concept project would be conducted at no additional cost to the refuge over staff time and boat operating expenses in support of the project.

Section 5. Reporting

Describe reports developed from this survey:

Include details on reporting schedule/frequency, distribution, archiving, etc… Include links and citations for previous reports if applicable.

Results were included in Anaho Island NWR section of the Stillwater NWR Complex Annual Narrative Reports through 2008, at which time these annual reports were no longer prepared. Printed copies of these reports are stored in the Stillwater NWR Complex Office file system, and digital scans of these reports are located on the Stillwater NWR Complex office server (//ifw8stlw=fs1) common (M:) Narratives (1996-2008) and (M:) 2011 SNWRC Legacy Data Mining Project. Data collected during this survey will be shared with other organizations compiling data to assess the status of colonial waterbird species on a State or regional level (such as the Great Basin Bird Observatory's Nevada Aquatic Bird Count and the Pacific Flyway's AWPE and DCCO monitoring strategies).

Section 6. Other Survey Information

Please use the space below to comment on additional survey elements and issues to consider when implementing the survey:

Budget

The following table contains estimated annual costs associated with conducting Anaho Island Colonial waterbird monitoring on Anaho Island over the last 8 years (2006-2013). Approximate total cost (staff time and associated costs) to conduct one on-island colonial waterbird count is $1,115.00, based on 1-GS-11 Wildlife Refuge Specialist, 13 hours @ $48.00/hour (9 hours field time + 4 hours office time) ($624.00) plus 1 Wage Grade (boat operator), 12 hours @ $38.00/hour (9 hours field time + 4 hours boat maintenance) ($456.00) plus truck and boat fuel ($100.00).

Estimated Costs for Colonial nesting bird monitoring on Anaho Island NWR (2006-2013 average)

Average Number of Visits/Year On Island	Number of Management Staff/visit	Number of Mgmt Staff Hours/visit (prep+on the ground + in office data time)	Total Mgmt Staff Hours	Mgmt Staff Hourly Rate	Total Mgmt Staff Salary Costs	Number of Maintenance Staff (Boat Operator) /visit	Number of Mtnc Staff Hours/visit (boat prep+boat operation)	Total Mtnc Staff Hours	Mtnc Staff Hourly Rate	Total Mtnc Staff Salary Costs	Total Staff Hours	Total Staff Salary Costs	Vehicle Fuel Cost/Trip	Boat Fuel Cost/Trip	Total Fuel Cost/trip	Total Fuel Cost
6	1	13	78	$48.00	$3,744.00	1	12	72	$38.00	$2,736.00	150	$6,480.00	$60.00	$35.00	$95.00	$570.00

Number of Visits/Year Opposite Shoreline	Number of Management Staff/visit	Number of Mgmt Staff Hours/visit (prep+on the ground + in office data time)	Total Mgmt Staff Hours	Mgmt Staff Hourly Rate	Total Mgmt Staff Salary Costs	Number of Maintenance Staff (Boat Operator) /visit	Number of Mtnc Staff Hours/visit (boat prep+boat operation)	Total Mtnc Staff Hours	Mtnc Staff Hourly Rate	Total Mtnc Staff Salary Costs	Total Staff Hours	Total Staff Salary Costs	Vehicle Fuel Cost/Trip	Boat Fuel Cost/Trip	Total Fuel Cost/trip	Total Fuel Cost
6	1	8	48	$48.00	$2,304.00	0	0	0		$0.00	48	$2,304.00	$30.00	$0.00	$30.00	$180.00

Ave. Annual FWS Staff Time (Hours)	Ave Annual FWS Staff Costs	Ave Annual Operating Costs
198	$8,784.00	$750.00
(~25 days)		

Description of attachments/supplemental documents/data sets:

Use the space below to describe supplemental documents (e.g., maps, etc) uploaded to the ServCat record.

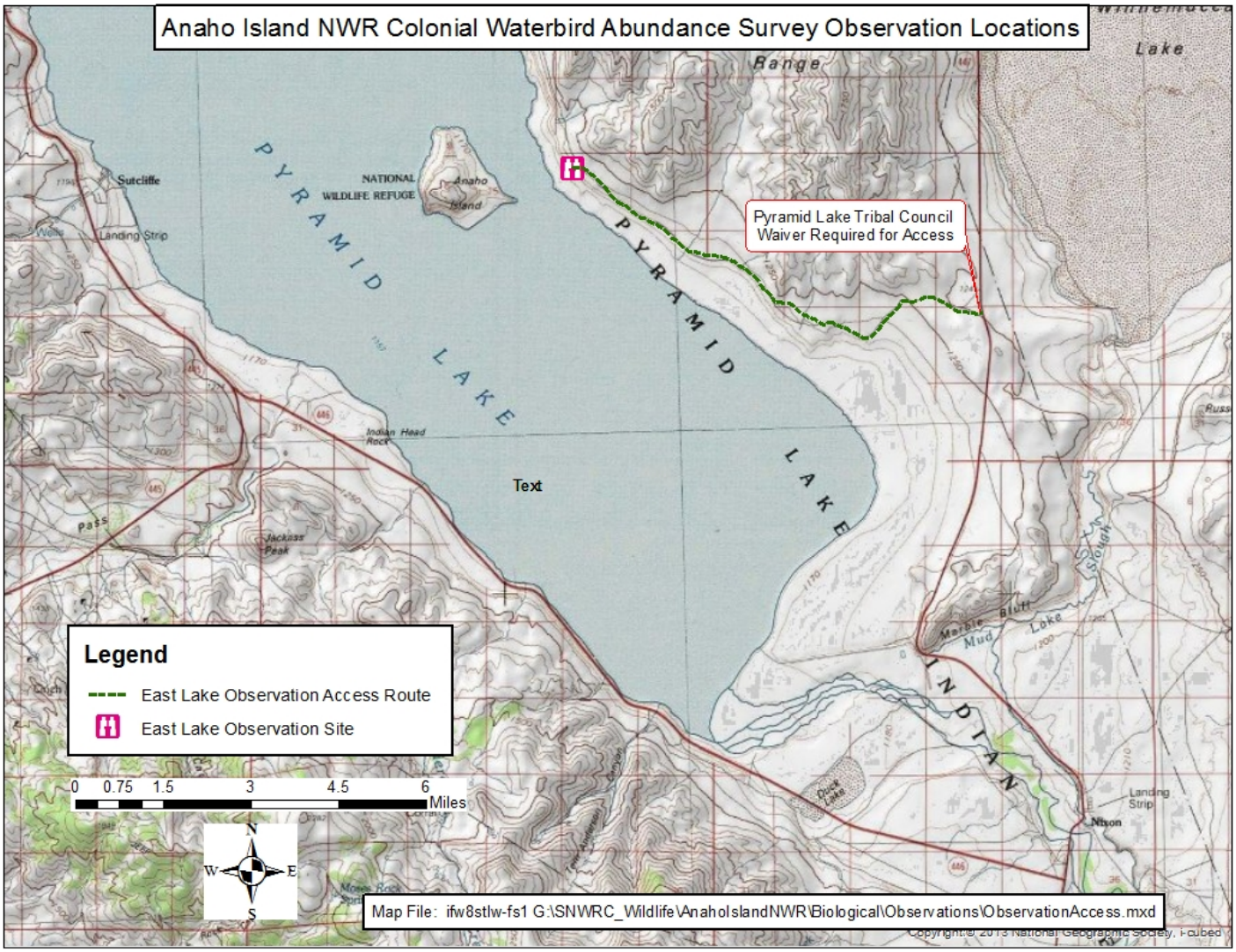
Figure 1. Access Route to East Lake Observation Site along Tribal Route 5 from State Route 447.
Figure 2. Access Route from Northwest Anaho Island Boat Beach to Observation Locations, with Sub-Colony Areas viewable from each location.
Figure 3. Location of Pelican Point Boat Launch Ramp and Northwest Anaho Island Boat Beach.

Form 1. Anaho Island NWR Colonial Bird Monitoring Field Data Form

Maps and Appendices:

You can insert maps and any appendices of information (e.g., progress tables, timelines, budgets, activity logs, etc.) directly into this document in the space below or upload individual documents separately as part of the ServCat record.

Figure 1. Access Route to East Lake Observation Site along Tribal Route 5 from State Route 447.



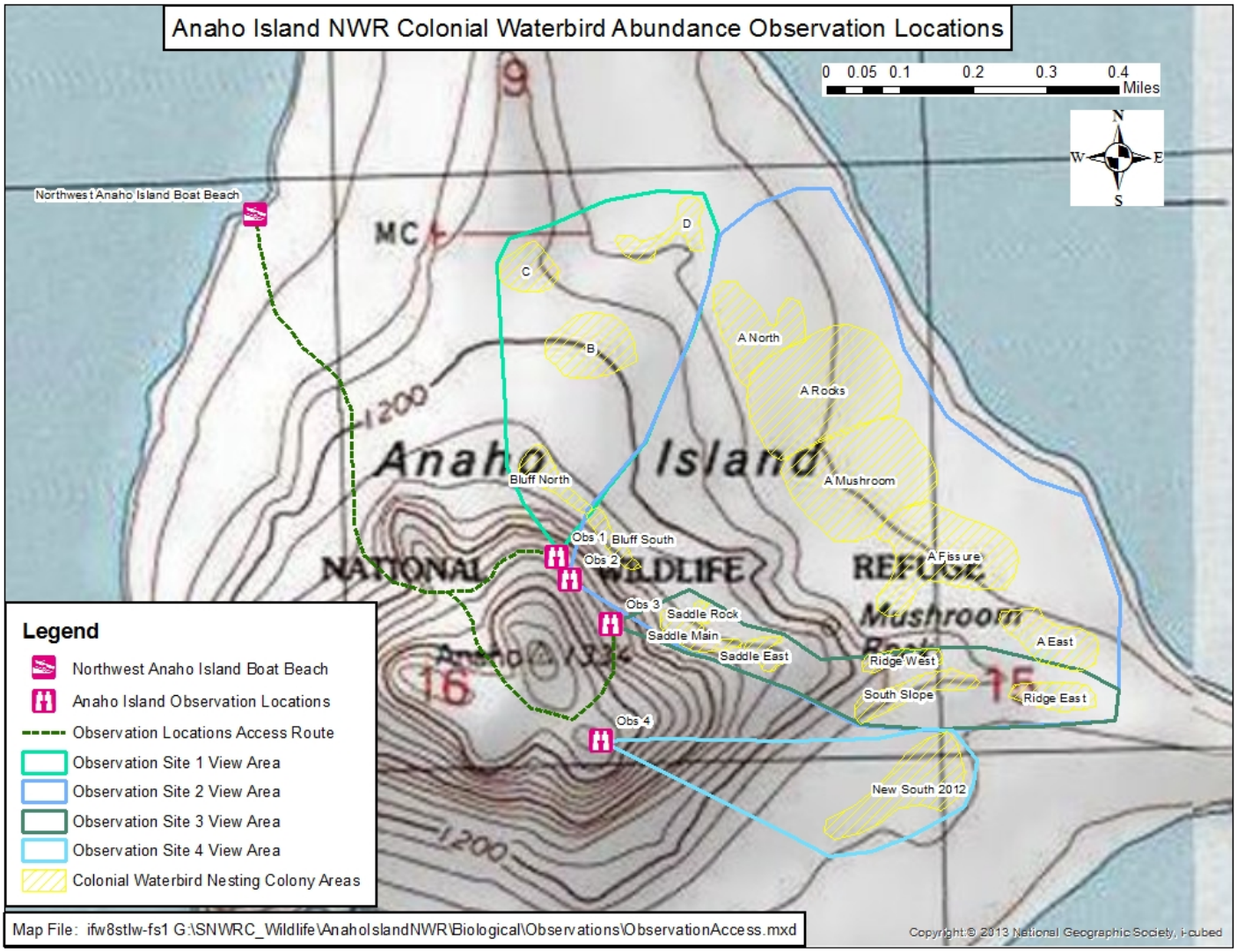


Figure 2. Access Route from Northwest Anaho Island Boat Beach to Observation Locations, with Sub-Colony Areas viewable from each location

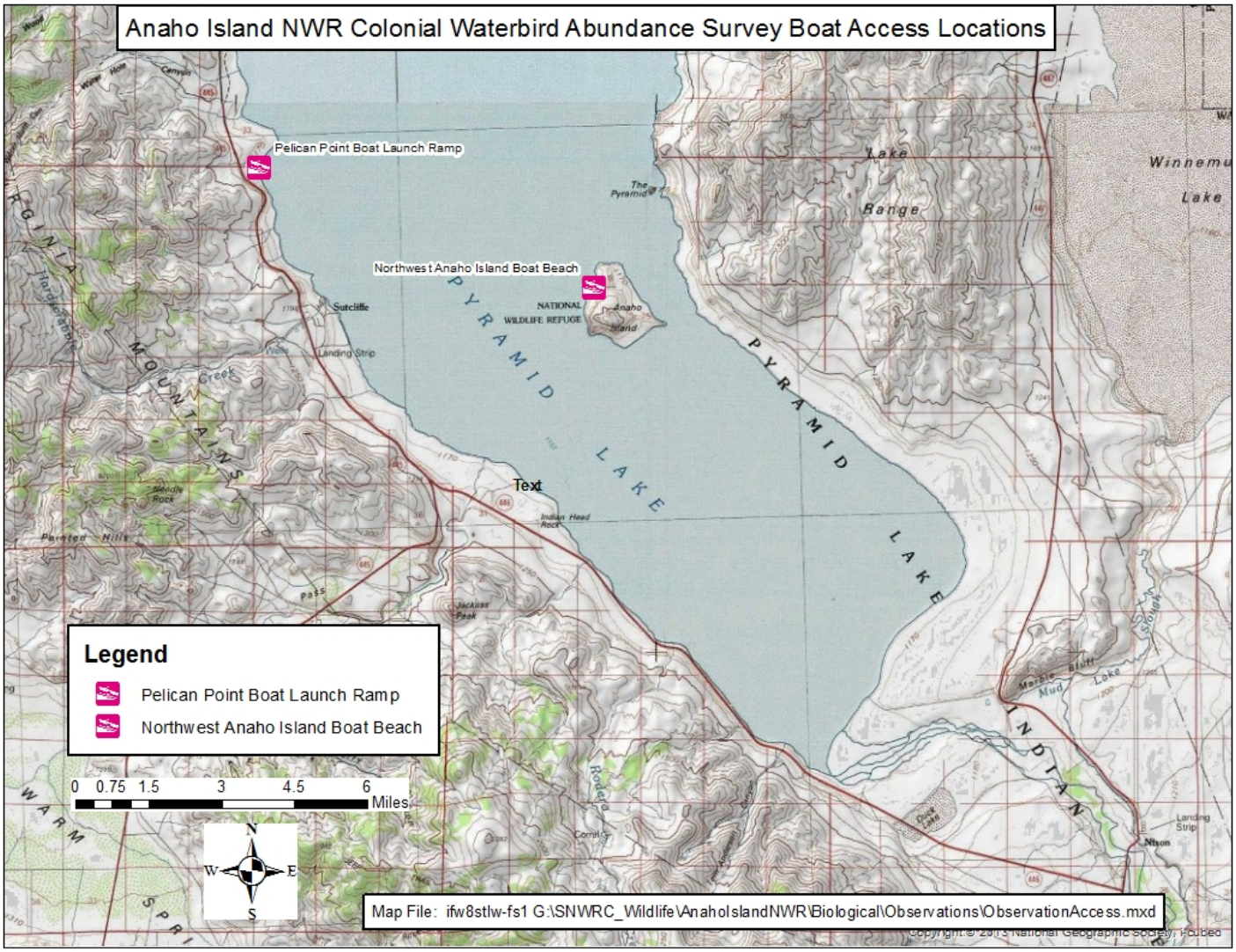


Figure 3. Location of Pelican Point Boat Launch Ramp and Northwest Anaho Island Boat Beach.

Figure 4: Group of AWPE adults in early pair bonding stage – Not Active Nests (FWS photo)

Figure 5: AWPE incubating - Active Nests (FWS photo)

Figure 6: AWPE at active nest with egg, hatchling, and young beginning to get downy feathers (Jim Stamates photos)

Figure 7: Unattended AWPE young in a creche (FWS photo)

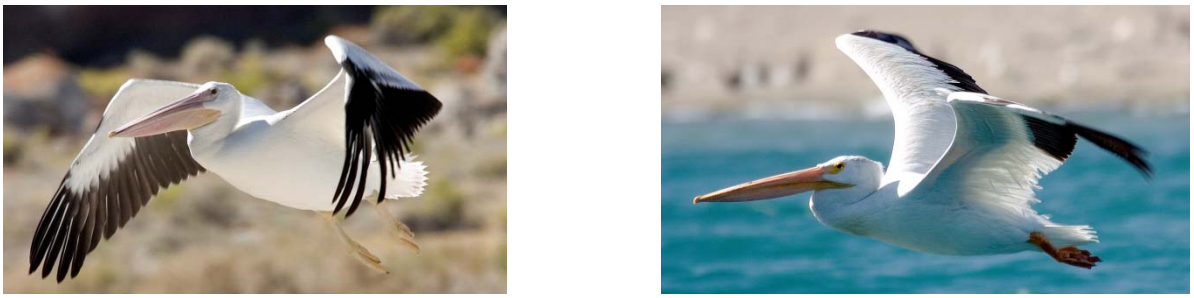


Figure 8: Fledged young AWPE and adult AWPE - note difference in bill length & color and body size (Bill Page photos)

Anaho Island NWR Colonial Bird Monitoring Field Data Form

Date _____ YYYY/MM/DD **Start Time** _____ hhmm **End Time** _____ hhmm Photos Taken: Yes No

Observer _____ First Name Last Name **Observation Location** _____ Anaho/Lake East Shore/Boat/Other

Comments _____

Bird Activity i.e. unsettled, paired, copulation, eggs, hatchlings, etc.; general observations re vegetation, weather, etc.

Species	AWPE		AWPE													
Life Stage	Active Nests	Total Count or Estimate?	Unattended Young	Total Count or Estimate?	Active Nest		Active Nest		Active Nest		Active Nest		Active Nest			
Area Counted	# Counted		# Counted		Present? (√)	# Counted	Present? (√)	# Counted	Present? (√)	# Counted	Present? (√)	# Counted	Present? (√)	# Counted		
A North to Rocks																
A Rocks to Mushroom																
A Mushroom to Fissure																
A Fissure to East																
A East																
B																
C																
D																
Bluff North																
Bluff South																
Saddle Main																
Saddle East																
Saddle Rocks																
Ridge West																
Ridge East																
South Slope																
New																
Shoreline East																
Shoreline South																
Shoreline North																
Shoreline West																
In Water																
Flying																

Species	AWPE	BCNH	CAGU	CATE	DCCO	GBHE	SNEG
	American white pelican	black-crowned night heron	California gull	Caspian tern	double-crested cormorant	great blue heron	snowy egret

ANWR_ColonialBirdMonitoring_FieldDataForm_Master_v20140729.xlsx

Form 1. Anaho Island NWR Colonial Bird Monitoring Field Data Form
(electronic copy stored at ifw8stlw=fs1 dwithers (U:) MyFiles/Anaho Island NWR/ ANWR_ColonialBirdMonitoring/ ANWR_ColonialBirdMonitoring_MasterDataSheets/ ANWR_ColonialBirdMonitoring_FieldDataFormMaster)

Section 7. List of References

Elzinga, C. L., D. W. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring plant and animal populations. Blackwell Science, Inc., Malden, MA.

Intermountain West Joint Venture. 2013. Implementation Plan – Strengthening Science and Partnerships. Intermountain West Joint Venture, Missoula, MT.

Jones, S. L. 2008. Western Colonial Waterbird Survey Protocols. Unpublished report. U.S. Department of Interior, Fish and Wildlife Service, Nongame Migratory Birds Coordinator's Office. Denver, CO.

Loth, E. 1984. Stillwater Wildlife Management Area Wildlife Inventory Plan. U.S. Fish and Wildlife Service and Nevada Fish & Game Commission. Fallon, NV.

Pacific Flyway Council. 2013a. A Monitoring Strategy for the Western Population of American White Pelicans within the Pacific Flyway. Pacific Flyway Council, U.S. Fish and Wildlife Service. Portland, OR.

Pacific Flyway Council. 2013b. A Monitoring Strategy for the Western Population of Double-crested Cormorants within the Pacific Flyway. Pacific Flyway Council, U.S. Fish and Wildlife Service. Portland, OR.

Stephensen, S. W., R. W. Lowe, W. T. Bridgeland, and D. B. Ledig. 2012. Seabird monitoring and response to independence day fireworks displays at two locations within Oregon Islands National Wildlife Refuge, Oregon. U.S. Fish and Wildlife Service. Newport, OR.

U.S. Fish & Wildlife Service. 2014a. Natural Resource Management Plan, Anaho Island National Wildlife Refuge, Pyramid Lake, Nevada. Sacramento, CA.

U.S. Fish & Wildlife Service. 2014b. Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge. Sacramento, CA.

Appendix H. Initial Survey Instructions for Pyramid Lake Water Elevation Monitoring

Survey Name:

Pyramid Lake Water Level Monitoring

Survey ID Number:

A unique identification number generated by PRIMR consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.

FF08RANH00-041

Refuge Name(s):

Anaho Island NWR

Natural Resource Management Plan:

Natural Resource Management Plan (NRMP) associated with the survey.

Natural Resource Management Plan, Anaho Island National Wildlife Refuge, Pyramid Lake, Nevada (U.S. Fish & Wildlife Service 2014a)

Inventory and Monitoring Plan:

Inventory and Monitoring Plan (IMP) associated with the survey.

Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge (U.S. Fish & Wildlife Service 2014b)

Submitted By and Contact Information:

Donna Withers, Wildlife Refuge Specialist
Stillwater NWR Complex, Fallon, Nevada
775-423-5128 ext 231; donna_withers@fws.gov

Background Information:

Maintaining Anaho Island as an island is vitally important for conserving sensitive colonial nesting waterbirds and other native species. Based on bathymetric data, the potential exists for a land bridge to form on the eastern side of the island if declining trends in Pyramid Lake water levels continue. The formation of a land bridge, or even the formation of a shallow-water zone, could allow mammalian predators (e.g., coyote, bobcat, fox, cat, etc.) to access the island and would increase colonization potential by a range of other native and nonnative species. Mammalian predators could decimate colonial nesting waterbird populations; colonization of the island by mainland native or nonnative species could threaten uniquely-evolved island populations of plants, reptiles and invertebrates.

The monthly Pyramid Lake water elevation data will be used to develop an Anaho Island isolation model as part of the Anaho Island Isolation Study; PRIMR ID: FF08RANH00-043. The island isolation model will be used

to estimate the current size of Anaho Island and the distance between the island and the eastern shoreline of Pyramid Lake. Staff will compare the results generated by the model with the thresholds established in the Integrated Pest Management Plan (NRMP Strategy 06), so that refuge staff can determine if management actions need to be taken.

Pyramid Lake water elevation data are manually collected by staff from the U.S. Geological Survey (USGS) Water Science Center, Carson City, Nevada following USGS protocol for the measuring station and then entered into the National Water Information System (NWIS):
http://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=10336500
Stillwater National Wildlife Refuge Complex (SNWRC) staff query the NWIS online database (NWISWeb) for Pyramid Lake water level elevation data and transfer the data to a Microsoft Excel spreadsheet maintained by the refuge.

Section 1. Survey Targets &Objectives

Target Species/Taxa/Community/Abiotic Feature:

Water level

Target Habitat(s) (*if applicable*):

Pyramid Lake

Management Objectives:

Management objectives are clearly articulated descriptions of a measureable standard, desired state, threshold value, amount of change or trend that you are striving to achieve for a particular population or indicator. Each objective requires six components: (1) species or indicator; (2) location; (3) attribute; e.g., size, distance, density, cover; (4) action; e.g., increase, decrease, maintain; (5) quantity/status; e.g., measureable state or degree of change for the attribute; and (6) time frame (Elzinga et al. 2001).

III. NRMP Goal 3.3: Over the next 30 years, the water surface elevation of Pyramid Lake is ≥1,166-m (0.72 mi) in order to maintain island isolation and preserve island biodiversity. This goal will be refined following the development of a model relating Pyramid water surface elevation, water depth and aquatic distance between Anaho Island and the mainland. The refuge wants to maintain the aquatic distance between Anaho Island and the mainland above 956-m (0.6 miles) (U.S. Fish & Wildlife Service 2014a).

Sampling Objectives:

Sampling objectives are included whenever monitoring involves sampling procedures. The sampling objectives include information on target levels of precision, power, the magnitude of change you are hoping to detect and acceptable false-change and missed-change error rates. For monitoring that does not involve sampling, the ability to assess success should be obvious from the management objectives themselves without the need to specify additional information (Elzinga et al., 2001).

n/a

Section 2. Survey Design

Is this part of a collaborative State, Regional, or National survey? Yes
If yes please fill out the items in the gray box below, if no (i.e., local refuge only) skip the gray box.

Coordinating organization(s):

USGS, National Water Information System

Is there recommended survey methods for the survey? Yes

Are there refuge-specific elements of implementation? Yes
If yes please specify refuge-specific elements of the survey in sections 2 thru 6 below.
If no please skip to the data management section 4 below.

Year of survey origin:
Add year of survey modification below origin if applicable.

1867

Are specific sampling units identified? No
If no skip to "Describe sampling design" below.

Select type of sampling unit (sampling geometry): Choose an item.
Other (describe):

Do sampling units remain fixed (i.e., same location from year to year)? Choose an item.

Describe survey/sampling design:
By "design" we mean detailed elements of survey design - study area or population of interest, whether the survey is a census (complete count) or a sample, how sampling units were selected (e.g., randomly, arbitrarily, grid), how samples were stratified, sample size, etc.

The water level of the lake is measured at a single point at the USGS surface water/reservoir elevation monitoring station USGS 10336500 Pyramid Lake near Nixon, Nevada, established on 09/01/1867.

Describe survey timing:
Examples of survey timing include # repeat visits each year, months, season, time of day, etc…

Lake elevation data are collected on a monthly basis but not always on the same day of every month. Data are generally collected during the first week of the month but may be collected during the last week of one month to serve as the data reading for the next month.

Section 3. Survey Methods

Primary metrics collected:

Water surface elevation (measured in feet)

How are sites marked?

Examples include GPS waypoints, flagging, etc…

See attached information from USGS

Describe preparatory requirements for the survey:

Examples include permits, training, contracts, other logistics…

See attached information from USGS

Describe equipment used during the survey:

See attached information from USGS

Describe detailed methodology (field and lab procedures):

You can upload any additional related documents describing methods to the ServCat record.

Information provided by USGS:

Gage

Lake elevations are determined by levels from reference marks along the lake shore. Reference marks are set from USC&GS BM N-21. Overland levels were used to establish reference marks at the old site (SW corner of lake). For the present site, overland levels were run from BM N-21 to the lake shore, then transferred across the lake by using two water-stage recorders on temporary platforms (one near each end of the lake traverse) to minimize errors due to seiche movements, wind, etc., then again by overland (conventional instruments) to the new reference marks. The reference marks should be checked against BM N-21 annually or more frequently if necessary to define shoreline subsidence. Observers: USGS personnel from the Carson City office make monthly measurements. Depending on the elevation of the lake, USGS personnel will use a folding rule to tape down from the mark or a rod at the edge of the water surface and a level to determine the difference in elevation between the water surface and the reference point to obtain the lake elevation.

Location of Monitoring Station
Lat 39°59'05", Long 119°30'00" referenced to North American Datum of 1927, in NE 1/4 NW 1/4 sec.3, T.24 N., R.22 E., Washoe County, NV, Hydrologic Unit 16050103, 0.25 mi north of the Pyramid, 1.6 mi northeast of Anaho Island, and 13 mi northwest of Nixon.
Road Log
to present site from Nixon:
Nixon store and service station..... 0.0
Go north on SR 447 toward Gerlach
Turn left onto dirt road - sign "pyramid"..... 8.3
Pass through fence..... 8.7
Road forks, keep right..... 16.8
Road forks, turn left..... 16.9
Road forks, turn right, stay on main road..... 17.0
Turn left to lake..... 17.3
Park vehicle..... 17.7

Bench mark and old site reference marks reached by driving south on State Route 447 from Nixon 0.8 mi to intersection with Pyramid Lake Road, turn right (west) onto Pyramid Lake Road, at 6.3 mi (cumulative mileage) park on left (south) side of road near intersection with dirt road (sign: Camp Foster). Reference marks are located along lakeshore in vicinity of large tufa formation that may be seen from southeast along railroad tracks about half a mile to concrete R.R. bridge over intermittent streambed.

Site Hazard Analysis
Accessing site requires an almost 10 mi drive down a dirt road. Although the road is usually well maintained, it may be difficult to travel during periods of heavy snow or rain. Several blind curves on the road may pose some vehicle collision risk with another vehicle or cattle, proceed with caution.

Paiute Tribal Police, 208 Capitol Hill, Nixon, NV (775) 574-1014
Washoe Urgent Care, 1343 Newland Dr East, Fernley, NV (775) 575-3600
Nevada Highway Patrol, statewide cell to nearest station *647 (*NHP)

Information provided by SNWRC staff:
SNWRC staff access the USGS NWIS online database and obtain the lake elevation readings for Pyramid Lake: http://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=10336500**.**

Readings for the current month are usually available by the first week of the month. The elevation is then entered into a Microsoft Excel spreadsheet by month (the actual date of data collection not currently included). This spreadsheet should be modified to include the actual date of data collection. The entire USGS database on Pyramid Lake elevations can be downloaded from NWIS web.

Staff Conducting Surveys:

Include interns, contractors, etc. if primary surveyors.

USGS collects the water level data. Donna Withers, SNWRC Wildlife Refuge Specialist, accesses the USGS NWIS online database.

Section 4. Data Management

Specify data entry file format(s):

Examples include MS Excel, MS Access, GIS, web dbs (e.g., SQL), etc…

Microsoft Excel 2010

Specify data storage/archive location (hardcopy and electronic):

Provide file names and locations here if applicable. You can upload any additional related documents to the ServCat record.

The Microsoft Excel spreadsheet is currently stored in a folder at dwithers$ (\\ifw8stlw-fs1) U:\MyFiles\ANH_Anaho Island NWR\ANH_Inventory & Monitoring\ANH_I&MPlan_2014\ANH_I&MSurveys\ANH_3.1_041_PyramidLakeWaterLevel \ANH_PyramidLakeLevel_Master.xlsx; a copy could also be stored in a folder on the SNWRC Common Drive M:\SNWRC_ProjectFiles\ANH_AnahoIslandNWR\ANH_PyramidLakeLevel.

Describe procedure for verifying/checking/securing the data:

Donna Withers is only one (besides FWS IT Administrator) with access to the file currently. If the file is relocated to a limited-access drive (SNWRC Common Drive), then other staff would also have access.

Describe methods/software used in data analysis:

No data analysis has been needed up to this point.

Section 5. Reporting

Describe reports developed from this survey:

Include details on reporting schedule/frequency, distribution, archiving, etc… Include links and citations for previous reports if applicable.

Results from this survey will be incorporated into the Anaho Island isolation model that will be developed during the Anaho Island Isolation Study (Survey ID FF08RANH00-043). The isolation model will determine threshold water level(s) for Pyramid Lake that might trigger specific management actions.

Section 6. Other Survey Information

Please use the space below to comment on additional survey elements and issues to consider when implementing the survey:

USGS contact: Sonya Vasquez, slvasque@usgs.gov

Description of attachments/supplemental documents/data sets:

Use the space below to describe supplemental documents (e.g., maps, etc) uploaded to the ServCat record.

Maps and Appendices:

You can insert maps and any appendices of information (e.g., progress tables, timelines, budgets, activity logs, etc.) directly into this document in the space below or upload individual documents separately as part of the ServCat record.

Section 7. List of References

Elzinga, C. L., Salzer, D. W., Willoughby, J. W., & Gibbs, J. P. (2001). Monitoring plant and animal populations (p. 360). Malden, MA: Blackwell Science, Inc.

U.S. Fish & Wildlife Service. (2014a). Natural Resource Management Plan, Anaho Island National Wildlife Refuge, Pyramid Lake, Nevada. Sacramento, CA.

U.S. Fish & Wildlife Service. (2014b). Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge. Sacramento, CA.

Appendix I. Initial Survey Instructions for Anaho Island Isolation Monitoring

Survey Name:

Anaho Island Isolation Monitoring

Survey ID Number:

A unique identification number generated by PRIMR consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.

FF08RANH00-015

Refuge Name(s):

Anaho Island NWR

Natural Resource Management Plan:

Natural Resource Management Plan (NRMP) associated with the survey.

Natural Resource Management Plan, Anaho Island National Wildlife Refuge, Pyramid Lake, Nevada (U.S. Fish & Wildlife Service 2014a)

Inventory and Monitoring Plan:

Inventory and Monitoring Plan associated with the survey.

Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge (U.S. Fish & Wildlife Service 2014b)

Submitted By and Contact Information:

Donna Withers, Wildlife Refuge Specialist
Stillwater NWR Complex, Fallon, Nevada
775-423-5128 ext 231; donna_withers@fws.gov

Background Information:

Continued aquatic isolation is key to preserving the biological diversity of Anaho Island. The unique biological community of interacting organisms at Anaho Island has been shaped in large part by its aquatic isolation and associated lack of terrestrial predators (e.g., coyotes). The degree of island isolation is a function of the surface elevation of Pyramid Lake, the topography of Anaho Island and the uplands surrounding Pyramid Lake, and the bathymetry of Pyramid Lake. As Pyramid Lake water levels decrease, the distance and depth of the water between Anaho Island and the mainland decreases, and the risk of invasive/nuisance plant and animal species introductions to Anaho Island increases.

Pyramid Lake elevation is monitored monthly by the Carson City, Nevada office of the USGS. Pyramid Lake water surface elevation data downloaded from the USGS waterdata website (http://waterdata.usgs.gov/nv/nwis/dv?cb_00062=on&format=html&period=&begin_date=2012-04-

10&end_date=2013-04-10&site_no=10336500&referred_module=sw) documents the fluctuations in the lake level. The lowest Pyramid Lake elevation (3,783.9 feet) was recorded by USGS during January and February 1967. Pyramid Lake bathymetry data collected by the USGS documented that the bottom of Pyramid Lake between Anaho Island and the east shoreline of Pyramid Lake was 27 feet below the lake's water surface, which was 3,789 feet above mean sea level in May 1968 (Harris 1970). From this data, an estimate can be made that a land bridge may be completely exposed, connecting Anaho Island to the eastern shoreline of Pyramid Lake, if lake level drops to 3,762 feet. A distance of 0.25 mile between Anaho Island and the mainland in May 1968 can also be estimated from Harris (1970). Pyramid Lake surface elevation has increased since early 1967, but continues to fluctuate. On June 2, 2014, the surface elevation of Pyramid Lake was 3,798.66 feet above sea level (USGS water data website; http://waterdata.usgs.gov/nwis).

A study of urban coyotes along the east coast suggested that a single coyote can cross a 1-km (0.62 mi) wide canal (Way 2002). There have been no documented crossings by terrestrial predators to date at Anaho Island. The threat of decreasing water supply to Pyramid Lake is a significant refuge concern. Introduction of novel predators and/or other invasive/nuisance plant and animal species (e.g., feral sheep and goats, invasive plants) could significantly alter the Anaho Island ecosystem as a result of increased predation, herbivory and competition.

Manual Calculation of Island-Mainland Distance (current)
Currently, refuge staff use aerial imagery and tools within Google Earth to manually estimate the island-mainland distance. Pyramid Lake elevation data for approximately the same time period as the imagery is obtained from the USGS water data website (http://waterdata.usgs.gov/nwis). This information is compiled into an MS Excel spreadsheet.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
A bathymetric model relating Pyramid Lake water levels to water depth and aquatic distance between Anaho Island and the mainland is in development as part of the Anaho Island Isolation Study, Survey ID Number FF08RANH00-043. When the model is complete, the distance to mainland and a depth profile will be automatically generated using Pyramid Lake water levels (Pyramid Lake Water Level Monitoring, FF08RANH00-041) as input.

Section 1. Survey Targets & Objectives

Target Species/Taxa/Community/Abiotic Feature:

Shortest open water distance between Anaho Island and the Pyramid Lake mainland

Target Habitat(s) (*if applicable*):

Management Objectives:

Management objectives are clearly articulated descriptions of a measureable standard, desired state, threshold value, amount of change or trend that you are striving to achieve for a particular population or indicator. Each objective requires six components: (1) species or indicator; (2) location; (3) attribute; e.g., size, distance, density, cover; (4) action; e.g., increase, decrease, maintain; (5) quantity/status; e.g., measureable state or degree of change for the attribute; and (6) time frame (Elzinga et al. 2001).

NRMP Goal 3.3: Over the next 30 years, the water surface elevation of Pyramid Lake is ≥1,166-m (0.72 mi) in order to maintain island isolation and preserve island biodiversity (U.S. Fish & Wildlife Service 2014a). This goal will be refined following the development of a model relating Pyramid water surface elevation, water depth and aquatic distance between Anaho Island and the mainland. The refuge wants to maintain the aquatic distance between Anaho Island and the mainland above 956-m (0.6 miles). This goal and the status rating scale may be modified based on the results of the Anaho Island Isolation Study (Survey ID Number FF08RANH00-043).

Sampling Objectives:

Sampling objectives are included whenever monitoring involves sampling procedures. The sampling objectives include information on target levels of precision, power, the magnitude of change you are hoping to detect and acceptable false-change and missed-change error rates. For monitoring that does not involve sampling, the ability to assess success should be obvious from the management objectives themselves without the need to specify additional information (Elzinga et al. 2001).

n/a

Section 2. Survey Design

Is this part of a collaborative State, Regional, or National survey? No

If yes please fill out the items in the gray box below, if no (i.e., local refuge only) skip the gray box.

Coordinating organization(s):

Is there an established protocol for the survey? No

Are there refuge-specific elements of implementation? Yes

If yes please specify refuge-specific elements of the survey in sections 2 thru 6 below.
If no please skip to the data management section 4 below.

Year of survey origin:

Add year of survey modification below origin if applicable.

2014

Are specific sampling units identified? No

If no skip to "Describe survey/sampling design" below.

Select type of sampling unit (sampling geometry): Choose an item.

Other (describe):

Do sampling units remain fixed (i.e., same location from year to year)? Choose an item.

Describe survey/sampling design:

By "design" we mean detailed elements of survey design - study area or population of interest, whether the survey is a census (complete count) or a sample, how sampling units were selected (e.g., randomly, arbitrarily, grid), how samples were stratified, sample size, etc.

Manual Calculation of Island-Mainland Distance (current)
The current survey design consists of measuring a single attribute: the horizontal distance between the easternmost shore of Anaho Island and the mainland. This is a direct measurement, thus no sampling design is required.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
In the future, a bathymetric model will be used to calculate the annual island-mainland distance and generate an annual depth profile of the lake between the easternmost shore of Anaho Island and the mainland (Anaho Island Isolation Study, Survey ID Number FF08RANH00-043). These calculations do not require a sampling design.

Describe survey timing:

Examples of survey timing include # repeat visits each year, months, season, time of day, etc…

Manual Calculation of Island-Mainland Distance (current)
The island-mainland distance is calculated from aerial imagery whenever new imagery is available and is correlated to the surface elevation of Pyramid Lake at approximately the date of the imagery.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Once the model is developed, the island-mainland distance and depth profiles can be generated monthly by entering the lake level measurement obtained from the USGS water data website (http://waterdata.usgs.gov/nwis).

Section 3. Survey Methods

Primary metrics collected:

Manual Calculation of Island-Mainland Distance (current)

(1) Horizontal distance between the easternmost shore of Anaho Island and the mainland

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)

(2) Monthly horizontal distance between the easternmost shore of Anaho Island and the mainland
(3) Profile of water depth between the easternmost shore of Anaho Island and the mainland

How are sites marked?

Examples include GPS waypoints, flagging, etc…

Manual Calculation of Island-Mainland Distance (current)
The "Placemark" tool within Google Earth is utilized to obtain latitude and longitude coordinates for the easternmost point of Anaho Island and the closest mainland point. The "Path" tool is used to draw a line between the placemarks.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
The bathymetric model, when complete, will be used to automatically generate x-y coordinates for the easternmost point of Anaho Island and the closest mainland point at any water level for Pyramid Lake.

Describe preparatory requirements for the survey:

Examples include permits, training, contracts, other logistics…

Manual Calculation of Island-Mainland Distance (current)
Google Earth (or another source of aerial imagery) must be accessible via a FWS computer.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Development of the Anaho Island isolation model (Anaho Island Isolation Study, Survey ID Number FF08RANH00-043) will be required. In addition, the collection of monthly Pyramid Lake surface elevation data will be needed to inform the model (Pyramid Lake Water Level Monitoring, FF08RANH00-041).

Describe equipment used during the survey:

Manual Calculation of Island-Mainland Distance (current)

- Computer
- Aerial imagery (e.g., Google Earth)

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)

- Computer
- ArcGIS software
- Additional details to be determined.

Describe detailed methodology (field and lab procedures):

You can upload any additional related documents describing methods to the ServCat record.

Manual Calculation of Island-Mainland Distance (current)
Refuge staff access Google Earth and zoom into Anaho Island and the eastern shoreline of Pyramid Lake. The dates of the imagery available within Google Earth are determined. For each available image, the following steps are performed to estimate the island to mainland distance. The Placemark tool is used to mark the easternmost point of Anaho Island. The Measure tool is used to determine the shortest distance between the Anaho Island mark and the closest point on the eastern shoreline of Pyramid Lake. The distance is recorded on the Anaho Island Isolation Distance MS Excel spreadsheet currently located at dwithers$ (\\ifw8stlw-fs1) U:\MyFiles\ANH_Anaho Island NWR\ANH_Inventory & Monitoring\ANH_I&MPlan_2014\ANH_I&MSurveys\ANH_3.2_015_IsolationMonitoring\\

ANH_IsolationDistance.xlsx . The Placemark tool is used to mark the closest point on the eastern shoreline of Pyramid Lake. The distance is again verified between the two marks. The Path tool is used to create a line between the Anaho Island mark and the eastern Shoreline mark. The latitude and longitude of the Anaho Island and Pyramid Lake shoreline marks are recorded on the Anaho Island Isolation spreadsheet. The File/Save/Save Image tool is used to save a .jpg image of aerial imagery with the marks and line. This image is added to the Anaho Island Isolation spreadsheet. The USGS water data website (http://waterdata.usgs.gov/nwis) is accessed to obtain the Pyramid Lake elevation data available for the time period closest to the date of the imagery and the data are added to the Anaho Island Isolation spreadsheet.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Monthly Pyramid Lake surface elevation data will be entered into the Anaho Island isolation model using desktop ArcGIS 10, which will then calculate the island-mainland distance and create a profile of water depth. Additional details regarding how the model was developed will be added when available.

Staff Conducting Surveys:

Include interns, contractors, etc. if primary surveyors.

Manual Calculation of Island-Mainland Distance (current)
Wildlife Refuge Specialist, currently Donna Withers

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Wildlife Refuge Specialist (currently Donna Withers) and a GIS volunteer

Section 4. Data Management

Specify data entry file format(s):

Examples include MS Excel, MS Access, GIS, web dbs (e.g., SQL), etc…

Manual Calculation of Island-Mainland Distance (current)
MS Excel
Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
ArcGIS

Specify data storage/archive location (hardcopy and electronic):

Provide file names and locations here if applicable. You can upload any additional related documents to the ServCat record.

Manual Calculation of Island-Mainland Distance (current)
dwithers$ (\\ifw8stlw-fs1) U:\MyFiles\ANH_Anaho Island NWR\ANH_Inventory & Monitoring\ANH_I&MPlan_2014\ANH_I&MSurveys\ANH_3.2_015_IsolationMonitoring\ ANH_IsolationDistance.xlsx .
Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Details regarding data storage will be added when available.

Describe procedure for verifying/checking/securing the data:

Manual Calculation of Island-Mainland Distance (current)
The distance measurement is obtained by using the measure tool in Google Earth. Minor variations occur with repeated measurement due to variation in the exact start and stop points of the measuring tool.
Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Details regarding data checking will be added when available.

Describe methods/software used in data analysis:

Manual Calculation of Island-Mainland Distance (current)
No analysis of distance measurements obtained using Google Earth has been conducted.

Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Details regarding analysis will be added when available.

Section 5. Reporting

Describe reports developed from this survey:

Include details on reporting schedule/frequency, distribution, archiving, etc. Include links and citations for previous reports if applicable.

Manual Calculation of Island-Mainland Distance (current)
Distance measurements obtained using Google Earth have not been included in any reports to date.
Model-based Calculation of Island-Mainland Distance and Depth Profile (future)
Details regarding reporting will be added when available.

Section 6. Other Survey Information

Please use the space below to comment on additional survey elements and issues to consider when implementing the survey:

Description of attachments/supplemental documents/data sets:

Use the space below to describe supplemental documents (e.g., maps, etc) uploaded to the ServCat record.

Maps and Appendices:

You can insert maps and any appendices of information (e.g., progress tables, timelines, budgets, activity logs, etc.) directly into this document in the space below or upload individual documents separately as part of the ServCat record.

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U.S. Fish & Wildlife Service. (2014b). Inventory and Monitoring Plan for Anaho Island National Wildlife Refuge. Sacramento, CA.