



Priorities for Fiscal Year 2019

Purpose

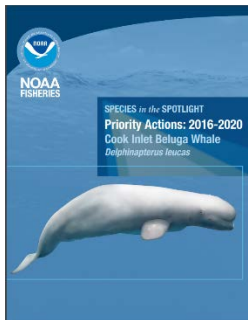
The Southwest Fisheries Science Center (SWFSC) Strategic Science Plan establishes our strategic direction, as guided by National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS) goals and priorities. This FY19 priorities document describes our mission, fiscal setting and challenges, and our strategic approach and funding priorities for meeting our core mission while maintaining focus on emerging needs. We also drill down to division-specific FY19 activities that will address SWFSC priorities. This document lays out our vision for the year ahead.

Our Mission

Our mission is to provide sound scientific advice in support of sustainable fisheries and the recovery and conservation of protected resources, using ecosystem-based approaches. We are guided by our Congressional legislative mandates, goals and priorities. We are also guided by strategic planning documents of the Department of Commerce, NOAA, NMFS, and our West Coast Regional Office. Additional documents outline work plans and areas of emphasis and emerging needs for the NMFS and SWFSC. These



include the NOAA Fisheries Climate Science Strategy and associated Western Regional Action Plan; NOAA Fisheries Ecosystem Based Fishery Management Policy, Roadmap and Implementation Plan; and SWFSC Program Review Reports, and planning documents of partner agencies



with shared objectives. NMFS has also identified eight species occurring in US waters that require immediate action to prevent extinction, but that have prospects for improvement from conservation actions; six of the eight occur within the West Coast Region. The “Species in the Spotlight” is a major agency initiative to change the trajectory of these species and place them on the road to recovery. Collectively, these documents and initiatives represent our core mission and emerging needs for FY19. We also anticipate conducting a Center strategic planning activity in conjunction

with partners in FY19.

Fiscal Landscape and Challenges

SWFSC has received essentially similar budgets for several years. The FY18 Congressionally-approved budget reflected the previous year for the Center in most areas, with some areas slightly above our FY17 level. Much of the work completed in FY18 could not have been accomplished without partnerships and leveraging of funds. For example, FY18 funding from other federal and state agencies provided support for salmonid recovery and other Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) activities (e.g., abalone, cetaceans and aquaculture). These types of partnerships have become integral to how we accomplish our mission.

The President's FY19 NOAA Budget request includes an approximately 10% reduction in the overall NMFS budget. If passed, much of that reduction would be taken from external grant programs. However, some of the reductions would likely directly impact our operations, although it is as yet unknown how those cuts would be distributed across the agency. The budget process is long and takes into consideration the budget mark-ups of the House and Senate before a final appropriations bill is signed. In addition, increased agency fee-for-service programs within NOAA to improve corporate services will continue to impact our resources. Prudent planning includes preparation for both level funding and reduction scenarios for SWFSC.

FY19 Priorities

NMFS has adopted many of the same steps SWFSC has put in place in recent years to define priorities, so we will continue to develop our priority-based resource allocation process that consists of:

1. A Strategic Science Plan;
2. Activities Descriptions for each Major Activity in the Center;
3. Ranking Criteria (based on NMFS Criteria) (see Appendix B);
4. Annual Priorities Memo;
5. Priority and Risk-Based Allocations of funding;
6. Performance Plans Aligned with Center's Prioritized Activity Plans; and
7. Communication to Staff.

The following are the key priorities for SWFSC base programs in FY19, in no particular order:

- Magnuson-Stevens Act stock assessments, economic analyses and fisheries surveys for Coastal Pelagic Species (CPS), Highly Migratory Species (HMS), Groundfish, and Salmon. Within this list, priority will be given to stocks that are commercially and/or recreationally fished in CA Current Large Marine Ecosystem (CCLME) waters and have significant economic impacts on the West Coast, as well as those identified through Treaties and international agreements with Regional Fishery Management Organizations and Regional Fishery Organi-

zations. Two new priorities in this realm include deploying new moorings and glider observation platforms in the Antarctic, and analysis of data from new unmanned platforms begun in FY18.

- Updating marine mammal assessments (abundance and trends, population structure, health and condition, and placement into an ecosystem context) for CCLME species using data from the FY18-19 CA Current Ecosystem Survey. These assessments will fulfill a SWFSC requirement as a part of our partnership with Navy and BOEM to jointly fund marine mammal surveys in many regions of the Pacific.
- Marine turtle research and assessments, especially for Species in the Spotlight Leatherback turtles.
- ESA-listed Species in the Spotlight winter run Chinook and coastal coho salmon population research, as well as research on Upper Klamath Basin coho to support WCRO decision-making. Commitments made to outside agencies are high priorities to fulfill.
- Deep Sea Coral habitat survey and research in the CA Current to support Pacific Fishery Management Council actions on essential fish habitat.
- Ecosystem research to implement the agency's Western Region Implementation Plan under the Ecosystem Based Fisheries Management Roadmap, the Western Regional Action Plan for climate variability and U.S. strategic interests in Antarctica. Special emphasis will be on integrating across divisions to achieve synergies and efficiencies with the Center's new Center Ecosystem Science Committee. The Center's new funding from the dissolved NMFS RFP funding programs for Fisheries and the Environment (FATE), Advanced Survey Technologies (AST) and Stock Assessment (SAAM) will be put towards these efforts.
- Support of commercial aquaculture research for yellowtail species, as well as research for recovery of species, such as white abalone (a Species in the Spotlight), will continue to be a high priority.
- Implementation of innovative technologies that increase information content per unit of cost while reducing overall costs (e.g., Antarctic autonomous observing platforms, etc.).
- Training and development of staff, as well as increasing diversity and inclusion efforts to both provide opportunities to our workforce and bolster our ability withstand attrition.

While we will most likely see less operational funding in FY19, the base resources available to support research in the Southwest will remain considerable (likely in excess of \$37M). We expect to carry out planned major surveys, process, disseminate, and archive core fisheries data and conduct fisheries stock assessments. We also expect to continue to provide relative abundance information on several marine mammal and turtle species. We plan to conduct research on environmental forcing that will advance the agency's commitment to ecosystem-based fisheries management and improve our understanding of how the environment affects commercial

and recreational fisheries over a range of temporal and spatial scales. In addition, a significant number of research projects will be funded through reimbursable agreements with other agencies as well as with temporary funding from NMFS Headquarters Offices. Recognizing we may be doing less research overall in FY20 than now, we will need to make strategic decisions in FY19 on how we are organized and the activities we choose to conduct. Flexibility will be key. However, the selection of which programs to be eliminated, or reduced in scale, will be done strategically and transparently.

Strategic Approaches for Addressing Priorities

Partnerships

Partnerships have long been important to carrying out our work, and that importance will continue in FY19. External funds will be sought to support the above priorities, as needed. For example, two new NMFS Strategic Initiatives for 1) genetics and genomics and 2) use of Fourier transform-near infrared spectroscopy for aging should be leveraged. External funds should not be sought if they do not support the Center's priorities.

Cost Containment

We expect future budget decreases will hamper our ability collect core data and address emerging fisheries, marine mammal/turtle and operational issues. Given these challenges and those outlined above we look to innovate and partner on new ways to collect and analyze data and to grow fisheries, marine mammal/turtle and other operations. Staffing costs are by far our largest expense and these rise each year on average by 3-4%. We also face increased maintenance costs from aging facilities. We will take steps to contain these costs over the short and longer term to allow SWFSC to devote adequate resources to support research operations.

Alignment of Research Activities and Workforce Capabilities

In this environment, we will bolster our efforts to re-engineer SWFSC science advice and services based on trade-offs between internal base funding levels, staffing requirements, technological advances, strategic partnerships and shared priorities among the SWFSC, West Coast Regional Office, Pacific Fishery Management Council, and NMFS Headquarters. The following strategies will be used to align our workforce capabilities and research activities with fiscal realities:

- Use non-competitive reassignments where possible to fill labor shortfalls;
- Use SWFSC resource allocation process to provide incentives to motivate this workforce re-alignment;
- Continue progress in research integration through cross-divisional staff integration;
- Continue efforts to control federal and contract labor costs.

In Appendix A each SWFSC division will briefly lay out some FY18 highlights and plans for FY19.

Appendix A - Division Priorities

Antarctic Ecosystem Research Division (AERD)

FY18 Accomplishments

Several accomplishments from FY18 provide a foundation for establishing the AERD's priorities in FY19. During FY18, the AERD acquired and tested the equipment and supplies needed to implement a new research program that will ultimately link high-resolution (in time and space) data on variations in krill biomass and "flux" to the foraging dynamics of krill-dependent predators. Employees within the AERD learned to maintain, deploy, duty cycle, and pilot a new suite of instruments, including gliders and moorings outfitted with various acoustic and oceanographic sensors and animal-borne video cameras. The Division is thus primed to transform its field research with technologies that can increase operational flexibility and simultaneously facilitate scientific inquiry across a hierarchy of spatiotemporal scales.

FY19 Priorities

During FY19 the AERD will prioritize work that builds on its accomplishments from previous years to address issues of immediate importance to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Specifically, the AERD will prioritize efforts to:

1. collect data on oceanographic conditions and Antarctic krill using gliders and moorings as well as integrate these data with concomitant observations on krill-dependent predators, including observations collected by animal-borne video cameras; and
2. provide scientific advice on spatial management of human activities in the Antarctic.

The aim of Priority 1 above is to collect data that can be used to quantify the functional relationships between krill-dependent predators and their prey. The word "integrate" purposefully implies that the ultimate products of this work will be generated from synthetic analyses of multiple data streams; these products will be relevant to ecosystem-based management of the Antarctic krill fishery. The aim of Priority 2 is to inform the U.S. Delegation to CCAMLR about the expected outcomes of various existing and proposed strategies to manage Antarctic fisheries by purposefully distributing fishing effort or catch limits in space.

Environmental Research Division (ERD)

FY18 Accomplishments

ERD continued to conduct research on climate and environmental variability and providing integrated data services for the sound management of trust species in the Southwest. Major FY18 accomplishments included:

- producing the annual CalCOFI *State of the California Current Report* and co-lead the *State of the California Current Ecosystem Report* for the Pacific Fishery Management Council (PFMC)
- providing joint leadership with the WCRO and NWFSC of the ongoing implementation of the *Western Regional Action Plan (WRAP)*, the west coast component of the

NOAA/NMFS Fishery Climate Science Strategy and the *Western Regional Implementation Plan* (WRIP) for the NOAA/NMFS Ecosystem-based Fisheries Management Roadmap

- publishing EcoCast, a dynamic ocean management strategy for reducing bycatch
- developing a new set of upwelling indices that reduce the known biases in the Bakun index by using higher resolution of the atmospheric winds
- releasing a new ERDDAP web-interface software with enhanced data searches, visualization and access.

FY19 Priorities

ERD's FY19 priorities will continue to be informed by SWFSC internal planning, recommendations of the 2016 Ecosystem Science review, and advancement of key national initiatives such as EBFM/WRIP, NCSS/WRAP and PARR. ERD will continue to support ecosystem modeling and development of integrated products made available through enhanced data access tools. The California Current Integrated Ecosystem Assessment (CCIEA) tool will assess broad-scale biological and physical conditions in the California Current as input to ecosystem approaches to fisheries management.

Other important FY19 efforts are:

- multi-sector dynamic ocean management applications.
- releasing a web interface for the computation of the new upwelling indices Coastal Upwelling Transport Index (CUTI) and Biologically Effective Upwelling Index (BEUTI), which includes the vertical nitrate flux into the surface layer
- development of the web-based dynamic access and plotting of CCIEA Indicators.
- developing new ERDDAP and CoastWatch services to enhance PARR.
- Transformation of the Fisheries And The Environment (FATE) team from the advisement of a national program to assisting regions with the development and evaluation of ecological indicators important for quantifying long-term environmental variability

Fisheries Ecology Division (FED)

FY18 Accomplishments

FED maintained its focus on providing critical science support to our management partners while advancing basic research to provide the basis for such support into the future. Some notable highlights included:

- Launching a 5-year Carmel River Basin steelhead smolt production study
- An evaluation of the Evolutionarily Significant Unit (ESU) structure and demographic condition Upper Klamath-Trinity River Chinook salmon in support of a status review of that ESU
- Development of microhaplotypes to increase the power of SNP-based genetic methods
- Successful application of a variety of machine-learning techniques to diverse problems in ecology

- Development of a new Central Valley winter Chinook forecast model and fishery control rule for application in FY19 fisheries management
- Successful PFMC methodology review of novel Bayesian hierarchical model for species composition of rockfish landings
- Publication of the first National Ocean Recreation Expenditure Survey

FY19 Priorities

On the PFMC front, we will conduct assessments of groundfish and salmon stocks. On the ESA front, we will maintain our focus on winter-run Chinook salmon and California Coast coho salmon, both Species in the Spotlight. We will also engage in Center-wide efforts to advance ecosystem-based fisheries management. Some particular projects will include:

- Assessing three groundfish stocks and two salmon stocks, and completion of overfishing reports for two salmon stocks declared overfished by PFMC in FY18
- Supporting the WCRO's re-initiation of consultation on long-term operations of water projects in the Central Valley and ongoing stakeholder engagement to increase adoption of our modeling tools
- Conducting the 37th annual rockfish recruitment and ecosystem assessment survey and a deep-sea coral survey
- Hosting and leading a workshop on applying empirical dynamical modeling and nonlinear forecasting to fisheries data
- Collaborating with fishers to collect critical data to support assessment of nearshore rockfish species
- Evaluation of the costs and affordability of fish passage projects on high-head dams
- Further investigation of the genomic basis of life history variation in salmonids

Fisheries Resources Division (FRD)

FY18 Accomplishments

In FY18, FRD focused on conducting science directly supporting mandates of the MSA and ESA to provide scientific assessments and advice for managing fish stocks and recovery of protected species. Major accomplishments included:

- completing an independent methodological review of its acoustic-trawl-method survey for estimating CPS biomasses and other variables
- completing 4 CalCofi cruises as well as an 80 day joint survey to survey CPS and marine mammals from Vancouver Island, Canada to the Mexican border
- initiating testing and evaluation of the use of unmanned systems to sample nearshore
- completing stock assessments on Pacific bluefin tuna, shortfin mako shark, and Pacific sardine
- initiating a program to sample commercially caught opah to acquire basic biological information on the diet, growth and age of the species
- completing an economic analysis of west coast swordfish fisheries and socioeconomic analysis of the west coast HMS recreational fisheries

- providing environmental, biological and economic data to the development of the California Current Integrated Ecosystem Assessment (CCIEA)
- convening a 2nd international workshop on *Seriola*
- completing a white abalone growout facility for white abalone
- publishing a new identification guide for tunas and a new Billfish newsletter

FY19 Priorities

FRD's FY19 priorities continue to be informed by internal planning processes from the 2013-2017 MSRA Science Reviews, Species in the Spotlight Initiatives, and other national initiatives. Within the SWFSC, FRD will also focus on two Science Center initiatives; ecosystem indicators and trophic interactions of top predators including trophic dynamics of forage species. In addition, FRD will respond to the national strategic initiatives once they are announced.

FRD will also continue to focus on scientific support for white abalone identified as one of eight ESA listed *Species in the Spotlight*. This includes finalizing the White Abalone Recovery Plan. In collaboration with our international partners, the FRD will continue its efforts on Pacific Bluefin tuna, including the development and implementation of Close-Kin Genetic methods, completing a Management Strategy Evaluation (MSE) for North Pacific albacore tuna, and initiating an MSE for Pacific bluefin tuna.

Other important FY19 priorities include:

- continuing to support stock assessment research for HMS (North Pacific striped marlin and Pacific Bluefin tuna) and CPS (Pacific sardine and Pacific mackerel);
- continuing to support quarterly CalCOFI cruises as well as a California Current Ecosystem Survey in the summer of 2019
- advancing better sampling technology through survey and research, and continue EK80 and SX90 testing and development
- assessing the utility of unmanned systems technology to inform inshore biomass estimates of CPS in the California current ecosystem
- expanding research on the deep scattering layer by incorporating acoustic survey information with available trawling data
- continuing to execute actions from the National Saltwater Recreational Fisheries Implementation Plan
- expanding managed fish stock climate vulnerability analyses and incorporate guidance on changing climate information into management practices
- exploring requirements for transitioning to a production aging process within the Life History Program to meet the increasing demands for high-quality aging data in stock assessments using Fourier-transform Near-infrared Spectroscopy (FT-NIRS) Analysis of otoliths and vertebrae
- designing a practical and implementable individual transferable effort credit program with empirical analysis for the purse seine fishery of the Eastern Pacific Ocean.

Information Technology Services (ITS)

FY18 Accomplishments

Despite a challenging year with no permanent ITS director until July, the ITS team pulled together to implement significant accomplishments during FY 18:

- Replaced the phone system with a Voice over Internet Protocol (VoIP) solution to provide a better and more cost efficient solution. This upgrade will save the Center approximately \$37K annually in telecommunications service costs.
- Installed new tape backup libraries at Santa Cruz and upgraded those at La Jolla to increase data protection capability while reducing the time to complete backups.
- Stood up base components for SWFSC's newest archival data solution. This new solution is cost-effective and scalable.
- Recruited a new employee for Internet work to address security issues as well as other web development work for the Center.

FY19 Priorities

FY 19 priorities are informed by ongoing internal planning, IT requirements from NOAA and NMFS Office of the Chief Information Officer (O-CIO), as well as SWFSC priorities. In FY 19, we hope to bring stability to the ITS team and the overall services we provide to the SWFSC.

Additional projects planned for FY 19 include:

- VoIP Phase II involves the roll out of Cisco Jabber, which will provide voice, video, chat, screen share, voicemail and WebEx collaboration and integration.
- Implement Network Access Control (NAC), which will significantly reduce risk by detecting and preventing vulnerable computer systems from connecting to our network.
- Move La Jolla to N-Wave, NOAA's enterprise network solution that provides high-speed internet connectivity.

Marine Mammal and Turtle Division (MMTD)

MMTD's priorities are informed by our statutes, internal (MMTD and SWFSC) planning processes, action items arising from NOAA Fisheries' National 2015 review of Protected Species Science (<https://swfsc.noaa.gov/2015ProtectedMammalTurtleReview/>), advancement of key national initiatives, and science needs of the WCRO, other Pacific Regional Offices, and the HQ offices of Office of Protected Resources and Office of Science and Technology. Major priorities focus on marine mammals and turtles and fall into four general categories: 1) estimate abundance and trends; 2) clarify population structure; 3) assess health and condition; and 4) place our trust species into an ecosystem context. These priorities are implemented through field, laboratory, and analytical research that maintains critical time series, expands the use and devel-

opment of advanced technologies, further develops quantitative tools to facilitate implementation of our statutes, and strengthens existing partnerships and creates new ones, within and external to the agency.

FY18 Accomplishments

- California Current Ecosystem Survey aboard FSV REUBEN LASKER;
- Aerial survey for Loggerhead Turtles in the Southern California Bight;
- Leatherback foraging ecology research in Monterey Bay;
- Twenty-fifth consecutive survey of eastern Pacific gray whale calf production;
- Assessing health and condition of Southern Resident killer whales, Cook Inlet Belugas, North Atlantic right whales using unmanned aerial systems and photogrammetry;
- Improvements in molecular genetics capabilities;
- Vaquita Conservation, Recovery, Protection;
- Renewed focus on eastern tropical Pacific research; and

FY19 Priorities

- Completion of California Current Ecosystem Survey and analysis of data;
- Green turtle research in Southern California;
- Continuing science-based approaches to mitigation of large whale entanglements and ship strikes in the California Current;
- Marine Mammal Stock Delineation Handbook;
- Revising abundance estimates for depleted dolphin stocks in the eastern tropical Pacific based on new analytical methods;
- Enhancing assessments of health and condition of endangered cetaceans;
- Quantifying behavioral and physiological responses of cetaceans to Navy sonar;
- Providing science-based tools to facilitate identification of and impact of anthropogenic stressors on humpback whale Distinct Population Segments in the California Current;
- Completion of NextGen (genomics) analysis for leatherback population structure and vital rates;
- Eastern Pacific gray whale population abundance survey;
- Continued marine mammal and turtle stranding response and necropsy;
- Quantifying age and growth of green turtles in southern California; and
- Clarifying cetacean taxonomy and stock structure.

Operations and Management Division (O&M)

FY18 Accomplishments

- Completed over 350 procurement actions including contract awards, modifications and deobligations on SWFSC contracts and on the Scientific Services IDIQ as well as established reimbursable agreements and oversaw the Center's Purchase Card Program.
- Secured a Contracting Officer with a \$150K Warrant. The SWFSC Contracting Officer obligated the most amount of funds and awarded the second highest number of purchase orders in the field delegate program for NMFS

- Launched the O&M Intranet website which houses a multitude of administrative information, policies, form and links for use by SWC staff
- Managed the Center's transition to the DOC's Enterprise Services Portal for all HR related actions and benefits
- Worked with headquarters to field test and make recommendations for improvement of the HR Connect system and resolved staff concerns to ensure a seamless and successful roll-out
- Continually review and receive training for new WFMO policies and procedures to facilitate adoption and update internal processes
- Managed logistics and communications for Federal Retirement Training (group instruction and personal counseling sessions)
- Successfully directed and executed 350 HR actions for the Center
- Spearheaded the processing for annual Center Awards

FY19 Priorities

- Develop and implement a SWFSC Pathways Program to recruit, train and retain well-qualified future career civil servants in support of the Center's succession planning efforts
- Develop and implement a succession plan that focuses on building a talent pool within the Center.
- Develop strategies and hiring practices to improve diversity and inclusion.
- Plan and execute Center-wide Employee Labor Relations training.
- Provide Center-wide mandatory acquisition training in the areas of unauthorized commitments, ethics in contracting and familial relationships, and general purchasing information.
- Transition to the ProTech IDIQ contract vehicle

Appendix B - Criteria for SWFSC Activity Assessment¹

Key Questions and Evaluation Scale

Part I: Characterize Mission Attributes

A) To what degree is this Activity mandated?

5: Very High – NMFS/NOAA/DOC has exclusively identified that SWFSC will conduct this specific activity

4: High – NMFS/NOAA/DOC has identified that SWFSC and other FMCs will conduct this specific activity

3: Moderate – SWFSC is permitted to act

¹ * NMFS criteria adapted to SWFSC.

2: Low –

1: Very Low – There are no statutes or orders compelling or permitting SWFSC to act.

Mandated activities include those required by statute, judicial order, treaty or convention. These include but are not limited to:

- Assessments, recovery plans, status reviews and data reporting requested by the PFMC and WCRO.
- Data reporting requested by RFOs, RFMOs, and Commissions to which the US is a party.
- Assessments and analyses requested by RFOs, RFMOs, and Commissions to which the US is a party and there is a science requirement.
- Assessments or status reviews required by the MMPA.
- ESA requirements assigned to the SWFSC, such as priority actions identified in the US Pacific Sea Turtle Recovery Plans
- Actions defined in recovery plans [does this go under/with ESA requirements?]
- Actions required by Biological Opinions
- Interagency Agreements that support our statutes (MSA, ESA, MMPA).

B) If SWFSC did not execute this Activity, to what degree would other organizations NOT be able to provide similar capabilities (products/services/data/information/other)?

5: Very High – Only SWFSC can provide this Activity’s capabilities.

4: High – The number of other organizations including FMCs which could provide this Activity’s capabilities is limited and the quality, timeliness, and/or utility of the capabilities would be inferior compared to SWFSC completion of this Activity.

3: Moderate – Many other organizations could provide this Activity’s capabilities, but the quality, timeliness, and/or utility of the capabilities would be inferior to those of this Activity.

2: Low –

1: Very Low – Many other organizations could provide this Activity’s capabilities and the quality, timeliness, and/or utility of the capabilities would be similar to those of this Activity.

C) Is the Activity central to SWFSC’s ability to achieve its strategic plan’s goals and objectives?

5: Very High – Critical to achieve goals/objectives and/or a SWFSC fixed cost requirement.

4: High Important to achieve goals/objectives, but discretionary other than associated fixed cost labor requirements.

3: Moderate – Important discretionary activity with no fixed labor costs.

1: Low – Discretionary activity

D) Is the Activity one of the emphasis areas in the current SWFSC Annual Priorities Memorandum?

5: Yes

1: No

Part II: Risk Assessment of potential impacts

E) If SWFSC did not execute this Activity, what would be the scale of the impact on relevant communities, stakeholders and economies, i.e., what would be the degree of impact for those segments that are affected?

5: Catastrophic

4: Major

3: Moderate

2: Minor

1: Minimal

F) If SWFSC did not execute this Activity, how severe would the risks be to the scientific, technical and organizational capabilities required to execute SWFSC's mission functions today?

5: Catastrophic

4: Major

3: Moderate

2: Minor

1: Minimal

G) If SWFSC did not execute this Activity, the risk to a trust resource population would be:

5: Greatly increase

3: Increase

1: Remain unchanged