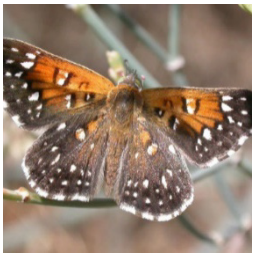

"The conservation landscape has changed, the playing field has changed and the stakes have changed. Human demands on the environment combined with environmental stressors are creating an urgent need for conservation choices. The scale of issues and challenges we face is unprecedented and impacts us all; no single entity has the resources necessary to address these challenges on its own. Conserving the Future acknowledges that **strategic, collaborative, science-based landscape conservation—along with effective public outreach, education and environmental awareness—is the only path forward** to conserve America's wildlife and wild places."

CONSERVING THE FUTURE: WILDLIFE REFUGES AND THE NEXT GENERATION (USFWS 2011)

San Francisco Bay National Wildlife Refuge Complex Inventory and Monitoring Plan

October 2019

ON THE COVER

From left to right, top to bottom

California tiger salamander (*Ambystoma californiense*), USFWS

Tidal marsh, Judy Irving © Pelican Media

Western snowy plover (*Charadrius alexandrinus nivosus*), © Aric Crabb, Bay Area News Group

Farallon Islands, Brian O'Neil

Marin Islands National Wildlife Refuge, USFWS

Lange's metalmark butterfly (*Apodemia mormo langei*), USFWS

Children restoring native plants, Student and Teachers Restoring a Watershed, (Point Blue Conservation Science)

Marbled godwits and willets, Judy Irving © Pelican Media

Vernal pool grasslands, USFWS

SUGGESTED CITATION:

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San Francisco Bay National Wildlife Refuge Complex Inventory and Monitoring Plan

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Abbreviations

ATD	Antioch Dunes National Wildlife Refuge
CCP	Comprehensive Conservation Plan
CDE	Coastal Dune Ecosystem
EIE	Estuarine Island Ecosystem
ELS	Ellicott Slough National Wildlife Refuge
FRL	Farallon Islands National Wildlife Refuge
IMP	Inventory and Monitoring Plan
ISI	Initial Survey Instructions
MIE	Marine Island Ecosystem
MRI	Marin Islands National Wildlife Refuge
NWR	National Wildlife Refuge
NRMP	Natural Resource Management Plan
PRIMR	Planning and Review of Inventory and Monitoring on Refuges Database
PVW	Pajaro Valley Watershed
RDE	Riverine Dune Ecosystem
Service	United States Fish and Wildlife Service
SF Refuge Complex, Complex	San Francisco Bay National Wildlife Refuge Complex
SFB	Don Edwards San Francisco Bay National Wildlife Refuge
SLR	Salinas River National Wildlife Refuge
SMART	Specific, Measurable, Achievable, Results-oriented, Time-bound
SNP	San Pablo National Wildlife Refuge
TME	Tidal Marsh Ecosystem
VPG	Vernal Pool Grassland
WTB	Waterbirds

Chapter 1 — Introduction

The San Francisco Bay National Wildlife Refuge Complex (Complex) consists of seven National Wildlife Refuges (NWRs): Farallon Islands NWR (1909), Don Edwards San Francisco Bay NWR (1972), Salinas River NWR (1973), San Pablo Bay NWR (1974), Ellicott Slough NWR (1975), Antioch Dunes NWR (1980), and Marin Islands NWR (1992). Due to their geographic proximity and common challenges, the U.S. Fish and Wildlife Service (Service) organized the seven refuges as a Complex for administrative purposes. These refuges were established in response to declining wildlife populations caused by commercial harvesting in the late 19th century and rapid habitat loss from human development in the middle 20th century. Now, these refuges protect a variety of wetland and upland ecosystems that support nesting, foraging, wintering, and resting habitat for millions of migratory birds along the Pacific Flyway. These refuges also provide vital habitat for hundreds of native plant and wildlife species— including species that are federally or state- listed as endangered. Unlike other refuges located in rural or remote locations, these seven refuges share the challenge of pursuing wildlife conservation objectives while providing compatible wildlife-dependent recreation in the midst of a highly urbanized area. The San Francisco-Monterey Bay area is home to nearly 9 million people across 11 counties and more than 100 incorporated cities spread over some 10,000 square miles, including the major metropolitan areas of San Francisco, Oakland, and San Jose.

A wide variety of biological surveys are conducted in the Complex, such as assessing population trends of endangered birds, evaluating species richness of native plant communities, or evaluating water quality and quantity. A survey is defined as "a specific data-collection effort to complete an inventory or conduct monitoring of biotic or abiotic resources" (USFWS 2013b). Complex staff identified 150 surveys (including inventory, monitoring, and research) as either current or expected within the next 15 years (FY 2018-2033). Some of these surveys are conducted by Complex staff (N=58 surveys, 39%) while others are coordinated and carried out by our conservation partners (N=91 surveys, 61%). Each survey serves a particular purpose, such as informing progress on conservation goals and objectives, understanding the ecology of a species, meeting regulatory obligations, or assessing changes in biodiversity in response to threats such as climate change. However, the funding and personnel needed to lead, carry out, or otherwise support these surveys are extremely limited. In order to meet this challenge, staff categorized and prioritized surveys to better decide which are the most important to execute in the next 15 years.

This Inventory and Monitoring Plan (IMP) describes the process used by the Complex to document, prioritize, and then select the most important natural resource surveys to conduct over the next 15 years. The IMP also describes the purpose, management context, and partnerships involved with those surveys. Ultimately, the IMP aims to assist managers with budget allocation decisions and to provide the biological program with guidance, transparency, and continuity. Information about surveys identified in this IMP are maintained in the Planning and Review of Inventory and Monitoring on Refuges (PRIMR) database. Products associated with surveys are stored in ServCat (such as a protocol, data, reports, and maps). Survey products stored in ServCat are then linked to PRIMR survey records. This cataloguing of survey information provides an important legacy of information to ensure consistency and credibility through time.

This IMP should be revisited annually by refuge staff to ensure the highest priority surveys to conduct (referred to in this IMP as 'tier 1 surveys') are relevant, the refuge has the resources to conduct them, and that new issues and/or constraints are considered. Following approval of the IMP, Refuge staff will work collaboratively with Inventory & Monitoring (I&M) staff and others to document high priority survey protocols. The IMP can be approved before all protocols have been developed, but the addition or deletion of surveys within the IMP (tier 1 surveys) requires additional revision and approval of this IMP. The process for revising or amending the IMP is described in the I&M policy (USFWS 2013b).

Conservation Planning Context

This IMP is tightly linked to the Complex's Natural Resource Management Plan (NRMP) (USFWS 2019), which is a step-down management plan from Comprehensive Conservation Plans (CCPs) developed for each of the seven refuges in the Complex. The NRMP was developed using the Open Standards for the Practice of Conservation, a systematic approach for planning, implementing, and monitoring conservation initiatives (The Conservation Measures Partnership 2013). An important result of this effort was to 1) refine the focus of conservation efforts across the Complex given a limited set of resources and 2) increase the capacity of the Complex to evaluate, learn, and adapt, and, ultimately, improve conservation outcomes. Another important outcome of the NRMP process was refinement of Complex goals and objectives so that they are SMART – Specific, Measurable, Achievable, Results-oriented, and Time-bound. In doing so, the Complex has a better understanding about expected conservation outcomes, in terms of priority natural resources (conservation targets) and reduction of critical environmental threats. This increase in specificity makes it clear what surveys are critical to informing conservation progress.

Important terms associated with the NRMP process and this IMP are defined below:

- **A conservation target** is a specific species, community, or ecosystem that the refuge selected as a focus of conservation. It is also known as a "priority resource of conservation concern" (ROC). The eight ROCs identified in the Complex NRMP are listed in table 1.
- A **goal** specifies the desired status of a conservation target over the long term. Goals are stated in terms of important ecological attributes related to target size/extent, condition, or ecological processes/drivers that are critical to sustaining the target. A good goal meets the criteria of being linked to targets and is Specific, Measurable, Achievable, Results-oriented, and Time-bound (SMART). These may also be referred to as 'target-specific objectives'.
- An **objective** specifies the interim desired change(s) expected as a result of management strategies – and which contribute to achieving goals. This includes changes in the state of threats (such as contaminants, invasive species, predators, or disease) or restoration of an ecological attribute (such as hydrological regime). Like goals, a good objective meets the criteria of being SMART.
- A **strategy** 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.

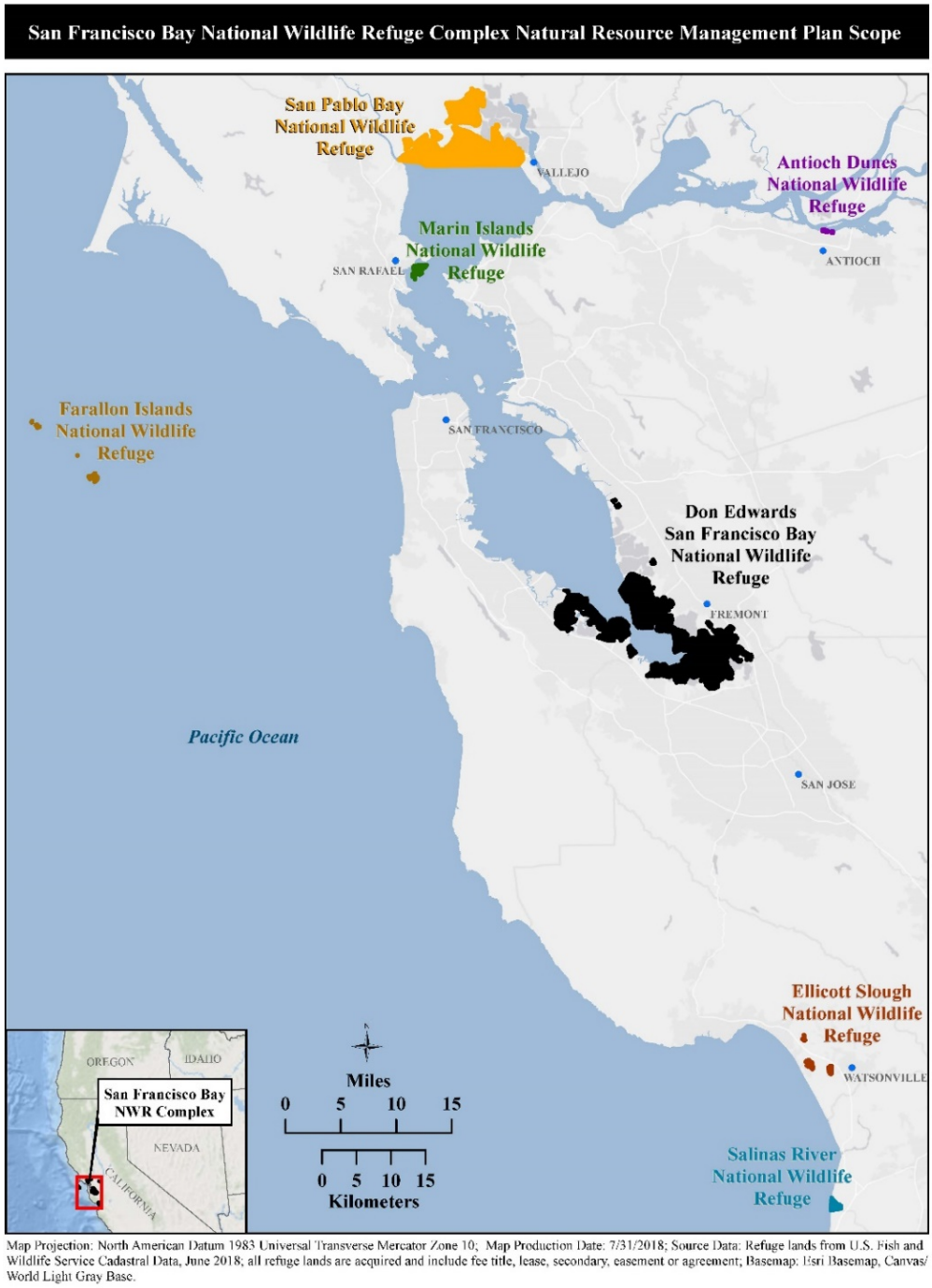

Figure 1. Geographic setting of the San Francisco Bay National Wildlife Refuge Complex.

Table 1. Priority Resources of Concern (ROC, conservation targets) of the San Francisco Bay National Wildlife Refuge Complex.

Target	*Associated Refuge(s)*	*Nested Targets*
Coastal Dune Ecosystem (CDE)	Salinas River	Central dune scrub, beach and central foredune, Smith's blue butterfly, western snowy plover
Estuarine Island Ecosystem (EIE)	Marin Islands	Oak/buckeye forest, grasslands, coastal scrub, coast bluff-cliffs, intertidal marsh beach, locally rare native plants, arboreal salamander, native pollinators
Marine Island Ecosystem (MIE)	Farallon Islands	Breeding seabirds, pinnipeds, Farallon camel cricket, arboreal salamander, maritime goldfields, pinnipeds
Pajaro Valley Watershed (PVW)	Ellicott Slough	California tiger salamander, Santa Cruz long-toed salamander, ephemeral ponds, oak woodlands, grasslands
Riverine Dune Ecosystem (RDE)	Antioch Dunes	Lange's metalmark butterfly, Contra Costa wallflower, Antioch Dunes evening primrose
Tidal Marsh Ecosystem (TME)	Don Edwards San Francisco Bay, San Pablo Bay	Ridgway's rail, salt marsh harvest mouse, common yellowthroat, song sparrow, marsh-upland transition zone, low marsh, high marsh, native tidal marsh plants, native fish, harbor seal
Vernal Pool Grasslands (VPG)	Don Edwards San Francisco Bay	Contra Costa goldfields, vernal pool plants, vernal pool tadpole shrimp, California tiger salamander
Waterbirds (WTB)	Don Edwards San Francisco Bay, San Pablo Bay	Breeding waterbirds (Don Edwards San Francisco Bay NWR): Forster's tern, Caspian tern, American avocet, black-necked stilt Breeding waterbirds (Marin Islands NWR): great blue heron, great egret, snowy egret, black-crowned night heron, wintering and migratory shorebirds, waterfowl, and grebes

Chapter 2 — Methods

In July of 2017, a 1-day workshop was held at the Complex headquarters in Fremont, California and attended by Complex and I&M staff. The objective of the workshop was to prioritize Complex natural resource surveys. This work was informed by staff knowledge and results of the NRMP process, including priority conservation targets, priority threats, and SMART goals and objectives. Refuge staff made the evaluations and decisions leading to survey selection, while I&M staff facilitated the process. For several months following the workshop, staff continued to refine survey information and priorities until final decisions were made about which surveys are most important to conduct in the Complex.

2.1 Development of Comprehensive List of Surveys

The first documentation of Complex surveys in PRIMR was completed in 2012. In 2017, I&M exported survey information from PRIMR to help Complex teams review and revise survey information. Revisions to PRIMR survey information were carried out by I&M staff. As a result of this effort, some surveys were marked as historic and some surveys were added (either current or expected). Survey additions included surveys that are needed to inform new NRMP goals or objectives, surveys carried out by partners for research purposes, or surveys required to meet permit requirements. Although research projects carried out by Complex staff were documented in PRIMR, they were not ranked during the IMP process because they were identified as priority NRMP strategies.

2.2 Survey Status

Surveys in PRIMR, and in most IMPs, are classified by their status using terms like selected, non-selected, historical, current, future, and expected. They are defined as such:

1. **Selected:** Surveys that will be conducted by the Complex within the next 15 years
    a. **Current:** Surveys that will be 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.
    b. **Expected:** New surveys that have a likely chance of being conducted during the span of the IMP (15 years) because of moderate to high priority and it is likely that capacity to conduct the survey will become available over the life of the IMP.
2. **Non-selected:** Survey that has previously been, or will be, conducted by the Complex
    a. **Future:** Surveys that have been prioritized but have a low chance of being conducted by the Complex during the span of the IMP because of low priority or because NWRS capacity to conduct the survey will be difficult to secure.
    b. **Historical:** Surveys that have been completed.

This IMP also organizes surveys into tiers to reflect their relative importance in the Complex (table 2, tables 4-10). tier 1 surveys, represented in tables 4-10, are the most important surveys to carry out in the Complex over the next 15 years because they directly inform management – they are linked to Complex priority resources of concern (targets, ROCs) (table 1) and associated SMART goals and objectives (appendix A). Further, it is likely that capacity to carry out the surveys will be available. All tier 1 surveys are classified as 'selected' (current or expected). Tier 2 surveys (appendix C) are required by

permit but do not directly inform Complex goals and objectives. Tier 3 surveys (appendix D) are all other surveys Conducted by the Complex. Historic surveys are not included in this IMP, but they are documented in PRIMR. This IMP only provides survey narratives (table 11) for tier 1 surveys (table 11). Many tier 2 surveys are associated with tidal marsh restoration projects carried out at Don Edwards San Francisco Bay and San Pablo Bay NWRs. Over the next 5 years, the Complex will work with regulating agencies and conservation partners to refine these requirements so that there is better alignment between regulatory monitoring requirements and Complex tier 1 surveys.

It is important to note that a tier 1 survey does not exclude permit surveys. There are a few tier 1 surveys that directly inform a goal or objective but that are also required by permit (i.e. tier 2). These surveys are denoted in tables 4-10.

Table 2. Survey tiers for the San Francisco Bay National Wildlife Refuge Complex.

Survey Tier ID	*Survey Tier Description*	*Location in the IMP*
1	The survey directly informs a SMART goal or objective of the San Francisco Bay National Wildlife Refuge Complex and the capacity to conduct the survey is likely within the life of the IMP. The attribute(s) measured by the survey match the attribute(s) measure(s) specified in a SMART goal or objective. These surveys may or may not be linked to a regulatory requirement or other Complex commitment. These are the highest priority surveys for the Complex. Survey status in PRIMR is 'current' or 'expected' over the life of the IMP.	Tables 4-10 (Summary Tables), Table 11 (Survey Narratives)
2	The survey does not meet the conditions specified in tier 1 but the San Francisco Bay National Wildlife Refuge Complex is required by a regulatory agency to carry out the survey. This includes monitoring required by an agency permit or biological opinion. Capacity to conduct these surveys is uncertain. Survey status in PRIMR can be 'current', 'expected', or 'future'.	Appendix C: Permit Surveys
3	The survey does not meet the conditions specified in tier 1 or tier 2. Capacity to conduct these surveys is unlikely unless additional resources are available. These are the lowest priority surveys to carry out or support in the San Francisco Bay National Wildlife Refuge Complex. Survey status in PRIMR can be 'current', 'expected', or 'future'.	Appendix D: Other Surveys

2.3 Prioritizing Surveys

Complex and I&M staff used the National Wildlife Refuge System survey prioritization tool ("Smart Tool," USFWS 2014; version 2.1) to rank surveys. The Smart Tool provides 24 criteria to assist with prioritizing surveys. Refuge staff reviewed the criteria and selected 9 of the original 24 criteria (appendix B). Some of the SMART Tool criteria were modified to promote consistent interpretation by Complex staff. Criteria were also weighted by Complex staff to represent the degree of importance a criterion should have in influencing survey priorities.

2.4 Storing Survey Data in PRIMR

More detailed information about the surveys presented in this IMP, or any survey conducted on the Complex, was documented in PRIMR. As of the time this IMP is published, PRIMR holds the most up-to-date Complex-wide natural resource survey information. Refuge staff should review survey information in PRIMR at regular intervals (such as annually) to ensure survey information is up-to-date. Ideally, persons responsible for maintaining Complex or refuge-specific survey information in PRIMR and ServCat (see section 2.4 'Storing Survey Information in ServCat') are identified and updated, as needed, over time.

2.5 Storing Survey Information in ServCat

ServCat is an online repository designed to centralize, preserve, and provide easy access to important National Wildlife Refuge System information. Survey products should be stored in ServCat (such as protocols, data, reports, or maps). For example, when a survey protocol is becomes available, it is catalogued as a ServCat record and then linked to the appropriate survey in PRIMR. Additionally, any survey-related product stored in ServCat can be linked to PRIMR survey records as they are developed.

To help users find products related to surveys, each survey should be added as a record in ServCat and assigned a "project" reference type. A "project" reference is broadly defined as a record that bundles products, and in this case survey products. Each survey product is also a record in ServCat with an associated reference type (such as a report, protocol, or dataset). For example, a survey in ServCat (represented by a "project" reference type) will bundle survey products like blank datasheets, protocols survey reports, datasets, and maps. For assistance with setting up surveys in ServCat, please contact your regional I&M data manager.

Chapter 3 — Results

A total of 146 surveys were identified in the Complex. Of these, 59 (40%) were tier 1 surveys (tables 4-10), 34 (23%) were 'permit surveys' (tier 2 surveys) (appendix C), and 53 (36%) were 'other' surveys (tier 3 surveys) (appendix D). Tables 4-10 (tier 1 surveys) are organized by refuge, conservation target, and survey priority. A summary of surveys by refuge, ROC, and tier is presented in table 3. Tables 4-10 include basic information about each of the Complex tier 1 surveys. Additional information about tier 1 surveys, such as survey rationale ("Why does the Complex conduct this survey?") and the SMART Complex goal or objective the survey informs is provided in table 11. A complete list of goals and objectives referenced in tables 4-10 is provided in appendix A. The annual timing of surveys across the Complex is presented in appendix E. See PRIMR for additional survey metadata.

Table 3. Distribution of inventory and monitoring surveys across the San Francisco Bay National Wildlife Refuge Complex: refuges, priority resources of concern (conservation target), and survey tiers.

National Wildlife Refuge	*Priority Resource of Concern*[1]	*No. tier 1 surveys*[2]	*No. tier 2 surveys*	*No. tier 3 surveys*	*Total number of surveys*[3]
Antioch Dunes	RDE	3	0	2	5
Don Edwards San Francisco Bay	TME	6	9	5	20
	VPG	6	0	1	7
	WTB	10	1	4	15
Farallon Islands	MIE	12	0	28	40
Marin Islands	EIE	2	0	0	2
	WTB	2	0	0	2
Salinas River	CDE	3	0	2	5
San Pablo Bay	TME	7	21	10	38
	WTB	2	3	1	6
Ellicott Slough	PVW	6	0	0	6
Total number of surveys		59	34	53	146[3]

Table notes: [1]Priority resources of concern (ROC)(aka conservation targets): Riverine Dune Ecosystem (RDE), Tidal Marsh Ecosystem (TME), Vernal Pool Grassland (VPG), Waterbirds (WTB), Marine Islands Ecosystem (MIE), Estuarine Island Ecosystem (EIE), Coastal Dune Ecosystem (CDE), Pajaro Valley Watershed (PVW). [2]Tiers: tier 1 = surveys that directly inform goals and objectives, tier 2 = surveys that are required by a regulatory permit, tier 3 = all other surveys . [3]Excludes surveys related to research.

3.1 Survey Summary Tables: Tables 4-10

The following tables provide basic information about selected (tier 1) surveys for the Complex. A table was constructed for each of the 7 refuges of the Complex. Selected surveys are presented in priority order under each ROC or priority conservation target applicable to the given refuge. Individual survey scores from the SMART Tool will be stored, along with this IMP, in ServCat. Survey scores can be examined in other ways, such as across the Complex as a whole rather than by individual refuge x ROC as they are presented here.

The following notes define and describe fields in tables 4-10.

1. **ROC-Survey Priority.** The priority resource of concern the survey is associated with and the survey priority. The rank for each survey is listed in order of priority for each ROC. ROC acronyms: RDE=riverine dune ecosystem, TME=tidal marsh ecosystem, VPG=vernal pool grasslands, WTB=waterbirds, MIE=marine island ecosystem, CDE=coastal dune ecosystem, PVW=Pajaro Valley Watershed.
2. **Survey ID Number.** A unique identification number consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.
3. **Survey Name (Type).** 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. **Survey Status**. Surveys selected for the timespan of this IMP (i.e., Current, Expected). *=survey also required by a regulatory permit.
5. **Survey Area.** General scope of the survey, ranging from a single unit of the refuge to an international scale survey.
6. **Staff time (FTE).** Estimates of Service (FWS) and/or non-Service (Other) staff time needed to complete the survey (1 work year = 2080 hours = 1 FTE). TBD = to be determined (applies to expected surveys).
7. **Avg. Ann. Cost (OPR).** Estimates of average annual operations costs for conducting the survey during the years it is conducted (e.g. equipment, contracts, travel) but not including staff time (staff time, measured in hours, is documented on the PRIMR database). TBD = to be determined (costs will be calculated when survey planning and protocol development is initiated).
8. **Survey Timing.** Timing and frequency of survey field activities. TBD = to be determined (costs will be calculated when survey planning and protocol development is initiated).
9. **Survey Length.** The years during which the survey is conducted
10. **Survey Coord.** The position of the survey coordinator if lead by the refuge. If the survey is not lead by the refuge, the name of the organization is provided. Specific names of survey leads are maintained in the PRIMR database. Refuge position acronyms: WRS = Wildlife Refuge Specialist, WB = Wildlife Biologist, BOT=botanist, RM=refuge manager. Organization abbreviations: CCC=California Coastal Conservancy, STB=Save the Bay, SFBBO=San Francisco Bay Bird Observatory, PBCS=Point Blue Conservation Science, USGS=U. S. Geological Survey, BFA=Brian Fulfrost and Associates, ACR=Audubon Canyon Ranch, AFWO=Arcata Fish and Wildlife Office, ISP=Invasive Spartina Project, DU=Ducks Unlimited.
11. **Protocol Status.** The current status of survey documentation. Abbreviations: ND=no documentation as of yet, initial survey instructions (ISI), site-specific protocol draft (PD), site-specific protocol in review (PR), or site-specific protocol is approved (PA). Here, ISI means

survey documentation exist, but lacks one or more of the 8 required elements of a survey protocol (USFWS 2013a). All other documentation levels (PD, PR, PA) contain the 8 protocol elements.

12. Cooperative Monitoring (CM) surveys that are not funded directly by the Complex; the cooperator funds the survey or provides in-kind support
13. The survey informs a Complex goal or objective AND is also required by a permit or formal agreement with another organization. These surveys are not repeated in the appendix of Permit Surveys (appendix C).

Table 4. Antioch Dunes National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: riverine dune ecosystem (RDE).

ROC-Survey Priority[1]	*Survey ID Number[2]*	*Survey Name (Type)[3]*	*Survey Status[4]*	*Survey Area[5]*	*Staff Time (FTE)[6]*	*Avg. Ann. Cost (OPR)[7]*	*Survey Timing[8]*	*Survey Length[9]*	*Survey Coord. [10]*	*Protocol Status[11]*
RDE-1	FF08RATD00-006	Vegetation Monitoring: Antioch Dunes NWR (M)	Expected	Entire station	TBD	TBD	Recurring every three years	2020/ Indefinite	WRS	ISI
RDE-2	FF08RATD00-002	Lange's Metalmark Butterfly Survey (M)	Current	Entire station	FWS: 0.07, Other: 0.31	$0	Fall-Spring/ Recurring annually	1986/ Indefinite	WB	ISI
RDE-2	FF08RATD00-012	Lange's Metalmark Pupae Release Success Survey (M)	Expected	Multiple mgt. units	TBD	TBD	Recurring every three years	2020/ Indefinite	WB	ISI

Table 5. Don Edwards San Francisco Bay National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: tidal marsh ecosystem (TME), vernal pool grassland (VPG), and waterbirds (WTB).

Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
TME-1	FF08RSFB00-052	Secretive Marsh Bird Survey (M)[13]	Current	Regional	FWS: 0.1, Other: 0.02	$200	January-April/ Recurring annually	2017-Indefinite	WB	PA
TME-2	FF08RSFB00-010	Western Snowy Plover Window Survey (CM)	Current	Regional	Other: 0.0	$0	May/ Recurring annually	2004-Indefinite	SFBBO	ISI
TME-3	FF08RSFB00-046	Invasive Spartina Survey (CM)	Current	Multiple stations	FWS: 0.01, Other: 0.01	$50	June-September/ Recurring annually	2000-Indefinite	CCC	ISI
TME-4	FF08RSFB00-044	Habitat Evolution Mapping Project (HEMP) (CM)[13]	Expected	Multiple mgt. units	TBD	TBD	Summer/ Recurring every five years	2019- 2021	BFA	ND
TME-5	FF08RSFB00-048	La Riviere Monitoring Survey (FLAP project): Vegetation Survey (M)[13]	Current	Single mgt. unit	N/A	$0	Fall/winter/ Recurring annually	2017- 2027	WB	ISI
TME-6	FF08RSFB00-017	Weed Inventory and Monitoring (M)	Current	Entire station	N/A	$0	Spring/ Recurring annually	2010-Indefinite	WB	ISI
TME-6	FF08RSFB00-065	Bair Island Restoration Project: ecotone vegetation composition monitoring (CM)	Current	Single mgt. unit	N/A	$0	Spring/ Recurring annually	2016- 2022	STB, SFBBO	ISI
VPG-1	FF08RSFB00-024	Vernal Pool Vegetation Survey (2012-current) (M)[13]	Current	Single mgt. unit	FWS: 0.04, Other: 0.03	$0	Spring/ Recurring annually	2012-Indefinite	BOT	ISI

Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
VPG-2	FF08RSFB00-026	Native Plant Restoration Success Survey (M)	Expected	Single mgt. unit	TBD	TBD	Spring, Summer/ Recurring every three years	2023-Indefinite	BOT	ND
VPG-3	FF08RSFB00-027	Vernal Pool Hydroperiod Survey (M)	Current	Single mgt. unit	FWS: 0.03, Other: 0.03	$0	Beginning of the wet season until pools are dry, typically Dec-June/ Recurring annually	2012-Indefinite	BOT	ISI
VPG-4	FF08RSFB00-015	Residual Dry Matter Survey (M)[13]	Current	Single mgt. unit	FWS: 0.02	$0	September to October / Recurring annually	2004-Indefinite	WRS	ISI
VPG-5	FF08RSFB00-028	California Tiger and Salamander and Vernal Pool Tadpole Shrimp Survey (M)[13]	Current	Single mgt. unit	FWS: 0.08, Other: 0.08	$0	December-April, every 4 weeks / Recurring annually	2012-Indefinite	BOT	ISI
VPG-6	FF08RSFB00-029	Summer Vegetation Survey (M)	Current	Single mgt. unit	FWS: 0.07, Other: 0.05	$0	June to July/ Recurring annually	2017-Indefinite	WRS	ISI
WTB-1	FF08RSFB00-008	Managed and Salt Pond Waterbird Survey (CM)[13]	Current	Regional	N/A	$0	Year-round/ Recurring annually	2002-Indefinite	SFBBO	ISI

Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
WTB-2	FF08RSFB00-006	Mid-Winter Waterfowl Survey (CM)	Current	National	FWS: 0.01	$0	First week in January/ Recurring annually	1981-Indefinite	USGS	ISI
WTB-3	FF08RSFB00-061	Managed Ponds: Water Monitoring (M)[13]	Current	Multiple mgt. units	FWS: 0.07, Other: 0.01	$1,500	Year-round/ Recurring annually	2004-Indefinite	RM	ISI
WTB-4	FF08RSFB00-057	Avian Predator Nest Survey (M)	Current	Regional	Other: 0.04	$0	March-June/ Recurring annually	2013-Indefinite	WB	ISI
WTB-4	FF08RSFB00-058	Avian Predator Survey (CM)	Current	Regional	FWS: 0.0, Other: 0.08	$200	March-September/ Recurring annually	2004-Indefinite	SFBBO	ISI
WTB-5	FF08RSFB00-062	Predator Management Effectiveness Survey (M)	Expected	Regional	TBD	TBD	TBD/ Recurring annually	2023-Indefinite	TBD	ND
WTB-6	FF08RSFB00-009	Pacific Flyway Migratory Shorebird Project (CM)	Current	Regional	FWS: 0.02	$0	November/ Recurring annually	1992-Indefinite	PBCS	ISI
WTB-7	FF08RSFB00-064	Managed Ponds: Vegetation Monitoring (M)	Current	Multiple mgt. units	FWS: 0.01, Other: 0.02	$0	Feb-March; Sept-Oct/ Recurring annually	2017-Indefinite	WB	ISI
WTB-8	FF08RSFB00-007	Colonial Waterbird Breeding Season Surveys (CM)	Current	Regional	Other: 0.01	$0	February-August/ Recurring annually	1984-Indefinite	SFBBO	ISI

Table 6. Farallon Islands National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: marine island ecosystem (MIE).

ROC-Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
MIE-1	FF08RFRL00-021	Ashy and Leach's Storm-petrel Reproductive Performance Survey (CM)	Current	Single management unit	FWS: 0.0	$0.00	April-November/ Recurring annually	1971 - Indefinite	PBCS	ISI
MIE-2	FF08RFRL00-004	Capture-recapture of Ashy and Leach's Storm-Petrels (CM)	Current	Multiple management units	FWS: 0.0	$75,000	April 1-August 15/ Recurring annually	1992 - Indefinite	PBCS	ISI
MIE-3	FF08RFRL00-026	Burrowing Owl Population Monitoring (CM)[12]	Current	Single management unit	FWS: 0.35	$0.00	Fall-Spring/ Recurring annually	1969 - Indefinite	PBCS	ISI
MIE-3	FF08RFRL00-037	Non-native Small Mammal Presence-absence Surveys (CM)[12]	Expected	Single management unit	FWS: 0.0	$0.00	daily/ Recurring annually	2023 - Indefinite	RM	ND
MIE-4	FF08RFRL00-049	Vegetation Monitoring: Farallon Islands NWR (CM)[12]	Current	Single management unit	FWS: 0.02	$30,000	Early spring (March-April)/ Recurring annually	2017 - Indefinite	WRS, RM	ISI
MIE-5	FF08RFRL00-031	Cassin's Auklet Reproductive Performance (CM)	Current	Single management unit	FWS: 0.0	$0.00	Spring-Summer/ Recurring annually	1971 - Indefinite	PBCS	ISI
MIE-6	FF08RFRL00-045	Rhinoceros Auklet Reproductive Performance (CM)	Current	Single management unit	FWS: 0.0	$0.00	Spring-Summer/ Recurring annually	1985 - Indefinite	PBCS	ISI

ROC-Survey Priority[1]	Survey ID Number[2]	Survey Name (Type)[3]	Survey Status[4]	Survey Area[5]	Staff Time (FTE)[6]	Avg. Ann. Cost (OPR)[7]	Survey Timing[8]	Survey Length[9]	Survey Coord.[10]	Protocol Status[11]
MIE-7	FF08RFRL00-012	Weekly Pinniped Census (CM)	Current	Single management unit	FWS: 0.0	$66,000	Weekly, January to August/ Recurring annually	1970 - Indefinite	PBCS	ISI
MIE-8	FF08RFRL00-028	Cassin's Auklet and Rhinoceros Auklet Capture-Recapture Survey (CM)	Current	Single management unit	FWS: 0.0	$0.00	Spring-Summer/ Recurring annually	1991 - Indefinite	PBCS	ISI
MIE-9	FF08RFRL00-034	Farallon Camel Cricket Survey (CM)[12]	Current	Single management unit	FWS: 0.0	$0.00	quarterly/ Recurring annually	2013 - Indefinite	PBCS	ISI
MIE-10	FF08RFRL00-007	Arboreal Salamander Long Term Monitoring (CM)[12]	Current	Multiple management units	FWS: 0.0	$0.00	Rainy season (Fall-Spring)/ Recurring annually	2007 - Indefinite	PBCS	ISI
MIE-11	FF08RFRL00-025	Brandt's Cormorant, Pelagic Cormorant, and Common Murre Population Size (CM)	Current	Single management unit	FWS: 0.0	$24,000	June/ Recurring annually	1971 - Indefinite	PBCS	ISI

Table 7. Marin Islands National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: estuarine island ecosystem (EIE).

ROC-Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
EIE-1	FF08RMRI00-003	Invasive Plant Inventory: Marin Islands NWR (I)	Current	Entire station	FWS: 0.03	$15,000	spring, summer, winter/ Occurs one time only	2018	WB	ISI
EIE-2	FF08RMRI00-004	Vegetation Monitoring: Marin Islands NWR (M)	Current	Entire station	FWS: 0.01	$0	spring, summer, winter/ Recurring every three years	2019-Indefinite	WB	ISI
WTB-1	FF08RMRI00-008	Predator Management Effectiveness Survey: Marin Islands NWR (M)	Expected	Regional	TBD	TBD	TBD/ Recurring annually	2023-Indefinite	RM	ND
WTB-2	FF08RMRI00-002	Marin Islands: Colonial Nesting Waterbird Survey (M)	Current	Single mgt. unit	Other: 0.03	$0	February-August/ Recurring annually	1976-Indefinite	ACR	ISI

Table 8. Salinas River National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: coastal dune ecosystem (CDE).

ROC-Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.* [10]	*Protocol Status*[11]
CDE-1	FF08RSLN00-005	Coastal Dune Vegetation Survey: Salinas River NWR (M)	Expected	Entire station	TBD	TBD	May to October / Recurring every five years	2019 - Indefinite	WB	ND
CDE-2	FF08RSLN00-002	Western Snowy Plover Productivity Survey (CM)	Current	Regional	FWS: 0.14, Other: 0.12	$300	March-Sept/October/ Recurring annually	1987 - Indefinite	PBCS	ISI
CDE-3	FF08RSLN00-006	Smith's Blue Butterfly Survey (M)	Current	Entire station	FWS: 0.04, Other: 0.0	$50	Mid-June to mid-August/ Recurring annually	2015 - Indefinite	WB	ISI

Table 9. San Pablo Bay National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: tidal marsh ecosystem (TME), waterbirds (WTB).

ROC-Survey Priority[1]	*Survey ID Number*[2]	*Survey Name (Type)*[3]	*Survey Status*[4]	*Survey Area*[5]	*Staff Time (FTE)*[6]	*Avg. Ann. Cost (OPR)*[7]	*Survey Timing*[8]	*Survey Length*[9]	*Survey Coord.*[10]	*Protocol Status*[11]
TME-1	FF08RSNP00-049	Secretive Marsh Bird Survey: Don Edwards San Francisco Bay and San Pablo Bay NWRs (M)	Current	Regional	FWS: 0.09, Other: 0.02	$100	January-April/ Recurring annually	2005-Indefinite	WB	PA
TME-2	FF08RSNP00-065	Salt Marsh Extent Monitoring (M)	Expected	Multiple mgt. units	TBD	TBD	Recurring every five years	2023-Indefinite	WB	ND
TME-3	FF08RSNP00-055	Sonoma Creek: Sediment Accretion Surveys (M)	Current	Single mgt. unit	FWS: 0.01	$0	summer/ Recurring every two years	2016- 2026	WB	ISI
TME-3	FF08RSNP00-031	Cullinan Ranch: Sedimentation (CM)	Current	Single mgt. unit	FWS: 0.01	$50	May/ Recurring every five years	2016-2031	DU	ISI
TME-4	FF08RSNP00-005	Invasive Spartina Survey (CM)	Current	Regional	N/A	$0	June-September/ Recurring annually	2000-Indefinite	CCC, ISP	ISI
TME-5	FF08RSNP00-016	Tidal Marsh Transition Zone Native Plant Restoration Monitoring (CM)	Current	Multiple mgt. units	FWS: 0.0	$0	Summer/ Recurring annually	2007-Indefinite	PBCS	ISI
TME-5	FF08RSNP00-033	*Lepidium latifolium* Monitoring: San Pablo Bay NWR (M)	Expected	Multiple mgt. units	FWS: 0.01	$0	Summer/ Recurring every three years	2023-Indefinite	WB	ND
WTB-1	FF08RSNP00-011	San Francisco Bay Mid-Winter Waterfowl Survey (CM)	Current	National	FWS: 0.0, Other: 0.0	$0	winter/ Recurring annually	1988-Indefinite	USGS	ISI
WTB-2	FF08RSNP00-006	Pacific Flyway Migratory Shorebird Project (CM)	Current	Regional	FWS: 0.09, Other: 0.02	$100	Fall/ Recurring annually	2006-Indefinite	USGS	ISI

Table 10. Ellicott Slough National Wildlife Refuge selected surveys (tier 1). Surveys are focused on the following priority resources of concern: Pajaro Valley Watershed (PVW).

ROC-Survey Priority[1]	***Survey ID Number[2]***	***Survey Name (Type)[3]***	***Survey Status[4]***	***Survey Area[5]***	***Staff Time (FTE)[6]***	***Avg. Ann. Cost (OPR)[7]***	***Survey Timing[8]***	***Survey Length[9]***	***Survey Coord.[10]***	***Protocol Status[11]***
PVW-1	FF08RELS00-007	Pond Hydrology Survey: Ellicott Slough NWR (M)	Current	Entire station	FWS: 0.03, Other: 0.0	$400	year-round/Recurring annually	2013-Indefinite	WB	ISI
PVW-2	FF08RELS00-009	Salamander Population Dynamics: Ellicott Slough NWR (M)	Expected	Entire station	TBD	TBD	Recurring annually	2020-Indefinite	WB	ND
PVW-3	FF08RELS00-010	Landcover Survey: woodland and grassland (M)	Current	Entire station	N/A	$0	Recurring annually	2018-Indefinite	WB	ISI
PVW-4	FF08RELS00-006	Vegetation Monitoring: Ellicott Slough NWR (M)	Current	Entire station	N/A	$0	Recurring every five years	2018-Indefinite	WB	ISI
PVW-5	FF08RELS00-005	Dipnet Survey: special status amphibian species (M)	Current	Entire station	FWS: 0.06, Other: 0.01	$100	April-July, 2 surveys per pond/Recurring annually	1998-Indefinite	RM	ISI
PVW-6	FF08RSLN00-004	Visual Encounter Survey: special status amphibian species (M)12	Current	Entire station	FWS: 0.04, Other: 0.01	$100	October-March, night time/Recurring annually	1990-Indefinite	Diane Kodama (RM)	ISI

3.2 Survey Narratives

Table 11. San Francisco Bay National Wildlife Refuge Complex tier 1 survey narratives and corresponding SMART goals and objectives the survey informs.

Table Notes:

1. **Refuge.** National Wildlife Refuge System LIT code: Antioch Dunes (ATD), Don Edwards San Francisco Bay (SFB), Farallon Islands (FRL), Marin Islands (MRI), Salinas River (SLR), San Pablo Bay (SNP), Elicott Slough (ELS).
2. **ROC ID and Survey Priority.** Priority Resource of Concern the survey is associated with. Abbreviations: CDE = Coastal Dune Ecosystem, EIE = Estuarine Island Ecosystem, MIE = Marine Island Ecosystem, PVW = Pajaro River Watershed, RDE = Riverine Dune Ecosystem, TME = Tidal Marsh Ecosystem, VPG = Vernal Pool Grassland, WTB = Waterbirds.
3. **Management Goal or Objective ID: Indicator.** SMART goals or objectives the survey informs and the associated indicator that is measured. Source: San Francisco Bay National Wildlife Refuge Complex Natural Resource Management Plan or endangered species recovery plan.
4. **Rationale.** Rationale's based on information in the San Francisco Bay National Wildlife Refuge Complex Natural Resource Management Plan (USFWS 2019). Please see this plan for the list of literature cited.

Refuge [1]	*ROC ID - Survey Priority* [2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
ATD	RDE-1	FF08RATD00-006	Vegetation Monitoring: Antioch Dunes NWR	RDE_G01, RDE_G02, RDE_O02, RDE_O03, RDE_O09, RDE_O10, RDE_O11: % open sand, % plant cover (native, invasive)	This survey evaluates the status and trends of vegetation cover and composition at Antioch Dunes NWR. Sand dune vegetation cover and composition is indicated by 1) % cover open sand (non-vegetated) and 2) % cover desirable native plant species (dune-associated and beneficial to Lange's metalmark butterfly). Understanding the status and trends of dune vegetation is critical to the recovery and health of the sand dune ecosystem at Antioch Dunes NWR because changes in vegetation cover and composition have a strong influence on dune-dependent species, and therefore biodiversity. For example, the federally endangered Lange's metalmark butterfly (*Apodemia mormo langei*, LMB) relies on dune-adapted plant species, such as naked stem buckwheat (*Eriogonum nudum var. psychicola*), for its continued existence. The health of the vegetation community is also indicative of intact ecological processes such as sand movement and sand dune formation. Without such processes, the health and continued existence of dune plants and wildlife are at risk. Lastly, it is important to understand the status and trends of federally endangered species, such as Contra Costa wallflower (*Erysimum capitatum var. capitatum*) and Antioch Dunes evening primrose (*Oenothera deltoides var. howellii*).

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
ATD	RDE-02	FF08RATD00-002	Lange's Metalmark Butterfly Survey	RDE_O06: Lange's metalmark butterfly population size	This survey evaluates the status and trends of Lange's metalmark butterfly (LMB) population size at Antioch Dunes NWR. LMB population size is a key ecological attribute of the riverine sand dune ecosystem at Antioch Dunes NWR because the continued existence of the species is dependent, in part, on the health and integrity of the riverine dune ecosystem. The entire lifecycle of the butterfly occurs only in the remnant dunes found on the refuge. LMB relies on dune-associated plant species to survive, such as naked stem buckwheat and other nectar plants. It is unknown whether a small LMB population size is creating a genetic bottleneck and limiting the ability of the species to recover, even if many components of the ecosystem are restored. Small populations are at a greater risk of extinction because they are subject to inbreeding (mating between closely related individuals) and subsequently a loss of genetic diversity. An intensive examination of genetic issues and minimum effective population size is needed to understand the potential for LMB recovery.
ATD	RDE-03	FF08RATD00-012	Lange's Metalmark Pupae Release Success Survey	RDE_G03, RDE_O04: Lange's metalmark presence/absence	This survey evaluates the efficacy of a management strategy to propagate and release the federally endangered LMB at Antioch Dunes NWR. The Antioch Dunes NWR recovery plan (USFWS 1984) recommended that controlled rearing of LMB should be performed to safeguard against extinction, especially following severe population declines in 2006-2007. A captive propagation program for LMB began in 2007 and is expected to continue. Although the propagation has been ongoing since 2007, it is uncertain whether pupae released onto the refuge actually survive and ultimately contribute to recovery of LMB.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
ELS	PVW-01	FF08RELS00-007	Pond Hydrology Survey: Ellicott Slough NWR	PVW_G03: number of weeks pond water depth is ≥1-foot	This survey evaluates the status and trends in pond hydroperiods at Ellicott Slough NWR. Pond hydroperiod is indicated by the number of continuous weeks ponds at ELS (N=4) hold at least one foot in water depth between December 1 and June 30 (assessed for each pond, N=4). Pond hydroperiod is a key ecological attribute (KEA) of the Pajaro River watershed, of which the refuge is a part. It is a KEA because native amphibian species that use the ponds, such as the federally threatened California tiger salamander (CTS, *Ambystoma californiense*) and federally endangered Santa Cruz long-toed salamander (SCLTS, *Ambystoma macrodactylum croceum*), are dependent on pond water conditions for reproduction (egg and larval stage to metamorphosis). The amount and period of pond water is driven by annual precipitation patterns. The refuge has the capacity to manage water levels at 3 of the 4 ponds: one has a well and water control structures, one has a water control structure (flashboard riser), and one has a well. This survey helps inform what actions, if any, are necessary to support sensitive amphibian species such as CTS and SCLTS.
ELS	PVW-02	FF08RELS00-009	Salamander Population Dynamics: Ellicott Slough NWR	PVW_G04: Santa Cruz long-toed salamander and California tiger salamander population size	This survey evaluates status and trends in population size of two salamander species, the federally endangered Santa Cruz long-toed salamander (SCLTS, *Ambystoma macrodactylum croceum*) and the federally threatened California tiger salamander *(CTS, Ambystoma californiense)* at Ellicott Slough NWR. Population size of these species is a key ecological attribute of the Pajaro Valley watershed (of which the refuge is a part of) because healthy salamander populations is indicative of a healthy watershed. The life cycle of these two salamander species is dependent on the quantity and quality of uplands (woodlands and grassland) and wetlands (waterways, ephemeral ponds). Trends in salamander population size can reflect the changes in the quantity and quality of these environments and the watershed as a whole. This survey, once a protocol is developed and the survey is implemented, will replace the dipnet survey.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
ELS	PVW-03	FF08RELS00-010	Landcover Survey: woodland and grassland	PVW_G04: % cover woodlands and grasslands	This survey evaluates the status and trend in the extent of woodlands and grasslands at Ellicott Slough NWR. Along with wetlands (such as ephemeral ponds), grasslands and woodlands provide important habitat for sensitive species of the Pajaro River watershed such as the federally endangered Santa Cruz long-toed salamander (SCLTS, *Ambystoma macrodactylum croceum*) and federally threatened California Tiger salamander *(CTS, Ambystoma californiense)*. Both species seasonally migrate through these environments. They also spend most of the summer underground in these upland environments. CTS use small mammal burrows, such as those of ground squirrels and pocket gophers, found in open grasslands. The SCLTS prefers small mammal burrows found in woodlands and will burrow along the root systems of oaks and willows. Therefore, changes in the extent of high-quality grasslands and woodlands will influence the biodiversity of the Pajaro River watershed.
ELS	PVW-04	FF08RELS00-006	Vegetation Monitoring: Ellicott Slough NWR	PVW_O07: plant species presence-absence, richness, and % cover	This survey evaluates the status and trends of vegetation cover and composition at Ellicott Slough NWR in response to management activities aimed at reducing the abundance and distribution of invasive plant populations. Invasive plants deteriorate the ecological integrity of coastal scrub, oak woodland, and wetland native plant communities found at the refuge. They change vegetation composition and structure, making them less suitable for special status species such as the federally endangered SCLTS, federally threatened CTS, and federally threatened California red-legged frog (*Rana draytonii*). For example, invasive plants can affect the viability of ephemeral breeding ponds either directly by altering the inundation regime or more indirectly by changing the hydrology of the surrounding watershed. Further, invasive species such as eucalyptus (*Eucalyptus* spp.), jubata grass (*Cortaderia jubata*) and pampas grass (*Cortaderia selloana*) reduce the area available for native vegetation, and thus reduce the availability of root systems that are preferred by the SCLTS for underground refuge. The presence of non-native invasive plants may also reduce the numbers of invertebrates available as prey for SCLTS (Service 2009). Measures taken from this survey will be evaluated relative to SMART vegetation management objectives and ultimately used to adapt management strategies as needed. A baseline assessment of invasive plants is expected in 2019. Results from this initial baseline survey will information inform new refuge management objectives.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
ELS	PVW-05	FF08RELS00-005	Dipnet Survey: special status amphibian survey	PVW_G02: California tiger salamander and Santa Cruz long-toed salamander larvae presence-absence	This survey evaluates the reproductive success of sensitive amphibian species: the federally endangered Santa Cruz long-toed salamander (SCLTS, *Ambystoma macrodactylum croceum*), the federally threatened California tiger salamander *(CTS, Ambystoma californiense)*, and federally threatened California red-legged frog (*Rana draytonii*) in ephemeral ponds at Ellicott Slough NWR. Reproductive success of these species is a key ecological attribute of the Pajaro River watershed (of which the refuge is a part of) because their success is indicative of a healthy watershed. The life cycle of these native amphibian species is dependent on the quantity and quality of uplands (woodlands and grassland) and wetlands (waterways, ephemeral ponds). Trends in amphibian reproductive success can therefore reflect the changes in the quantity and quality of these environments and the watershed as a whole. Survey measures will be evaluated relative to SMART refuge goals or objectives (see above) and used to adapt management strategies if progress is not achieved as expected. The dipnet survey provides an index of population size. The refuge is working towards developing methods to better estimate population size of salamanders on the refuge. If successful, such a survey would likely replace the dipnet survey.
ELS	PVW-06	FF08RELS00-004	Visual Encounter Survey: special status amphibian species	PVW_G01: Santa Cruz long-toed salamander and California tiger salamander population size	This survey serves as an index of population size for two salamander species: the federally endangered Santa Cruz long-toed salamander (SCLTS, *Ambystoma macrodactylum croceum*) and the federally threatened California tiger salamander *(CTS, Ambystoma californiense)* at Ellicott Slough NWR. Population size of these species is a key ecological attribute of the Pajaro River watershed (of which the refuge is a part of) because healthy salamander populations are indicative of a healthy watershed. The life cycle of these two salamander species is dependent on the quantity and quality of uplands (woodlands and grassland) and wetlands (waterways, ephemeral ponds). Trends in salamander population size can reflect the changes in the quantity and quality of these environments and the watershed as a whole. This survey will eventually be replaced by a survey aimed at estimating the size of salamander populations at the refuge ("Salamander Population Dynamics: Ellicott Slough NWR").

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
FRL	MIE-01	FF08RFRL00-021	Ashy and Leach's storm-petrel Reproductive Performance Survey	MIE_O06: number of ashy storm-petrel active nests	This survey evaluates the success of management actions aimed at increasing nesting habitat for crevice-nesting seabird species at Farallon Islands NWR. Talus slopes are used by crevice nesting storm-petrels and other seabird species (such as auklets, guillemots and puffins) for nesting. Talus slopes were altered or lost when humans constructed buildings and other human infrastructure at the refuge. Although most buildings have been removed, many concrete foundations remain, thereby rendering habitat unusable for nesting seabirds. Enhancement of crevice nesting habitat involves conversion of human infrastructure or removal of human infrastructure (when reuse is not possible) to create nesting habitat for crevice-nesting seabirds. The expected result is that crevice-nesting species will use newly created or enhanced nesting habitat and ultimately lead to improved reproductive success at Farallon Islands NWR.
FRL	MIE-02	FF08RFRL00-004	Capture-recapture of Ashy and Leach's Storm-Petrels	MIE_G01: ashy storm petrel population size	Data from this survey is used to generate an index of population trends for Ashy storm petrel (*Oceanodroma homochroa*) and Leach's storm petrel (*Oceanodroma leucorhoa*) at Farallon Islands NWR. The refuge supports the world's largest colony and approximately 50% of the world population of ASSP (Warzybok et. al. 2016). Further, the species has unique food requirements, exploiting more pelagic foraging grounds than most other California seabird breeding species and feeds on deep dwelling fish and invertebrates that migrate to the surface at night. They also have unique breeding habitat requirements, using small rock crevices in talus slopes and artificial rock walls.
FRL	MIE-03	FF08RFRL00-026	Burrowing Owl Population Monitoring	MIE_O04: % burrowing owl population size	This survey evaluates the efficacy of a management strategy to eradicate invasive rodent species (mice) and reduce populations of predatory burrowing owls from Farallon Islands NWR. Mice and burrowing owls are critical threats to the biodiversity of the marine island ecosystem at the refuge. For example, mice provide food for and therefore attract fall migrant burrowing owls. When the mouse population crashes in winter, owls switch to preying primarily on ashy storm-petrels and reduces storm-petrel adult survivorship and population size (Nur et al. 2013, USFWS 2013, Chandler et al. 2016). It is assumed that eradication of mice will result in reduced prey for migrating burrowing owls. As a result, owl populations and their predation on seabirds is expected to decrease.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
FRL	MIE-03	FF08RFRL00-037	Non-native Small Mammal Presence-absence Surveys	MIE_O02: non-native house mouse presence-absence	This survey evaluates the efficacy of a management strategy to eradicate invasive rodent species (mice) from Farallon Islands NWR. Mice are a critical threat to the biodiversity of the marine island ecosystem at FRL. For example, mice provide food for and therefore attract fall migrant burrowing owls. When the mouse population crashes in winter, owls switch to preying primarily on ashy storm-petrels and negatively impact their population (Nur et al. 2013, USFWS 2013, Chandler et al. 2016). Mice also feed on native plants and plant seeds, native invertebrates including endemic camel crickets, and possibly on juvenile salamanders. Mice may also compete with salamanders for invertebrate prey (USFWS 2013).
FRL	MIE-04	FF08RFRL00-049	Vegetation Monitoring: Farallon Islands NWR	MIE_G03 MIE_O03, MIE_O08, MIE_O10: plant species presence-absence, % cover, and distribution	This survey evaluates the efficacy of a management strategy to reduce or eradicate invasive plant species from Farallon Islands NWR. Invasive plants out-compete the mostly annual native plant community and could lead to extirpation or near extirpation of some native plant species. Anecdotal observations also suggest that non-native invasive species-dominated areas are avoided by nesting seabirds and Farallon arboreal salamanders (*Aneides lugubris farallonensis*). Results from this survey will be used to inform where to focus management actions and to evaluate success of actions taken, learn, and adapt management actions (as needed).

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
FRL	MIE-05	FF08RFRL00-031	Cassin's Auklet Reproductive Performance	MIE_O05: % of climate smart nest boxes in use by Cassin's auklets	This survey serves two purposes: 1) to generate an index of population trends for five seabird species inhabiting Farallon Islands NWR and 2) to evaluate the success of management actions aimed at increasing nesting habitat crevice nesting seabird species at the refuge. The five species monitored to evaluate seabird population trends are: Cassin's auklet (*Ptychoramphus aleuticus*), Rhinoceros auklet (*Cerorhinca monocerata*), common murre (*Uria aalge*), Brandt's cormorant (*Phalacrocorax penicillatus*), and Pelagic cormorant (*Phalacrocorax pelagicus*). These species were selected by refuge staff to represent the diversity of seabird habitat requirements (breeding, food) among seabird species that utilize the refuge. Further, they are identified as priority monitoring target in the USFWS California Current Seabird Monitoring Plan. All species can be monitored concurrently but methods of assessing population trends varies. Talus slopes are used by crevice nesting storm-petrels and other seabird species (such as auklets, guillemots and puffins) for nesting. Talus slopes were altered or lost when humans constructed buildings and other human infrastructure at the refuge. Although most buildings have been removed, many concrete foundations remain, thereby rendering habitat unusable for nesting seabirds. Enhancement of crevice nesting habitat involves conversion of human infrastructure or removal of human infrastructure (when reuse is not possible) to create nesting habitat for crevice-nesting seabirds. The expected result is that crevice nesting auklets will use this newly available nesting habitat and contribute to increased reproductive success at Farallon Islands NWR.
FRL	MIE-06	FF08RFRL00-045	Rhinoceros Auklet Reproductive Performance	MIE_O05: % of climate smart nest boxes in use by rhinoceros auklets	This survey evaluates the success of management strategy to create or enhance nesting habitat for crevice-nesting seabird species at Farallon Islands NWR. Talus slopes are used by crevice nesting storm-petrels and other seabird species (such as auklets, guillemots and puffins) for nesting. Talus slopes were altered or lost when humans constructed buildings and other human infrastructure at the refuge. Although most buildings have been removed, many concrete foundations remain, thereby rendering habitat unusable for nesting seabirds. Enhancement of crevice nesting habitat involves conversion of human infrastructure or removal of human infrastructure (when reuse is not possible) to create nesting habitat for crevice-nesting seabirds. The expected result is that crevice-nesting species will use newly created or enhanced nesting habitat and ultimately lead to improved reproductive success at the refuge.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
FRL	MIE-07	FF08RFRL00-012	Weekly Pinniped Census	MIE_G04: pinniped species richness and population size	This survey evaluates the status and trends of pinniped populations inhabiting Farallon Islands NWR. Like seabirds and native flora, pinnipeds are an important component of biodiversity at the refuge. Five species of marine mammals breed or haul-out on the Refuge: northern fur seal (*Callorhinus ursinus*), Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), and northern elephant seal (*Mirounga angustirostris*). In addition, the rare Guadalupe fur seal (*Arctocephalus townsendi*) has been recorded around the refuge. There are no accurate historical estimates available for most species. However, historic accounts suggest that pinnipeds numbered in the tens to hundreds of thousands or more prior to human occupation. Because of their size and concentrations, pinnipeds have a strong influence on island vegetation and wildlife habitats. The health of pinnipeds, like seabirds, is representative of the health of the ecosystems upon which they depend – including both the terrestrial islands and the surrounding ocean ecosystem. Like seabirds, pinnipeds are sensitive to changes in prey abundance, ocean conditions, and related environmental threats (such as human disturbance and climatic changes) (Berger 2017).
FRL	MIE-08	FF08RFRL00-028	Cassin's Auklet and Rhinoceros Auklet Capture-Recapture Survey	MIE_G02: Cassin's and rhinoceros auklet population index	This survey helps evaluate status and trends of five seabird species inhabiting Farallon Islands NWR using a population index. The species are Cassin's auklet, Rhinoceros auklet, common murre, Brandt's cormorant, and Pelagic cormorant. These species were selected by refuge staff to represent the diversity of seabird habitat requirements (breeding, food) among seabird species that utilize the refuge. Further, they are identified as priority monitoring target in the USFWS California Current Seabird Monitoring Plan. All species can be monitored concurrently, but methods of assessing population trends varies.
FRL	MIE-09	FF08RFRL00-034	Farallon Camel Cricket Survey	MIE_O03: Farallon camel cricket population size	This survey evaluates the response of Farallon camel cricket populations to invasive mouse eradication at Farallon Islands NWR. Invasive mice are critical threats to the biodiversity of the marine island ecosystem of the refuge and it is assumed when mice are eradicated, camel cricket populations will increase.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
FRL	MIE-10	FF08RFRL00-007	Arboreal Salamander Long Term Monitoring	MIE_O03: arboreal salamander population size	This survey evaluates the response of arboreal salamander populations to invasive mouse eradication at Farallon Islands NWR. Invasive mice are critical threats to the biodiversity of the marine island ecosystem of the refuge and it is assumed when mice are eradicated, arboreal salamander populations will increase.
FRL	MIE-11	FF08RFRL00-025	Brandt's Cormorant, Pelagic Cormorant, and Common Murre Population Size	MIE_G02: Brandt's cormorant, pelagic cormorant, and common murre population size	This survey helps evaluate status and trends of 5 seabird species inhabiting Farallon Islands NWR using a population index. The species are Cassin's auklet (*Ptychoramphus aleuticus*), Rhinoceros auklet (*Cerorhinca monocerata*), common murre (*Uria aalge*), Brandt's cormorant (*Phalacrocorax penicillatus*), and Pelagic cormorant (*Phalacrocorax pelagicus*). These species were selected by refuge staff to represent the diversity of seabird habitat requirements (breeding, food) among seabird species that utilize the refuge. Further, they are identified as priority monitoring target in the USFWS California Current Seabird Monitoring Plan. All species can be monitored concurrently but methods of assessing population trends varies.
MRI	EIE-01	FF08RMRI00-003	Invasive Plant Inventory: Marin Islands NWR	EIE_O02: distribution and abundance (% cover) of priority invasive plants	This survey documents the distribution and abundance of priority invasive plants at Marin Islands NWR. This information is needed to refine the 2005 Marin Islands vegetation management plan (Baye 2005). Revisions will focus on refining what actions to take, where, and when based on results of the inventory. Information for this survey will be used to inform new vegetation management objectives, inform a new vegetation monitoring protocol, and serve as a baseline for future comparisons.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
MRI	EIE-02	FF08RMRI00-004	Vegetation Monitoring: Marin Islands NWR	EIE_G01, EIE_G02, EIE_G03, EIE_O04, EIE_O05: presence-absence and density of native *Platanthera* species; % plant cover (native, non-native, invasive)	This survey serves 2 purposes: 1) evaluate the status and trends of plant composition, distribution, and abundance and 2) evaluate efficacy of vegetation management at Marin Islands NWR. Native plant community composition form the principal biotic structure of the terrestrial portion of the Marin Islands and provide habitat for a variety of wildlife including birds, insects, reptiles, and amphibians. As such, changes in native vegetation cover and composition are likely to have a cascading effect on wildlife and influence the long-term biodiversity of the islands, including unique plant and animal genotypes that have formed since island isolation (>3,00 yr B.P.). Three indicators were selected to indicate status and trends of native plant community composition and abundance on East Marin Island: 1) native plant species richness, 2) relative cover of native plants (%), and 3) population density of 3 native orchid species. The abundance and richness of native plants have commonly been used as indicators of ecological restoration success, and several studies have found correlates between vegetation, recovery of wildlife populations (such as birds and insects) and ecological processes (such as nutrient availability) (Ruiz-Jaen and Aide 2005). The population status of the three native orchid species was selected as an indicator due to rarity and unique ecology of the species.
MRI	WTB-01	FF08RMRI00-008	Predator Management Effectiveness Survey: Marin Islands NWR	WTB_O03: presence-absence of raccoons	This survey evaluates the effectiveness of predator management aimed at reducing the presence of raccoons at Marin Islands NWR. Predator management at Marin Islands NWR (proposed as of 2017) is expected to reduce mortality of and disturbance to colonial nesting waterbirds who breed at the refuge. Predation is thought to be the number one cause of colonial nesting waterbird nest failure.
MRI	WTB-02	FF08RMRI00-002	Marin Islands: Colonial Nesting Waterbird Survey	WTB_G02: Number of colonial nesting waterbird breeding pairs (herons, egrets)	This survey evaluates the status and trend in colonial nesting waterbird populations (N = 4 species) at Marin Islands NWR. Waterbirds are a priority conservation target for San Francisco NWR Complex and include the heron and egret rookery of the refuge. Marin Islands NWR was also established to protect the rookery. The heron and egret rookery spans both East Marin Island and West Marin Island and its presence dates back to at least the 1920s. Monitoring since the late 1960s indicates that the Marin Islands (primarily West Marin Island) have supported one of the largest heron and egret rookeries in the San Francisco Bay area (USFWS 2007).

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SFB	TME-01	FF08RSFB00-052	Secretive Marsh Bird Survey: Don Edwards San Francisco Bay and San Pablo Bay NWRs	TME_G01, TME_G02: California Ridgway's rail population size	This survey evaluates status and trends of secretive marshbird populations inhabiting tidal marsh of the San Francisco Estuary, including San Pablo Bay and Don Edwards San Francisco Bay NWRs. In addition to the federally endangered California Ridgway's rail (*Rallus obsoletus obsoletus*) and the California state threatened black rail (*Laterallus jamaicensis coturniculus*), five other secretive marsh bird species are monitored in the San Francisco Estuary including Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), yellow rail (*Coturnicops noveboracensis*), American bittern (*Botaurus lentiginosus*), and least bittern (*Ixobrychus exilis*). Understanding the status and trends of California Ridgway's rail is particularly important because 1) they are federally endangered, 2) survey results inform recovery objectives of the USFWS Tidal Marsh Recovery Plan (USFWS 2013) and 3) the species is sensitive to changes in the tidal marsh ecosystem (such as elevation, hydrological regimes, and plant and invertebrate communities. Therefore, California Ridgway's rail is a good indicator of overall marsh health.
SFB	TME-02	FF08RSFB00-010	Western Snowy Plover Window Survey	TME_O07: number of individual breeding snowy plovers	This survey evaluates the status and trend in federally threatened western snowy plovers (*Charadrius nivosus nivosus*) who breed in managed ponds at Don Edwards San Francisco Bay NWR, including federally threatened western snowy plovers. Although the restoration of former salt ponds to tidal marsh across the refuge (as part of the South Bay Salt Pond Restoration Project [SBSPRP] and other restoration projects) will increase habitat for many estuarine-dependent wildlife, there is concern that habitat availability for some breeding and wintering waterbirds could be reduced. A goal of the SBSPRP is to maintain current waterbird populations. Data from this survey will be used to adapt, as needed, future wetland enhancement and restoration activities on the refuge.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	TME-03	FF08RSFB00-046	Invasive Spartina Survey	TME_O18, TME_O19: presence-absence and % cover invasive *Spartina* species	This survey evaluates the effectiveness of a management strategy to eradicate invasive Spartina species in the San Francisco Estuary, including Don Edwards San Francisco Bay NWR and San Pablo Bay NWR. Over the last 25 years, introduced Spartina species have spread rapidly, both vegetatively and by seed, becoming established in tidal marsh throughout the Estuary. Impacts from Spartina invasion include alteration of sediment dynamics and hydrology, displacement of native *Spartina foliosa*, and alteration of invertebrate communities. These impacts cascade to impacts at higher trophic levels, including sensitive species such as the California Ridgway's rail. The San Francisco Estuary Invasive Spartina Project (ISP) is a coordinated regional effort established to eradicate invasive Spartina species in the Estuary. Established by the San Francisco Bay NWR Complex and the California State Coastal Conservancy in 2000, ISP is progressing toward its goal of eliminating this aggressive introduced species, working in close cooperation with its many partners around the Bay. Survey data will be used to inform on-the-ground activities, assess progress, and adapt the management strategy, if needed.
SFB	TME-04	FF08RSFB00-044	Habitat Evolution Mapping Project (HEMP)	TME_G03, TME_O05, TME_O06: acres of high-quality tidal marsh	This survey evaluates the status and trend in the extent (acres) of high-quality tidal marsh at Don Edwards San Francisco Bay NWR. The survey also informs progress on management strategies aimed at increasing tidal marsh extent through active restoration or maintain tidal marsh extent in light of sea level rise. Loss of tidal marsh occurred over the past two centuries in response to human developments, including agriculture and salt production. In the future, sea level rise threatens to decrease the extent of tidal marsh throughout the San Francisco Estuary. The extent of tidal marsh is critical to maintaining ecological processes (such as sediment dynamics) and supporting tidal-marsh dependent wildlife such as the federally endangered Ridgway's rail and salt marsh harvest mouse (*Reithrodontomys raviventris*).

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SFB	TME-05	FF08RSFB00-048	La Riviere Monitoring Survey (FLAP Project): vegetation survey	TME_O09: % vegetation cover	This survey evaluates effectiveness of management strategies aimed at enhancing or restoring tidal marsh at the Don Edwards San Francisco Bay NWR. In the southern portion of the San Francisco Estuary, thousands of acres of tidal marsh were converted to commercial salt ponds, including portions of Don Edwards San Francisco Bay NWR. Here, tidal marsh was reclaimed for salt production beginning around 1860 (Ver Planck 1958). Loss of tidal marsh continued well into the 20th century. Several projects have been implemented by Don Edwards San Francisco Bay NWR and its partners to restore tidal marsh ecosystem processes or composition lost to reclamation for salt production. Data collected from this survey will assess whether a given project is achieving expected near-term outcomes along the way to a 'restored' or 'enhanced' tidal marsh. Ultimate, information gained will inform what adaptations are needed, if any, to achieve project objectives.
SFB	TME-06	FF08RSFB00-017	Weed Inventory and Monitoring	TME_O15: % invasive plant cover	This survey evaluates effectiveness of management actions aimed at preventing or reducing invasive plants at Don Edwards San Francisco Bay NWR. In 2013, the refuge developed and began implementing a plan to manage invasive plants. The plan, titled 'South San Francisco Bay Weed Management Plan' identifies the highest priority invasive species to manage (termed weeds) and lays out activities to manage them. The plan uses an adaptive management approach to prioritize, implement and evaluate invasive plant treatment and re-vegetation actions. Survey data will be used to inform on-the-ground activities, assess progress, and adapt plan activities, if needed.
SFB	TME-06	FF08RSFB00-065	Bair Island Restoration Project: ecotone vegetation composition survey	TME_O08: % native plant cover	This survey evaluates the effectiveness of management strategies aimed at enhancing or restoring tidal marsh at the Don Edwards San Francisco Bay NWR. In the southern portion of the San Francisco Estuary, thousands of acres of tidal marsh were converted to commercial salt ponds, including portions of Don Edwards San Francisco Bay NWR. Here, tidal marsh was reclaimed for salt production beginning around 1860 (Ver Planck 19B8). Loss of tidal marsh continued well into the 20th century. Several projects have been implemented by the refuge and its partners to restore tidal marsh ecosystem processes or composition lost to reclamation for salt production. Data collected from this survey will assess whether a given project is achieving expected near-term outcomes along the way to a 'restored' or 'enhanced' tidal marsh. Ultimately, information gained will inform what adaptations are needed, if any, to achieve project objectives.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	VPG-01	FF08RSFB00-024	Vernal Pool Vegetation Survey (2012-current)	VPG_G04, VPG_G05: % native plant cover, native plant species richness	The survey informs adaptive management of the vernal pool grassland ecosystem at the Warm Springs Unit of Don Edwards San Francisco Bay NWR (see specific and measurable goal or objective statement above). Specifically, the survey assesses the health of the vernal pools at Warm Springs, in terms of vegetation. Vernal pool vegetation composition is indicated by the percent relative cover of native vernal pool and wetland plant species. Relative cover of vernal pool obligate species and wetland species indicates the state of ecosystem processes, particular those that relate to the pools. Vernal pool species can be surveyed during a very narrow time frame (usually April) and cannot be combined with later spring or summer surveys. Thus, while data from vernal pool vegetation and grassland vegetation do not overlap, they are complementary for describing the state of the vernal pool grassland ecosystem. This survey is required under the Warm Springs endowment, Biological Opinion, and Long-term Monitoring Plan.
SFB	VPG-02	FF08RSFB00-026	Native Plant Restoration Success Survey	VPG_O04, VPG_O05: % native plant cover, native plant species richness	This survey evaluates the efficacy of a management strategy to actively restore (seeding, planting) native vernal pool plant species in the Warm Springs Unit of Don Edwards San Francisco Bay NWR. In grassland and vernal pool restoration, research has shown that a lack of adequate seedbank of native species is among the top limiting factors in vernal pool and grassland ecosystem restoration and seeding or planting repeatedly over the years may lead to a more sustainable and resilient plant community. Strong presence of native species is also associated with higher resistance to exotic species invasion.
SFB	VPG-03	FF08RSFB00-027	Vernal Pool Hydroperiod Survey	VPG_G01, VPG_G06: presence and persistence of water in vernal pools	This survey evaluates the status and trend in vernal pool hydroperiods in the Warm Springs Unit of Don Edwards San Francisco Bay NWR. This information is used in combination with other priority surveys to assess health of the vernal pool grassland ecosystem. The presence and persistence of water in vernal pools is the principal factor determining persistence and survival of federally threatened California tiger salamanders (*Ambystoma californiense*, CTS) and federally endangered vernal pool tadpole shrimp (*Lepidurus packardi*), with longer periods of inundation allowing for larger growth of metamorphs and increased chances of survival (Loredo 2016). Adequate hydroperiod for CTS is 100 days of continuous inundation with water depth >5cm. Refuge surveys show reproductive success of CTS and other vernal pool plants and animals at Warm Springs is strongly influenced by rainfall and resulting pool inundation duration.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	VPG-04	FF08RSFB00-015	Residual Dry Matter (RDM) Survey	VPG_O01: pounds per acre residual dry matter	This survey evaluates the efficacy of management strategy (grazing) to improve vegetation conditions of the vernal pool grassland ecosystem in the Warm Springs Unit of Don Edwards San Francisco Bay NWR. Vernal pool grasslands are a priority conservation target of the San Francisco Bay NWR Complex. Grazing is used as a management tool in vernal pool grasslands to combat exotic grass species, which not only directly compete for resources with native plants, but they may alter the hydrology of the pools by invading and ultimately shortening pool inundation time through transpiration (Pyke and Marty 2005). Survey data collected at the end of the growing season feed into calculations to assess grazing target attainment and provide carrying capacity data. This data is used to update the grazing targets for each pasture for the following year. In addition, observations on vegetation structure during routine site visits are used to direct cattle movement among pastures. This survey is required under the Warm Springs endowment, Biological Opinion, and Long-term Monitoring Plan.
SFB	VPG-05	FF08RSFB00-028	California Tiger Salamander and Vernal Pool Tadpole Shrimp Survey	VPG_G01, VPG_G06: use of vernal pools by California tiger salamander	The survey informs adaptive management of the vernal pool grassland ecosystem at the Warm Springs Unit of Don Edwards San Francisco Bay NWR. The vernal pool grassland ecosystem consists of two distinct features: the pools and the uplands. Because California Tiger Salamander (CTS) require the pools and the surrounding grasslands to complete their life cycle, they represent habitat needs similar to other aquatic and upland species (such as ground squirrels, burrowing owls) at Warm Springs. Because CTS are assumed to complete their entire life cycle at the site (a barrier fence prevents CTS movement), we infer continued presence of CTS larvae in vernal pools reflects the overall health of the vernal pool grassland ecosystem. Vernal pool tadpole shrimp and vernal pool fairy shrimp are vernal pool obligate species. Their continued persistence also indicates the health of the vernal pool grassland ecosystem. This survey is required under the Warm Springs endowment, Biological Opinion, and Long-term Monitoring Plan.
SFB	VPG-06	FF08RSFB00-029	Summer Vegetation Survey	VPG_G02, VPG_G03: % native plant cover and native plant species richness	This survey evaluates the status and trend in vegetation structure and composition of the vernal pool grassland ecosystem in the Warm Springs unit of Don Edwards San Francisco Bay NWR. The focus here is upland vegetation surrounding the vernal pools. Vegetation structure and composition have a strong influence on the native biodiversity of the vernal pool grassland ecosystem. Vegetation structure and composition also reflect the state of important ecological processes such as nutrient cycling and hydrologic regimes.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	WTB-01	FF08RSFB00-008	Managed and Salt Pond Waterbird Survey	WTB_G04, WTB_G03: waterfowl and grebe species richness and population size (count)	This survey helps evaluate the effectiveness in managing ponds for the benefit of waterbirds at Don Edwards San Francisco Bay NWR (SFB). Direct management of depth, salinity, bathymetric and vegetation characteristics can influence waterbird populations (e.g., Athearn et al 2012). For example, water level management is important for nesting birds because water levels that are too high can flood out nests and water levels that are too low can provide a bridge to nesting islands for mammalian predators and limit available foraging habitat for wetland-invertebrate dependent species such as American avocets. Understanding waterbird distribution and abundance differences suggest that pond water levels, water quality, or vegetation characteristics can be targeted to meet specific habitat requirements for key waterbirds; thus it may be possible to maintain bird numbers by maintaining managed ponds within targeted characteristics. Waterbirds are able to quickly adapt to landscape changes as they are highly mobile and can move between habitats. But maintaining sufficient habitat for waterbirds that have come to depend on ponds requires careful planning by resource managers to determine the number and characteristics of ponds and their management strategy to ensure that sufficient habitat remains. Data from this survey will be used to adapt, as needed, future wetland enhancement and restoration activities on the refuge.
SFB	WTB-02	FF08RSFB00-006	Mid-Winter Waterfowl Survey	WTB_G03: wintering waterfowl species richness and abundance	This survey evaluates the status and trend of wintering waterfowl species richness and abundance in the San Francisco Estuary (Estuary), including Don Edwards San Francisco Bay NWR and San Pablo Bay NWR. The Estuary is one of the most important sites along the Pacific Flyway for wintering and migratory birds. Shifts in waterfowl species richness and abundance can indicate changes in the overall health of the estuary because these species depend on, and are sensitive to, a variety of estuarine environments to meet their needs. Changes in waterfowl species richness and abundance at Don Edwards San Francisco Bay NWR also help evaluate the effectiveness of pond management (adequate water levels and salinity). At San Pablo NWR, changes in waterfowl populations indicate the availability of roosting and foraging habitat in tidal ponds and extensive open water and mudflat environments. For example, canvasbacks and scaup are known to be sensitive to dietary changes and organic contaminants/heavy metals in their wintering habitats.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	WTB-03	FF08RSFB00-061	Managed Ponds: Water Monitoring	WTB_O01: pond depth, salinity, and bathymetric measures attained (per SFB Pond Operations Plan)	This survey evaluates the effectiveness in managing water levels and salinity within managed ponds at Don Edwards San Francisco Bay NWR. Direct management of depth, salinity, and bathymetric characteristics of can help maintain (or improve) waterbird populations (Athearn et al 2012). Water level management is important for nesting birds because water levels that are too high can flood out nests and water levels that are too low can provide a bridge to nesting islands for mammalian predators and limit available foraging habitat for wetland-invertebrate dependent species such as American avocets. Distribution differences among species and guilds suggest that pond salinity and depth can be targeted to meet specific habitat requirements for key waterbirds; thus, it may be possible to maintain bird numbers by maintaining managed ponds within targeted salinity and depth ranges. Waterbirds are able to quickly adapt to landscape changes as they are highly mobile and can move between habitats. But maintaining sufficient habitat for waterbirds that have come to depend on ponds requires careful planning by resource managers to determine the number and characteristics of ponds and their management strategy to ensure that sufficient habitat remains. The refuge Pond Operations Plan contains minimum and maximum pond water levels by season, as well as open and closure prescriptions for water control structures. Pond salinity is also monitored in the summer in order to prevent discharge of water above 44 ppt (parts per thousand) per RWQCB permitting. Data from this survey will be used to adapt, as needed, future wetland enhancement and restoration activities on the refuge.
SFB	WTB-04	FF08RSFB00-058	Avian Predator Survey	WTB_O06: gull colony presence-absence	This survey is conducted to monitor avian predator populations (particularly gull species) in sensitive natural resource areas of Don Edwards San Francisco Bay NWR. Survey information is utilized to track trends in avian predator populations and inform avian predator management activities (per Complex predator management plan).

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	WTB-04, TME	FF08RSFB00-057	Avian Predator Nest Survey	WTB_O07, TME_O13: number of successful raven or raptor nests on PG&E towers	This survey is conducted to monitor active nests of avian predators in sensitive natural resource areas of Don Edwards San Francisco Bay NWR. Survey information is utilized to remove avian predator nests on towers and other structures and track predator trends. Avian predators are a high threat to Ridgway's rails, salt marsh harvest mice, and breeding waterbird species such as Forster's terns (*Sterna forsteri*), American avocets (*Recurvirostra americana*), California least tern (*Sterna antillarum browni*), Western snowy plover (*Charadrius alexandrinus nivosus*). Avian predators such as peregrine falcon (*Falco peregrinus*), common raven (*Corvus corax*), and California gull (*Larus californicus*) predate upon all waterbird life stages (adult, chick, and egg), negatively affecting reproductive success (annual SFBBO reports, Ackerman et al 2014). Impacts can be even more severe when introduced or human-subsidized avian predator population numbers are inflated, such as the case for California gulls, common ravens, and American crows. For example, gull numbers have increased dramatically in the South Bay (Strong et al 2004) and abundant food resources in the form of landfill and other waste may be subsidizing their population numbers (Osterback et al 2015). As a result, the refuge conducts a variety of activities to reduce predation pressure, including removing nests of avian predators in priority waterbird breeding areas.
SFB	WTB-05, TME	FF08RSFB00-062	Predator Management Effectiveness Survey: Don Edwards San Francisco Bay NWR	WTB_O04, WTB_O05: number of feral cat feeding stations, number of red fox sightings	This survey evaluates the status and trends in mammalian predator populations (such as feral cats and red fox) and informs predator management activities at Don Edwards San Francisco Bay NWR. Predators are a high threat to Ridgway's rails, salt marsh harvest mice, and breeding waterbird species such as Forster's terns (*Sterna forsteri*), American avocets (*Recurvirostra americana*), California least tern (*Sterna antillarum browni*), Western snowy plover (*Charadrius alexandrinus nivosus*). Predator species of concern include rats (*Rattus spp.*), red foxes (*Vulpes vulpes*), gray foxes (*Urocyon cinereoargenteus*), raccoons, striped skunks (*Mephitis mephitis*), opossum, and feral cats (*Felis spp*). These species negatively affect waterbird reproductive success by foraging on waterbird adults, chicks, and eggs.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	WTB-06	FF08RSFB00-009	Pacific Flyway Migratory Shorebird Project	WTB_G04: migratory shorebird species' richness and population size (count)	This survey, which is part of the larger Pacific Flyway Shorebird Project (lead by Point Blue Conservation Science), evaluates the status and trend in migratory shorebird species richness and abundance in the Estuary, including Don Edwards San Francisco Bay NWR and San Pablo Bay NWR. The Pacific Flyway Council has endorsed the Pacific Flyway Shorebird Survey as a valuable asset to the ability to conserve shorebirds in the Pacific Flyway. The Don Edwards San Francisco Bay, San Pablo Bay, and Marin Island NWRs were established, in part, to protect migratory birds on either their wintering, migratory or breeding grounds. Due to extensive wetland habitat loss in California's Central Valley and in other places along the Pacific Flyway, the Estuary has become an increasingly important site for waterfowl and shorebirds over the past 100 years. Habitat important for waterbirds within the Estuary includes tidal waters, mudflats, sloughs and marshes, and also highly managed habitats such as former salt evaporation ponds of the South Bay. Therefore, shifts in migratory shorebird species richness and abundance can indicate changes in the overall health of the Estuary, or elsewhere along the Pacific Flyway.
SFB	WTB-07	FF08RSFB00-064	Managed Ponds: Vegetation Monitoring	WTB_O02: island vegetation (% vegetated, average vegetation height)	This survey helps evaluate the effectiveness in managing pond vegetation (on pond islands) for the benefit of waterbirds at Don Edwards San Francisco Bay NWR. Direct management of depth, salinity, bathymetric and vegetation characteristics can influence waterbird populations (e.g., Athearn et al 2012). Understanding waterbird distribution and abundance differences suggest that pond water levels, water quality, or vegetation characteristics can be targeted to meet specific habitat requirements for key waterbirds; thus, it may be possible to maintain bird numbers by maintaining managed ponds within targeted characteristics. Waterbirds are able to quickly adapt to landscape changes as they are highly mobile and can move between habitats. But maintaining sufficient habitat for waterbirds that have come to depend on ponds requires careful planning by resource managers to determine the number and characteristics of ponds and their management strategy to ensure that sufficient habitat remains.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SFB	WTB-08	FF08RSFB00-007	Colonial Waterbird Breeding Season Surveys	WTB_G01: number of breeding pairs of Forster's tern, Caspian tern, American avocet, and snowy plover	This survey helps evaluate the effectiveness in managing ponds (water levels, salinity) for the benefit of waterbirds at Don Edwards San Francisco Bay NWR (SFB). In particular, it helps support adaptive management of waterbirds in relation to the South Bay Salt Pond Restoration Project and other restoration projects in the South Bay. Direct management of depth, salinity, bathymetric and vegetation characteristics can influence waterbird populations (e.g., Athearn et al 2012). For example, water level management is important for nesting birds because water levels that are too high can flood out nests and water levels that are too low can provide a bridge to nesting islands for mammalian predators and limit available foraging habitat for wetland-invertebrate dependent species such as American avocets. Understanding waterbird distribution and abundance differences suggest that pond water levels, water quality, or vegetation characteristics can be targeted to meet specific habitat requirements for key waterbirds; thus, it may be possible to maintain bird numbers by maintaining managed ponds within targeted characteristics. Waterbirds are able to quickly adapt to landscape changes as they are highly mobile and can move between habitats. But maintaining sufficient habitat for waterbirds that have come to depend on ponds requires careful planning by resource managers to determine the number and characteristics of ponds and their management strategy to ensure that sufficient habitat remains. Data from this survey will be used to adapt, as needed, future wetland enhancement and restoration activities on the refuge.
SLR	CDE-01	FF08RSLN00-005	Coastal Dune Vegetation Survey: Salinas River NWR	CDE_G01, CDE_G02, CDE_O01: % vegetation cover (native, non-native)	This survey evaluates the status and trend in sand dune vegetation composition and cover at Salinas River NWR. Understanding the status and trends of dune vegetation is important because vegetation cover and composition have a strong influence on biodiversity of the sand dunes – many dune-adapted species depend on availability of open sand and dune-adapted plant species. For example, Smith's blue butterfly survival is dependent on two dune plant species, seaside and sea cliff buckwheat, and the snowy plover is associated with sparsely vegetated environments found in intact sand dunes. Further, trends in sand dune vegetation are linked to underlying sand dune dynamics and formation. Alteration of sand dune vegetation will influence sand dunes, and in turn, the species that depend on them.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SLR	CDE-02	FF08RSLN00-002	Western Snowy Plover Productivity Survey	CDE_G03, CDE_G04, CDE_O02: SNPL clutch hatching success ([# nests with ≥1 egg hatched/total # nests]*100); SNPL fledging success ([# banded chicks fledged/# banded chicks]*100); number of SNPL egg, chick, and fledgling predation events	This survey assesses the reproductive success of Pacific coast snowy plovers (SNPL). The Pacific coast population of western snowy plovers is defined as those individuals that nest adjacent to tidal waters of the Pacific Ocean. The Pacific coast population was federally listed as threatened in 1993 due to a variety of human-induced threats including human disturbance, urban development, predation by birds and mammals, and invasive plants. Reproductive success of SNPL is a key ecological attribute of the coastal dune ecosystem at Salinas River NWR because SNPL are dependent on the health of the sand dune ecosystem (particularly the fore dunes). The species responds quickly to changes in land cover characteristics (such as % sand cover) and threats such as human disturbance and predators. Because of this sensitivity, this survey can provide early warning signals of stress to the sand dune ecosystem. Understanding the reproductive success of SNPL also helps inform SNPL recovery objectives for the Monterey Bay Area.
SLR	CDE-03	FF08RSLN00-006	Smith's Blue Butterfly Survey	CDE_G05: population size of Smith's blue butterfly	The refuge supports the northernmost population of this federally endangered species. Because of the strong link between Smith's blue butterfly (SBB) populations with intact coastal sand dunes containing seaside and sea cliff buckwheat plant populations, status and trends of SBB populations can provide an indication of sand dune ecosystem health.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SNP	TME-04	FF08RSNP00-005	Invasive Spartina Survey	TME_O18, TME_O19: presence-absence, % cover invasive *Spartina* species	This survey evaluates effectiveness of a management strategy to eradicate invasive Spartina species in the Estuary, including Don Edwards San Francisco Bay and San Pablo Bay NWRs. Over the last 25 years, introduced *Spartina* species have spread rapidly, both vegetatively and by seed, becoming established in tidal marsh throughout the Estuary. Impacts from Spartina invasion include alteration of sediment dynamics and hydrology, displacement of native *Spartina foliosa*, and alteration of invertebrate communities. These impacts cascade to impacts at higher trophic levels, including sensitive species such as the California Ridgway's rail. The San Francisco Estuary Invasive Spartina Project (ISP) is a coordinated regional effort established to eradicate invasive Spartina species in the Estuary. Established by the Don Edwards San Francisco Bay NWR Complex and the California State Coastal Conservancy in 2000, ISP is progressing toward its goal of eliminating this aggressive introduced species, working in close cooperation with its many partners around the Bay. Survey data will be used to inform on-the-ground activities, assess progress, and adapt the management strategy, if needed.
SNP	TME-05	FF08RSNP00-016	Tidal Marsh Transition Zone Native Plant Restoration Monitoring	TME_O02: distribution and abundance (% cover) of rhizomatous grasses, sedges, and rushes	This survey evaluates effectiveness of management strategies aimed at enhancing or restoring tidal marsh at the San Pablo Bay NWR. Over the last 100+ years, humans have altered tidal marsh of San Pablo Bay, resulting in high levels of contaminants and conversion of tidal environments to other uses such as agriculture, salt production, and roadways. In addition, hydraulic mining operations in the Sierra Nevada foothills (1850s) released large amounts of sediment into San Pablo Bay, resulting in the rapid expansion of some tidal marsh. Several projects have been implemented by San Pablo Bay NWR and its partners to restore tidal marsh ecosystem processes or composition lost to human developments. Data collected from this survey will assess whether a given project is achieving expected near-term outcomes along the way to a 'restored' or 'enhanced' tidal marsh. Ultimately, information gained from this survey will inform what adaptations are needed, if any, to achieve project objectives.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SNP	TME-03	FF08RSNP00-031	Cullinan Ranch: Sedimentation	TME_O01: tidal marsh elevation (feet NAVD)	This survey evaluates effectiveness of management strategies aimed at enhancing or restoring tidal marsh at the San Pablo Bay NWR. Over the last 100+ years, humans have altered tidal marsh of San Pablo Bay, resulting in high levels of contaminants and conversion of tidal environments to other uses such as agriculture, salt production, and roadways. In addition, hydraulic mining operations in the Sierra Nevada foothills (1850s) released large amounts of sediment into San Pablo Bay, resulting in the rapid expansion of some tidal marsh. Several projects have been implemented by San Pablo Bay NWR and its partners to restore tidal marsh ecosystem processes or composition lost to human developments. Data collected from this survey will assess whether a given project is achieving expected near-term outcomes along the way to a 'restored' or 'enhanced' tidal marsh. Ultimately, information gained from this survey will inform what adaptations are needed, if any, to achieve project objectives.
SNP	TME-05	FF08RSNP00-033	Lepidium Latifolium Monitoring: San Pablo Bay NWR	TME_O17: % cover *Lepidium latifolium*	This survey evaluates effectiveness of a management strategy to reduce the extent and abundance of Perennial pepperweed (*Lepidium latifolium*) at San Pablo Bay NWR. This introduced species has now spread throughout the Estuary and is a priority threat to the tidal marsh of the refuge. The species forms near monocultures and excludes native tidal marsh vegetation required by tidal marsh-dependent species, including the federally endangered Ridgway's Rail and salt marsh harvest mouse. In 2007, San Pablo Bay NWR developed and began implementing a plan to reduce the extent and abundance of pepperweed. Survey data will be used to inform on-the-ground activities, assess progress, and adapt the management strategy, if needed.
SNP	TME-01	FF08RSNP00-049	Secretive Marsh Bird Survey: Don Edwards San Francisco Bay and San Pablo Bay NWRs	TME_G01, TME_G02: Ridgway's rail population rate of increase and population size	This survey evaluates status and trends of secretive marshbird populations (density) inhabiting tidal marsh of the Estuary, including San Pablo Bay and Don Edwards San Francisco Bay NWRs. In addition to the federally endangered California Ridgway's rail and the California state threatened black rail, five other secretive marsh bird species are monitored in the Estuary, including Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), yellow rail (*Coturnicops noveboracensis*), American bittern (*Botaurus lentiginosus*), and least bittern (*Ixobrychus exilis*). Understanding the status and trends of California Ridgway's rail is particularly important because 1) they are federally endangered, 2) survey results inform recovery objectives of the USFWS Tidal Marsh Recovery Plan (USFWS 2013), and 3) the species is sensitive to changes in the tidal marsh ecosystem (such as elevation, hydrologic regimes, and plant and invertebrate communities). California Ridgway's rail therefore acts as good indicator of overall marsh health.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SNP	TME-03	FF08RSNP00-055	Sonoma Creek: Sediment Accretion Surveys	TME_O10: sediment accretion (inches)	This survey evaluates effectiveness of management strategies aimed at enhancing or restoring tidal marsh at the San Pablo Bay NWR. Over the last 100+ years, humans have altered tidal marsh of San Pablo Bay, resulting in high levels of contaminants and conversion of tidal environments to other uses such as agriculture, salt production, and roadways. In addition, hydraulic mining operations in the Sierra Nevada foothills (1850s) released large amounts of sediment into San Pablo Bay, resulting in the rapid expansion of some tidal marsh. Several projects have been implemented by the refuge and its partners to restore tidal marsh ecosystem processes or composition lost to human developments. Data collected from this survey will assess whether a given project is achieving expected near-term outcomes along the way to a restored or enhanced tidal marsh. Ultimately, information gained from this survey will inform what adaptations are needed, if any, to achieve project objectives.
SNP	TME-02	FF08RSNP00-065	Salt Marsh Extent Monitoring	TME_G03: acres of high quality tidal marsh	This survey evaluates the status and trend in the extent (acres) of high-quality tidal marsh at SNP. The survey also informs progress on management strategies aimed increasing tidal marsh extent through active restoration or maintain tidal marsh extent in light of sea level rise. Loss of tidal marsh occurred over the last two centuries in response to human developments, including agriculture. In the future, sea level rise threatens to decrease the extent of tidal marsh throughout the San Francisco Estuary. The extent of tidal marsh is critical to maintaining ecological processes (such as sediment dynamics) and supporting tidal-marsh dependent wildlife (such as the federally endangered Ridgway's rail and salt marsh harvest mouse.
SNP	WTB-02	FF08RSNP00-006	Pacific Flyway Migratory Shorebird Project	WTB_G04: migratory shorebird species richness and abundance (count)	This survey evaluates status and trends of migratory shorebird species richness and abundance in the Estuary, including Don Edwards San Francisco Bay and San Pablo Bay NWRs. The Estuary is one of the most important sites along the Pacific Flyway for wintering and migratory birds and is a site of "hemispheric importance" (Harrington and Perry 1995) to wintering and migrating shorebirds. On the conterminous U.S. Pacific coast, the bay holds more total shorebirds than any other wetland in all seasons, and it holds the majority of individuals of the 13 most abundant shorebirds in one or more seasons (Page et al. 1999)" (in L.E. Stenzel, et al., 2002). Like waterfowl, shorebirds are sensitive to local and larger landscape scale environmental changes, including efforts to restore wetland environments of the Estuary. For example, changes in shorebird populations are used to evaluate pond management effectiveness in maintaining adequate and appropriate water levels and salinity.

Refuge[1]	*ROC ID*[2]	*PRIMR Survey ID*	*PRIMR Survey Name*	*Management Goal or Objective ID: Indicator(s)*[3]	*Rationale (Why is it important to conduct the survey?)*[4]
SNP	WTB-01	FF08RSNP00-011	San Francisco Bay Mid-Winter Waterfowl Survey	WTB_G03: waterfowl species richness and abundance (count)	This survey evaluates the status and trend in wintering waterfowl species richness and abundance in the Estuary, including Don Edwards San Francisco Bay and San Pablo Bay NWRs. The Estuary is one of the most important sites along the Pacific Flyway for wintering and migratory birds. Shifts in waterfowl species richness and abundance can indicate changes in the overall health of the estuary because these species depend on, and are sensitive to, a variety of estuarine environments to meet their needs. Changes in waterfowl species richness and abundance at Don Edwards San Francisco Bay NWR also help evaluate the effectiveness of pond management (adequate water levels and salinity). At San Pablo Bay NWR, changes in waterfowl populations indicate the availability of roosting and foraging habitat in tidal ponds and extensive open water and mudflat environments. For example, canvasbacks and scaups are known to be sensitive to dietary changes, organic contaminants and heavy metals in their wintering habitats.

Appendix A

Survey Goals and Objectives

The following table contains SMART goals and objectives for the 7 refuges of the San Francisco Bay National Wildlife Refuge Complex (Complex). The goals and objectives presented here were obtained from the Complex Natural Resource Management Plan (NRMP) (USFWS 2019). The NRMP is a step-down plan from each of the 7 refuge Comprehensive Conservation Plans. All goals and objectives are associated with Complex priority resources of concern and are SMART (Specific, Measurable, Achievable, Results-oriented, and Time-bound). Each goal or objective has a unique identifier signifying the priority resource of concern (ROC) it is associated with (3-letter ROC code) and whether it is a goal (G) or objective (O). Priority ROC codes are as such:

- Coastal Dune Ecosystem (CDE)
- Estuarine Island Ecosystem (EIE)
- Marine Island Ecosystem (MIE)
- Pajaro Valley Watershed (PVW)
- River Dune Ecosystem (RDE)
- Tidal Marsh Ecosystem (TME)
- Vernal Pool Grassland (VPG)
- Waterbird (WTB)

Goals and objectives may be revised over time as learning happens or landscape conditions change.

Goal or Objective ID	*Goal or Objective Detail*
CDE_G01	Over the next 15 years (2018-2032), the proportion of dune vegetation cover comprised of dune-associated native plant species is >95% in the foredunes and >85% in the backdunes (dune scrub) at Salinas River NWR.
CDE_G02	Over the next 15 years (2018-2032), % sand cover is ≥90 in the foredunes and <20% bare ground in the backdunes (dune scrub) at Salinas River NWR.
CDE_G03	Over the next 15 years (2018-2032), western snowy plover clutch hatching success ([# nests with ≥1 egg hatched/total # nests]*100) is >40% at Salinas River NWR. Goal evaluated based on a 3-year moving average.
CDE_G04	Over the next 15 years (2018-2032), western snowy plover fledging success ([# banded chicks fledged/# banded chicks]*100) is >40% at Salinas River NWR. Goal evaluated based on a 3-year moving average.
CDE_G05	Over the next 15 years (2018-2032), the estimated population size of Smith's Blue butterfly is ≥900 at Salinas River NWR. Goal evaluated based on a 3-year moving average.
CDE_O01	By the end of 2022, the San Francisco NWR Complex understands the abundance and distribution of the most critical invasive plant threats to the coastal dune ecosystem at Salinas River NWR. This new understanding will be used to refine (as needed) the management approach and develop new management objectives.
CDE_O02	Over the next 5 years (2018-2022), the frequency of snowy plover egg, chick, and fledgling predation events decreases at Salinas River NWR.
CDE_O03	Over the next 5 years (2018-2022), seasonal fencing around snowy plover breeding areas at Salinas River NWR is maintained and prevents human entry, evidenced by no plover nests lost as a direct result of humans.
CDE_O04	By 2022, at least 5-10 docents are trained and implementing the beach user education program at Salinas River NWR to educate the public on reducing impacts to the coastal dune ecosystem.
CDE_O05	Over the next 15 years (2018-2032), the Service is aware of coastal dune protection opportunities in the Monterey Bay area and continues to support these efforts with its conservation partners.
CDE_O06	By 2020, a Pacific coastal dune forum is formed and by 2023 the refuge has gained information from the forum to improve Salinas River NWR conservation strategies or natural resource surveys.
EIE_G01	Over the next 15 years (2018-2032), at least 95% of the native plant species documented on East Marin Island continue to persist.
EIE_G02	Over the next 15 years (2018-2032), % relative cover of native plants (to non-native plants) increases to >50% on East Marin Island.
EIE_G03	Over the next 15 years (2018-2032), the estimated densities of native *Platanthera* species on East Marin Island are: *Platanthera michaelii* ≥50, *P. elongata* ≥5, *P. transversa* ≥5. Density calculation is based on 3 defined survey areas of East Marin Island of the Marin Islands NWR.
EIE_O01	Within 6 months of active volunteer recruitment, the SF Complex has identified at least two volunteers who are regularly (at least 4 hours per month on island) carrying out invasive plant management and native plant restoration at Marin Islands NWR.
EIE_O02	By the end of 2018, the Service understands the distribution and abundance of priority invasive plants at Marin Islands NWR.

Goal or Objective ID	Goal or Objective Detail
EIE_O03	By the end of 2021, a vegetation management plan for Marin Islands NWR is completed and identifies optimal strategies and associated SMART objectives for reducing the threat of priority invasive plants and restoring native plants given limited resources.
EIE_O04	Over the next 15 years (2018-2032), areas of East Marin Island documented as free (0% cover) of priority invasive plants are maintained as such. Clean areas will be identified during an invasive plant inventory (in 2018).
EIE_O05	By 2032, French broom is reduced by 60% within existing management areas (baseline = 2017 control area map, 2018 inventory) on East Marin Island of Marin Islands NWR.
MIE_G01	Over the next 5 years, ashy storm-petrel population size at Farallon Islands NWR is stable or increasing (based on 5-yr running trend)
MIE_G02	Over the next 5 years, indices of population size for Cassin's auklet, rhinoceros auklet, common murre, Brandt's cormorant, and Pelagic cormorant population trends at Farallon Islands NWR are stable or increasing (based on 5-yr running trend).
MIE_G03	By 2027, >85% of the vegetative cover on Southeast Farallon Island is comprised of native plants.
MIE_G04	Over the next 5 years, 5 pinniped species at South Farallon Islands exhibit stable or increasing populations of adults and pups (based on 5-yr running trend)
MIE_O01	By 2020, non-native house mouse eradication at the Farallon Islands National Wildlife Refuge is underway
MIE_O02	Within two years of implementation of mouse eradication at Farallon Islands National Wildlife Refuge, non-native mice are declared eradicated (two consecutive years of monitoring with no mice detection)
MIE_O03	Within five years of implementation of mouse eradication at Farallon Islands National Wildlife Refuge, statistically significant increases in ashy storm-petrels (2001-current baseline data), Farallon arboreal salamander (2013-2015 baseline data), Farallon camel cricket (2013-2015 baseline data, in prep), and maritime goldfields (2018 baseline data) are detected.
MIE_O04	After the first year of mouse eradication, overwintering burrowing owls are reduced by 50 percent of pre-eradication ten-year average at Farallon Islands National Wildlife Refuge
MIE_O05	By 2023, 75% of new (since FY 2018) climate smart nest boxes are occupied by Cassin's and rhinoceros auklets at Southeast Farallon Islands
MIE_O06	By 2023, at least 40 ashy storm petrel active nests are detected annually in artificial rock wall nesting habitat on Southeast Farallon Islands
MIE_O07	No human disturbance events at Sea Lion Cove seabird colony are detected on the Farallon Islands National Wildlife Refuge.
MIE_O08	By 2023, % cover of New Zealand spinach (*Tetragonia tetragonoides*) decreases by 10%, *Malva* species (*Malva perviflora*, *Marva neglecta*, and *Malva pseudolavatera*) decrease by 25%, narrowleaf plantain (*Plantago coronopus*) by 10%, and *Ehrharta erecta* by 30% (based on 2018 baseline) on Southeast Farallon Island of the Farallon Islands National Wildlife Refuge.
MIE_O09	By 2023, an invasive plant management plan is completed for Farallon Islands National Wildlife Refuge.

Goal or Objective ID	Goal or Objective Detail
MIE_O10	By 2033, eradicate New Zealand Spinach (Te*tragonia tetragonoides*); three species of Malva including cheeseweed (*Malva parviflora*, *Malva neglecta*, and *Malva pseudolavatera*); narrowleaf plantain (*Plantago coronopus*); and *Ehrharta erecta* on the South Farallon Islands of the Farallon Islands National Wildlife Refuge.
MIE_O11	By 2022, the San Francisco Bay NWR Complex understands how to respond to an oil spill (an oil spill response plan for the Refuge Complex is completed and understood by staff involved with managing marine-influences conservation targets of the Complex.
MIE_O12	Over the next 15 years (2018-2032), at least one refuge staff member associated with each of the marine-influenced conservation targets of the San Francisco Bay NWR Complex understands how to respond to an oil spill that affects the Complex. For example, they have current certification in HAZWOPER (Hazardous Waste Operations and Emergency Response).
MIE_O13	Within three years of the implementation of the Farallon Islands Biosecurity Plan, no new establishments of non-native plant or animal species are detected on the Farallon Islands National Wildlife Refuge.
PVW_G01	Over the next 15 years (2018-2032), the estimated population size of Santa Cruz long-toed salamanders at Ellicott Slough NWR is >9,000 at the Ellicott unit and >2000 at the Buena Vista unit.
PVW_G02	Over the next 15 years (2018-2032), California tiger salamander and Santa Cruz long-toed salamander larvae are present on an annual basis in all ponds (N=4) at Ellicott Slough NWR.
PVW_G03	Over the next 15 years (2018-2032), the average number of weeks ponds (N=4 ponds) have a foot or more of water is ≥21 weeks, and no pond has <15 weeks for 3 consecutive years at Ellicott Slough NWR. The 'average' is calculated from the previous 4 years.
PVW_G04	Over the next 15 years (2018-2032), the proportion of landcover occupied by grassland and woodland at Ellicott Slough NWR is as follows: 1) Calabasas Unit: woodland maintained at 26-40%, 2) Buena Vista Unit: increase grassland to 11-25% and maintain 26-40% woodland, 3) Ellicott Unit: increase grassland to 26-40% and maintain 26-40% woodland.
PVW_O01	By 2022, a study design for assessing salamander (Santa Cruz long-toed, CA tiger) upland habitat needs at Ellicott Slough NWR is completed.
PVW_O02	Within 3 years of initiating the salamander upland habitat needs study, the Service understands salamander (Santa Cruz long-toed, CA tiger) upland habitat needs and uses this information to review and refine its conservation strategies for upland habitat management at Ellicott Slough NWR.
PVW_O03	By 2020, the Service has secured funding to conduct a native salamander recruitment study at Ellicott Slough NWR.
PVW_O04	Within 3 years of initiating the native salamander recruitment study, the Service understands 1) priority aquatic threats to salamanders (Santa Cruz long-toed, CA tiger), 2) aquatic habitat variables driving population recruitment, and 3) uses this information to review and refine management strategies at Ellicott Slough NWR.
PVW_O05	By 2020, a protocol id developed for estimating Santa Cruz long-toed and California tiger salamander population size at Ellicott Slough NWR.
PVW_O06	Over the next 15 years (2018-2032), the Service is aware of seasonal pond, grassland, and oak woodland protection and restoration opportunities in the Pajaro River Watershed and continues to support these efforts with conservation partners.

Goal or Objective ID	Goal or Objective Detail
PVW_O07	By 2023, eucalyptus trees with <14-inch diameter at breast height are eradicated from Ellicott Slough NWR.
RDE_G01	By 2028, the Stamm unit of Antioch Dunes NWR contains at least 30% open sand (or <70% vegetated) and at least 46% of the vegetative cover is comprised of native dune-associated plant species.
RDE_G02	By 2031, Sardis unit of Antioch Dunes NWR contains at least 20% open sand (<80% vegetated) and at least 21% of the vegetative cover is comprised of native dune-associated plant species.
RDE_G03	By 2031, Lange's metalmark butterfly is re-established in the Stamm unit (species is present for 3 consecutive years through natural recruitment) and the annual refuge peak count is ≥ 151 individuals over 3 consecutive years at Antioch Dunes NWR.
RDE_O01	By 2019, a long-term sand dune restoration and management plan is completed for the Stamm Unit of Antioch Dunes NWR.
RDE_O02	Over the next 15 years (2018–2032), invasive plants occupy <5% of the landcover where sand placement has occurred in the Stamm unit of Antioch Dunes NWR.
RDE_O03	Contra Costa wallflower and Antioch Dunes evening primrose occupy ≥20% of the vegetative cover and naked stem buckwheat comprises at least 20% of the vegetative cover at the Stamm unit once desired sand depths are attained in dune restoration areas (per Antioch Dunes NWR sand dune management plan).
RDE_O04	Naturally occurring Lange's metalmark butterfly larvae are documented in dune restoration areas of the Stamm Unit of Antioch Dunes NWR within 5 years of attaining desired sand depths (per Antioch Dunes NWR sand dune management plan).
RDE_O05	Over the next 15 years (2018-2032), the number of LMB pupae and adults propagated for Antioch Dunes NWR is ≥20 per field-collected female.
RDE_O06	Over the next 5 years (2018-2022), ≥80% of propagated Lange's metalmark butterfly pupae eclose (hatch) following release at Antioch Dunes NWR.
RDE_O07	Refuge staff continue to maintain USFWS 10(a)(1)(A) permit for the Lange's metalmark butterfly propagation program at Antioch Dunes NWR, including capture, propagation, transfers, releases, data management, and annual reporting.
RDE_O08	By 2019, an Antioch Dunes NWR Integrated Pest Management Plan is completed and implementation has begun. The Plan identifies priority invasive weeds for control, optimal strategies, and associated SMART objectives informed by the 2017 invasive plant inventory.
RDE_O09	By 2033, cover of ripgut brome, vetch, yellow star thistle, and Russian thistle is reduced by at least 50% and Himalayan blackberry is reduced by at least 80% (baseline = 2017 inventory) at the Stamm unit of Antioch Dunes NWR.
RDE_O10	By 2033, cover of tree of heaven is reduced by 75% (baseline = 2017 inventory) at the Sardis and PG&E West units of Antioch Dunes NWR.
RDE_O11	By 2033, oak cover is <20% at the Sardis Unit of Antioch Dunes NWR.
RDE_O12	Over the next 15 years (2018-2032), the number of wildfires at Antioch Dunes NWR is <6 or the average number of fires per year is <0.4 (0.80 wildfires per year for the period 1980-2013) and <20 acres are burned (105 acres burned for the period 1980-2013).
TME_G01	During the period 2017-2063, achieve an average annual rate of increase in the CA Ridgway's rail population at Don Edwards San Francisco Bay NWR of at least 4.3% (2.3% during 2017-2032 and 5.5% during 2032-2063); during the period 2017-2063, achieve an average annual rate of increase in the CA Ridgway's rail population at San Pablo Bay NWR of at least 1.9%.

Goal or Objective ID	Goal or Objective Detail
TME_G02	Over the next 15 years (2018-2032), CA Ridgway's rail populations are stable or increasing at Don Edwards San Francisco Bay and San Pablo Bay NWRs.
TME_G03	By 2025, extent of tidal marsh within the San Francisco Bay NWR Complex (San Pablo Bay NWR, Don Edwards San Francisco Bay NWR) increases to 14,500 acres (5,900 hectares). This represents a 50% increase in tidal marsh extent. A tidal marsh is defined as a vegetated, intertidal, sedimentary wetland that develops in coastal environments sheltered from high wave energy, with variable ecological influence from marine or estuarine salinity.
TME_O01	By 2022, mid marsh elevation (6.5 ft NAVD) has been achieved at the Cullinan Ranch East Unit of San Pablo Bay NWR through active sediment placement.
TME_O02	By 2028, the revegetation plan for the bayside transition habitat on the 2.5 mile long North Dickson Unit levee (Elliot Trail) at San Pablo Bay NWR is implemented, and 50% of the bayside transition habitat is dominated with native rhizomatous grasses, rhizomotous sedges, rushes and large interspersed patches of competitive native broadleafs.
TME_O03	By 2022, on-the-ground construction of the pre-breach, Haire Ranch (Phase I) restoration at San Pablo Bay NWR has been completed, including earth movement, channel creation, reservoir creation, and planting (interim seasonal habitat creation) on 1,100 acres.
TME_O04	By 2025, the final design for Skaggs Island is complete, and Phase II of the tidal marsh restoration, including cell creation, is underway at San Pablo Bay NWR.
TME_O05	By 2023, approximately 1000 acres (405 hectares) of tidal marsh are created at Don Edwards San Francisco Bay NWR. Applies to units R4, A1, A2W).
TME_O06	By 2023, approximately 90 acres (36 hectares) of transition zone habitat has been built at Don Edwards San Francisco Bay NWR. Applies to units R4, A1, A2W, and A8.
TME_O07	By the completion of Phase 2 of the South Bay Salt Pond Restoration project, western snowy plovers have been annually maintained at 250 breeding birds in the South Bay.
TME_O08	By 2028, native plants cover ≥50% of the marsh-upland ecotone at Inner Bair Island (approximately 40 acres). The marsh upland ecotone is the transitional area between tidal marsh and uplands (includes marsh mounds).
TME_O09	By 2022, the FLAP project at Don Edwards San Francisco Bay NWR has been completed and met the success criteria outlined in the project: vegetative cover in the mitigation area and along the bridge construction area of 60% of the reference wetland adjacent to the mitigation site.
TME_O10	By 2025, an average of 5 inches of sediment accretes within the 100-acre central basin of the Sonoma Creek Marsh Enhancement Project site at San Pablo Bay NWR.
TME_O11	Over the next 6 years (2018-2023), there are no feral cat feeding stations directly adjacent to priority areas (as defined in predator management annual workplan) of Don Edwards San Francisco Bay NWR.
TME_O12	By 2023, there is information available about the level of predation on waterbird and tidal marsh wildlife (rails or mice) and the effectiveness of predator management activities at Don Edwards San Francisco Bay NWR.
TME_O13	Over the next 15 years (2018-2032) there are no successful raven or raptor nests on PG&E towers in priority areas, as identified in the Don Edwards SFBNWR Predator Management Plan and annual work plans. Objective applies to predetermine towers that are accessible.

Goal or Objective ID	Goal or Objective Detail
TME_O14	By 2022, a strategy for preventing or reducing priority invasive plants at San Pablo Bay NWR is developed and documented. Priority invasive plants were identified in 2013 and inventoried in from 2013 to 2016. The plan will incorporate and update information in 2007 *Lepidium latifolium* control plan.
TME_O15	By 2022, the percent cover of Algerian sea lavender in tidal marsh at Don Edwards San Francisco Bay NWR is reduced by 50% of 2017 levels.
TME_O16	By the end of 2019, at least 80% of landowners (businesses and private landowners) adjacent to San Pablo Bay NWR are aware of *Lepidium latifolium* control success on the refuge.
TME_O17	Over the next 15 years (2018-2032), % cover of *Lepidium latifolium* is ≤5% of the 2007 baseline inventory. This objective applies to the control/treatment area established in 2007, and includes the following management units: Tolay Creek, Lower Tubbs Island, Tubbs Island Setback, Sonoma Creek West, Sonoma Baylands, Strip Marsh West.
TME_O18	By 2025, *Spartina densiflora* and *Spartina anglica* are eradicated and absence is documented over 3 consecutive years at Don Edwards San Francisco Bay and San Pablo Bay NWRs.
TME_O19	Over the next 8 years (2018-2025), there is a decrease (observed annually) in the percent cover of *Spartina alterniflora* (and hybrids) at Don Edwards San Francisco Bay and San Pablo Bay NWRs.
VPG_G01	Over the next 5 years (2018-2022), the average annual number of pools occupied by California tiger salamanders is >27 (of the 58 pools monitored AND with hydroperiods long enough for metamorphosis to occur, typically 100+ days) at the Warm Springs unit of Don Edwards San Francisco Bay NWR. The average is calculated as the mean of the best 3 of the last 5 years.
VPG_G02	By 2032, absolute native plant species cover is ≥20% in 8 pastures and ≥50% in 4 pastures at the Warm Springs unit of Don Edwards San Francisco Bay NWR.
VPG_G03	By 2027, maintain or increase native plant species richness (relative to 2013-2019) at the Warm Springs unit of Don Edwards San Francisco Bay NWR.
VPG_G04	By 2032, relative cover of native vernal pool and wetland plant species is ≥35% at the Warm Springs unit of Don Edwards San Francisco Bay NWR. Measure based on an average of 19 pools monitored.
VPG_G05	By 2026, maintain or increase the number of native vernal pool and wetland plant species (relative to 2013-2019) in 19 vernal pools monitored for vegetation at the Warm Springs unit of Don Edwards San Francisco Bay NWR.
VPG_G06	Over the next 5 years (2018-2022), the average annual number of pools occupied by vernal pool tadpole shrimp is >40 (of the 58 pools monitored AND with hydroperiods long enough to complete breeding cycle, typically 54 days) at the Warm Springs unit of Don Edwards San Francisco Bay NWR. The average is calculated as the mean of the best 3 of the last 5 years.
VPG_O01	Over the next 15 years (2018-2032), annually maintain residual dry matter to 1000-1500 lbs/acre at the end of the growth cycle (end of September) in upland grassland areas of the Warm Springs unit of Don Edwards San Francisco Bay NWR.
VPG_O02	Over the next 15 years (2018-2032), targeted non-native plant species (excluding grasses) comprise <30% cover at the Warm Springs unit of Don Edwards San Francisco Bay NWR. Targeted non-native plant species are identified in the Warm Springs Monitoring Plan and in the South San Francisco Bay Weed Management Plan.

Goal or Objective ID	Goal or Objective Detail
VPG_O03	Through 2023, vegetation height is maintained at <6 inches around select ground squirrel burrows in order to provide summering habitat for California tiger salamanders at the Warm Springs Unit of Don Edwards San Francisco Bay NWR.
VPG_O04	Relative cover of native plant species increases by ≥5% within 4 years of vernal pool plant restoration (seeding/planting native plants) at the Warm Springs Unit of Don Edwards San Francisco Bay NWR.
VPG_O05	Absolute cover of native plant species increases by ≥10% within 5 years of vernal pool plant restoration (seeding/planting native plants) at the Warm Springs Unit of Don Edwards San Francisco Bay NWR.
WTB_G01	By 2021, the annual peak number of waterbird nests in managed ponds at Don Edwards San Francisco Bay NWR is >250 for Forster's tern, >175 for Caspian tern, >175 for American avocet; and the peak number of SNPL observed during the breeding season is >60. Desired number of black-necked stilt nests to be determined in the future.
WTB_G02	By 2032, the annual number of colonial nesting waterbird breeding pairs at Marin Islands NWR increases to ≥300. Colonial nesting waterbird species include great blue heron, great egret, snowy egret, and black-crowned night heron.
WTB_G03	Over the next 5 years (2018-2022), annual wintering waterfowl species richness and abundance is stable (does not decrease) at Don Edwards San Francisco Bay and San Pablo Bay NWRs relative to a 2012 baseline: Don Edwards San Francisco Bay NWR, 14 species waterfowl, eared grebes = 5,343, waterfowl = 80,793; San Pablo Bay NWR: 10 waterfowl species, waterfowl count = 31,984.
WTB_G04	Over the next 5 years (2018-2022), wintering shorebird species richness and abundance does not decrease at San Pablo Bay NWR (SNP) and increases at Don Edwards SF Bay NWR (SFB) relative to 2015 baseline (SFB: 56,147, 22 spp; SNP: 14 spp). Expected values: SFB = 22 shorebird species, 70-90,000 individuals, SNP = 14 spp). Abundance baseline needed for SNP.
WTB_O01	Over the next 10 years (2018-2027), managed ponds at Don Edwards San Francisco Bay NWR attain water and salinity levels specified in the Pond Operations Plan.
WTB_O02	Over the next 10 years (2018-2027), ≥80% of the existing pond islands at Don Edwards San Francisco Bay NWR used by nesting waterbirds have the following vegetation characteristics: 1) <50% vegetated, 2) average vegation height <1-foot, 3) no vegetation >1-foot in height.
WTB_O03	By 2020, raccoon's presence is not detected (such as by video, photo, footprints, or scat) on Marin Islands NWR.
WTB_O04	By 2023, there are no feral cat feeding stations immediately adjacent to Don Edwards San Francisco Bay and Salinas River NWRs.
WTB_O05	By 2023, red fox sightings are reduced to zero on Don Edwards San Francisco Bay NWR.
WTB_O06	Over the next 15 years, (2018-2032), there are no successful gull colonies established in priority areas of Don Edwards San Francisco Bay NWR (SFB), as identified in the SFB Predator Management Plan and annual work plans.
WTB_O07	Over the next 15 years, (2018-2032), there are no successful raven and raptor nests on PG&E towers in accessible priority areas of Don Edwards San Francisco Bay NWR (SFB), as identified in the SFB Predator Management Plan and annual work plans.
WTB_O08	By 2025, 100 informational brochures/rack cards are distributed each year to at least 3 major stakeholders of the Marin Islands NWR (such as Loch Lomond Marina, Condominium Homeowners Association, and Andy's Market).

Goal or Objective ID	*Goal or Objective Detail*
WTB_O09	By 2022, illegal human trespassing is reduced by at least 50% (baseline = 2018) within 100-m of island shorelines (including the islands) at Marin Islands NWR.

Appendix B

Survey Ranking Criteria

The Complex selected nine criteria to help identify priority natural resource surveys. The criteria were selected (and adapted) by staff from a set of 24 criteria presented in the User's Guide for a SMART Prioritization Tool' (USFWS 2014). Staff also weighted criteria to represent the degree of importance or weight each should have in calculating a total survey score. The nine criteria are described below and include the original tool category (such as refuge priorities and management needs), original criteria ID (such as 1A, 1B, etc.) and associated weight assigned by staff (in parentheses).

1. Refuge Priorities and Management Needs

1A. Refuge Purpose (.127)

Does the survey provide information to evaluate if the Complex 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 (Executive Order) or under ANILCA in Alaska. A survey addressing wilderness character addresses purpose for a refuge with proposed or designed wilderness.

Example: Kodiak NWR was founded to protect the breeding and feeding grounds of brown bears. A brown bear survey directly relates to this purpose.

1. No
2. Yes

1B. Links between Survey Information and Complex/Refuge Conservation Goals and Objectives (.164)

What goals or objectives does the survey inform? The Complex work plan? A CCP? Other step-down management plan?

1. Survey is not tied to a 'measurable' goal or objective (from any SF Complex plan)
2. Addresses one or more 'measurable' CCP or refuge step-down plan (such as predator management plan or IPM plan) objectives or goals, but not tied to a Complex work plan goal or objective
3. Addresses a Complex workplan goal or objective. The survey measure(s) will directly inform a SF Complex work plan goal or objective (the survey measure and the measure mentioned in a workplan goal or objective match)

1D. Management Utility (Decision Support) for the Refuge (.161)

Does the survey provide data for recurring management decisions, especially as part of an existing decision framework that is implemented on a regular basis? Surveys providing information to either directly evaluate or serve as indicators of high- priority management actions can be considered as earning a 3 or 4 rating for this criterion.

1. No set application for the refuge
2. May have management implications, but they are not explicitly defined
3. Has management implications, but no current decision framework
4. Part of an existing adaptive management decision framework

2. Partner Priorities and Management Needs

2A. FWS Programs (.062)

Does the survey provide information that directly contributes (meaning data is shared and utilized by the FWS) to evaluating the status and trends of resources that are a priority 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 a management priority identified by a FWS regional or national program or initiative
2. Addresses a management priority identified by 1 FWS regional or national program or initiative
3. Addresses a management priority identified by 2 FWS regional or national programs or initiatives
4. Addresses a management priority identified by ≥3 FWS regional or national programs or initiatives

3. Ecological Applications

3B. Refuge Processes (.096)

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

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

4. Additional Legal Mandates

4A. Listed Species or communities (.112)

Is the objective of the survey a species or 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

5. Immediacy of Need

5B. Threat (.121)

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

1. The survey does not directly relate to evaluating the status of a threat or effectiveness of management aimed at reducing a threat (such as invasive plant management or predator management)
2. Yes, the survey assesses the status or supports decision making to address a Low threat
3. Yes, the survey assesses the status or supports decision making to address a Medium threat
4. Yes, the survey assesses the status or supports decision making to address a High or Very High threat

6. Scope and Scale

6A. Baseline Data (.110)

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). A one-time baseline assessment of previously unknown information.

1. No
2. Yes

6B. 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?

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. Example: 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.

1. Low: Survey covers <1% of the species' or communities' population/range
2. Medium: Survey covers 1-10% of the species' or communities' population/range
3. High: Survey covers ≥10% of the species' or communities' population/range

Appendix C

Surveys Required by Permit

Natural resource surveys required by permits issued to the Complex for wetland restoration activities. The surveys listed here do not inform refuge conservation goals and objectives. Surveys required by permit that also inform refuge conservation goals and objectives are listed in tables 4-10, as identified by a footnote. Additional information about the permit surveys below, such as start and end years, are in PRIMR.

Refuge	*Target ID*[1]	*PRIMR Survey Name*	*PRIMR Survey ID*	*PRIMR Survey Type*[2]	*Permitting Agency*[3]
Don Edwards San Francisco Bay National Wildlife Refuge (N = 10 surveys)					
SFB	TME	Bair Island Restoration Project : Habitat Development Monitoring (aerial imagery)	FF08RSFB00-039	M	BCDC, RWCQB
SFB	TME	Bair Island Restoration Project: Marsh Morphology Monitoring (aerial imagery)	FF08RSFB00-040	M	BCDC, RWCQB
SFB	TME	Bair Island Restoration Project: Secretive Marsh Bird Survey	FF08RSFB00-041	M	BCDC, RWCQB
SFB	TME	Bair Island Restoration Project: Salt Marsh Harvest Mouse Survey	FF08RSFB00-042	M	BCDC, RWCQB
SFB	TME	Bair Island Restoration Project: Vegetation Monitoring	FF08RSFB00-043	M	BCDC, RWCQB
SFB	TME	Experimental Methods to Enhance and Restore Tidal Marsh-upland Transition Zone Habitats	FF08RSFB00-045	CR	BCDC, RWQCB
SFB	TME	LaRiviere Monitoring Survey (FLAP project): photo points	FF08RSFB00-047	M	RWQCB, BCDC
SFB	TME	LaRiviere Monitoring Survey (FLAP project): sediment	FF08RSFB00-049	M	RWQCB, BCDC
SFB	TME	Water Quality Monitoring for RWQCB Permit for South Bay Salt Pond Restoration Project	FF08RSFB00-021	M	RWQCB
SFB	WTB	Using Biosentinels to Monitor Effects of Wetland Restoration for the South Bay Salt Pond Restoration Project	FF08RSFB00-063	CM	BCDC, RWQCB
San Pablo Bay National Wildlife Refuge (N = 24 surveys)					
SNP	TME	Cullinan Ranch: Aerial or Satellite Photo Monitoring	FF08RSNP00-026	CM	
SNP	TME	Cullinan Ranch: Field Photo Monitoring	FF08RSNP00-032	M	
SNP	TME	Cullinan Ranch: Fish Surveys	FF08RSNP00-028	CM	
SNP	TME	Cullinan Ranch: Ridgway's Rail	FF08RSNP00-029	M	

Refuge	*Target ID*[1]	*PRIMR Survey Name*	*PRIMR Survey ID*	*PRIMR Survey Type*[2]	*Permitting Agency*[3]
SNP	TME	Cullinan Ranch: Salt Marsh Harvest Mouse	FF08RSNP00-061	M	
SNP	TME	Cullinan Ranch: Tidal Channel Evolution (Ducks Unlimited)	FF08RSNP00-030	CM	
SNP	TME	Cullinan Ranch: Vegetation Assessment	FF08RSNP00-027	CM	
SNP	TME	Dickson: Aerial or Satellite Photo Monitoring for Plant Communities	FF08RSNP00-039	CM	BCDC, RWQCB
SNP	TME	Dickson: Aerial or Satellite Photo Monitoring for Tidal Channel Development	FF08RSNP00-040	CM	BCDC, RWQCB
SNP	TME	Dickson: Birds	FF08RSNP00-042	CM	BCDC, RWQCB
SNP	TME	Dickson: Field Photo Monitoring	FF08RSNP00-038	CM	BCDC, RWQCB
SNP	TME	Dickson: Methyl Mercury	FF08RSNP00-041	CM	BCDC, RWQCB
SNP	TME	Dickson: Salt Marsh Harvest Mouse	FF08RSNP00-045	M	
SNP	TME	Dickson: Seasonal Wetlands Assessment	FF08RSNP00-044	CM	BCDC, RWQCB
SNP	TME	Dickson: Sedimentation	FF08RSNP00-037	CM	BCDC, RWQCB
SNP	TME	Dickson: Vegetation Assessment	FF08RSNP00-043	CM	BCDC, RWQCB
SNP	TME	Sonoma Creek Marsh: Channel Geometry	FF08RSNP00-024	CM	BCDC
SNP	TME	Sonoma Creek: Aerial or Satellite Photo Monitoring	FF08RSNP00-051	M	
SNP	TME	Sonoma Creek: Field Photo Monitoring	FF08RSNP00-054	M	BCDC, RWQCB
SNP	TME	Sonoma Creek: Marsh Transgression	FF08RSNP00-056	M	
SNP	TME	Sonoma Creek: Salt Marsh Harvest Mouse	FF08RSNP00-058	M	
SNP	WTB	Cullinan Ranch: Waterbird Surveys	FF08RSNP00-062	CM	BCDC, RWCQB
SNP	WTB	Dickson: Waterbird Surveys	FF08RSNP00-063	CM	BCDC, RWQCB
SNP	WTB	Sonoma Creek: Waterbird Surveys	FF08RSNP00-064	M	BCDC, RWQCB

1. Refuge. Don Edwards San Francisco Bay National Wildlife Refuge (SFB), San Pablo Bay National Wildlife Refuge (SNP).
2. Ecosystem Target ID: CDE = Coastal Dune Ecosystem, EIE = Estuarine Island Ecosystem, MIE = Marine Island Ecosystem, PVW = Pajaro River Watershed, RDE = Riverine Dune Ecosystem, TME = Tidal Marsh Ecosystem, VPG = Vernal Pool Grassland, WTB = Waterbirds
3. Survey types: Inventory (I), Cooperative Baseline (CB), Monitoring to Inform Management (M), Cooperative Monitoring to Inform Management (CM), Research (R), and Cooperative Research (CR)
4. Permitting Agency: BCDC = San Francisco Bay Conservation and Development Commission, RWQCB = San Francisco Bay Regional Water Quality Control Board. If cell is blank, refuge needs to identify the agency that issued a permit, blank = not provided by refuge staff

Appendix D

Appendix of "Other" Surveys

These surveys are conducted by Complex staff or partners but do not directly tie to conservation goals and objectives nor are they required by a permit; and the capacity to conduct the survey will be difficult to secure beyond what is available to conduct tier 1 surveys or meet existing permit requirements for monitoring. These surveys are all classified as 'future': surveys that are not likely to be conducted by Complex staff during the span of the IMP unless additional resources are secured.

Target ID	*PRIMR Survey Name*	*PRIMR Survey ID*	*PRIMR Survey Type*
Antioch Dunes NWR (N = 2)			
RDE	Dune Restoration Monitoring	FF08RATD00-009	CM
RDE	Herpetology Inventory	FF08RATD00-010	CI
Farallon NWR (N = 28)			
MIE	Aerial Photographic Surveys: common murre, Brandt's cormorant, double-crested cormorant	FF08RFRL00-020	CB
MIE	Bat Roost Survey	FF08RFRL00-022	CB
MIE	Brandt's Cormorant Diet	FF08RFRL00-023	CB
MIE	Brandt's Cormorant Reproductive Performance	FF08RFRL00-024	CB
MIE	California Gull Breeding Population Size	FF08RFRL00-027	CB
MIE	Cassin's Auklet Chick Diet	FF08RFRL00-029	CB
MIE	Cassin's Auklet Known Age Reproductive Performance	FF08RFRL00-030	CB
MIE	Common Murre Chick Diet	FF08RFRL00-032	CB
MIE	Common Murre Reproductive Performance	FF08RFRL00-033	CB
MIE	Double-Crested Cormorant Population Size	FF08RFRL00-035	CB
MIE	Elephant Seal Breeding Population and Reproductive Performance Monitoring	FF08RFRL00-011	CB
MIE	Landbird Migration	FF08RFRL00-036	CB
MIE	House Mouse Population Inventory	FF08RFRL00-038	CI
MIE	Northern Fur Seal Breeding Population Size and Tag Reading	FF08RFRL00-013	CB
MIE	Pelagic Cormorant Reproductive Performance	FF08RFRL00-039	CB
MIE	Pigeon Guillemot Chick Diet	FF08RFRL00-040	CB
MIE	Pigeon Guillemot Population Size	FF08RFRL00-041	CB
MIE	Pigeon Guillemot Reproductive Performance	FF08RFRL00-042	CB
MIE	Pigeon Guillemot Wintering Range Study (Global Location Sensing tags)	FF08RFRL00-043	CR
MIE	Rhinoceros Auklet Chick Diet	FF08RFRL00-044	CB
MIE	Rhinoceros Auklet Wintering Range Study (Global Location Sensing tags)	FF08RFRL00-046	CR
MIE	Shorebird Occurrence	FF08RFRL00-047	CB

Target ID	*PRIMR Survey Name*	*PRIMR Survey ID*	*PRIMR Survey Type*
MIE	Statewide Aerial Steller Sea Lion Surveys	FF08RFRL00-056	CB
MIE	Tufted Puffin Population Size	FF08RFRL00-048	CB
MIE	Western Gull Foraging Ecology	FF08RFRL00-050	R
MIE	Western Gull Population Size	FF08RFRL00-051	CB
MIE	Western Gull Reproductive Performance	FF08RFRL00-052	CB
MIE	White Shark Research at Southeast Farallon Island	FF08RFRL00-006	R
Don Edwards San Francisco Bay NWR (N = 10)			
TME	Harbor Seal Survey	FF08RSFB00-016	CB
TME	Monitoring the Response of Fish Communities to Salt Pond Restoration	FF08RSFB00-033	CM
TME	Salt Marsh Harvest Mouse Survey	FF08RSFB00-018	BM
TME	Tidal Marsh Bird Surveys	FF08RSFB00-053	CB
TME	Tidal Marsh Elevation and Vegetation Inventory	FF08RSFB00-054	I
VPG	Burrowing Owl Monitoring[3]	FF08RSFB00-030	CM
WTB	Breeding Bird Survey	FF08RSFB00-059	CB
WTB	Christmas Bird Count	FF08RSFB00-060	CB
WTB	Western Snowy Plover Monthly Population Counts	FF08RSFB00-004	CM
WTB	Western Snowy Plover Nest Monitoring	FF08RSFB00-005	CM
Salinas River NWR (N = 2 surveys)			
CDE	Salinas River Fish Inventory	FF08RSLN00-008	CI
CDE	Range-Wide Western Snowy Plover Window Surveys	FF08RSLN00-004	CM
San Pablo Bay NWR (N = 11 surveys)			
TME	Skaggs Island: Breeding Raptor Survey	FF08RSNP00-013	CM
TME	North Parcel: Bird Survey	FF08RSNP00-047	CM
TME	North Parcel: Grassland Vegetation Survey	FF08RSNP00-046	CM
TME	Marsh Elevation Monitoring: Sediment Elevation Tables	FF08RSNP00-018	CM
TME	Dickson: Marsh Mound Erosion Study	FF08RSNP00-050	CR
TME	Mosquito Monitoring	FF08RSNP00-059	CM
TME	Skaggs Island: Wintering and Migratory Raptor Survey	FF08RSNP00-014	CB
TME	Salt Marsh Harvest Mouse Genetic Survey	FF08RSNP00-048	R
TME	Salt Marsh Harvest Mouse Survey	FF08RSNP00-007	M
TME	Tidal Marsh Bird Surveys	FF08RSNP00-052	CB
WTB	Skaggs Island: Heron and Egret Nest Monitoring	FF08RSNP00-012	CM

[1]Conservation targets of the San Francisco Bay National Wildlife Refuge Complex: RDE = River Dune Ecosystem, MIE = Marine Island Ecosystem, TME = Tidal Marsh Ecosystem, VPG = Vernal Pool Grasslands, WTB = Waterbirds, CDE = Coastal Dune Ecosystem

[2] Title of the survey in the PRIMR database and its corresponding survey type: Inventory (I), Cooperative Baseline (CB), Monitoring to Inform Management (M), Cooperative Monitoring to Inform Management (CM), Research (R), and Cooperative Research (CR)

[3]This survey *is* called out in a long-term monitoring plan associated with the Complex.

Appendix E

Survey Timing

Schedule of tier 1 surveys at the San Francisco Bay National Wildlife Refuge Complex.

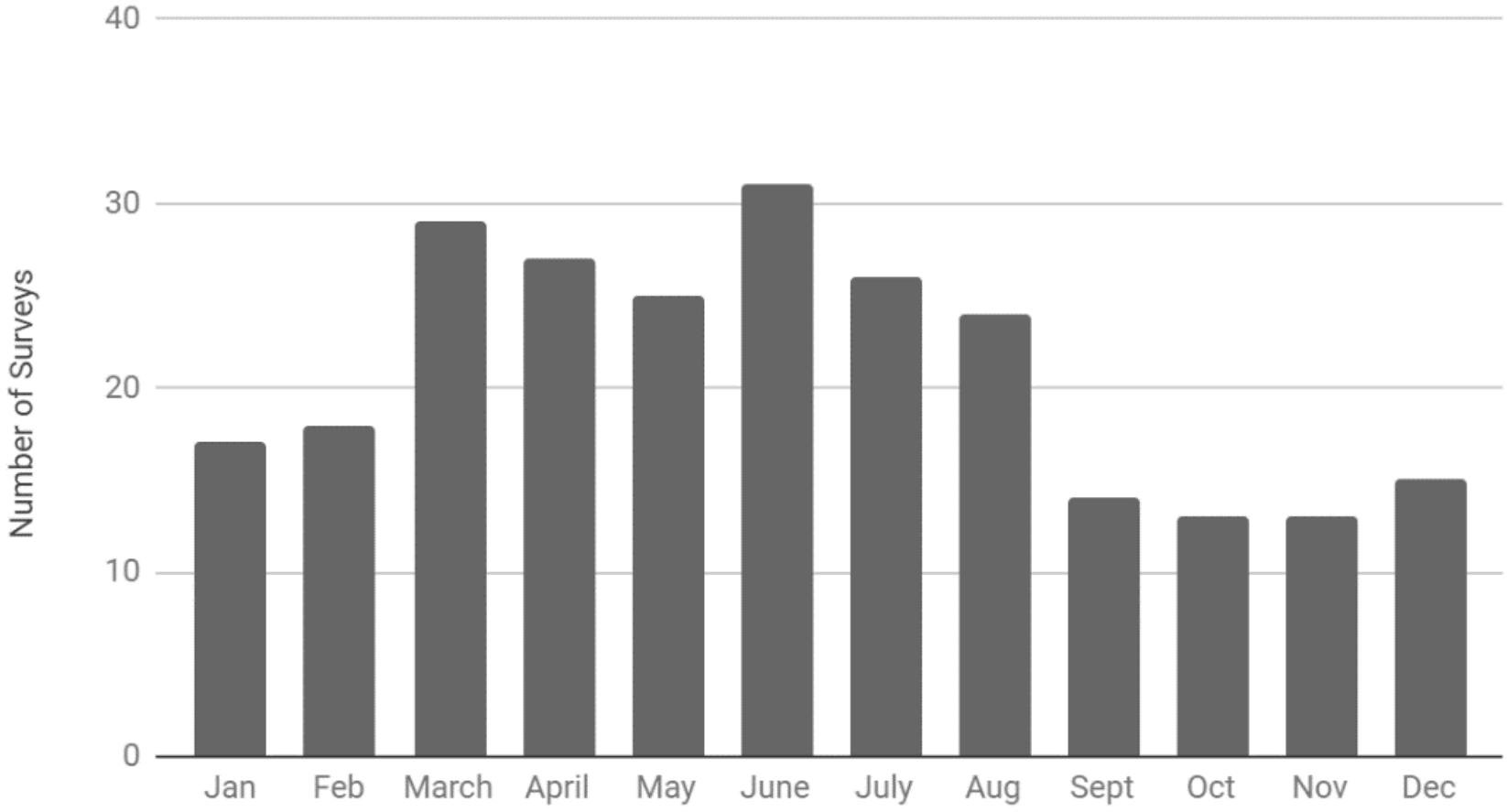
Refuge[1]	*Target ID*[2]	*PRIMR Survey Name*	*PRIMR Survey ID*	*Jan*	*Feb*	*Mar*	*April*	*May*	*Jun*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
ATD	RDE	Vegetation Monitoring: Antioch Dunes NWR	FF08RATD00-006												
ATD	RDE	Lange's Metalmark Butterfly Survey	FF08RATD00-002												
ATD	RDE	Lange's Metalmark Pupae Release Success Survey	FF08RATD00-012												
ELS	PVW	Pond Hydrology Survey: Ellicott Slough NWR	FF08RELS00-007												
ELS	PVW	Salamander Population Dynamics: Ellicott Slough NWR	FF08RELS00-009												
ELS	PVW	Landcover Survey: woodland and grassland	FF08RELS00-010												
ELS	PVW	Vegetation Monitoring: Ellicott Slough NWR	FF08RELS00-006												
ELS	PVW	Dipnet Survey: special status amphibian survey	FF08RELS00-005												
ELS	PVW	Visual Encounter Survey: special status amphibian species	FF08RELS00-004												
FRL	MIE	Ashy and Leach's storm-petrel Reproductive Performance Survey	FF08RFRL00-021												
FRL	MIE	Arboreal Salamander Long Term Monitoring	FF08RFRL00-007												

Refuge[1]	*Target ID*[2]	*PRIMR Survey Name*	*PRIMR Survey ID*	*Jan*	*Feb*	*Mar*	*April*	*May*	*Jun*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
FRL	MIE	Brandt's Cormorant, Pelagic Cormorant, and Common Murre Population Size	FF08RFRL00-025												
FRL	MIE	Capture-recapture of Ashy and Leach's Storm-Petrels	FF08RFRL00-004												
FRL	MIE	Non-native Small Mammal Presence-absence Surveys	FF08RFRL00-037												
FRL	MIE	Burrowing Owl Population Monitoring	FF08RFRL00-026												
FRL	MIE	Vegetation Monitoring: Farallon Islands NWR	FF08RFRL00-049												
FRL	MIE	Cassin's Auklet Reproductive Performance	FF08RFRL00-031												
FRL	MIE	Rhinoceros Auklet Reproductive Performance	FF08RFRL00-045												
FRL	MIE	Weekly Pinniped Census	FF08RFRL00-012												
FRL	MIE	Cassin's Auklet and Rhinoceros Auklet Capture-Recapture Survey	FF08RFRL00-028												
FRL	MIE	Farallon Camel Cricket Survey	FF08RFRL00-034												
FRL	Target ID[1]	PRIMR Survey Name	PRIMR Survey ID	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
MRI	EIE	Invasive Plant Inventory: Marin Islands NWR	FF08RMRI00-003												
MRI	EIE	Vegetation Monitoring: Marin Islands NWR	FF08RMRI00-004												
MRI	WTB	Predator Management Effectiveness Survey: Marin Islands NWR	FF08RMRI00-008												
MRI	WTB	Marin Islands: Colonial Nesting Waterbird Survey	FF08RMRI00-002												
SFB	TME	Secretive Marsh Bird Survey: Don Edwards San Francisco Bay and San Pablo Bay NWRs	FF08RSFB00-052												

Refuge[1]	*Target ID*[2]	*PRIMR Survey Name*	*PRIMR Survey ID*	*Jan*	*Feb*	*Mar*	*April*	*May*	*Jun*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
SFB	TME	Invasive Spartina Survey	FF08RSFB00-046						■	■	■	■			
SFB	TME	Habitat Evolution Mapping Project (HEMP)	FF08RSFB00-044						■	■	■				
SFB	TME	La Riviere Monitoring Survey (FLAP Project): vegetation survey	FF08RSFB00-048	■	■							■	■	■	■
SFB	TME	Bair Island Restoration Project: ecotone vegetation composition survey	FF08RSFB00-065			■	■	■							
SFB	TME	Weed Inventory and Monitoring	FF08RSFB00-017			■	■	■							
SFB	TME	Western Snowy Plover Window Survey	FF08RSFB00-010					■							
SFB	VPG	Vernal Pool Vegetation Survey (2012-current)	FF08RSFB00-024			■	■	■							
SFB	VPG	Native Plant Restoration Success Survey	FF08RSFB00-026			■	■	■	■	■	■				
SFB	VPG	Vernal Pool Hydroperiod Survey	FF08RSFB00-027	■	■	■	■	■	■						■
SFB	VPG	Residual Dry Matter (RDM) Survey	FF08RSFB00-015									■	■		
SFB	VPG	California Tiger and Salamander and Vernal Pool Tadpole Shrimp Survey	FF08RSFB00-028	■	■	■	■								■
SFB	VPG	Summer Vegetation Survey	FF08RSFB00-029						■	■					
SFB	WTB	Managed and Salt Pond Waterbird Survey	FF08RSFB00-008	■	■	■	■	■	■	■	■	■	■	■	■
SFB	WTB	Mid-Winter Waterfowl Survey	FF08RSFB00-006	■											
SFB	WTB	Managed Ponds: Water Monitoring	FF08RSFB00-061	■	■	■	■	■	■	■	■	■	■	■	■
SFB	WTB	Avian Predator Survey	FF08RSFB00-058			■	■	■	■	■	■	■			
SFB	WTB	Pacific Flyway Migratory Shorebird Project	FF08RSFB00-009											■	
SFB	WTB	Managed Ponds: Vegetation Monitoring	FF08RSFB00-064		■	■						■	■		

Refuge[1]	*Target ID*[2]	*PRIMR Survey Name*	*PRIMR Survey ID*	*Jan*	*Feb*	*Mar*	*April*	*May*	*Jun*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
SFB	WTB	Colonial Waterbird Breeding Season Surveys	FF08RSFB00-007		■	■	■	■	■	■	■				
SFB	WTB, TME	Avian Predator Nest Survey	FF08RSFB00-057			■	■	■	■						
SFB	WTB, TME	Predator Management Effectiveness Survey: Don Edwards San Francisco Bay NWR	FF08RSFB00-062												
SLR	CDE	Coastal Dune Vegetation Survey: Salinas River NWR	FF08RSLN00-005					■	■	■	■	■	■		
SLR	CDE	Western Snowy Plover Productivity Survey	FF08RSLN00-002			■	■	■	■	■	■	■	■		
SLR	CDE	Smith's Blue Butterfly Survey	FF08RSLN00-006						■	■	■				
SNP	TME	Secretive Marsh Bird Survey: Don Edwards San Francisco Bay and San Pablo Bay NWRs	FF08RSNP00-049	■	■	■	■								
SNP	TME	Salt Marsh Extent Monitoring	FF08RSNP00-065			■	■	■							
SNP	TME	Sonoma Creek: Sediment Accretion Surveys	FF08RSNP00-055						■	■	■				
SNP	TME	Invasive Spartina Survey	FF08RSNP00-005						■	■	■	■			
SNP	TME	Tidal Marsh Transition Zone Native Plant Restoration Monitoring	FF08RSNP00-016						■	■	■				
SNP	TME	*Lepidium Latifolium* Monitoring: San Pablo Bay NWR	FF08RSNP00-033						■	■	■				
SNP	WTB	San Francisco Bay Mid-Winter Waterfowl Survey	FF08RSNP00-011	■	■									■	■
SNP	WTB	Pacific Flyway Migratory Shorebird Project	FF08RSNP00-006									■	■	■	

1. National Wildlife Refuge codes: ATD= Antioch Dunes, SFB = Don Edwards San Francisco Bay, ELS = Ellicott Slough, FRL = Farallon Islands, MRI = Marin Islands, SLR = Salinas River, SNP = San Pablo
2. Ecosystem Target codes: TME = Tidal Marsh Ecosystem Codes, MIE = Marine Island Ecosystem, EIE = Estuarine island Ecosystem, VPG = Vernal Pool Grassland, PVW = Pajaro River Watershed, CDE = Coastal Dune Ecosystem, RDE = River Dune Ecosystem, WTB = Waterbirds



Number of natural resource surveys conducted by month at the San Francisco Bay National Wildlife Refuge Complex

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