

1
2 REQUEST FROM THE
3 CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
4 FOR A
5 LETTER OF AUTHORIZATION UNDER SECTION 101(a)(5)(A) OF THE
6 MARINE MAMMAL PROTECTION ACT
7 FOR THE TAKE OF MARINE MAMMALS
8 INCIDENTAL TO FISHERIES AND ECOSYSTEM MONITORING AND
9 RESEARCH ACTIVITIES CONDUCTED BY
10 THE INTERAGENCY ECOLOGICAL PROGRAM
11 WITHIN THE
12 SAN FRANCISCO BAY-DELTA ESTUARY, CALIFORNIA, USA
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15 **01/21/2022**
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213 *as far as Knights Landing, CA on the Sacramento River a distance of 224 rkm from the GGB; and also in*
214 *Clifton Court Forebay a distance of 133 rkm inland from the GGB to the radial gates of the forebay.58*
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1. SECTION 1: DETAILED DESCRIPTION OF THE SPECIFIC ACTIVITY OR CLASS OF ACTIVITIES THAT CAN RESULT IN INCIDENTAL TAKING OF MARINE MAMMALS

This application, submitted by the California Department of Fish and Wildlife (CDFW) to the National Marine Fisheries Service (NMFS) Office of Protected Resources, requests a letter of authorization (LOA) under the Marine Mammal Protection Act (MMPA) of 1972 (amended 1994) for the incidental take of marine mammals during fisheries surveys and related research activities conducted by the Interagency Ecological Program (IEP). Take as defined under the MMPA means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1362). An incidental take is an unintentional, but not unexpected, taking. Management of certain marine mammal species within the waters of the United States is under the jurisdiction of the NMFS under the MMPA. Marine mammals protected by the MMPA include cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions). NMFS under the MMPA has the authority to assess the effect of incidental takings and to authorize appropriate levels of take of whales, dolphins, porpoises, seals, and sea lions.

CDFW developed this application for a letter of authorization (LOA) on behalf of the IEP consisting of multiple State and Federal agencies operating in the San Francisco Bay and Sacramento-San Joaquin Delta ("San Francisco Estuary"). This application is to address inadvertent capture of common and abundant marine mammals (California sea lion, harbor seal, northern elephant seal, and harbor porpoise) during fish monitoring activities. A MMPA LOA is necessary for accidental capture as "take" that could result in serious injury or mortality and allows the maximum of 5 years coverage. The scale of take requested will:

- Be of small numbers,
- Have no more than a "negligible impact" on those marine mammal species or stocks,
- Not have an "unmitigable adverse impact" on the availability of the species or stock for subsistence uses.

This application for a large programmatic permit has been developed with the guidance of NMFS staff, to be a single application submitted by CDFW with the LOA to be issued to CDFW for the IEP. CDFW staff facilitate many of the IEP programmatic functions. A model for this programmatic permit already exists with CDFW currently the lead of a multi-agency permit issued by NMFS to CDFW (permit 1440-3R) for authorized take of federally listed salmonids and sturgeon that includes several IEP member agencies conducting long-term fish monitoring studies. Many of the gears and methods described in permit 1440-3R are described within this application, as they could result in inadvertent capture of marine mammals.

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CDFW seeks a LOA for 5 years of take coverage due to gear entanglement resulting in inadvertent capture with minor injury, serious injury, or mortality. Per NMFS staff, non-injurious contact of marine mammal with gear without entanglement is not take. Take is only requested in relation to anticipated gear interaction incidents in which injury (at minimum) may have occurred. Request for take will be identified for studies based on high level “Gear Categories” summarized from the gear types (nets, trawls, setlines, and fykes) used by the various studies. IEP fish monitoring studies include use of various gears including midwater, otter, and Kodiak trawls (trawls), gill and trammel nets, purse seines and Lampara nets (nets), setlines and longlines (setlines) and hoop and fyke traps (fykes) that could result in inadvertent take via entanglement by net mesh, entrapment by fyke, or hooking by setlines. IEP studies also use a variety of other gears, such as backpack or boat mounted electrofishers, larval fish trawl nets, zooplankton nets, water samplers and instrumentation (acoustic receivers, water quality sondes, etc.) that are not included in this LOA request as these gears are not expected to result in take of marine mammals. Take will be managed as a pool over 5 years for Gear Categories, with the various Gear Categories to sum to the programmatic total. It will be important for CDFW to describe all gear types and effort levels for the duration of 5 years covered in this LOA application. Changes to activities or reporting, such as addition of novel gear type, will be communicated to the permitting agency when appropriate. CDFW will further clarify reporting, avoidance, and mitigation proposals in this permit application.

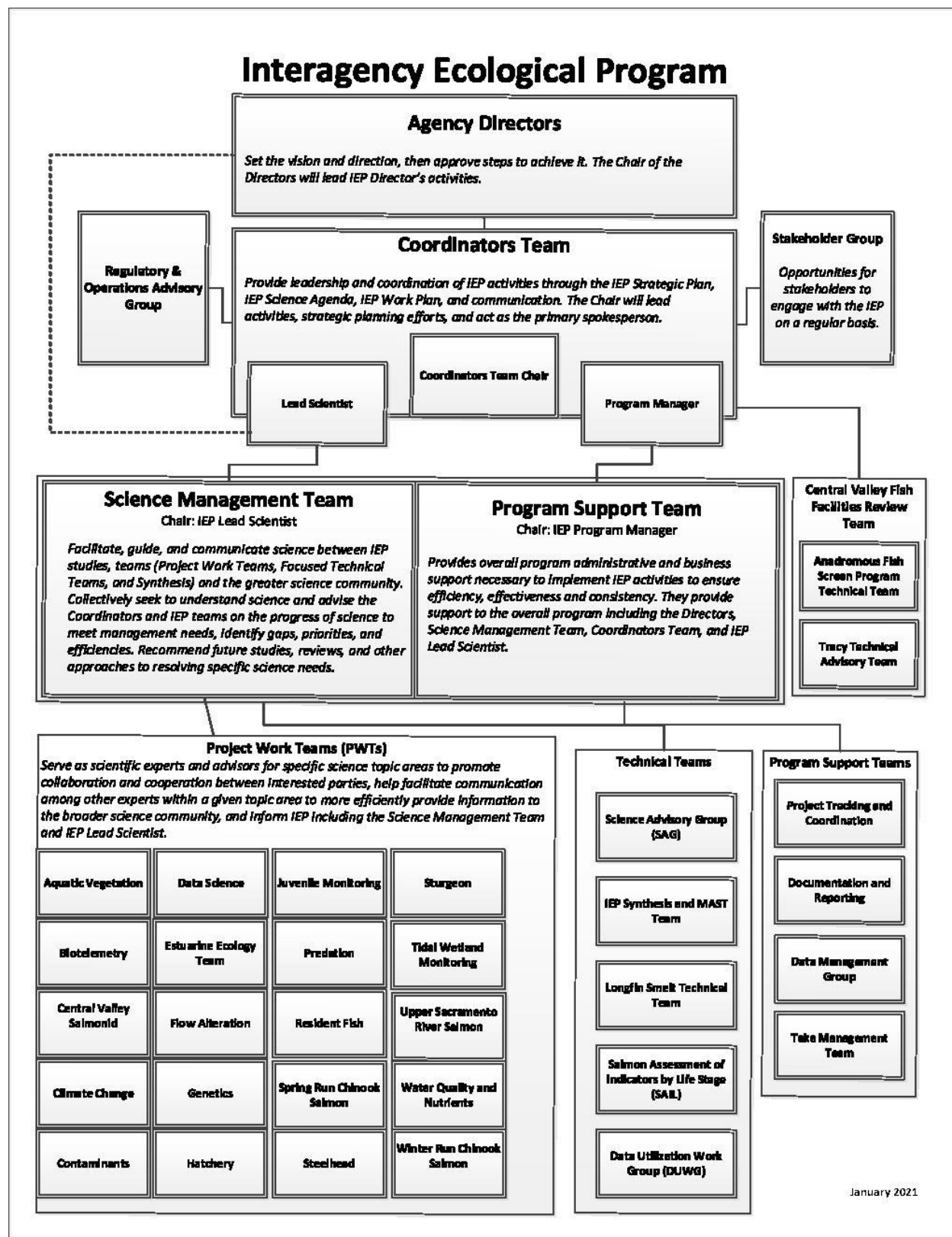
Interagency Ecological Program (IEP) Description

The IEP is a consortium of nine member agencies, including three State ([CDFW], California Department of Water Resources [DWR], State Water Resources Control Board [SWRCB]), six Federal (U.S. Bureau of Reclamation [USBR], U.S. Geological Survey [USGS], U.S. Fish & Wildlife Service [USFWS], U.S. Army Corps of Engineers [USACE], National Marine Fisheries Service [NMFS], and U.S. Environmental Protection Agency [USEPA]). Only 4 of the 9 member agencies are included in this application, as they conduct sampling activities that could result in possible bycatch of marine mammals, please refer to Table 1-1 below for relevant agencies. The IEP has been conducting cooperative ecological investigations since the 1970s (Herrgesell 2012). IEP agencies partner with non-governmental organizations that work together to develop a better understanding of the Bay-Delta estuary's fish and wildlife, water quality, hydrodynamics and impacts of human activities on ecology. IEP's key studies specifically address the effects of the State Water Project (SWP) and Federal Central Valley Project (CVP) water project operations on the Delta and San Francisco Estuary. Many of the surveys monitor abundance and distribution of fish so to reduce entrainment risk at the water project export facilities in the south Delta. The majority of the IEP surveys included in this permit are specifically mandated by, while some inform the following, SWRCB Water Rights Decision 1641 (D-1641), the Central Valley Program

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Improvement Act (CVPIA), the USFWS 2019 Biological Opinion on the Coordinated Operations of the Central Valley Project and State Water Project, the 2020 Incidental Take Permit (ITP) for Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta issued by CDFW to the State Water Project, or the 2009 NMFS Biological and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project. The mission of the IEP is, in collaboration with others, to provide ecological information and scientific leadership for use in management of the San Francisco Estuary. The purpose for this collaboration is to efficiently and cooperatively gather ecological information so that agencies can effectively respond to management needs and regulatory responsibilities. The IEP is a dynamic program and changes in response to management needs or changes in the estuary. There are a variety of elements that compose the IEP, but many are not described here because they are analytical exercises, model simulations, laboratory experiments or unlikely to result in interaction with NMFS trust marine mammal species. Current activities described in this permit application will not prevent future activities of other IEP members from being covered under the LOA issued to CDFW.

This application and permitted activities that follow will be administered by CDFW staff that operate within the IEP Program Support Team. This staff communicates with and supports the Science Management Team, Coordinator Team and IEP Director Team that produce and approve of IEP activities as summarized in annual work plans. More information on IEP governance and core processes can be found in the IEP Governance Framework (2015) document (available at <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=185009&inline>). The following content in this section is a summary of how the IEP is organized and framework for how the nine member agencies that make up the IEP work together to implement the program's mission. Implementation of the IEP requires engagement of agency participants at several levels based on the roles and responsibilities necessary to conduct activities. Roles and responsibilities are summarized by the IEP Organizational Chart (Figure 1.1).



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335 Figure 1-1 IEP Organizational Chart

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The IEP describes its activities in an annual work plan which is available, as are other programmatic documents, online at: <https://iep.ca.gov/>. IEP conducts both Long-Term Monitoring compliance (LTM) decadal scale and Short Term/Special activities. The annual work plan captures the changes in activities and tracks them using a program element number (PEN) unique for each study and describes in brief the mandates or compliance activities it informs. Thorough project descriptions for individual elements are also available upon request. A subset of the total activities in the work plan are addressed in this MMPA LOA application, specifically sampling activities that target fish using fykes, nets, trawls, and setlines that could result in inadvertent bycatch of marine mammals. These activities are conducted by 4 of the 9 member agencies. The specific IEP work plan program elements for consideration have been assigned a “Study Number” to track individual PENs throughout this application (Table 1.1). Some of the study numbers are also assigned a letter designation to clarify the study “Gear Category” for which take is being requested (Table 1.1).

Table 1-1 Summary of Interagency Ecological Program study program element numbers and gear categories.

Study Number	Study Name	Agency	PEN	Gear Category
1A	Adult Striped Bass Population Estimates	CDFW	002	Fyke
1B	Adult Striped Bass Population Estimates	CDFW	002	Net
2	Fall Midwater Trawl Survey	CDFW	003	Trawl
3A	Adult Sturgeon Population Estimates	CDFW	005	Net
3B	Adult Sturgeon Population Estimates	CDFW	005	Setline
4	Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)	CDFW	011	Trawl
5	Yolo Bypass Fish Monitoring Program	DWR	047	Fyke
6	Delta Juvenile Fish Monitoring Program (Chippis, Sac, and Mossdale Trawls)	USFWS	053	Trawl
7	Spring Kodiak Trawl	CDFW	088	Trawl
8	UCD Suisun Marsh Fish Monitoring	UCD/DWR	093	Trawl
9	Mossdale Spring Trawl - CDFW Region 4	CDFW	071	Trawl
10	Gear Efficiency Evaluations	CDFW	249	Trawl
11	Investigation of the Distribution and Abundance of Longfin Smelt in the SFE	CDFW	296	Trawl
12A	FRP Tidal Wetland Monitoring Pilot Study	CDFW	311	Trawl
12B	FRP Tidal Wetland Monitoring Pilot Study	CDFW	311	Net
15	Enhanced Delta Smelt Monitoring	USFWS	325	Trawl
16	CDFW Central Valley Salmon and Steelhead Monitoring (Mainstem Sacramento River Mark-Recapture Project)	CDFW	N/A	Fyke

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352 The IEP conducts activities to help inform water projects in the Delta. The SWP and CVP water
353 projects in the South Delta (Contra Costa County northwest of Tracy, California) facilitate the
354 protection of the public health and welfare in supplying water resources throughout California
355 to millions of people. The SWP includes a pumping facility that moves water from a shallow
356 reservoir, Clifton Court Forebay (CCF), into the California Aqueduct. The CVP includes a
357 pumping facility that raises water from Old River in the Delta into the Delta-Mendota Canal.
358 MMPA Section 109(h) would exempt State and Federal water project operations in the Delta
359 from prohibitions on marine mammal take, so the water project facilities are not included in
360 this request for an LOA.

361

362 IEP Study Descriptions (IEP-program element number)

363 The following study descriptions include purpose, description, and methods for specific studies,
364 identified by “Study Number” assigned in this application and by IEP program element number
365 (PEN). A summary of study descriptions by gear category is provided in Table 1.2. Information
366 includes study descriptions and programmatic documentation for activities planned over the
367 next 5 years. Study descriptions that follow include text from applications and permits for
368 ongoing NMFS authorized survey work in addition to study and programmatic documentation.
369 It is important to recognize the majority, if not all the listed studies in this application are
370 activities already reviewed and approved by NMFS that could result in the accidental and/or
371 targeted take of federally listed salmon and sturgeon. Specifically, in this application study
372 numbers 1-5, 7, 8, and 12 operate under NMFS permit 1440-3R, studies 6, 10, and 15 operate
373 under NMFS permit 13791-4A, study 9 operates under NMFS permit 19262, study 11 operates
374 under NMFS permit 19820, and study 16 operates under permit 14808-3A.

375 Note, study descriptions include gear types that might result in incidental bycatch of marine
376 mammals, and also descriptions of gears that might not. Some study descriptions include gears
377 that will not result in bycatch of mammals but were included to show the breadth of the study
378 activity being conducted in the field.

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380 *Table 1-2 Summary of Interagency Ecological Program study descriptions by gear category and effort. Please see individual study*
 381 *descriptions for details.*

Gear Category	Study Number	Study Name	General Area of Operation	Gear Used	Season, Frequency	Gear Details	Number of Samples
Trawl	2 PEN 003	Fall Midwater Trawl Survey	San Pablo Bay upstream through Delta	Midwater Trawl	Monthly surveys September-December	Tow speed: 1.4 kts Duration: 12 minute tow	122 tows per month
Trawl	4 PEN 011	Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)	South San Francisco Bay upstream through the Delta	Midwater Trawl	Monthly surveys January-December	Tow speed: 1.7 kts Duration: 12 minute tow	52 stations per month
			South San Francisco Bay upstream through the Delta	Otter Trawl	Monthly surveys January-December	Tow Speed: 3.2 kts Duration: 5 minute tow	52 stations per month
Trawl	6 PEN 053	Delta Juvenile Fish Monitoring Program (Chippis, Sac, and Mossdale Trawls)	Suisun Bay at Chippis Island	Surface Midwater Trawl	January-April 5 days per week; May-Jun 2 days per week, Jul-Dec 3 days per week	Tow speed: 0.9 to 1.12 m/s Duration: 20 minute tow	10 tows per sampling day
			Sacramento River at Sherwood Harbor	Surface Midwater Trawl	April 5 days per week; May-Jun 2 days per week; Jul-Sep 3 days per week	Tow speed: 0.7 to 1.0 m/s	10 tows per sampling day

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						Duration: 20 minute tow	
				Kodiak Trawl	Oct 3 days per week; Nov-Mar 5 days per week	Tow speed: 0.45 to 0.67 m/s Duration: 20 minute tow	10 tows per sampling day
			San Joaquin River at Mossdale	Kodiak Trawl	July to March 3 days per week (April-June conducted by Study 9)	Tow speed: 0.45 to 0.67 m/s Duration: 20 minute tow	10 tows per sampling day
Trawl	7 PEN 088	Spring Kodiak Trawl	San Pablo Bay and upstream through Delta	Kodiak Trawl	Monthly surveys December through May	Tow speed: 1.5 kts Duration: 10 minute tow	41 stations visited per month
Trawl	8 PEN 093	UCD Suisun Marsh Fish Monitoring	Suisun Marsh	Otter Trawl	Monthly surveys January - December	Duration: 5 or 10 minute tows	24 per month
Trawl	9 PEN 071	Mossdale Spring Trawl - CDFW Region 4	San Joaquin River at Mossdale, Near the City of Lathrop	Kodiak Trawl	April, May and June. 5 days per week, 91 DAS	Tow speed: 0.8 to 8 km/hr Duration: 20 minutes	10 tows per sampling day.
Trawl	10 PEN 249	Gear Efficiency Evaluations	San Pablo Bay and upstream through Delta	Midwater Trawl, Otter Trawl, Kodiak Trawl	Any month, based on life stage of fish targeted	Duration: 5 or 10 minute tows	A few days per year
Trawl	11 PEN 296	Investigation of the Distribution and Abundance of Longfin Smelt in the SFE	South San Francisco Bay upstream through the Delta	Otter Trawl	Monthly July-September	Duration: 5 or 10 minute tow	14-16 stations per survey

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Trawl	12A PEN 311	FRP Tidal Wetland Monitoring	Suisun Bay upstream through the Yolo Bypass	Otter Trawl	June-December	Tow duration: 5 minutes	60 trawls per month
Trawl	15 PEN 325	Enhanced Delta Smelt Monitoring	San Pablo Bay and upstream through Delta	Kodiak Trawl	July through March	Duration: 10 minute tows	On average, Kodiak trawl sampling occurs with three sites per day, up to 4 tows per site, four days per week. 3 crews sample each day.
Net	1B PEN 002	Adult Striped Bass Population Estimates	Suisun Bay upstream through Confluence of Sacramento and San Joaquin rivers	Gill Net	Sampling weekly Monday-Friday during March-April	Net drifted up to 30 minutes, plus retrieval, about 8 times per day per vessel	8 drifts x 5 days x 10 weeks = 400 samples
Net	3A PEN 005	Adult Sturgeon Population Estimates	San Pablo and Suisun bays upstream through the confluence of Sacramento and San Joaquin rivers	Trammel Net	Sampling weekly Monday-Friday during August-October	Net drifted up to 30 minutes, plus retrieval, about 5-6 times per day	6 drifts x 5 days x 12 weeks = 360 samples
Net	5 PEN 047	Yolo Bypass Fish Monitoring	Yolo Bypass	Gill net	August-November, 5 days per week	Gill net soak up to 1 hour, but checked continuously to remove fish	150 sets per year
Net	12B PEN 311	FRP Tidal Wetland Monitoring	Suisun Bay upstream through the Yolo Bypass	Lampara Net, Gill Net	Lampara: Jan, Mar, May, Jun-Dec Gillnet: May-June	Lampara set in a circular pattern to trap fish. Gillnet set for 30-60 minutes	Up to 32 Lampara sets per month Up to 8 gillnet sets per month
Fyke	1A PEN 002	Adult Striped Bass Population Estimates	Sacramento River near Knights Landing	Large Fyke	Checked daily Monday-Friday during March-April	Submerged in river, fixed to bank	10 traps x 4 days x 10 weeks = 400 samples

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Fyke	5 PEN 047	Yolo Bypass Fish Monitoring Program	Yolo Bypass 0.8 miles downstream of the Lisbon Weir in the Toe Drain	Large Fyke	September-June, checked daily Tuesday through Friday.	Submerged in river, fixed to bank	1 trap fished 7 days per week.
Fyke	16	CDFW Central Valley Salmon and Steelhead Monitoring (Mainstem Sacramento River Mark-Recapture Project)	Mainstem Sacramento River at	Large Fyke	January-December (target months August through May) 7 days/week, 24 hours per day	Submerged in river, fixed to bank, when temps <72 F.	7-10 traps at Sacramento and American River downstream to Clarksburge; 3-5 traps at Knights Landing site
Setline	3B PEN 005	Adult Sturgeon Population Estimates	San Pablo and Suisun bays up through confluence of Sacramento and San Joaquin rivers	Setline	Mostly June-August, sometimes into December	Setline soak for average 24 hours	Up to 4 setlines baited per boat day, with 62 max in a year

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386 Study 1A and 1B - Adult Striped Bass Population Estimates (IEP-002)

387 The adult striped bass population study conducted by CDFW has been ongoing since 1969.
388 Mainly the study employs traditional mark-recapture methods, including release of a "high-
389 value" reward tag. The tagging program is designed to understand and monitor the population
390 dynamics of striped bass (*Morone saxatilis*), with the goal being to provide the tools to inform
391 science-based resource management decisions. These tools include relative and absolute
392 abundance, harvest rate, mortality rate, individual growth rates, and large-scale movement and
393 migration patterns.

394 Our objective during the field season is to capture, tag, take measurements, determine sex, and
395 release in good condition as many striped bass as possible. Documentation of previously-tagged
396 striped bass is also important. By applying tags to adult striped bass and monitoring the
397 subsequent ratio of tagged fish to untagged fish, we calculate adult striped bass abundance,
398 relative abundance, harvest rate, and survival rate. During April and May (and in a few years
399 into early June), we use large fyke traps near Knights Landing and gill nets near Antioch to
400 collect adult striped bass which are tagged and then released on-site. This study informs the
401 Central Valley Project Improvement Act (CVPIA) 3406(b)(1) that was signed into law in 1992.

402 This survey evaluates population dynamics of striped bass in the estuary and is the only
403 biological information available upon which to base striped bass angling regulation decisions
404 and provides population estimates needed for various models.

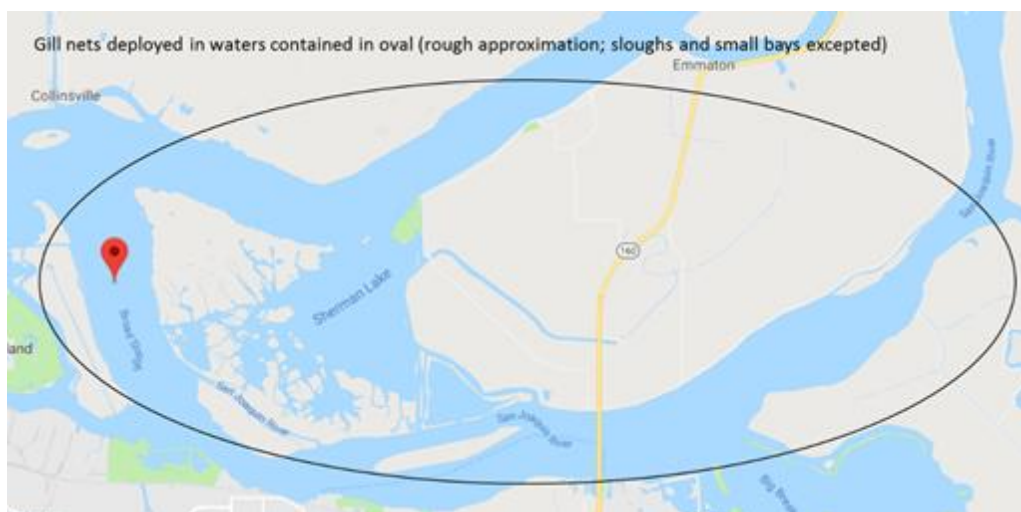
405 Sampling occurs annually from April through June. Up to ten cylindrical 3.05 m (10 ft) wide and
406 6.1m (20 ft) long fyke traps are deployed annually in the Sacramento River near Knight's
407 Landing. Gill nets are also fished - in years when staffing levels allow - in areas near or adjacent
408 to the confluence of the Sacramento and San Joaquin rivers. Legal-sized striped bass (≥ 42 cm
409 FL) and some sub-legal striped bass are sexed if possible, and then tagged with disk-dangler
410 tags. Fish sex is determined by presence or absence of milt, following gentle pressure to the
411 abdomen. Fish are released back to the water and subsequently recaptured in the recreational
412 fishery. This data is used to generate age and sex-stratified population estimates using a
413 modification of a Peterson mark-recapture estimate.

414 Up to ten fyke traps are deployed in the Sacramento River near Knights Landing up to 5 days a
415 week April through June each year. Fyke traps are cylindrical at length 6.1 m (20 ft), diameter
416 3.05 m (10 ft), and have 5.74 cm (2¼-inch) mesh made (largely) from 9-gauge wire. Flows must
417 be sufficient such that fyke traps are fully submerged when sampling. Traps are checked once a
418 day. To check traps, they are pulled partially up from the water so to open the forward
419 compartment. Fish are netted out, measured, tagged, and sexed if a striped bass, and released.

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420 An external disc dangler tag is applied, and scale sample are collected from adult Striped Bass.
421 Fyke traps are the primary sampling device and gill nets are used as a supplemental gear in
422 some years as staffing conditions permit. Gill nets are fished in areas near or adjacent to the
423 confluence of the Sacramento and San Joaquin rivers during the same period as the fyke nets.
424 Gill net dimensions are length = 182.9 m (100 fathoms), depth = 6.4 m (21 feet) and made up of
425 four different mesh panels, each 45.7 m (25 fathoms long). The four mesh panel measurements
426 are: 1) 10.2 cm (4 inch) mesh is 83 meshes deep with MT-16 twine size and strength 25 #, 2)
427 11.4 cm (4.5 inch) mesh is 74 meshes deep with MT-19 twine size and strength 28#, 3) 12.7 cm
428 (5 inch) mesh is 66 meshes deep with MT-26 twine size and strength 31#, and 4) 14.0 cm (5.5
429 inch) mesh is 60 meshes deep with MT-26 twine size and strength 31#. The hanging ratio is
430 50%. Gill nets are soaked for 30 minutes.

431 Regular Vessels Involved in tagging: R/V New Alosa (CF9301XS); to check fyke traps two 24ft
432 Kvichaks skiffs (CF3731XS and CF3732XS).



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435 *Figure 1-2 Map of Adult Striped Bass Tagging Study sampling locations A) fyke trap locations*
436 *along the Sacramento River near Knights Landing, CA, and B) gill net boat sampling at the*
437 *confluence of the Sacramento and San Joaquin rivers.*

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Figure 1-3. Pictures of a large fyke trap used in sampling of adult Striped Bass.

Study 2 – Fall Midwater Trawl Survey (IEP-003)

The Fall Midwater Trawl Survey (FMWT) has sampled annually since its inception in 1967, with the exceptions of 1974 and 1979, when sampling was not conducted. The FMWT was initiated to determine the relative abundance and distribution of age-0 striped bass in the estuary, but the data has also been used for other upper estuary pelagic species, including delta smelt (*Hypomesus transpacificus*), longfin smelt (*Spirinchus thaleichthys*), American shad (*Alosa sapidissima*), splittail (*Pogonichthys macrolepidotus*), and threadfin shad (*Dorosoma petenense*). The FMWT samples 122 stations each month from September to December and a subset of these data is used to calculate an annual abundance index. These 122 stations range from San Pablo Bay upstream to Stockton on the San Joaquin River, Hood on the Sacramento River, and the Sacramento Deep Water Ship Channel. Sampling takes approximately 10 days per month to complete.

FMWT equipment and methods have remained consistent since the survey's inception, which allows annual abundance indices to be compared across time. Monthly and annual abundance indices are calculated using catch data from 100 "index" stations grouped into 17 regional "areas". Monthly indices are calculated by averaging catch per tow for index stations in each regional area, multiplying these means by their respective weighting factors (i.e., a scalar based on water volume) for each area and summing these products for all 17 areas. Annual

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abundance indices are the sum of the 4 (September-December) monthly indices. An additional 22 stations have been added over time, in the early 1990s and again in the late 2000s, to better understand abundance and distribution of fish. The FMWT is mandated by the Delta Smelt Biological Opinion and longfin smelt incidental take permit (ITP) condition 8.1 for the coordinated operation of the Central Valley Project and the State Water Project.

This survey measures the abundance and distribution of age-0 striped bass, American shad, delta smelt, and longfin smelt. It is required in the 2008 USFWS and 2009 NOAA Biological Opinions, as well as the USFWS Recovery Plan for Native Fishes in the Sacramento San-Joaquin Delta. The FMWT samples in open-water embayment's and other offshore habitats monthly each September - December at 122 stations from western San Pablo Bay to Stockton on the San Joaquin River and Hood on the Sacramento River. A single 12-minute oblique tow (bottom to surface) using a midwater trawl is conducted at each station. The approximate overall net dimensions are 3.7m x 3.7m x 17.7m and a mouth area of 13.7 sq m. The net has 9 mesh panels of decreasing size starting at 20.3 cm (8 in) mesh at the mouth and ending with 1.3 cm (0.5 in) at the cod end. Catch at station is speciated, enumerated, and measured in order to calculate relative abundance indices. Latitude and longitude of station locations are provided in an attached file.

A single 12-minute oblique tow (bottom to surface) using a midwater trawl is conducted at each station. The approximate overall net dimensions are 3.7m x 3.7m x 17.7m and a mouth area of 13.7 sq m. The net has 9 mesh panels of decreasing size starting at 20.3 cm (8 in) mesh at the mouth and ending with 1.3 cm (0.5 in) at the cod end. Catch at station is identified, enumerated, and measured in order to calculate relative abundance indices. Latitude and longitude of station locations are provided in an attached file.

Regular Vessels Involved: R/V Scrutiny (CF3727XS) or R/V Munson (CF32112XS) or R/V New Alosa (CF9301XS) or R/V Hypomesus (CF0105XS) or R/V Triakis (CF3625XS).

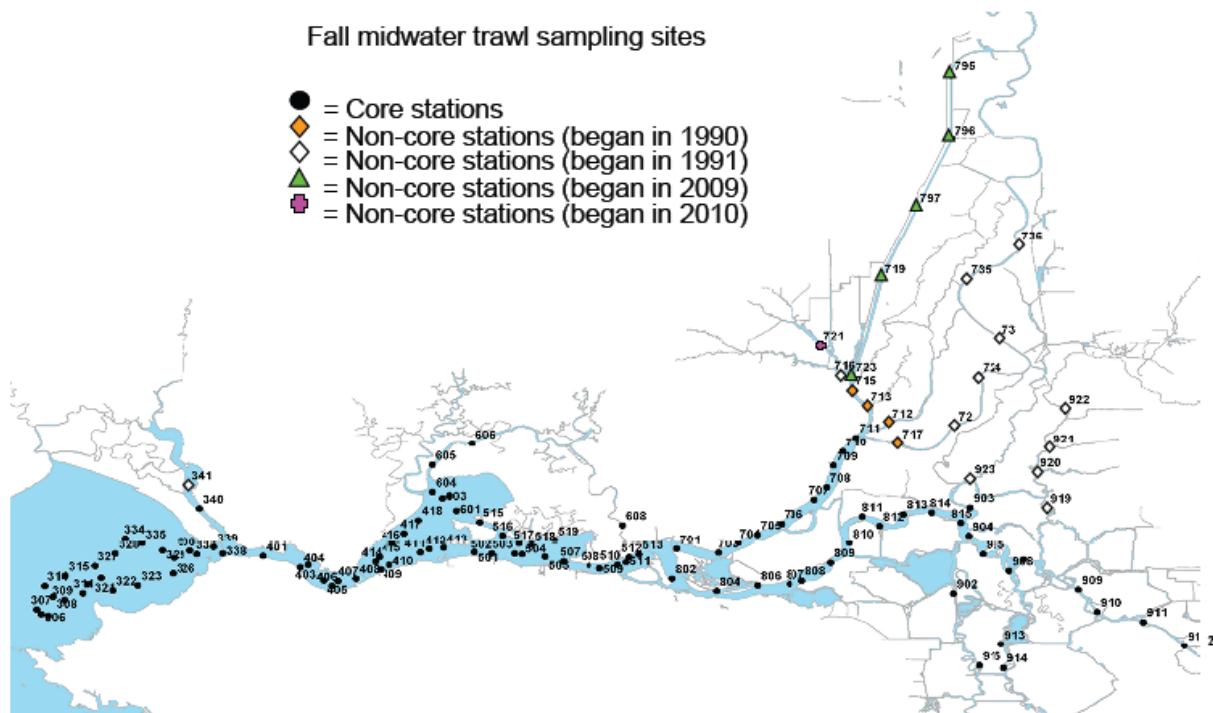


Figure 1-4 Map of Fall Midwater Trawl survey stations.

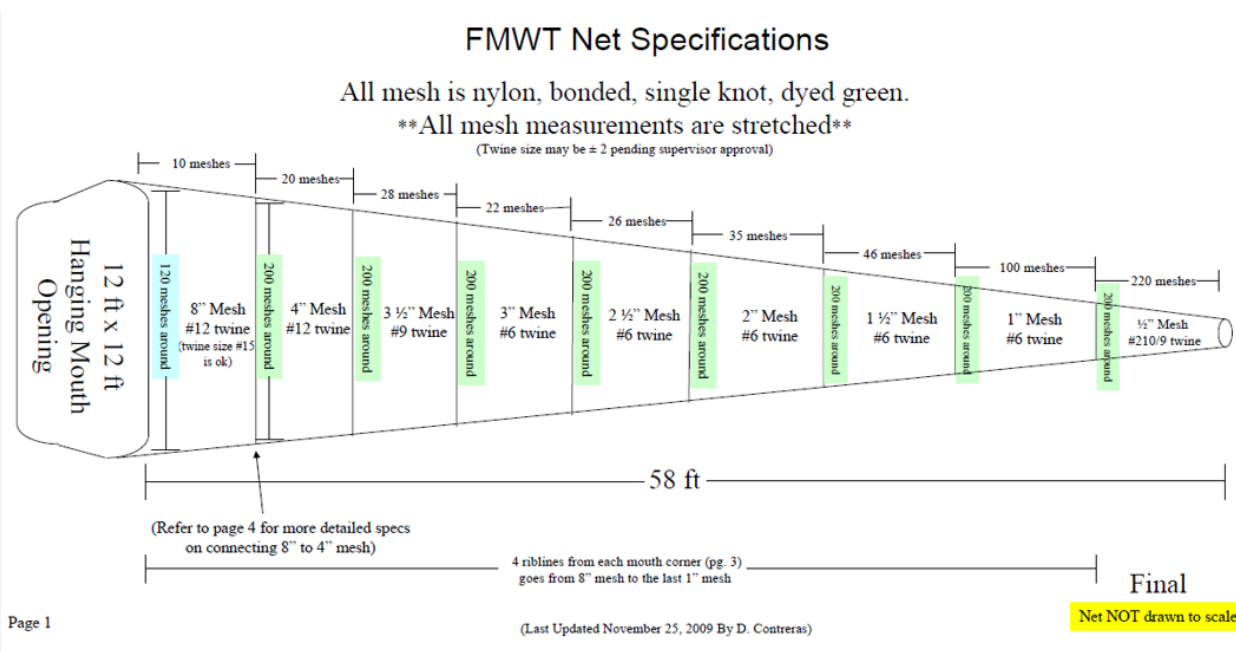


Figure 1-5 Diagram of Fall Midwater Trawl net specifications.

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Study 3A and B – Adult Sturgeon Population Estimates (IEP-005)

The Adult Sturgeon Population Study conducted by CDFW has been ongoing, some years intermittently, since 1967. The study employs traditional mark-recapture methods, including release of “high- value” reward tags. The study is designed to understand and monitor the population dynamics of white sturgeon (*Acipenser transmontanus*) with the goal being to provide the tools to inform management decisions. The study can also collect green sturgeon (*Acipenser medirostris*) which are measured and released. These tools include relative and absolute abundance, harvest rate, mortality rate, individual growth rates, and large-scale movement and migration patterns. This study informs CVPIA 3406(b)(1). The objective during the field season will be to capture, tag, measure, and release in good condition as many white sturgeon as possible and document previously tagged sturgeon. In addition, CDFW proposes to improve understanding of green sturgeon population dynamics and ecology by taking pectoral fin ray sections from green sturgeon caught incidentally to routine field work described for Interagency Ecological Program Element 005 (Adult Sturgeon Population Estimates). We also will collaborate with other researchers investigating various aspects of sturgeon biology and behavior.

This mark-recapture study monitors annual abundance, relative abundance, recruitment, harvest rate, and mortality rates of adult white sturgeon. It is the only study that can be used to determine if white sturgeon are adequately protected by water quality standards, water rights decisions, and angling regulations. Trammel nets are set (deployed) in San Pablo and Suisun bays 3 to 5 days a week during August, September, and October. Each 182.8 m (100-fathom) long net is comprised of four contiguous 45.7 m (25-fathom) long by 3.7 m (2-fathom) deep sections. Each 45.7 m (25-fathom) section is made up of a gillnet panel between two panels of trammel net. The gillnet is an Alaska salmon-style webbing made up of multi-strand monofilament twist. The trammel net is made up of three multi-strand twisted nylon braids. The diagonal dimension of the gillnet mesh varies by 45.7 m (25-fathom) net section and is assembled in the following order: 20.3 cm (8 inch), 17.8 cm (7 inch), 15.2 cm (6 inch), and 20.3 cm (8 inch). Trammel nets are fished up to 30 minutes then retrieved, which can take an additional 15-20 minutes to completely retrieve onto the boat. In 2014, average fishing time per set was about 43 ± 6.6 (SD) minutes while nets were set an average of 5 times per day per boat, both of which are values typical of routine planned operations. The lengths of each white sturgeon will be recorded, the presence of any extant tag on white sturgeon will be documented, white sturgeon meeting length and condition criteria will be tagged between fin ray of the dorsal fin (Peterson disk-dangler), and each white sturgeon will be immediately released on-site. Catch of green sturgeon is unavoidable. Green sturgeon take will be considered adult if captures are ≥ 150 cm total length, and juvenile if <150 cm total length (per Van Eenennaam J.P., Linares-Casenave J, Doroshov SI. 2006. Reproductive conditions of the Klamath River green sturgeon (*Acipenser medirostris*). Transactions of the American Fisheries

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Society 135:151–163.) Green sturgeon were marked nearly every year of the study through 2012. The lengths and condition (good, fair, or poor) of each green sturgeon will be recorded, the presence of any extant tag on green sturgeon will be documented, a subsample of green sturgeon captures will have a pectoral fin ray section removed, and each green sturgeon will be promptly released on-site. Data collected during each net set includes (1) the time of the start and end of the net set/retrieve, (2) the latitude/longitude of the start and end of the net set/retrieve, (3) the water temperature, and (4) the number of pinnipeds patrolling and raiding the net. All fish will be handled in accordance with standard guidelines established in the “2010 NOAA Technical Memorandum NMFS-OPR-45, A Protocol for Use of Shortnose, Atlantic, Gulf and Green Sturgeons” (Kahn & Mohead 2010).

Some juvenile sturgeon sampling has occurred during adult monitoring, to help improve understanding of the population structure. Baited setlines have been used to target white sturgeon 40-116 centimeters total length in the 1990s and early 2000s (DuBois et al. 2010). Up to 4 setlines baited with some combination of lamprey, squid, and shrimp were deployed by one boat each field day. Lines were set 343 times (Table 2). Typical lines were about 550 m (1,800-ft) long and fitted with about 80 gangions (Honey et al. 2004). Each gangion was fitted with one 2/0-, 4/0-, or 6/0-sized hook affixed by a 1-m (3-ft) leader (Honey et al. 2004). Lines were deployed and fished at 1-11 m depths, averaging about 4 m. White sturgeon and green sturgeon were usually measured to the nearest cm TL, and sturgeon greater than approximately 125 cm TL were sometimes counted and released without being measured. Sturgeon were speciated and counted if lost at the boat before a measurement was made. By-catch was counted and, in some cases, measured (cm fork length). Sampling occurred primarily in June through August, and sometimes into December. Sampling was conducted from San Pablo Bay and up through the confluence of the Sacramento and San Joaquin rivers. For collections when effort data were recorded, lines typically remained in the water for a day (N= 302, average = 22.54 h, range = 14.42-48.25 h). Annual hook-hours (Equation 1) by region were typically around 2,000 (Dubois et al. 2010 Table 4). This data excludes 14 lines that were noted as being compromised by theft, vandalism, or bait loss.

Although not currently used, setlines might be used during the period for this LOA as permitted by NMFS for fish sampling as a function of possible bycatch and take of listed salmon and sturgeon.

Regular Vessels Involved: R/V New Alosa (CF9301XS) and/or two 24-ft Kvichaks skiffs (CF3731XS and CF3732XS)

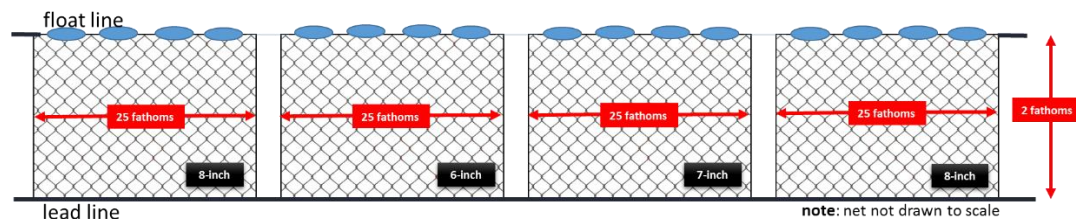


Figure 1-7 Diagram of trammel net.

The San Francisco Bay Study (Bay Study) was established in 1980 to determine the effects of freshwater outflow on the abundance and distribution of fish and mobile crustaceans in the San Francisco Estuary, primarily downstream of the Sacramento-San Joaquin Delta. Sampling ranges from south of the Dumbarton Bridge in South San Francisco Bay, to just west of Alcatraz Island in Central San Francisco Bay, throughout San Pablo and Suisun bays, north to the confluence of Steamboat and Cache sloughs on the Sacramento River, and east to Old River Flats on the San

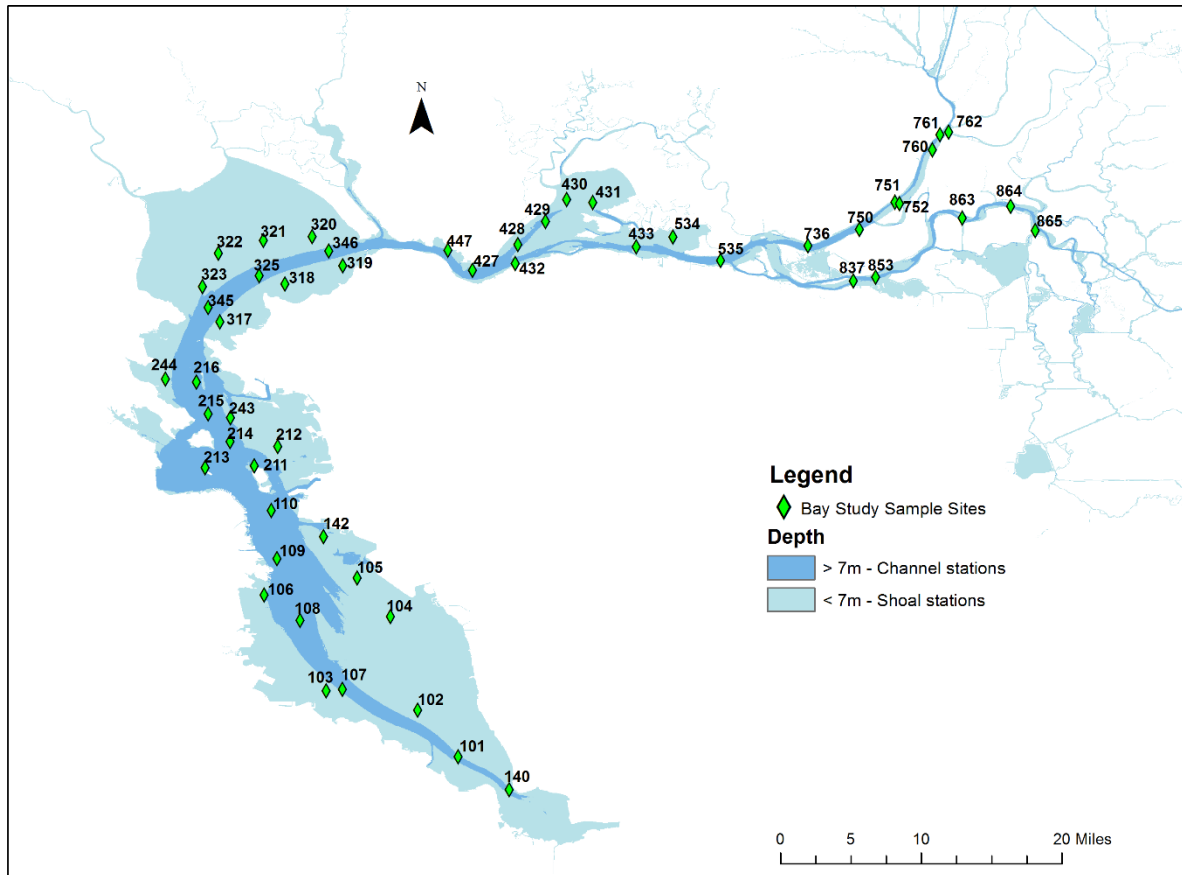
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Joaquin River. The open water boat survey samples 52 stations monthly January through December: 35 original stations, 7 stations added in 1988, 4 stations added in 1991, and 6 stations added in 1994.

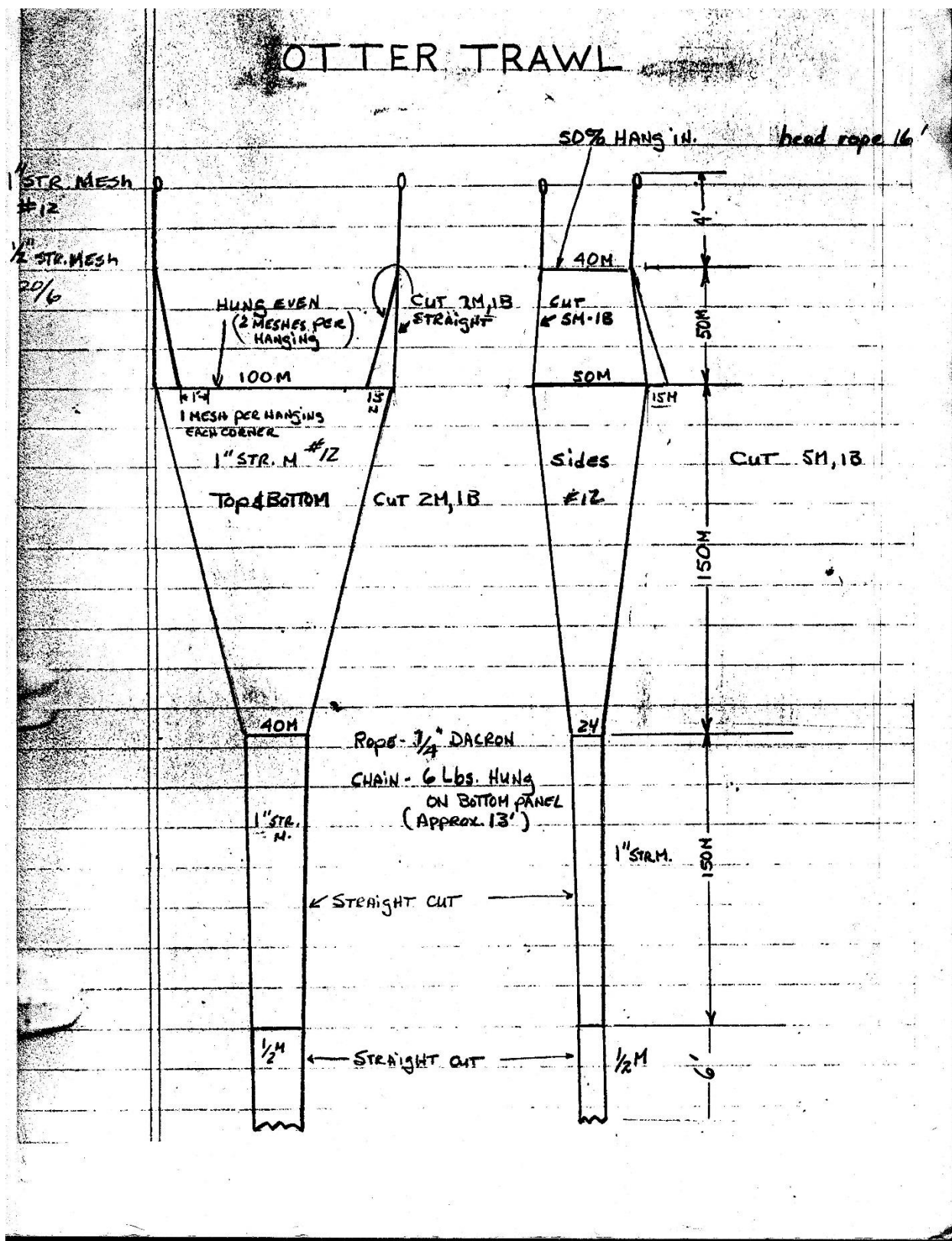
The Bay Study uses a 42-foot stern trawler to sample with 2 trawl nets at each station. The otter trawl has a 4.9 m headrope, a 2.5 cm stretch mesh body, and a 0.95 cm delta knotless mesh cod end and samples demersal fishes, shrimp, and crabs. It is towed against the current at a standard engine RPM for 5 minutes then retrieved. The midwater trawl has a mouth of 3.7 m x 3.7 m, graduated in 9 sections from 20.3 cm (8 inch) stretch mesh at the mouth to 1.3 cm (0.5 inch) at the cod end and samples pelagic fishes. It is towed with the current at a standard engine RPM for 12 minutes and retrieved obliquely such that all depths are sampled equally. The fishes and crabs collected by each tow are identified, enumerated, and measured and returned to the water, while the shrimp are sorted from the debris, fixed in 10% formalin, and returned to the lab for processing. The length or carapace width (crabs), catch, and effort data is used to calculate catch-per-unit-effort (CPUE) by species and age class. CPUE is used to calculate monthly and annual abundance indices, which are used to track seasonal and annual abundance trends. CPUE is also used to determine seasonal and annual distributional patterns.

Important factors that control or regulate the abundance and distribution of fish and mobile crustaceans in the estuary include salinity, temperature, freshwater outflow, ocean temperature, upwelling, and surface currents, primary and secondary productivity, and introduced species. We are interested in how species respond to changes in the physical environment on several temporal scales – seasonal, annual, decadal, and longer. We produce 3 annual Status and Trends reports that summarize recent changes for the most commonly collected species. This study informs compliance with the California State Water Resources Control Board Water Right Decision D-1641, and informs the 2008 USFWS BO RPA 1, 3.

Regular Vessels Involved: R/V Longfin (CF2011XS) or R/V New Alosa (CF9301XS)



611
612 *Figure 1-8 Map of Bay Study sampling stations.*



613

614 Figure 1-9 Diagram of otter trawl.

615

616 **Study 5 - Yolo Bypass Fish Monitoring Program (IEP-047)**

617 Sampling has been conducted for over 20 years in the Yolo Bypass, under DWR's Yolo Bypass
618 Fish Monitoring Program, a research and monitoring effort to understand fish and invertebrate
619 use of this seasonal floodplain. The program employs a suite of sampling methods designed to
620 monitor adult, juvenile, and larval fish populations, as well as drift invertebrates, zooplankton,
621 and chlorophyll. Unlike much of the San Francisco Estuary, there is no long-term database of
622 Yolo Bypass water quality, lower trophic levels, and fish abundance prior to 1997. Such data are
623 essential for the design, evaluation and adaptive management of habitat restoration projects in
624 the Yolo Bypass. The present effort focuses on the continued collection of pre-restoration data
625 for the Yolo Bypass. These current efforts include zooplankton, larval fish and drift samples
626 collected using trawls at the base of the Yolo Bypass. Additionally, juvenile and small pelagic
627 fish species composition and density is monitored using a screw trap and beach seining at core
628 stations in the floodplain and Toe Drain of the Bypass. Releases of coded wire-tagged juvenile
629 salmon will be used to evaluate fish growth and survival. Lastly, a fyke trap and gill nets are
630 used to monitor large adult fish species and abundance. Algal monitoring will be based on grab
631 samples.

632 The objectives of this program are to 1) collect baseline data on lower trophic levels
633 (phytoplankton, zooplankton and aquatic insects), larval, juvenile, and adult fish, hydrology,
634 water quality, and physical conditions; 2) analyze Yolo Bypass data collected during 1997-
635 present to elucidate potential ecological trends; and 3) examine the distribution of adult fish in
636 the floodplain using acoustic-tagging methods.

637 Sampling includes use of beach seines, a fyke trap, a rotary screw trap, invertebrate and larval
638 fish nets, and gill nets. Eleven beach seine sampling sites are located throughout the lower
639 bypass and each site is sampled biweekly, year-round (additional sites are sampled during
640 inundation events on a weekly time step). These beach seine sites are located in the Yolo
641 Bypass Toe Drain and span 30 miles beginning near the terminus of the Toe Drain directly east
642 of Liberty Island, up to Fremont Weir, north of Interstate 5. The beach seine used is 15.2 m (50
643 ft) long by 1.2 m (4 ft) tall with a 0.32 cm (1/8 inch) delta mesh. The primary fyke trap is 3.05 m
644 (10 ft) wide and 7.3 m (24 ft) long is installed 0.8 miles downstream of the Lisbon Weir in the
645 Toe Drain and is operated from September through June. This trap is checked daily, Tuesday
646 through Friday, except during weather events and inundation where the trap may be operated
647 and checked daily over the weekend. The rotary screw trap, with a 2.4 m (8 ft) diameter cone, is
648 located 9 miles south of Lisbon Weir and is operated from January to June and checked daily
649 from Tuesday through Friday. During inundation events, the trap may be operated, and
650 checked daily, during weekends. During periods of high debris loads in the Toe Drain, the trap

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may be fished during shorter duration periods where staff remain on board continuously removing debris and checking for fish. A single drift invertebrate, zooplankton, and larval fish sample is collected at the rotary screw trap site in the Yolo Bypass and at Sherwood Harbor on the Sacramento River. These samples are collected biweekly, year-round, and weekly during inundation events. The drift invertebrate net dimensions are 0.46 m x 0.3 m at the mouth, 0.91 m long, and 500 µm mesh. The zooplankton net has a 0.50 m diameter mouth, 2 m long, and 153 µm mesh. The larval fish net has a 0.75 m diameter mouth, is 2.5 m long, and has 500 µm mesh. Gill net operations occur in the fall, August to November, in the toe drain either at a site 1 km downstream of the screw trap or at Lisbon Weir. Due to the nature of fishing in these areas, the nets are monitored continuously and fish are immediately removed after detection. Thus, the nets remain in the water for up to an hour, but no fish remain in the nets more than a few minutes. These nets have 15.2 cm (6 inch) mesh and are 3.05 m (10 ft) deep and 45.7 m (150 ft) long. Adult fall run Chinook Salmon (*Oncorhynchus tshawytscha*) collected in the fyke and via gill net are acoustically tagged September to November to provide data on the effect of agricultural drainage flows on migration patterns. White sturgeon collected in the fyke trap are tagged February through May to provide information about the movements of adult white sturgeon under "natural" conditions in the Bypass and to determine if they can pass over Fremont Weir. Salmon and sturgeon for tagging are taken from our fyke trap, except during time periods where the trap is not being fished when they are captured using gill nets.

Sampling includes use of beach seines, a fyke trap, a rotary screw trap (RST), invertebrate and larval fish nets, and gill nets. Take is minimal for rotary screw trap and invertebrate and larval fish nets, no additional take is requested beyond what is provided in the take table for gill nets and Fyke nets.

Regular Vessels Involved: CF8853XS, CF9162XS CF3668XS

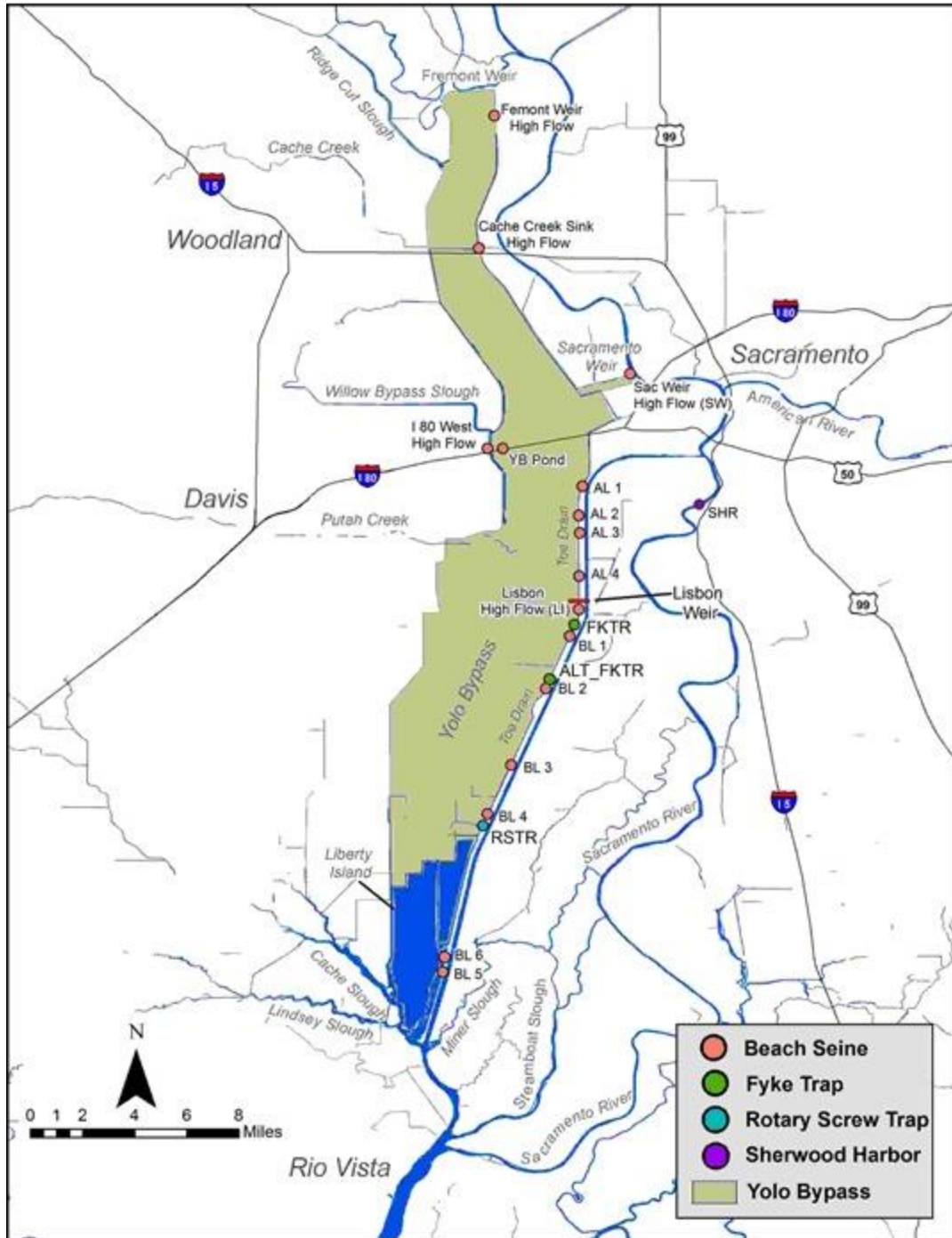


Figure 1-10 Map of Yolo Bypass Fish Monitoring Program sampling locations.



Figure 1-11 Picture of large fyke trap used by Yolo Bypass Fish Monitoring Program.

Study 6 - Delta Juvenile Fish Monitoring Program (DJFMP)(IEP-053)

The purpose of the monitoring conducted by the DJFMP has been and continues to provide natural resource managers near real-time biological and population data on resident and anadromous fishes to evaluate the effects of water operations (e.g., flow regimes, water exports, etc.) and fish management practices on fishes of management concern occurring within the San Francisco Estuary and its watershed. The data provided by the DJFMP has historically been used by several entities to (a) list species/populations under the state and federal ESAs, (b) support or establish biological opinions, and (c) research (e.g., life history characteristics) and manage fishes of management concern, which are intended to benefit, protect, and conserve native fishes such as the ESA-listed winter- and spring-run Chinook salmon and Central Valley steelhead. The monitoring conducted by the DJFMP is mandated, in part, by the 1997 National Marine Fisheries Service winter-run Chinook salmon biological opinion. The DJFMP trawl at Sacramento contributes catch data of Winter-run Chinook salmon to the Sacramento Catch Index. Since the 1970's, the DJFMP has monitored fish year round throughout the lower Sacramento and San Joaquin Rivers, Sacramento - San Joaquin Delta, and

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697 San Pablo and San Francisco Bays. This catch information is often used by governmental
698 agencies for permitting purposes and universities for baseline data. Information and analysis of
699 catch data is presented in the Lodi Fish and Wildlife annual report, available through the LFWO
700 website.

701 The purpose of the Early Warning Monitoring is to Detect Delta Smelt Movement and pilot a
702 new source of information that may help assess whether substantial movement of Delta Smelt
703 occurs in response to transient hydrodynamic, turbidity, and/or weather conditions. The overall
704 intent is to ascertain whether, during weather events and freshets, substantial numbers of
705 Delta Smelt are moving, or being moved, into areas potentially subject to entrainment. This
706 study has potential impacts on water management.

707 Weekly beach seining (year-round) within the lower Sacramento River and Delta, weekly
708 seining in the lower San Joaquin River (January through June), and bi-weekly seining in San
709 Francisco Bay and San Pablo Bay (November through June) to monitor the relative abundance
710 and distribution of juvenile Chinook Salmon in unobstructed near-shore habitats. In addition,
711 year-round surface trawling is conducted at Chipps Island and Sacramento to monitor juvenile
712 Chinook Salmon abundance entering and exiting the Delta, and surface trawling at Mossdale
713 from July to March to monitor the abundance and temporal distribution of juvenile Chinook
714 Salmon entering the Delta. The surface trawling at Mossdale is conducted in cooperation with
715 the California Department of Fish and Wildlife who monitor at Mossdale from April to June. A
716 seine efficiency study is included within the current work plan to test assumptions and make
717 inferences regarding shallow habitats more robust.

718 Monitoring occurs at 58 beach seine sites and 3 trawl sites located within the lower Sacramento
719 and San Joaquin rivers, at and between the entry and exit points of the Delta, and within the
720 San Francisco Bay. Beach seines are used to quantify the relative abundance and distribution of
721 fish in shallow habitats. Trawling is conducted to improve our understanding of the relative
722 abundance and survival of fish migrating through the Delta and Estuary. The DJFMP has
723 sampled the majority of these sites annually since the mid-1990s. A seine efficiency study is
724 included within the current work plan to test assumptions and make inferences regarding
725 shallow habitats more robust.

726 San Joaquin River at Mossdale trawl location will be sampled using a KDTR. The Sacramento
727 River at Sherwood Harbor trawl location will be sampled using a KDTR from October to March
728 and a MWTR for the remainder of each year due to boat safety concerns. During each sampling
729 day, a total of ten 20-minute tows will be attempted between sunrise and sunset. The MWTR
730 and KDTR nets will be towed by one and two vessels, respectively, in just the top few meters of
731 the water column at a speed necessary and distance apart (for KDTR) to ensure the net mouth
732 remains fully extended and submerged while in tow. The MWTR net that will be used at the

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Sacramento River at Sherwood Harbor trawl location is composed of six panels, each decreasing in mesh size towards the cod end. The mesh size for each panel ranges from 20.3 cm stretch at the mouth to 0.6 cm stretch just before the cod end. The cod end is composed of 0.3 cm weave mesh. The fully extended mouth size is 1.83 x 4.57m. Two depressors and hydrofoils will enable the net to remain fully extended at the top few meters of the water column while sampling. On each side of the net, the depressor and hydrofoil are connected to the towing vessel using a 30.5 m Amsteel rope bridle (0.64 cm diameter). As a result, the MWTR net that will be used at the Sacramento River at Sherwood Harbor trawl location is fished approximately 30 m behind the towing vessel. The MWTR net that will be used at the Suisun Bay at Chipps Island trawl location is composed of six panels, each with decreasing mesh size towards the cod end. The mesh size for each panel ranges from 10.2 cm stretch at the mouth to 1.3 cm stretch just before the cod end. The cod end is composed of 0.8 cm weave mesh. The fully extended mouth size of the MWTR net is 3.05 x 9.14 m. Two depressors and hydrofoils will enable the net to remain fully extended at the top few meters of the water column while sampling. On each side of the net, the depressor and hydrofoil are connected to the towing vessel using a 30.5 m Amsteel rope bridle (0.6 cm diameter) attached to a 15.2 m tow rope (0.95 cm diameter). As a result, the MWTR net that will be used at the Suisun Bay at Chipps Island trawl location is fished approximately 45 m behind the towing vessel. The KDTR nets that will be used at the Sacramento River at Sherwood Harbor, the San Joaquin River at Mossdale trawl location, and the San Joaquin Delta trawls at Jersey Point, Prisoners Point, and Site 902 will be composed of five panels, each decreasing in mesh size towards a live box at the cod end. The mesh size for each panel ranges from 5.1 cm stretch at the mouth to 0.3 cm stretch just before the live box. The live box (36 cm wide x 36 cm tall x 49 cm long) is composed of 0.18 cm thick aluminum that was perforated with numerous 0.46 cm diameter holes. The live box contains several internal baffles to minimize the effect of flow pressure on fishes being sampled. The fully extended mouth size of the KDTR nets is 1.83 x 7.62 m. A float line and lead line enables the nets to remain at the top few meters of the water column while sampling. In addition, at the front of each wing of the net is a 1.83 m bar with floats at the top and weights at the bottom to keep depth constant while sampling. The KDTR nets are connected to the two towing vessels using a 2.3 m rope bridle (2.4 cm diameter) attached to a 30.5 m tow rope (0.95 cm diameter) on each side of the net. As a result, the KDTR nets are fished approximately 31 m behind the towing vessels. At the end of each tow, the MWTR nets are retrieved expeditiously by the towing vessel using winches and are brought onto the towing vessel by hand. After retrieval, the cod end of the MWTR nets is placed in a fish holding container filled with river water, untied, and all fishes observed within are immediately emptied into the holding container for processing. At the end of each tow using the KDTR nets, the two towing vessels (i.e., net and chase boats) come together and the chase boat transfers its tow rope to the net boat. The crew on the chase boat expeditiously retrieves the live box from the KDTR net, collects all the fishes observed

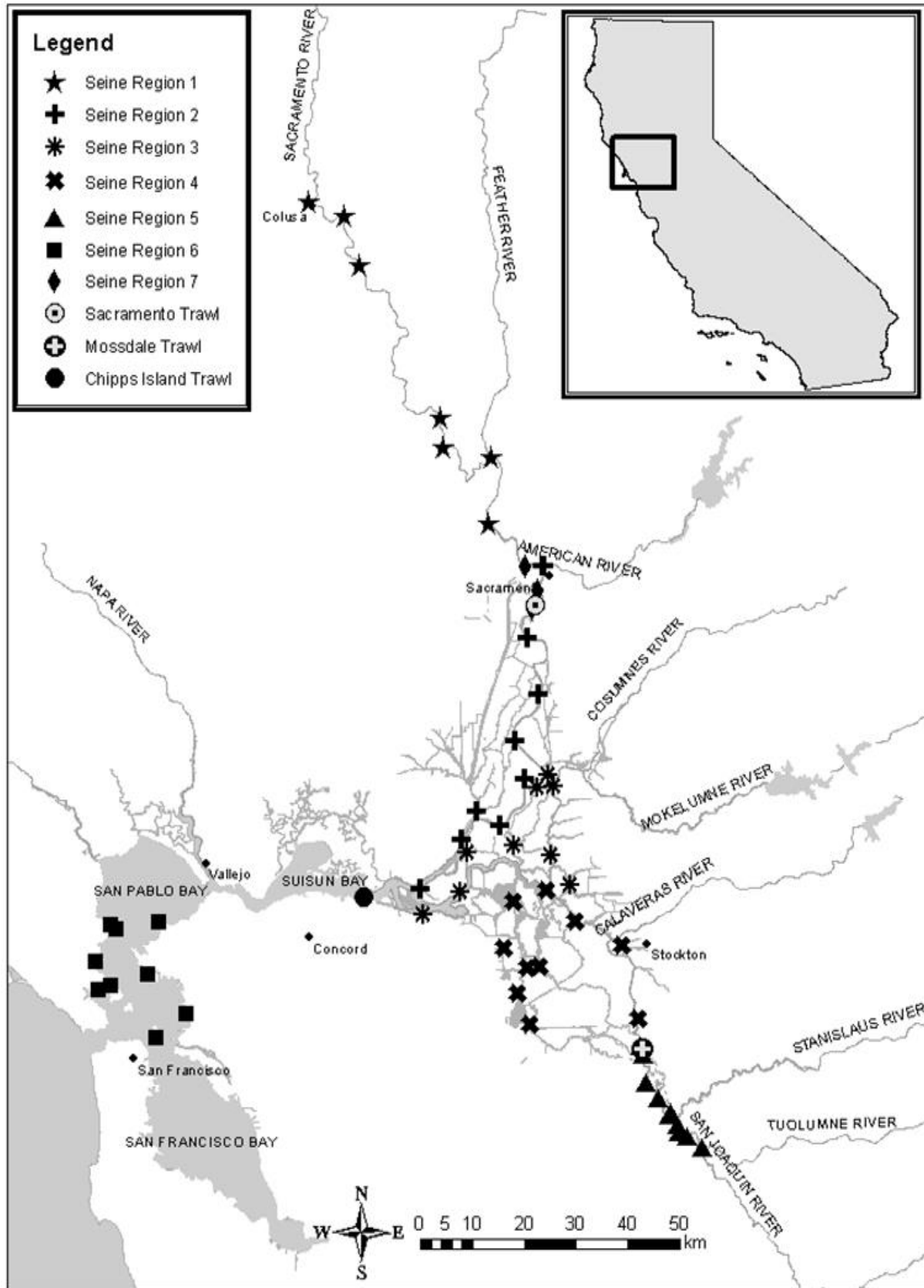
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within the live box, and places all collected fishes into a holding container filled with river water for processing. The river water within holding containers is replaced between all tows. After wetting the hands, all collected fishes are immediately identified to species, measured for fork length to the nearest millimeter, assessed for maturation or life stage, and released into or near the location sampled. If greater than 30 individuals of a species or race are collected, a sub sample of at least 30 individuals are randomly measured for fork length. For species of concern: Chinook salmon, Longfin smelt, Delta smelt, and splittail, up to fifty individuals are randomly measured for fork length. All efforts are made to process and release salmonids and ESA listed fishes prior to other fishes and before the MWTR or KDTR nets are reset for the next tow. The total holding time for processing Chinook salmon, steelhead, and green sturgeon is typically < 5 minutes depending upon the number of individuals captured.

The Early Warning Monitoring to Detect Delta Smelt Movement study will utilize multiple-haul Kodiak Trawl sampling at Jersey Point, Prisoners Point, and Site 902. The intensity (frequency) of multiple-haul sampling at Jersey Point, Prisoner's Point, and Site 902 will depend on the likelihood that a redistribution of smelt is about to occur, or is occurring. We propose an initial three-day sampling event at each site in the first week of December, and then weekly baseline sampling (one day at each site) that should occur year round, regardless of conditions. Following that event, sampling can be reduced to one day per week at each site, on consecutive days at the same tidal phase, until rain or other relevant environmental event is forecast. Depending on circumstances, it may be appropriate to sample at a higher frequency than this minimum, even absent a significant weather event.

Regular Vessels Involved:

Site typically used	Vessel Name	Hull number
Chipps Island	L.E. Whitesel	NOB3901412 82
Chipps Island	R/V Confluence	ZYGG4284A808
Sac Trawl or Mossdale or EDSM	Silverside, aka Reedsport	RMF00001J3 93
Mossdale	Rogue River, aka Slayer	RQJT1727L819
Mossdale	Rogue River , aka Dragon	RQJT1723K819
Sac Trawl or Mossdale or EDSM	Design Concepts, aka R4	GRZ10207J3 94
Sac Trawl	Shimo's Fury, aka SeaArk	SAMA0806J6 96
Sac Trawl or Mossdale or EDSM	Workskiff	MGN21W29F505
Sac Trawl or Mossdale or EDSM	Willie Boat	WIL17644I112
Sac Trawl or Mossdale or EDSM	Alumaweld I, aka Supervee	AWB16580F 001



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Figure 1-12 Map of Delta Juvenile Fish Monitoring Program sampling stations including Sacramento, Mossdale, and Chipps Island trawls.

Study 7 - Spring Kodiak Trawl (IEP-088)

The Spring Kodiak Trawl Survey (SKT) has sampled annually since its inception in 2002. The SKT determines the relative abundance and distribution of spawning delta smelt and samples 40 stations each month generally from January to May, but might start in December based on environmental conditions. These 40 stations range from Vallejo, CA on the Napa River upstream to Stockton on the San Joaquin River, Walnut Grove on the Sacramento River, and the Sacramento Deep Water Ship Channel. Supplemental sampling may occur in locations other than routine stations, and can span the entire upper Estuary, including San Pablo Bay and up to Napa on the Napa River. Each "Delta-wide" survey takes approximately 4 - 5 days per month to complete. Historically, "Delta-wide" surveys were followed by a "Supplemental" survey two weeks later to intensively sample areas of highest delta smelt concentration to estimate the proportion of male and female delta smelt that were in pre-spawning, spawning and spent maturation stages. Beginning in 2008, in an effort to minimize take of spawning adults, routine "Supplemental" surveys were discontinued and are now only conducted under the recommendation of the Smelt Working Group and the approval of managers. "Delta-wide" surveys are numbered consecutively beginning with number 1, and 'Supplemental' surveys are numbered consecutively beginning with number 11. All fish, shrimp, and jellyfish collected in the tow are identified and enumerated. Delta smelt are further processed to identify gender and maturity. Water temperature, electrical conductivity (specific conductance), Secchi depth, and turbidity are collected at the beginning of each tow.

This study is mandated under the 2008 USFWS biological opinion (BO) for the Long-Term Operational Criteria and Plan (OCAP) for coordination of the Central Valley Project and State Water Project specifically concerning delta smelt and its critical habitat. The USFWS's Biological Opinion for delta smelt has criteria pertaining to delta smelt protection based on SKT Survey results. Those Survey results, provided in near-real time, are used by state and Federal resource managers to assess the risk of entrainment of delta smelt at the CVP and SWP.

The objectives of this survey are to improve the detection of pre-spawning and post-spawning delta smelt, obtain maturity/egg-status data for adult delta smelt, and provide results to scientists and managers on a near real-time basis for use in resource management decisions. A standard Kodiak trawl with a mouth opening of 7.6 m (25 ft) wide by 1.8 m (6 ft) deep and an

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829 overall length of 19.8 m (65 ft) and 0.63 cm (0.25 in) cod-end net mesh. One ten-minute surface
830 tow is conducted at each station.

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832

833 *Figure 1-13. Photo of Kodiak net used by Spring Kodiak Trawl.*

834

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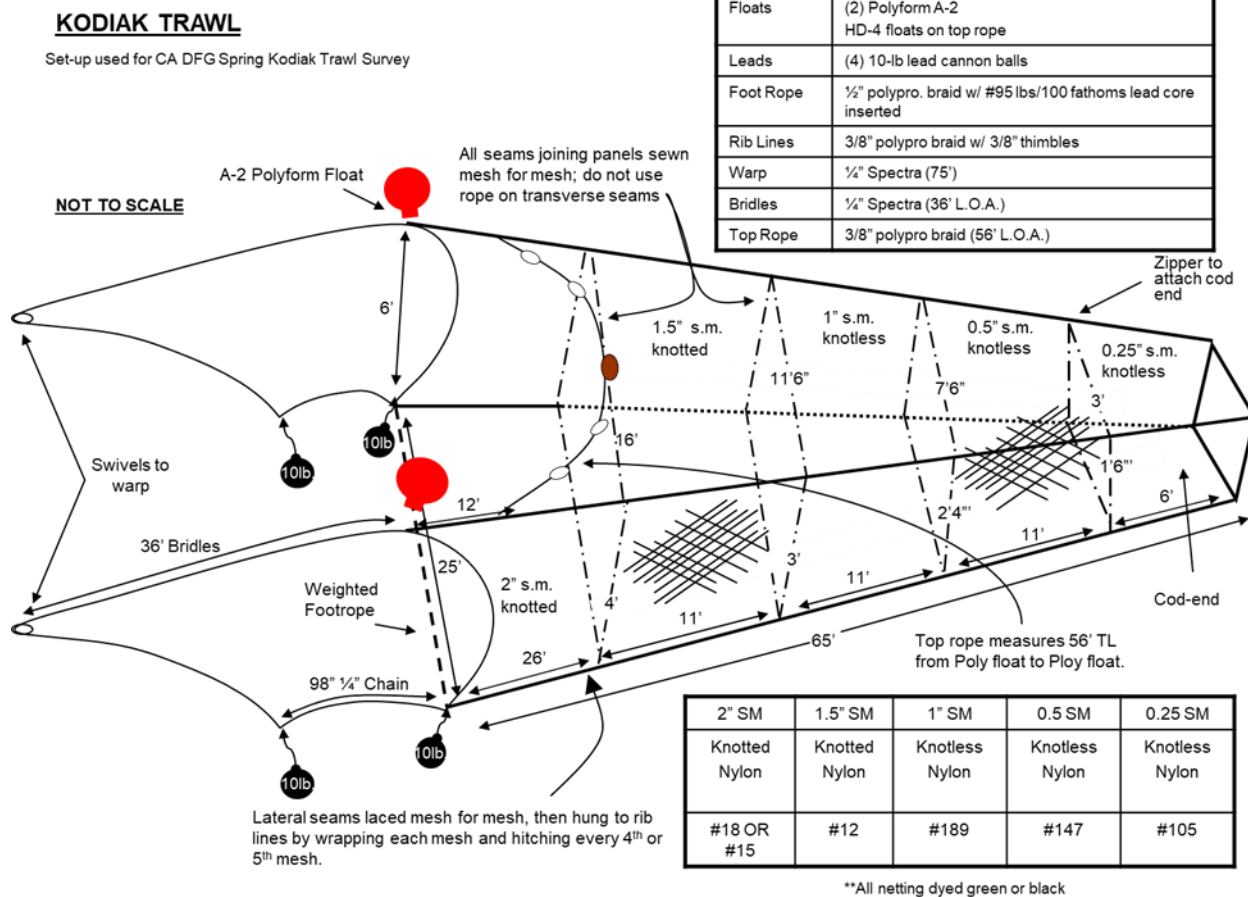


Figure 1-14. Diagram for Kodiak net used by Spring Kodiak Trawl.

All catch is speciated, enumerated and measured. Researchers will retain (directed mortality) some clipped hatchery spring-run and winter-run juvenile Chinook Salmon for CWT data. Steps to euthanize fish will be performed quickly to minimize stress. Fish will be euthanized with exposure to cold. Fish will be stored frozen prior to removal of coded wire tags (CWT). Methods suggested by the American Fisheries Society, Guidelines for the Use of Fishes in Research, include decapitation and cold shock. Latitude and Longitude of station locations are provided in an attached file.

Regular Vessels Involved: R/V Scrutiny (CF3727XS) or R/V Munson (CF3112XS) or R/V New Alosa (CF9301XS)

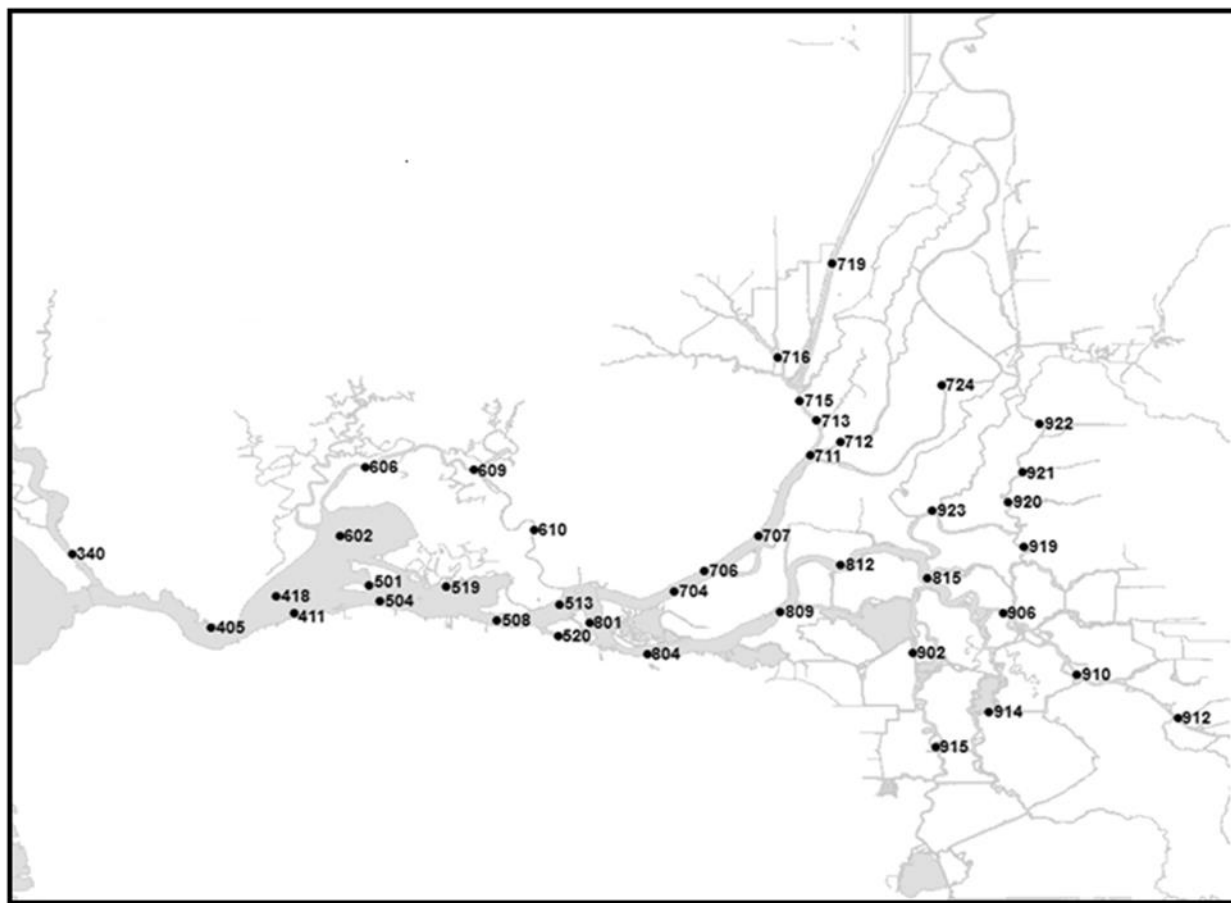


Figure 1-15 Map of Spring Kodiak Trawl survey stations.

Study 8 - UC Davis Suisun Marsh Fish Monitoring (IEP-093)

The purposes of the Suisun Marsh Fish Study are (1) to understand factors determining the abundance, distribution, and assemblage structure of introduced and native fishes, especially in relation to environmental variables; (2) to examine long-term changes in the Suisun Marsh ecosystem in relation to other changes in the San Francisco Estuary; (3) to monitor the effects of water management operations and associated infrastructure (e.g., Suisun Marsh Salinity Control Gates) as well as tidal restoration on marsh fishes; and (4) to contribute to understanding of the life history and ecology of key species in the marsh. Secondary goals of the project include training undergraduate and graduate students in estuarine studies and fish sampling; providing a venue for managers and biologists interested in the marsh to experience it firsthand; supporting studies by other investigators through special collections; providing background information for in-depth studies of other aspects of the Suisun Marsh aquatic system (e.g., studies of jellyfish biology); and contributing to the general understanding of estuarine systems through publication of peer-reviewed papers. The Suisun Marsh Fish Study is

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required monitoring and legally compliant with the following statutes: (1) the San Francisco Bay Conservation and Development Commission 4-84 (M) Special Condition B, (2) the US Army Corps of Engineers 16223E58B Special Condition 1, and (3) the Revised Suisun Marsh Monitoring Agreement (Agreement Number 4600000634).

Since 1980, juvenile and adult fish have been sampled monthly at standard sites within subtidal sloughs of Suisun Marsh. Originally, 47 trawl sites in 13 sloughs were sampled; several of these sites were sampled only in 1980 and 1981, with 17 sites in seven sloughs being sampled consistently until 1994. From 1994 to the present, 21 sites in nine sloughs have been regularly sampled by otter trawl (Figure 2). We have been sampling three additional trawl sites in Denverton, Nurse, and Montezuma sloughs (DV1, NS1, and MZ6, respectively; Figure Suisun Marsh Fish) since 2014 that are part of the Arc Project.

Trawling is conducted using a four-seam otter trawl with a 1.5-m X 4.3-m opening, a length of 5.3 m, and mesh sizes of 35-millimeter (mm) stretch in the body and 6-mm stretch in the cod end. The otter trawl is towed at 4 km/hr for 5 minutes in small sloughs and at the same speed for 10 minutes in large sloughs. For each site, temperature (degrees Celsius, °C), salinity (parts per thousand, ppt), and specific conductance (microSiemens, µS) are recorded with a Yellow Springs Instruments PRO2030 meter. Dissolved oxygen (DO) parameters (milligrams per liter, mg/l, and % saturation), first sampled in 2000, are also measured with the PRO2030. Water transparency (Secchi depth, cm), tidal stage (ebb, flood, high, low), and water depths (m) are also recorded.

Contents of each trawl or seine are placed into large containers of water. Fishes are identified and measured to the nearest mm standard length (mm SL), and then returned to the water. Sensitive native species are processed first and immediately released. Numbers of Black Sea jellyfish (*Maeotias marginata*), Siberian prawn (*Palaemon modestus*), oriental shrimp (*Palaemon macrodactylus*), California bay shrimp (*Crangon franciscorum*), Harris mud crab (*Rhithropanopeus harrisi*), overbite clam (*Potamocorbula amurensis*), Asian clam (*Corbicula fluminea*), and other macroinvertebrate species are also recorded. Crustaceans from the order Mysida are pooled into one category, "mysids," and given an abundance ranking: 1 = 1-3 mysids, 2 = 4-50 mysids, 3 = 51-100 mysids, 4 = 101-500 mysids, and 5 = >500 mysids.

Regular Vessels Involved: CF9555XS and CF3261XS

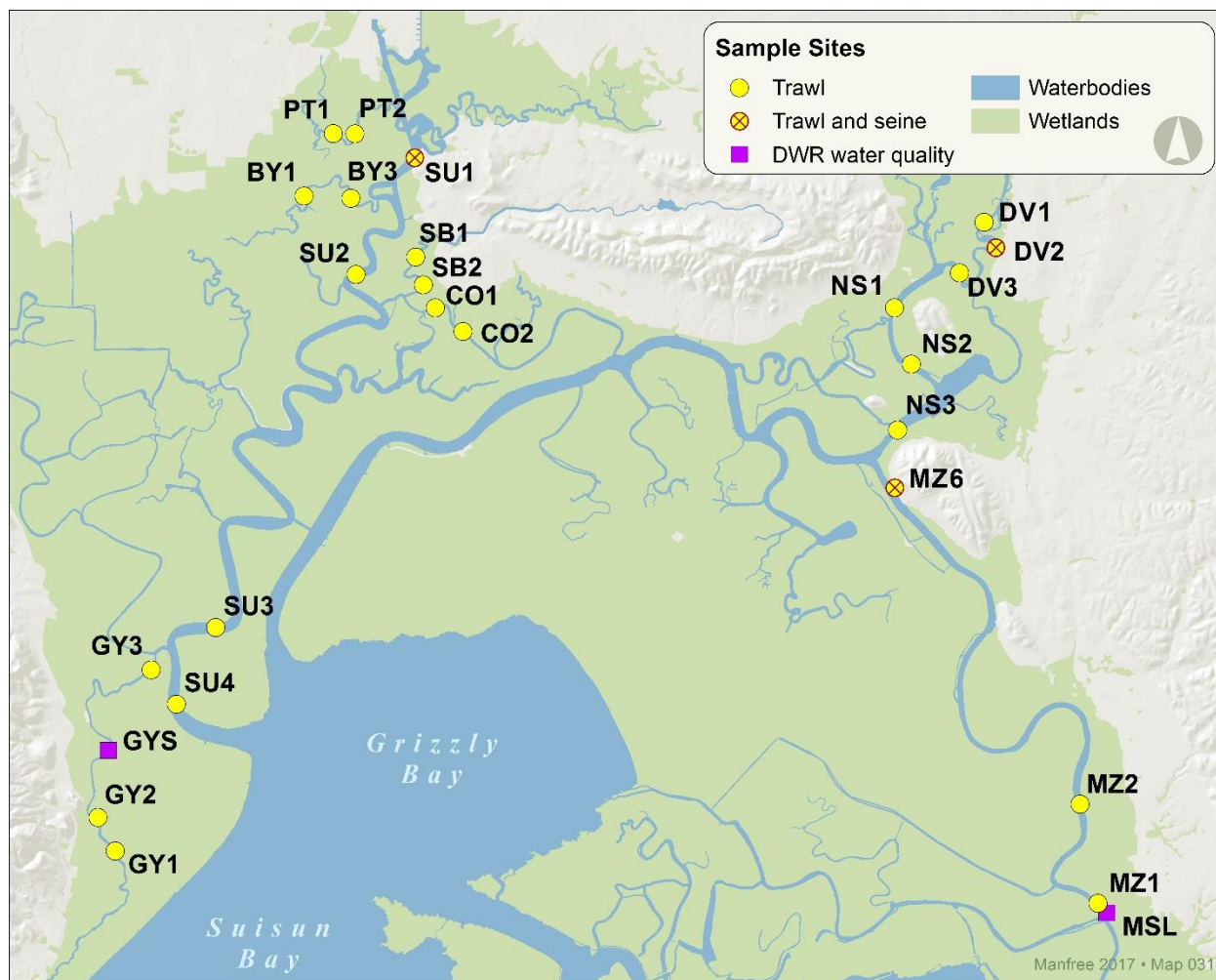


Figure 1-16 Map of UC Davis Suisun Marsh Fish Monitoring survey stations.

Study 9 - Mossdale Spring Trawl (IEP-071)

This study is part of an overall effort to provide "near-time" information on the relative vulnerability of key fish species (primarily Chinook salmon and steelhead) to water project operations. This supports CDFW's Region 4 field work, collation and reporting of data from the Mossdale trawl sampling program during April through June. Sampling results are made available within 48-hours via the Internet.

Mossdale Spring Trawl main goal is to generated timing and production for out-migrating fall-run Chinook salmon smolt. The main monitoring questions are: 1) Determine annual salmon smolt production in the San Joaquin Basin, 2) Develop smolt production trend information, 3) Determine the timing and magnitude of smolt out-migration into the Delta from the San Joaquin tributaries, 4) Document the occurrences of other species including listed species such as steelhead and Delta smelt, 5) Develop method to estimate number of steelhead using

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910 Mossdale trawl. Sampling is performed with a 6 x 25 foot (1.87m x 7.6m) Kodiak trawl net. The
911 Kodiak trawl uses two boats to pull a net equipped with spreader bars, wings, and a “belly” in
912 the throat of the net (to improve capture vulnerability). Fish are collected in a live box (36cm x
913 36cm x 49cm) attached to the end of the net. The sampling intensity was five days a week in
914 April and May and 3 days a week in June. All trawling occurred during daylight hours, generally
915 starting around 8:00 am. Sampling days usually consisted of 10 tows at 20 minutes per tow.
916 Sampling days were also extended on days when efficiency tests were conducted. Data is
917 analyzed and smolt production produced using three different estimations. A technical report
918 of the trawl survey is prepared in 18 months after sampling had ended.

919 Flows from the Merced, Tuolumne and Stanislaus Rivers converge in the lower San Joaquin
920 River near Vernalis. Currently releases from the reservoirs on these rivers are quite low in most
921 years resulting in low stream flows through the southern Sacramento-San Joaquin Delta. Low
922 flows through the South Delta combined with water exports can delay or terminate fish
923 migrations and therefore be detrimental to juvenile San Joaquin River Basin Chinook salmon.
924 The monitoring occurs two miles downstream of Mossdale Landing County Park (river miles 56),
925 and upstream of the Old River confluence. Timing and production (indices and estimates) for
926 the out-migrating fall-run Chinook salmon smolts has been monitored at this location since
927 1987. Additionally this trawl captures coded wire tagged Chinook smolts and is the primary
928 capture site for these fish being used to estimate survival of Chinook smolts in the river system.
929 Results from this project, therefore document information on the out-migration timing,
930 survival, and the magnitude of non-marked smolt production from the San Joaquin Basin
931 passing into the South Delta. The trawl also captures steelhead out-migrants and provides an
932 index of these out-migrants for the entire San Joaquin River Basin.

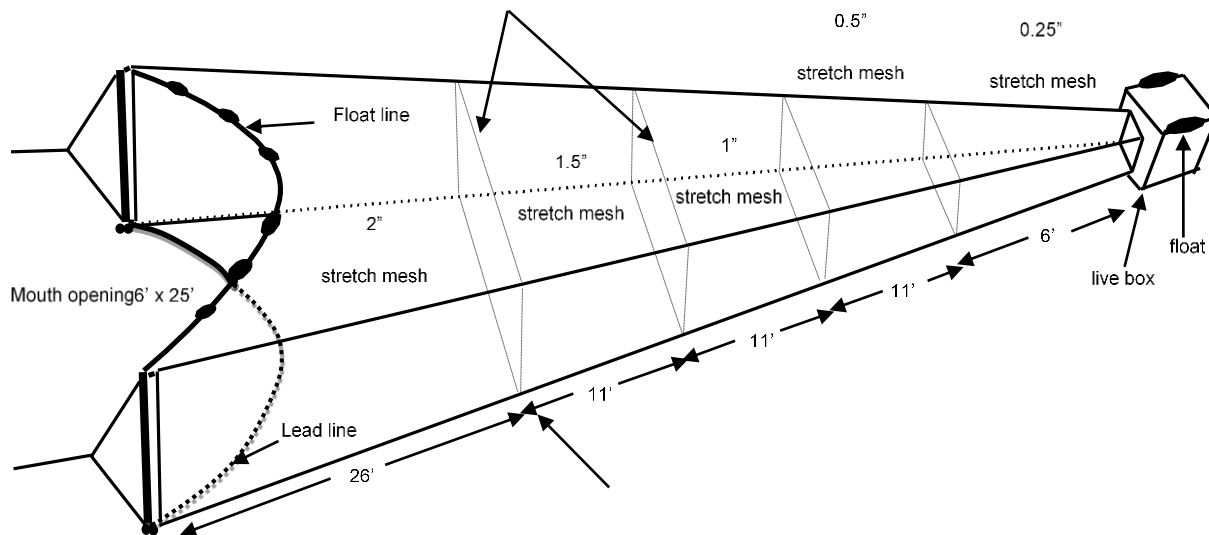
933 Mossdale Spring Trawl complies with 2009 NMFS Biological and Conference Opinion on the
934 Long-term Operations of the Central Valley Project and State Water Project 11.2.1.3.

935 Regular Vessels Involved: CF9031XS and CF9230XS. CF2497XS is our backup vessel.

936

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939

940 *Figure 1-17 Diagram of Kodiak trawl net used at Mossdale and picture of net deployed during*
941 *tow.*

942

943

944 Study 10 - Gear Efficiency Evaluations (IEP-0249)

945 Gear selectivity evaluations are helping to integrate catch data from multiple trawl surveys to
946 estimate abundance and ultimately to model population dynamics for delta smelt and other
947 species of management concern. Data from simultaneous, adjacent deployment of IEP survey
948 gears during the tidal cycle will permit the estimation of selection curves relating the relative
949 capture probability of delta smelt (and possibly other species) of a given size across gears.
950 Relative gear selectivity will be modeled statistically following Millar and Fryer (1999) based on

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data from proposed simultaneous, adjacent deployment of IEP fish sampling gears. This will also provide more information on relative gear selectivity, gear sampling volume by depth, vertical and lateral distribution of smelt by life stage, quantification of sampling variation due to tidal fluctuation, bias of fixed stations, estimates of contract selectivity with covered cod-end trawls, and insights on herding effects.

Methods included evaluation of existing IEP gear types, as described by Study 2 Fall Midwater Trawl (IEP-003), Study 6 Delta Juvenile Fish Monitoring Program and Study 7 Spring Kodiak Trawl.

Regular Vessels Involved: See descriptions for other studies.

Study 11 - Investigation of the Distribution and Abundance of Longfin Smelt in the SFE (IEP-296)

The purpose of this research is to determine the degree to which Longfin Smelt utilize tributaries of San Pablo Bay and South Bay as spawning and rearing habitat. Since most Bay tributaries are not sampled by current long-term surveys, a key question is to determine if Longfin Smelt spawn and recruit in Bay tributaries; and if so, whether they do so in appreciable numbers to have an effect on overall species abundance. Sampling of tributaries to San Francisco and San Pablo Bays (Bay tributaries) not previously monitored by IEP-DFW for adult and larval stages of Longfin Smelt will thus enhance our knowledge of the distribution of the species. Furthermore, analysis of otolith geochemical signatures from Bay tributary fish and fish collected by DFW abundance index surveys will provide for an assessment of the contribution of different geographical areas and salinity zones to the recruited juvenile and adult populations. Conducting this research during both wet and dry years will allow us to understand how freshwater inflow into and outflow from the estuary and its tributaries may influence tributary use and the contribution of Bay tributary spawning to the population abundance index.

To get a better understanding of the potential contribution of Bay tributaries to the population, reconnaissance of several Bay tributaries including the Napa River and adjacent restored salt ponds, Sonoma Creek and the Petaluma River in San Pablo Bay: Alameda Creek in South Bay and Coyote Creek in Lower South Bay and adjacent restored salt ponds. Reconnaissance will involve determining specific stations within each Bay tributary, determining safe access points, clearing of debris and other obstructions, mapping of habitat and quantification of available habitat and water volumes for expanding catch for abundance estimates and comparing difference gear types to determine the most effect sampling approach. We will also explore the

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utility of otolith geochemistry to detect Bay tributary derived fish among the recruited juvenile and adult populations to assess the degree to which Bay tributary spawning contributes to juvenile and adult abundance. Lastly we will expand on the otolith geochemistry approach and investigate the potential to use otolith geochemistry to estimate the proportion of Longfin Smelt that use nearshore ocean environments (rather than staying in the Bay) for the summer-fall period and if adults individuals could overwinter in the ocean. Using our established data on the geochemistry of the Sacramento-San Joaquin Delta and Napa Rivers (Hobbs 2010) and new geochemistry data collected in the initial year of this study, we will determine the degree to which we can reliably distinguish different habitats and tributaries, and determine our ability to quantify Longfin Smelt spawning and rearing in Bay tributaries and address questions regarding Bay tributary contributions to fall and winter indices of adult and juvenile Longfin Smelt abundance. The following tasks and methods are derived from existing experience in sampling shallow Bay tributaries. Again, the study is proposed as a multi-year effort to assess our tools to determine the contribution of different geographical areas and salinity zones across different water year types to the abundance of recruited juvenile and adult Longfin Smelt. Ideally, these studies would be at least a 5-year effort; however the timeline would depend on future climate conditions, and could potentially be completed in less than 5 years. In the first year, reconnaissance will be conducted to establish specific sampling locations in South Bay tributaries under the environmental conditions of the study year. Given varying field challenges in different water conditions, specific sites and gears may be subject to change across water year types. Otolith geochemistry methods from Year 1 will be expanded to determine the reliability of such signatures in different hydrologic conditions. The multi-year effort would allow the evaluation of the effects of different water year types (e.g. hydrologic conditions in the tributaries during the spawning/early rearing period) on smelt reproduction, and to follow individual cohorts to adulthood. In 2016, UCD will expand the study plan from 2014-15 in which the CDFW Smelt Larval Survey sled was used to sample larval Longfin Smelt in the Napa River and marshes, Sonoma Creek, Petaluma River and Coyote Creek bi-weekly from January 2016-April 2016, in freshwater, and low-salinity (1-3, 4-6 and 6-12ppt) regions of bay tributaries.

Several additional field surveys and sites are planned.

1. UCD will expand the Smelt Larval Survey into San Pablo Bay at Bay Study stations, bi-weekly. Sample sites will include deep channel sites and shallow sites from stations 317-346 (Figure G). Surveys will begin in December to be sure to capture the beginning of the spawning season for a total of 8 surveys. The total sampling effort and number of stations surveyed in San Pablo Bay will depend on weather conditions and freshwater outflow year type. If a wet year occurs and larvae are encountered in the first survey, additional day(s) may be devoted to expanding the spatial scale of larval distribution. To facilitate a maximum effort during an ideal study year, additional sampling may be included by ICF international (funded directly by MWD). To

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1023 facilitate the collection of larval fish for otolith analysis, SLS samples will be preserved in 95%
1024 ETOH. Larval identification may be more difficult using ETOH rather than the standard 10%
1025 formaldehyde preservative. To facilitate this new protocol, we will develop new identification
1026 techniques with ETOH specimens and confirm the identity of Longfin Smelt using genetic
1027 techniques in collaboration with Dr. Mandi Finger of the UC Davis Genomics Variation Lab.

1028 2. UCD will implement the use of the CDFW 20-mm survey net in natal tributaries, where larval
1029 Longfin Smelt are found and in San Pablo Bay stations. Surveys will occur bi-weekly from April
1030 through June for a total of 8 surveys. The overall number of sampling events and stations
1031 visited will depend on outflow year type and success of initial surveys. Surveys will begin in late
1032 March and extend through June or when juvenile Longfin Smelt are no longer encountered in at
1033 least one complete survey.

1034 3. UCD will sample monthly from July through September with otter trawls for juvenile and sub-
1035 adult over-summering in tributary sites where juvenile stages were found in the 20-mm survey.
1036 Otter trawls will also be conducted during the Smelt Larval Survey, with at least one trawl in
1037 each salinity zone.

1038 4. UCD will operate continuous water quality sondes in the Napa and Petaluma Rivers during
1039 the year as long as Longfin Smelt are found to occur in these habitats.

1040 Procedures Used (see methods below): All fish will be identified to species, enumerated, and
1041 released. A sub-sample of up to 30 fish of each species will be measured. Length data will be
1042 sent to CDFW and NOAA Fisheries and will be used to determine CV Chinook run of fish (based
1043 on length-at-date models).

1044 Procedures Used (see methods below): All fish will be identified to species, enumerated, and
1045 released.

1046 Trawling:

1047 -Project Component: 2

1048 Ten to 15 twenty min tows in each location will be made with a Kodiak trawl net. The Kodiak
1049 trawl net will have variable mesh ranging from 10cm to 1.3cm stretch 3.0 to 3.8 knots. The
1050 Kodiak trawl nets will have a float line and lead line attached to spreader bars that enable the
1051 net to fish the top 1.8m of the water column. The net will be fished with an aluminum live box
1052 at the cod end to avoid excessive fish mortality. One boat will maintain headway with both
1053 wings of the net attached at the end of the tow while the second boat motors back to retrieve
1054 the live box and process the catch. Crews will consist of a minimum of two boat operators and
1055 three deckhands. Trawling will not be conducted if water temperatures exceed 21°C. Trawl nets

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1056 and sampling gear will be dedicated to specific sampling areas to help prevent the spread of
1057 invasive species as part of the Hazard Analysis Critical Control Point Program (HACCP).

1058 Otter Trawl

1059 We will conduct daytime sampling at 14-16 stations per survey during spring tides to provide
1060 for diurnal maximum higher high tides to facilitate sampling in the restored salt ponds. Each
1061 site will be sampled with a four-seam otter trawl with a 1.5-m depth- 4.3-m width opening, a
1062 length of 5.3-m, and a mesh size of 35-mm stretch in the body and 6-mm stretch in the cod
1063 end. Trawls were towed for 5 minutes at an engine speed (rpm) of 3,500 in small sloughs (<3-m
1064 deep and <70-m wide) and for 10 minutes in larger sloughs (>3-m deep and >70-m wide).

1065 Larvae Sampling

1066 Larval fish will be sampled using the DFW "Smelt Larval Survey" sled, a cone shaped net 3.35-m
1067 in length with a mouth area of 0.37m². The net is mounted on a weighted tow net steel frame
1068 with skids. The net consisted of 505µm Nitex mesh netting with a cylindrical front section with a
1069 canvas mouth and a funnel shaped rear section with a canvas throat attached to a cod-end jar.
1070 A General Oceanics flow meter was mounted across the mouth of the net, located in the center
1071 of the mouth of the net.

1072 Procedures Used: Contents of the nets will be preserved in 95%ETOH and returned to the lab
1073 for sorting and identifying to species.

1074 Juvenile sampling

1075 The conical plankton net used in the surveys is 5.1 m long with a mouth opening of 1.5m. The
1076 net is constructed of 1,600µm knotless nylon delta mesh and is mounted on a weighted tow
1077 frame with skids. Fish are collected in a removable 2.2-L collection jar screened with 474-mm
1078 stainless steel wire bolting cloth. A General Oceanics flowmeter is mounted in the mouth of the
1079 net to estimate the volume (m³) of water sampled. To sample the entire water column, three
1080 10-min, stepped (1.2 m per step) oblique tows are completed at each station.

1081 Procedures Used: After each tow, the entire sample is transferred to a labeled holding jar
1082 containing 10% formalin neutralized (pH 7) with sodium borate.

1083

1084 Regular Vessels Involved: CF9976XS



Figure 1-18 Research vessel with otter trawl.

Study 12A and 12B - Fish Restoration Program (FRP) Tidal Wetland Monitoring Pilot Study (IEP-311)

Over the next several years, the Fish Restoration Program (FRP), an inter-agency agreement between the California Department of Fish and Wildlife (CDFW) and the California Department of Water Resources (DWR), will restore at least 8,000 acres of tidal wetlands in the Sacramento-San Joaquin Delta (Delta) and Suisun Marsh pursuant to requirements in federal Biological Opinions and the California Incidental Take Permit for operation of the State Water Project and Central Valley Project (CDFW 2009; NMFS 2009; USFWS 2008). The rationale for restoration is that state or federally listed fish species, Delta Smelt (*Hypomesus transpacificus*), spring-run and winter-run Central Valley Chinook Salmon (*Oncorhynchus tshawytscha*), and Longfin Smelt (*Spirinchus thaleichthys*) will benefit from increased availability of habitat and food web resources. Monitoring the effectiveness of this strategy is required by the Biological Opinions, and is integral to adaptive management of restoration programs.

The CDFW FRP Monitoring Team is responsible for monitoring the biological effectiveness of individual FRP tidal wetland restoration projects (Figure FRP). Ideally, monitoring of all similar projects would result in comparable data that would allow the assessment of system-wide effects of large-scale restoration. To that end, the FRP Monitoring Team led the Interagency Ecological Program Tidal Wetland Monitoring Project Work Team (PWT) in developing conceptual models, the Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary, and standard operating procedures that are available to all groups doing similar work. The Framework is designed to be a living document, changing and improving as we learn more about wetland restoration in the Delta and Suisun Marsh.

Mysid and zooplankton nets

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1111 Mysid nets have been used extensively to characterize macrozooplankton in the water column.
1112 We will sample macrozooplankton in the water column using a 50 cm diameter mouth (500 µm
1113 mesh size) mysid net and sample mesozooplankton with a 14.6cm diameter (150 µm mesh size)
1114 zooplankton net (Figure Inverts).

1115 These nets will be mounted on hoop nets for conducting surface tows. A flowmeter mounted in
1116 the net will measure sample volume, and we will standardize effort for towed nets by catch per
1117 liter of water sampled. The gear will be deployed alongside the boat via a davit and towed at 1-
1118 2 mph for five minutes. In deeper water (>2 m), a 40cm x 40cm mouth (0.500mm mesh size)
1119 mysid net mounted on a sled may be towed obliquely through the water column using a tow
1120 schedule or along the bottom. Sampling may occur year round, where 3-6 trawls may be
1121 conducted at each tidal restoration and reference wetland site.

1122 Benthic core

1123 Benthic cores have been used extensively to quantify chironomid and amphipod populations, as
1124 well as bivalves and other infauna in tidal wetlands. While many chironomids and amphipod life
1125 stages present in fish diets are pelagic, they also have benthic life stages. In shallow water (<1.5
1126 m), we will take a benthic core constructed of 4 in (20 cm) diameter (Figure 5A), hand-deployed
1127 to a depth of 20 cm. In deep water >1.5 m, we will use a 6 in by 6 in (15 cm x 15 cm) ponar grab
1128 modified for use in hard substrates, with three samples at each site. The core will be washed
1129 and sieved on board the boat to remove the sand/mud. Remaining material will be and
1130 preserved and any organic detritus and invertebrates processed. Two crew members will
1131 estimate percentage silt, sand, gravel in the field, and average the values. We will calculate
1132 effort as catch per surface area of substrate sampled. We may increase number of 4 in cores to
1133 create aggregate samples of areas equal to the ponar grab if invertebrate catch derived from
1134 single cores is too low for analysis. Sampling may occur year round, where up to 4 benthic grabs
1135 may be conducted at each tidal restoration and reference wetland site.

1136 Otter trawl

1137 The otter trawl has 1.4 m x 4.3 m mouth opening and is 6.7 m long, composed of 38 mm stretch
1138 nylon mesh in the body and 6.4 mm stretch mesh nylon in the cod end bag (Figure Otter). The
1139 otter trawl doors are composed of 1.9 cm thick plywood and measure 76.2 x 38.1 cm, weighing
1140 10 kg. The otter trawl is deployed off the stern of the boat. Once the net is deployed, two crew
1141 members each grab an otter trawl board and simultaneously drop them off the stern of the
1142 boat. The tow begins once the gear is fully deployed. The gear is towed for five minutes and
1143 then the otter trawl is retrieved on the side of the boat. Sampling will be conducted from June-
1144 December within and around tidal wetland restoration and reference wetland sites. Three to six
1145 trawls will be conducted at each of the sites.

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1146 Beach seine

1147 The beach seine measures 15 m long x 1.2 m high (3 mm delta square mesh) net with a 1.2 m³
1148 cod end bag (Figure Beach). One crew member will walk out into the water (up to 1.2 m in
1149 depth) holding one end of the net to measure the width and depth of the seine site. The second
1150 crew member will walk to the first crew member and place their seine pole where depth was
1151 recorded. The first crew member will walk parallel to the length of the shore and note seine
1152 length and site depth. Both crew members will haul the beach seine up onto the shore, leaving
1153 the cod end bag in the water.

1154 Lampara net

1155 Lampara net sampling will occur if no beach is present. The lampara measures 36.5 m wide and
1156 3.6 m at the cod end composed of 9.5 mm mesh (Figure Lampara). The flooring material
1157 connected to the cod end and wings is composed of 12.7 mm mesh. The net tapers on both
1158 sides of the wings, where each wing is composed of 69.9 mm, 146.1 mm, and 88.9 mm mesh.
1159 The vessel will deploy one side of the gear that is attached to an empty anchor bag (the bag fills
1160 with water) and buoy. The net will be deployed in a circular fashion around the site (much like a
1161 purse seine). The anchor bag will be brought back onboard and both sides of the net will be
1162 retrieved back onboard. Sampling will be conducted year round within and around tidal
1163 wetland restoration and reference wetland sites. Two to five lampara hauls will be conducted
1164 at each site.

1165 Gill net & ARIS

1166 The gill net will measure 6.1 m long x 1.8 m high and be composed of a (2 in) 5.08 cm
1167 monofilament mesh panel (Figure Gill Net). Gill nets will be deployed perpendicular across a
1168 channel, anchored by two 3.6 kg weights. Once the gill net is sampling, an Adaptive Resolution
1169 Imaging Sonar 1800 (ARIS) will be deployed from an anchored boat and face the net to record
1170 fish behavior near the gear. After 30-60 minutes of sampling, the ARIS unit will be shut off and
1171 the gill net retrieved. Four to six gill net sets will be conducted each month in May and June at
1172 Flyway Farms.

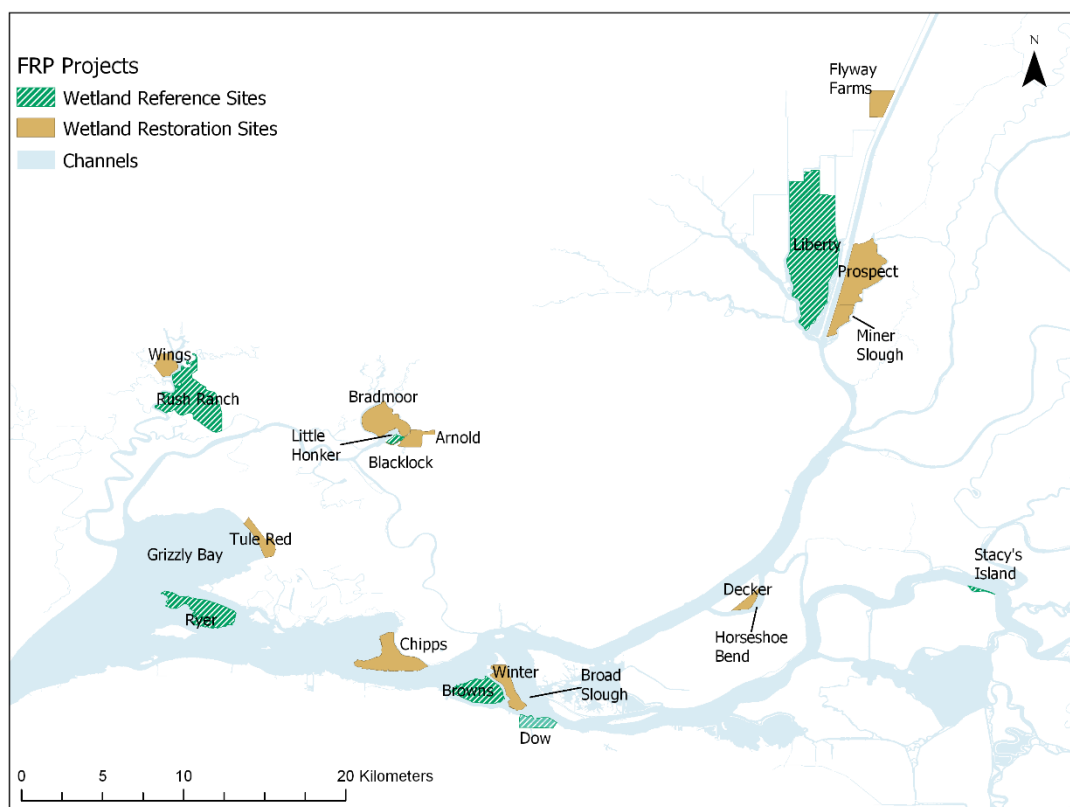
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1173

1174 *Figure 1-19 Regular Vessels Involved (from left to right): R/V Kvichak (CF 9277XS) or R/V Chinook (CF*
 1175 *9890XS) or R/V Mudsucker (CF 8867XS)*

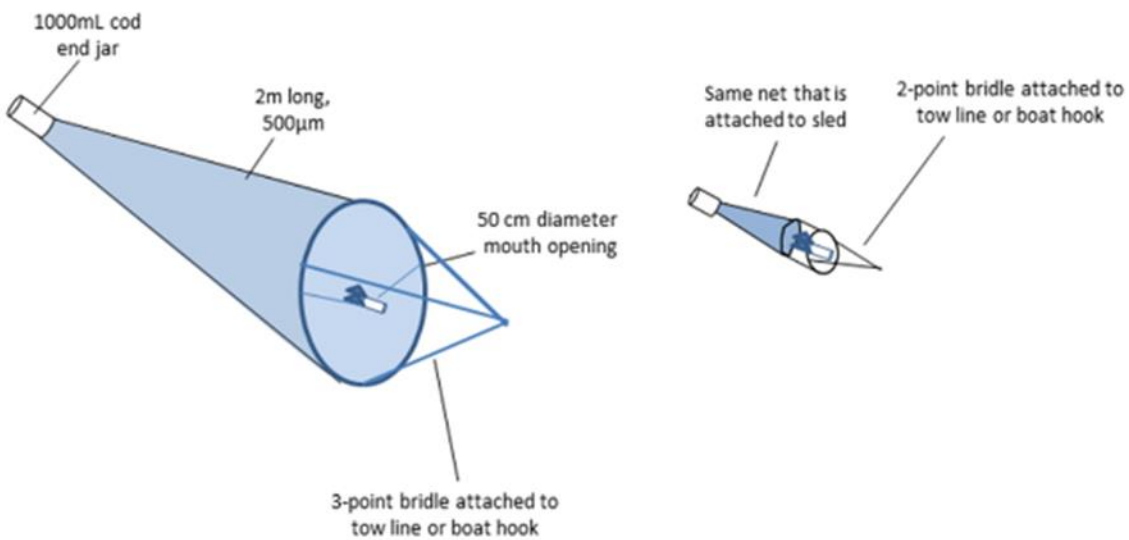
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1178 *Figure 1-20 Map of future and reference tidal wetland sites in the upper Estuary. Sampling locations are*
1179 *random or haphazardly chosen within wetland sites.*



1180



1181

1182 *Figure 1-21 Invertebrate sampling gears with A) hoop net and B) sled with CB and mysid nets.*

1183

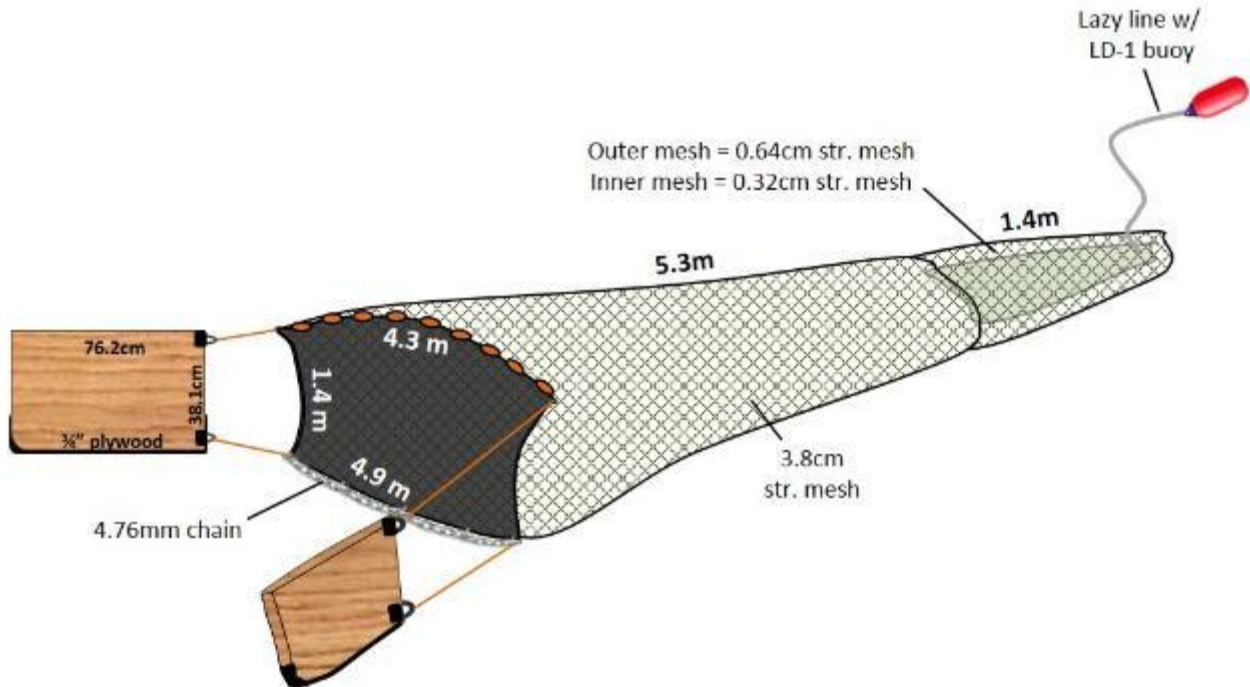


Figure 1-22 Schematic of otter trawl used to sample within and around tidal wetland sites.

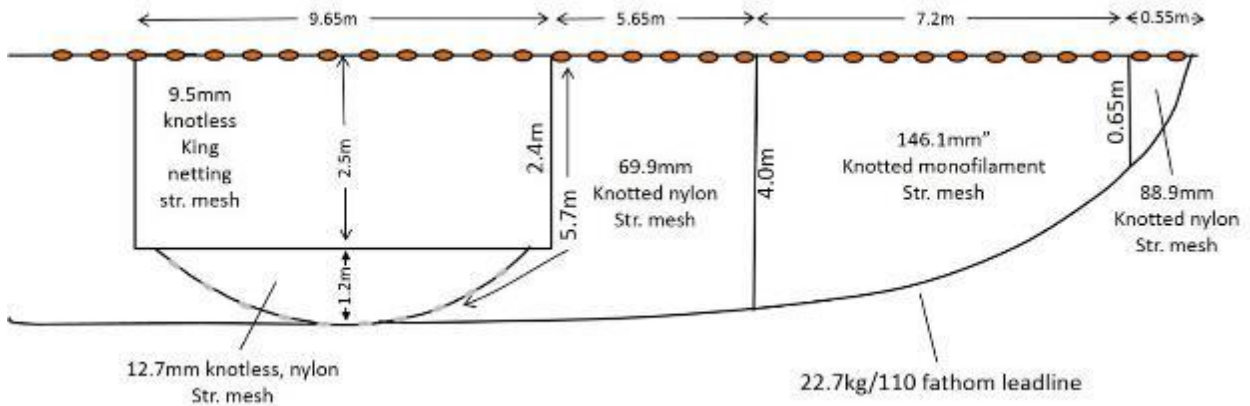


Figure 1-23 Schematic of one-half of the lampara net used to sample within and around tidal wetlands sites.

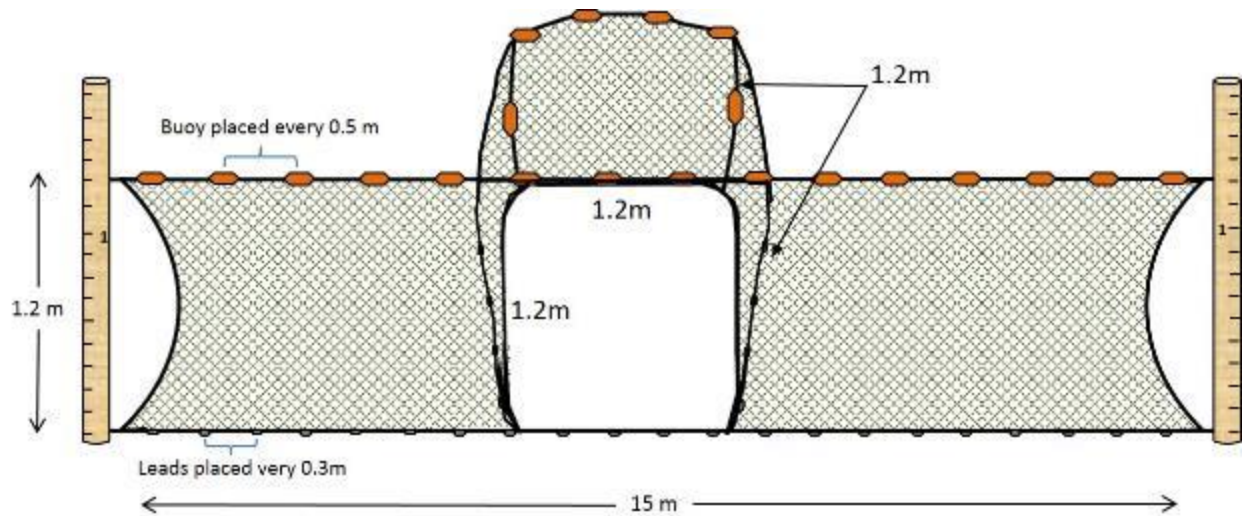


Figure 1-24 Schematic of the beach seine used to sample within and around tidal wetlands sites.

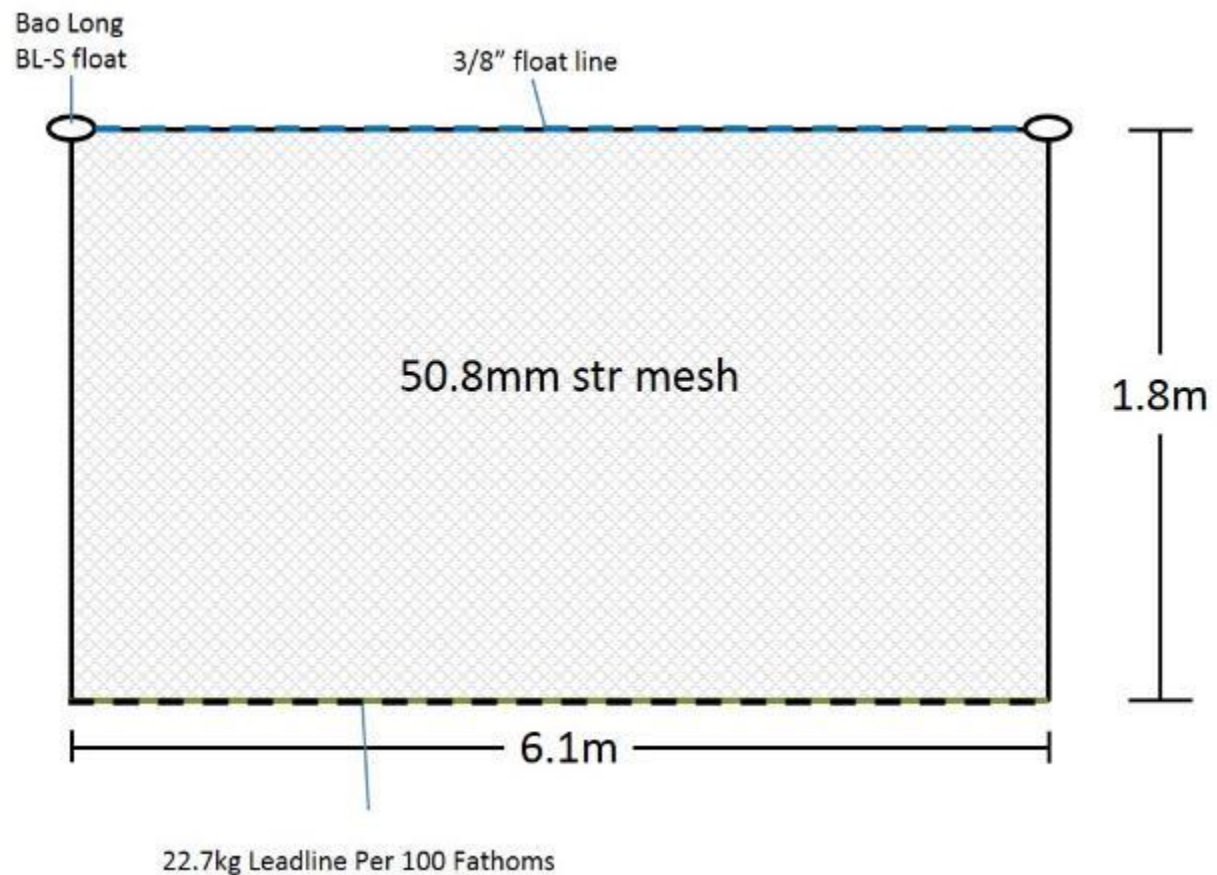


Figure 1-25 Schematic of the gill net used to sample Flyway Farms.

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1197 Study 15 - Enhanced Delta Smelt Monitoring (IEP-325)

1198 The purpose of the Enhanced Delta Smelt Monitoring study is to pilot a new source of
1199 information on the abundance and distribution of Delta Smelt. This study has potential impacts
1200 on water management.

1201 This study will utilize multiple-haul Kodiak Trawl and 20mm trawl sampling within 4 regions that
1202 cover a great proportion of the estuary. Sampling site is determined by stratified random
1203 sampling and method will be determined by time of year.

1204

1205 The EDSM began in November 2016 with initial pilot work, and has increased in spatial scope
1206 and sampling intensity. The life stage focus for the period from November through the
1207 following March will be on sub-adult and adult fish. The EDSM focus during April and
1208 subsequent months necessarily shifts to post-larvae and juvenile life stages as the spawned out
1209 adults die and larvae hatch and enter the water column.

1210

1211 Sampling will be stratified by regions that, based on differences in hydrodynamics, differ in
1212 Delta Smelt density and risk of entrainment. We will employ a sampling design that includes
1213 multiple crews trawling concurrently at multiple sites in pre-defined density stratum within the
1214 low- and/or high-risk zones of entrainment in the San Francisco Estuary. Post-larvae will be
1215 targeted approximately April through June using 20mm trawling gear, and Kodiak trawling gear
1216 will be employed the remainder of the year. Gear efficiency experiments and shallow water
1217 sampling will be incorporated when possible.

1218

1219 Enhanced Delta Smelt Monitoring Program Gear and Sampling

1220 The Enhanced Delta Smelt Monitoring Program (EDSM) uses different gears to sample for Delta
1221 Smelt depending on targeted life stage. A Kodiak trawl with a live box is deployed from July
1222 through March and 20-mm gear from April through June. EDSM sampling occurs at randomly
1223 selected locations throughout the Sacramento-San Joaquin Delta, which is spatially partitioned
1224 into strata.

1225 Kodiak trawling

1226 Kodiak trawls are used from July through March to target sub-adult and adult Delta Smelt
1227 throughout the sampling area. The sampling design involves up to three crews trawling
1228 concurrently at two or more sites per day with 5-6 tows (5 or 10 minutes maximum) per site.

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1229 On average, sampling occurs with three crews per day, two sites per day (each crew), and four
1230 days per week. At a minimum, sampling at each site consists of two tows; if at least one Delta
1231 Smelt is captured in the cumulative total of the first two tows at a site, then no more tows are
1232 completed at the site.

1233 Kodiak trawls (KDTR) are conducted with two vessels; a chase boat and a net boat (Figure 1).
1234 The KDTR nets used are composed of five panels, each decreasing in mesh size towards a live
1235 box at the cod end (Figure 2 and Figure 3). The mesh size for each panel ranges from 5.1 cm
1236 stretch at the mouth to 0.6 cm stretch just before the live box. The live box (30.5 cm wide x
1237 30.5 cm tall x 45.7 cm long) is composed of 0.18 cm thick aluminum that is perforated with
1238 numerous 0.46 cm diameter holes. The live box contains several internal baffles to minimize
1239 fish mortality and stress due to flow pressure. The fully extended mouth size of the KDTR net is
1240 1.83 x 7.62 m. A float line and lead line enable the net to remain at the top few meters of the
1241 water column while sampling. In addition, at the front of each wing of the net is a 1.83 m
1242 spreader bar with floats at the top and weights at the bottom to keep depth constant while
1243 sampling. The KDTR net is connected to the boats using a 2.3 m rope bridle (2.4 cm diameter)
1244 attached to a 30.5 m tow rope (0.95 cm diameter) on each side of the net. As a result, the net is
1245 fished approximately 31 m from the boats.

1246 20 mm Sampling

1247 EDSM 20-mm sampling of post-larvae and juvenile size Delta Smelt occurs from approximately
1248 April through June using trawl nets with a 1600µm mesh surface. On a weekly basis, up to three
1249 crews trawl concurrently at two or more sites per day with 2 tows (10 minutes maximum) per
1250 site. The 20-mm gear includes two different net sizes; a large net to be used in deep water and
1251 towed obliquely to sample the entire water column and a small net used in for shallow water
1252 surface sampling.

1253 EDSM uses the same 20-mm gear as the California Department of Fish and Wildlife (CDFW) 20-
1254 mm Survey. The CDFW Standard Operating Procedures (pg. 3) describe the gear with the
1255 following

1256 The large 20-mm survey fish net is a cone shaped plankton net 5.5 meters in length with an
1257 opening circumference of 4.93 meters and a mouth area of 1.51m² [Figure 4]. The net is
1258 comprised of two sections: a cylindrical front section that includes a durable canvas mouth with
1259 grommets for lashing onto the D-frame, and a funnel shaped back section with a canvas collar
1260 that attaches to the cod-end jar. The weight of the metal D-frame and two attached skis is
1261 approximately 80lbs; a solid iron weight is attached at the front end of each ski leg weighing
1262 approximately 26lbs each, giving a total sled weight of approximately 132lbs before the netting
1263 is added [Figure 5]. The mesh is 1600µm Delta (35lb test) knotless nylon netting and was

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chosen based on the minimum width of a 20mm Delta Smelt. The cod-end jar is a 2L Nalgene® polyethylene bottle, screwed into a General Oceanics ring (cod-end ring), and attached to the canvas collar with a hose clamp. A 3"x4" opening is cut into the cod-end jar which is screened with 4"x5" 474µm wire bolting cloth melted into the bottle.

A flowmeter is mounted across the mouth opening of the large 20-mm net.

The small 20-mm larval net is approximately 1/3 the size for the large net and without a sled. It has an opening circumference of 263 cm and is about 2.2 meters in length (Figure 6). It has a cylindrical front section with a canvas mouth attached to a circular frame and a funnel shaped back section with another section of canvas that attaches to the cod end jar. The cod-end jar is a 2L polyethylene bottle, screwed into a General Oceanics ring (cod-end ring), and attached to the canvas collar with a hose clamp. A 3"x4" opening is cut into the cod-end jar which is screened with 4"x5" 474µm wire bolting cloth melted into the bottle. A flowmeter is mounted across the mouth opening of the small net.

Regular Vessels Involved: Kvichak (CF6602XF), Silverside (CF3547XS), Winter Run (CF 5904 XF), Rogue 1 (CF5910XF), Coastal Starr (CF5919XF), Nighthawk (CF5862XF), Sounder 1 (CF5949XF), and Sounder 2 (CF5934XF)

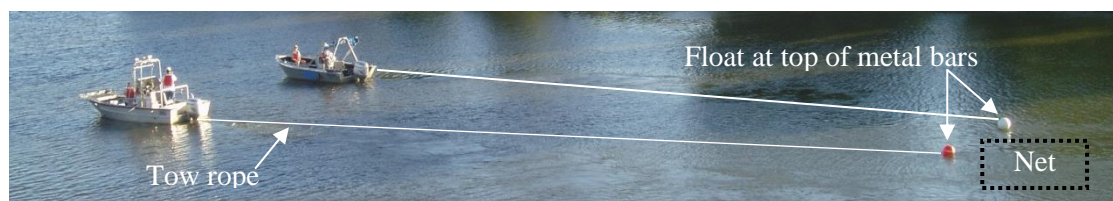


Figure 1-26 Research vessels trawling with a Kodiak net.

Study 16 - CDFW Central Valley Salmon and Steelhead Monitoring (Mainstem Sacramento River Mark-Recapture Project) (IEP-N/A)

The indigenous, anadromous fish populations of California's Central Valley have been severely reduced due to a variety of man-caused alterations to the environment. The region's Chinook salmon and steelhead populations have been extirpated from most of their historic range and the existence of the few remaining depleted populations are continually challenged. The increasing demand for the diversion of water continues to alter the timing and magnitude of

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flow that sustain the majority of the remaining viable habitat. The upper Sacramento River and its tributaries provide essential spawning and rearing grounds for the Central Valley's salmonid populations. Monitoring efforts are conducted in order to compile information on timing, composition (species/race), and relative abundance of Central Valley Chinook salmon and steelhead. This information enables the implementation of adaptive management practices, both up and downstream of the Delta, deemed necessary to protect Central Valley salmonids. Data collected over several years will further our understanding and aid in the recovery and protection of the Sacramento River's anadromous fish populations. Knights Landing Juvenile Emigration Monitoring: The loss of emigrating fish is increased by the many diversions, such as the Delta Cross Channel Gates (DCC) that lie between their natal streams and the Pacific Ocean. Potentially, the most imposing of these diversions are the Southern Sacramento-San Joaquin Delta's Harvey Banks Delta Pumping Plant (State Water Project [SWP]) and the Tracy Pumping Plant (Central Valley Water Project [CVP]). The work put forth for this study is a continuous effort upon the part of combined agencies to reduce the detrimental impacts of these facilities on Central Valley Chinook salmon and steelhead stocks. The ability to accurately measure the abundance and timing of emigrating salmonids would aid in addressing critical water management procedures. Current water management practices throughout the Delta and its corresponding tributaries influence the rate of survival of emigrating salmonids. Improved estimates of the timing and relative abundance of these species as they entered the Delta should improve confidence in defining impacts and protective measures to enhance overall protection, and potentially maximize water management flexibility. The recommended goals of this monitoring are as follows:

- Monitor the outmigration of juvenile salmonids on a real-time basis.
- Provide daily summaries of timing, abundance and size distribution of salmonids in the Sacramento River before they enter the Delta.
- Provide timing information to water agencies for better management decisions regarding operation of the DCC gates and to reduce frequency of entrainment by the SWP and the CVP.
- Look at how environmental conditions (flow, temperature, turbidity) affect the downstream movement of juvenile salmonids.

Regular Vessels Involved:

Central Valley Steelhead Monitoring Program: The primary goal is to provide recommendations for the development of steelhead monitoring programs that will provide the data necessary to help assess progress towards restoration and recovery goals. Information obtained will be used to examine the distribution, abundance, and population trends of CCV steelhead.

Objectives include:

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- 1330 • Estimate steelhead population abundance with estimated levels of precision in the
- 1331 Central Valley;
- 1332 • Examine trends in steelhead abundance in the Central Valley; and
- 1333 • Identify the spatial distribution of steelhead in the Central Valley to identify their
- 1334 current range and observe changes over time.

1335 Upper Sacramento River Restoration Site Monitoring: The purpose of the program is to restore,
1336 enhance, and protect aquatic and riparian habitat suitability to facilitate increases in the overall
1337 anadromous fish production of the Upper Sacramento River. These activities are a continuation
1338 of ongoing anadromous fish restoration activities authorized under the Central Valley Project
1339 Improvement Act of 1992 (CVPIA) Section 3604(b)(13). CDFW will establish salmonid baseline
1340 use at proposed restoration sites to help determine the success once restoration projects are
1341 implemented through juvenile presence/absence surveys at a variety of sites on the Upper
1342 Sacramento River. The observational survey results will help Restoration Ecologists design
1343 better projects in the future. Information collected will also help to determine locations where
1344 juvenile Chinook salmon are rearing upstream of Red Bluff Diversion Dam.

1345

1346 Objectives include: The Mainstem Sacramento River Mark-Recapture Program will use a
1347 temporally stratified mark-recapture survey design in the Lower Sacramento River. The survey
1348 will utilize wire fyke traps to capture, mark, and recapture upstream migrating adult steelhead
1349 in order to estimate adult steelhead escapement from the Sacramento River. Captured/marked
1350 steelhead will be released below the most downstream trap to maximize the probability of
1351 recapture and provide estimates with an acceptable level of error. Fyke trapping will occur from
1352 year round, temperature dependent, with target months of from August through May. Traps
1353 are fished 7 days/week, 24 hours a day. Traps are inspected, cleaned, and emptied at least
1354 once every 24 hours to minimize the period of time steelhead are detained. Traps are fished
1355 completely submersed from depths ranging near surface to 20-30 ft. Excluder devices are
1356 installed in the opening of the traps to minimize and deter sea lions from entering the traps. In
1357 the Sacramento study site, we operate 7-10 traps and in Knight Landing study site, we operate
1358 3-5 traps. See dates and duration and specified region below.

- 1359 • Year Round, water temperature dependent
- 1360 • Sacramento County, between Interstate 50/80 bridge south to Clarksburg.
- 1361 • Seasonally – August – Oct (This sampling area is being added to the permit)
- 1362 • Yolo County – Knights Landing area
- 1363

1364 The adult mark-recapture project is using large-wire fyke traps in the main stem Sacramento
1365 River to establish Sacramento River basin wide population estimates for wild and hatchery
1366 origin CV steelhead. Seven large-wire fyke traps are operated seven days a week between the

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American River confluence downstream to the town of Clarksburg (Figure 1). Large-wire fyke traps are operated annually from August through May when water temperatures are $\leq 72^{\circ}\text{F}$. Captured adult CV steelhead are sampled for origin, sex, fork length, scales, genetics, and assessed for marks and tags. Hatchery origin individuals receive a Passive Integrated Transponder (PIT) tag and Floy tag, while natural origin individuals receive only a PIT tag. A randomly selected subsample of the hatchery origin individuals will also receive an acoustic tag. All sampled individuals are transported by boat downstream of the lower most trap for release once they have fully recovered from sampling and tagging. During the first year (2015), 49 CV steelhead were captured, marked, and released; three natural origin and 46 hatchery origin. Five of the 46 hatchery origin adult CV steelhead captured received an acoustic tag. Preliminary detection data showed all five individuals continued upstream migration, entering the American River within three to five days after release. Incidentals or bycatch are also caught in the trap along with intended species. Bycatch included green sturgeon, white sturgeon, Chinook salmon, striped bass, and 19 other fish species.

The method of capturing fish for both marking and recapture will employ four or more 12-foot diameter by 20-foot long wire fyke traps set along the river bank during August through October. The study design requires traps to be set in series from downstream to upstream, with enough distance between single traps so that tagged and untagged fish mix thoroughly.



Figure 1-27 Large-wire fyke trap. (CDFW photo)

2. SECTION 2: DATES, DURATION, AND SPECIFIC GEOGRAPHIC REGION WHERE ACTIVITY WILL OCCUR

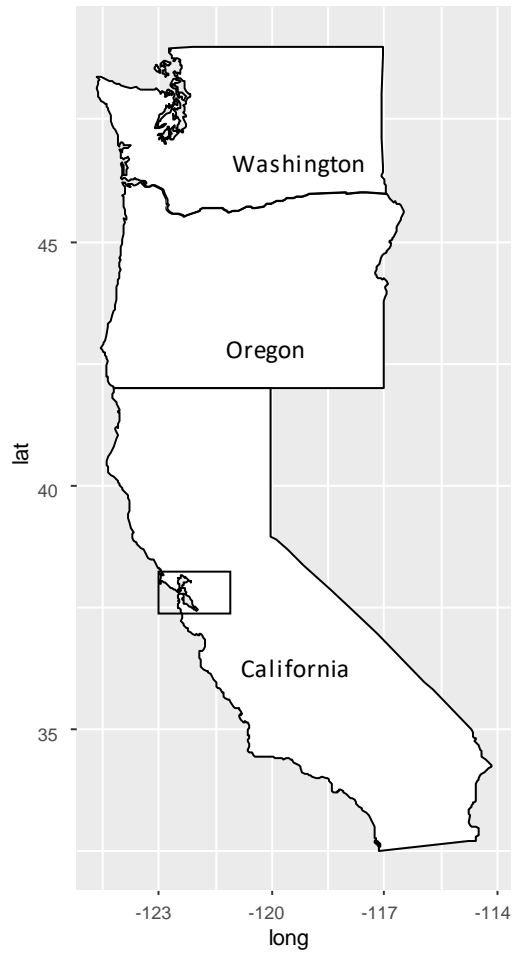
2.1 Dates and Duration of Activities

Table 1.2 is a summary of when and where Interagency Ecological Program surveys conduct activities. These surveys are likely to continue over the next 5 years, but some might not necessarily be conducted in all years.

2.2 Geographic Region

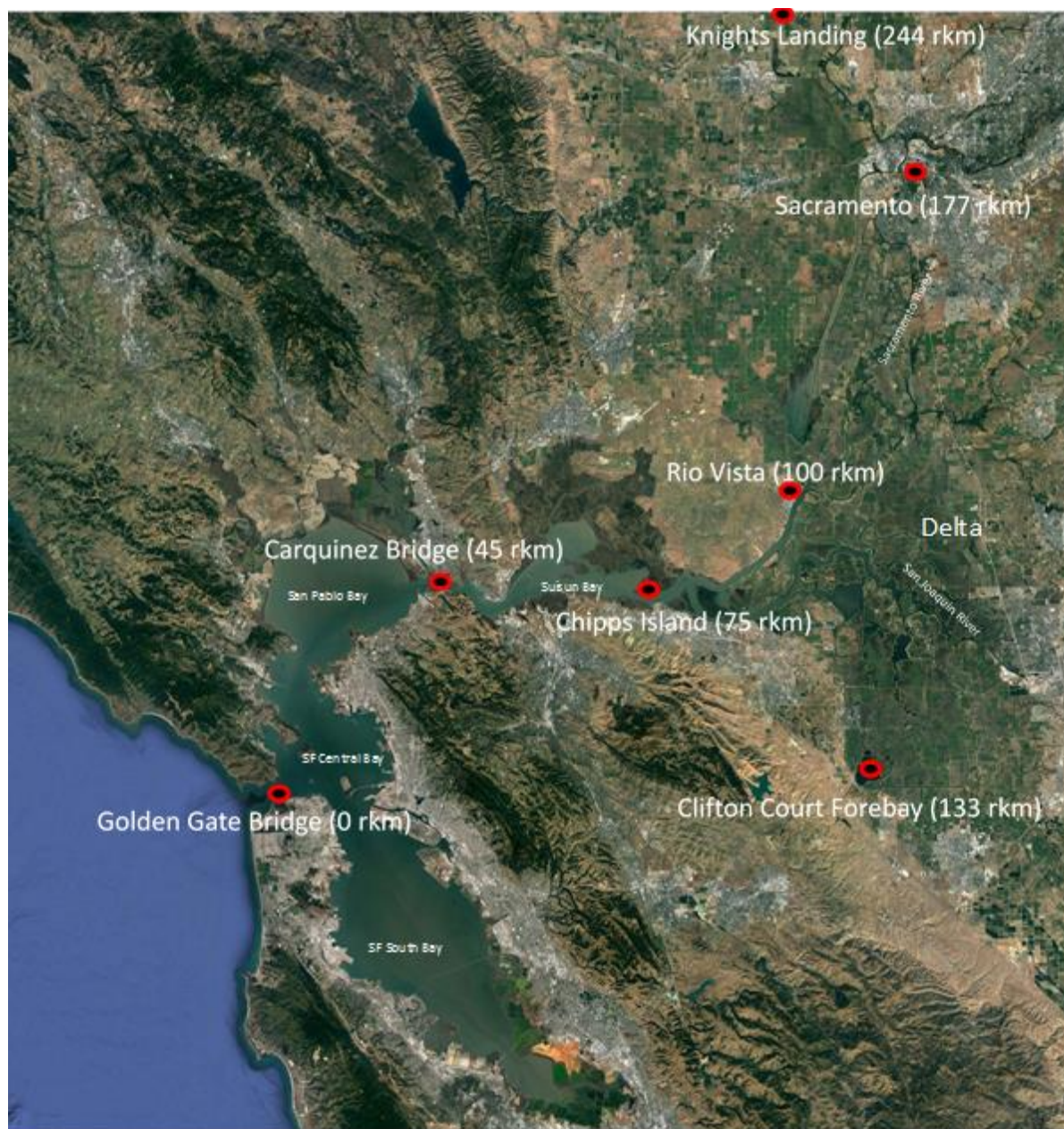
IEP activities are conducted within the San Francisco Bay-Delta Estuary located in California, USA (Figure 2.1). The San Francisco Estuary includes the waters of South and Central San Francisco Bay and upstream through San Pablo and Suisun bays, past the confluence of the Sacramento-San Joaquin river Delta, and upstream to the Yolo Bypass and north of Sacramento up to Knights Landing and Vernalis in the south (Figure 2.2). These water bodies include multiple counties of California, including: Marin, Sonoma, Napa, Solano, Sacramento, Sutter, Yolo, Contra Costa, San Joaquin, Alameda, Santa Clara, San Francisco, and San Mateo.

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1405

1406 *Figure 2-1 Map of western states with inset box identifying the San Francisco Bay-Delta Estuary,*
1407 *located in California, USA*



1408
1409 *Figure 2-2 Map of San Francisco Bay-Delta Estuary, California, USA, with river kilometer (rkm)*
1410 *distances of landmarks from the Golden Gate Bridge (GGB) marked with red points. Interagency*
1411 *Ecological Program studies operate in the Sacramento-San Joaquin River Delta and downstream*
1412 *through Suisun and San Pablo bays and into Central and South San Francisco bays. Pinnipeds*
1413 *have been observed inland as far as Knights Landing, CA on the Sacramento River a distance of*
1414 *224 rkm from the GGB; and also in Clifton Court Forebay a distance of 133 rkm inland from the*
1415 *GGB to the radial gates of the forebay.*

1416

3. SECTION 3: SPECIES AND NUMBERS OF MARINE MAMMALS LIKELY TO BE FOUND IN REGION OF ACTIVITY

The species likely to be found in the region of activity, within the San Francisco Bay-Delta estuary waters upstream of the Golden Gate Bridge, include California Sea Lion (*Zalophus californianus*), Harbor Seal (*Phoca vitulina*), Northern Elephant Seal (*Mirounga angustirostris*), and Harbor Porpoise (*Phocoena phocoena*). There are five other marine mammals reported as occurring in Central San Francisco Bay. These additional species are the Common Bottlenose Dolphin (*Tursiops truncatus*), Gray Whale (*Eschrichtius robustus*), Northern Fur Seal (*Callorhinus ursinus*), Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*), and Humpback Whale (*Megaptera novaeangliae*), but they are rare relative to the other mammals identified and not likely to be encountered by the few IEP activities operating in San Francisco Bay (Table 3.1). There are additional marine mammals present in coastal waters outside the Golden Gate Bridge, but these species are not likely to be present in the region of activity and so are not included in the take request.

Table 3-1 Marine mammals that may occur within the San Francisco Estuary, upstream of the Golden Gate Bridge, their status under the Endangered Species Act and Marine Mammal Protection Act.

Common Name	Scientific Name	Federal ESA ^a /MMPA Status ^b
California Sea Lion	<i>Zalophus californianus</i>	Not listed/Not Depleted
Harbor Seal	<i>Phoca vitulina</i>	Not listed/Not Depleted
Northern Elephant Seal	<i>Mirounga angustirostris</i>	Not listed/Not Depleted
Harbor porpoise	<i>Phocoena phocoena</i>	Not listed/Not Depleted
Gray Whale (Western North Pacific DPS)	<i>Eschrichtius robustus</i>	Endangered/Depleted
Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered/Depleted
Pacific White-sided Dolphin	<i>Lagenorhynchus obliquidens</i>	Not Listed/Not Depleted
Common Bottlenose Dolphin	<i>Tursiops truncatus</i>	Not Listed/Not Depleted
Northern Fur Seal	<i>Callorhinus ursinus</i>	Not Listed/Depleted Pribilof Island/Eastern Pacific Stock

^a ESA listed as threatened or endangered

^b MMPA listed as depleted

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These animals have been observed by fish sampling activities described in this application. Observations are a function of overall mammal abundance, and the range inland marine mammals will travel. Most IEP activities occur in the brackish waters of San Pablo Bay upstream through Suisun Bay and into the freshwater Delta. Within this area of high IEP activity, California Sea Lions are the most observed marine mammal in addition to the occasional Harbor Seal. Other marine mammals are rarely seen upstream of San Pablo Bay and thus are not at risk of most IEP activities. California Sea Lions are believed most abundant, and range furthest upstream have been reported at Knights Landing on the Sacramento River north of Sacramento, CA. Harbor Seals are seen in Suisun Bay and upstream through the confluence of Sacramento and San Joaquin rivers. There are a few reports of Northern Elephant Seals that have been found in Rio Vista, CA and at Clifton Court Forebay in the South Delta, but these observations were of one individual each and are rare in the freshwater areas. IEP activities do occur in Central and South San Francisco Bay (study 4), which have a greater marine influence and thus increased opportunity for collection of all the above mentioned mammals, including possibly Harbor Porpoise. Harbor Porpoises are abundant in California along the coast and have been observed near schools of Pacific Herring in Central Bay by the Pacific Herring Trawl and Gillnet Survey (Study 17).

A full summary of marine mammal species (as information is available) is included in Section 4.

4. SECTION 4: A DESCRIPTION OF THE STATUS AND DISTRIBUTION OF THE AFFECTED SPECIES IN THE ACTIVITY AREA

The following is a summary of information including description, status and trends, distribution and habitat use, and behavior and life history (when applicable), of the affected species or stocks of marine mammals likely to be affected by IEP activities as available in published literature, reports, and online sources (links provided). The majority of content that follows was adapted and copied directly from NOAA Fisheries online resources <https://www.fisheries.noaa.gov/species-directory>

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1473 4.1 California Sea Lion (*Zalophus californianus*)

1474 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/california-sea-lion>

1475 Status

1476 California sea lions, like all marine mammals, are protected under the MMPA.

1477 Species Description

Weight: 700 pounds for males, but can exceed 1,000 pounds; 240 pounds for females

Length: 7.5 feet for males, 6 feet for females

Appearance: dark brown with broad fore flippers and a long, narrow snout

Lifespan: 20-30 years

Diet: squid, anchovies, mackerel, rockfish, and sardines

Behavior: social animals, they form groups of several hundred individuals onshore;
fast, agile swimmers; deep divers, up to 1,760 feet deep

1478 California sea lions are members of the "eared seal" family, Otariidae. They are the most
1479 recognized pinniped species because they are commonly seen doing acrobatic tricks in shows at
1480 zoos and aquariums.

1481 Male California sea lions have a robust body while females and juveniles have a slenderer body.
1482 They have broad fore flippers and a long, narrow snout. Males have a broad forehead. Their
1483 coats are dark brown with females being slightly lighter in color.

1484 California sea lions are sexually "[dimorphic](#)" with males reaching average lengths of 7.5 feet and
1485 weighing about 700 pounds. Some large males exceed 1,000 pounds. Females are much
1486 smaller, reaching average lengths of 6 feet and weighing about 240 pounds. They have a
1487 lifespan of 20 to 30 years.

1488 California sea lions are social animals and form groups of several hundred individuals onshore.
1489 They are fast, agile swimmers and are often seen porpoising and wave riding. The deepest dive
1490 ever recorded for a California sea lion is 1,760 feet.

1491 Males are "[polygamous](#)" establishing breeding territories that may include up to fourteen
1492 females. They defend their territories with aggressive physical displays and vocalization. Sea
1493 lions reach sexual maturity at 4-5 years old. Breeding season lasts from May to August while
1494 most pups are born from May through July. Three weeks after giving birth, females are ready to
1495 mate again. Pups are weaned at 10 months old.

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1496 California sea lions feed mainly in upwelling areas on a variety of prey such as squid, anchovies,
1497 mackerel, rockfish, and sardines. They also take fish from commercial fishing gear, sport-fishing
1498 lines, and at fish passage facilities at dams and rivers.

1499 Habitat

1500 California sea lions reside in the Eastern North Pacific Ocean in shallow coastal and estuarine
1501 waters. Sandy beaches are preferred for haul out sites. In California, they haul out on marina
1502 docks as well as jetties and buoys.

1503 Distribution

1504 California sea lions range from the Pacific coast of Central Mexico north to British Columbia,
1505 Canada. Their primary breeding range is from the Channel Islands in Southern California to
1506 Central Mexico. There is one stock of California sea lions in U.S. waters that ranges from the
1507 U.S./Mexico border and extends to Canada.

1508 Population Trends

1509 The abundance of the U.S. stock of California sea lions is updated in the most recent [stock](#)
1510 [assessment report](#). The population has been increasing since at least 1975.

1511 Threats

- 1512 • incidental catch and entanglement in fishing gear, such as gillnets.
1513 However, estimated and reported levels of fishery-related mortality are so low that they
1514 likely have an insignificant impact on the population.
1515 • biotoxins, as a result of [harmful algal blooms](#)
1516 • gunshot wounds and other human-caused injuries, as California sea lions are sometimes
1517 viewed as a nuisance by commercial fishermen

1518 Conservation Efforts

1519 This species is protected under the [Marine Mammal Protection Act](#) of 1972, as amended.

1520 Regulatory Overview

1521 This species is protected under the [Marine Mammal Protection Act](#) of 1972, as amended.

1522 Taxonomy

1523 Kingdom: Animalia
1524 Phylum: Chordata
1525 Class: Mammalia
1526 Order: Carnivora
1527 Family: Otariidae
1528 Genus: *Zalophus*
1529 Species: *californianus*

1530

1531

1532 **4.2 Harbor Seal (*Phoca vitulina*)**

1533 Content as published by NOAA at <https://www.fisheries.noaa.gov/species/harbor-seal>

1534 **Status**

1535 Harbor seals, like all marine mammals, are protected under the MMPA.

1536 **Species Description**

Weight: about 245 pounds

Length: about 6 feet

Appearance: generally blue-gray back with light and dark speckling; they lack external ear flaps and have short forelimbs

Lifespan: about 25-30 years

Diet: mainly fish, shellfish, and crustaceans

Behavior: they tend to haul out on land and rest with head and flippers elevated, in a banana-like fashion

1537 Harbor seals are part of the "true seal" family, Phocidae. True seals lack external ear flaps and
1538 have short forelimbs that result in limited locomotion on land. Male harbor seals are slightly
1539 larger than females, weigh up to 245 pounds, and measure about 6 feet in length. Harbor seals
1540 in Alaska and the Pacific Ocean are generally larger than those found in the Atlantic Ocean.
1541 Harbor seals' color varies but they often have a blue-gray back with light and dark speckling.
1542 They have short, concave, dog-like snouts, and they tend haul out on land and rest with head
1543 and flippers elevated, in a banana like fashion. Harbor seals eat a variety of prey consisting
1544 mainly of fish, shellfish, and crustaceans. Researchers have found that seals complete both
1545 shallow and deep dives during hunting depending on the availability of prey (Tollit et al. 1997).
1546 Harbor seals mate at sea and females give birth during the spring and summer; although, the
1547 pupping season varies with latitude. Pups are nursed for an average of 24 days and are ready to
1548 swim minutes after being born.

1549 **Habitat**

1550 Harbor seals live in temperate coastal habitats and use rocks, reefs, beach, and drifting glacial
1551 ice as haul out and pupping sites. Harbor seals haul out on land for rest, thermal regulation,

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social interaction, and to give birth. Seals also haul out to avoid predators. Studies have shown that seals in groups spend less time scanning for predators than those that haul out alone.

Distribution

Harbor seals are generally non-migratory and occur on both the U.S east and west coasts. On the east coast, harbor seals are found from the Canadian Arctic to New York and occasionally in the Carolinas. On the west coast, harbor seals are found in the coastal and estuarine waters from British Columbia, Canada to Baja, California. They are found further west through the Gulf of Alaska and in the Bering Sea.

Population Trends

Harbor seal stocks have experienced different population trends over the past 30 years. Along the west coast, stocks are stable, and some are even increasing. In New England, the population is also increasing. Most stocks in Alaska are also stable or slightly increasing, but the Gulf of Alaska stock is small compared to its abundance in the 1970s and 1980s and may be continuing to decline. [More information on the populations of harbor seal stocks](#) is available in our stock assessment reports.

Threats

- incidental capture in fishing gear, including
 - gillnets
 - trawls
 - purse seines
 - weirs
- ship strikes
- oil spill exposure
- chemical contaminants
- power plant entrainment
- harassment by humans while hauled out on land

Conservation Efforts

In an effort to educate the public about proper wildlife viewing, NMFS and our collaborators created regional [guidelines for seal watching](#).

Regulatory Overview

All marine mammals, including harbor seals, are protected by the Marine Mammal Protection Act of 1972 as amended.

Taxonomy

Kingdom: Animalia
Phylum: Chordata

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1587 Class: Mammalia
1588 Order: Carnivora
1589 Family: Phocidae
1590 Genus: *Phoca*
1591 Species: *vitulina*

1592

1593

1594 4.3 Northern Elephant Seal (*Mirounga angustirostris*)

1595 Content as published by NOAA at <https://www.fisheries.noaa.gov/species/northern-elephant-seal>

1596 Status

1597 Northern elephant seals, like all marine mammals, are protected under the MMPA

1598 Species Description

Weight: males up to 4,400 pounds, females up to 1,300 pounds, pups are about 75 pounds at birth

Length: males up to 13 feet, females up to 10 feet, pups are about 4 feet at birth

Appearance: pups are black until they are weaned at about 6 weeks old, they molt and turn light silver;
adults are dark brown or gray;
males develop a large inflatable nose, or "proboscis," when they reach puberty (around 7 years old)

Lifespan: 13-19 years, with females living longer than males

Diet: mostly squid and fishes, but also rays and sharks

Behavior: When they return to land to breed or molt, they fast.

1599 Northern elephant seals are the largest phocid, or "true" seal, in the Northern Hemisphere.
1600 Fully grown males can reach lengths of over 13 feet (4 m) and can weigh nearly 4,400 pounds
1601 (2,000 kg). Females are significantly smaller than males but are also quite large growing to
1602 about 10 feet (3 m) long and weighing up to 1,300 pounds (600 kg).

1603 Pups are born in early winter from December to January. Breeding occurs from December to
1604 March, and gestation lasts around 11 months. Northern elephant seals are "[polygamous](#)";
1605 males establish dominance over large groups of females during the breeding season.

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1606 Northern elephant seal pups are about 4 feet (1.2 m) long and weigh about 75 lbs (35 kg) at
1607 birth. Pups are generally black until they are weaned, when they are about 6 weeks old. They
1608 then molt and turn light silver. They gradually become darker brown or gray, though they often
1609 remain pale ventrally, or on their underside.

1610 When males reach puberty at about 7 years old, they develop a large inflatable nose, or
1611 "proboscis." The proboscis overhangs their lower lip by about 8 inches (20 cm). They also
1612 develop a robust, thick neck that is heavily creased and lighter in color--even slightly pink--
1613 compared with their dark bodies. Conversely, females maintain their smaller noses and smooth
1614 necks.

1615 There is also a notable difference in life span between males and females. Females generally
1616 live for about 19 years, while males only live for about 13 years.

1617 When at sea, Northern elephant seals feed mostly on squid and fishes, but they also eat rays
1618 and even sharks. When they return to land to breed or molt, they fast. During these fasting
1619 periods, they can lose up to half of their body mass.

1620 Habitat

1621 Northern elephant seals spend much of the year, generally about 9 months, in the ocean. They
1622 are usually underwater, diving to depths of about 1,000-2,500 feet (330-800 m) for 20-30
1623 minute intervals with only short breaks at the surface. They are rarely seen out at sea for this
1624 reason. While on land, they prefer sandy beaches.

1625 Distribution

1626 Northern elephant seals are found in the eastern and central North Pacific Ocean. Though they
1627 range as far north as Alaska and as far south as Mexico, they typically breed in the Channel
1628 Islands of California or Baja California in Mexico.

1629 Population Trends

1630 Once thought to be extinct due to commercial sealing in the 1800s, the population began to
1631 steadily increase in the early 1900s. Though a complete population count of elephant seals is
1632 not possible because all age classes are not ashore at the same time, the most recent [stock](#)
1633 [assessment reports with population estimates](#) are available on our website.

1634 Threats

- 1635 • entanglement in marine debris
- 1636 • fishery interactions
- 1637 • boat collisions

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1638 Regulatory Overview

1639 Northern elephant seals, like all marine mammals, are protected under the [Marine Mammal](#)
1640 [Protection Act \(MMPA\) of 1972](#).

1641 Taxonomy

1642 Kingdom: Animalia
1643 Phylum: Chordata
1644 Class: Mammalia
1645 Order: Carnivora
1646 Family: Phocidae
1647 Genus: *Mirounga*
1648 Species: *angustirostris*

1649

1650

1651 4.4 Harbor porpoise (*Phocoena phocoena*)

1652 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/harbor-porpoise>

1653 Status

1654 Harbor porpoises, like all marine mammals, are protected under the MMPA.

1655 [CITES Appendix II](#) - throughout its range

1656 Species Description

Weight: 135-170 pounds

Length: 5-5.5 feet

Appearance: dark gray with white underside

Lifespan: about 24 years

Diet: herring, capelin, and cephalopods

Behavior: non-social animals usually seen in groups of 2 to 5 animals;
when surfacing for air, they do not splash, but roll from beak to fluke and arch
their backs

1657 Harbor porpoises have a small, robust body with a short, blunt beak. Females are slightly larger
1658 than males. They have a medium-sized triangular dorsal fin. Their back is dark gray while their

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1659 belly and throat are white. They have a dark gray chin patch and also intermediate shades of
1660 gray along their sides. Females reach sexual maturity at 3-4 years and may give birth every year
1661 for several years in a row. Gestation lasts for 10-11 months and lactation lasts for 8 to 12
1662 months. They feed on demersal and benthic species, mainly schooling fish and cephalopods.

1663 Habitat

1664 Harbor porpoises inhabit northern temperate and subarctic coastal and offshore waters. They
1665 are commonly found in bays, estuaries, harbors, and fjords less than 650 ft (200 m) deep.

1666 Distribution

1667 Harbor porpoises have a discontinuous distribution. In the North Atlantic, they range from West
1668 Greenland to Cape Hatteras, NC (but do not enter Hudson Bay), and from the Barents Sea to
1669 West Africa. In the North Pacific, they are found from Japan (34°N) north to the Chukchi Sea
1670 and from Monterey Bay, CA to the Beaufort Sea.

1671 Population Trends

1672 NMFS Stock Assessment Reports (SARs) include [estimated population sizes for U.S. stocks](#).

1673 Threats

- 1674 • "bycatch" in fishing gear, specifically in gillnets and trawls as well as herring weirs (in
1675 Canada)

1676 Regulatory Overview

1677 This species is protected under the Marine Mammal Protection Act of 1972 as amended.

1678 Taxonomy

1679 Kingdom: Animalia
1680 Phylum: Chordata
1681 Class: Mammalia
1682 Order: Cetacea
1683 Family: Phocoenidae
1684 Genus: *Phocoena*
1685 Species: *phocoena*

1686

1687

1688 4.5 Gray Whale

1689 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/gray-whale>

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1690 Status

1691 Gray Whales, like all marine mammals, are protected under the MMPA. The eastern North
1692 Pacific population was once listed as endangered under the ESA but has successfully recovered
1693 and was delisted in 1994. The western North Pacific population remains low, and its continued
1694 survival is questionable.

1695 Species Description

Weight: Approximately 90,000 pounds

Length: 42 to 49 Feet

Appearance: Gray whales have a mottled gray body with small eyes located just above the corners of the mouth

Lifespan: Unknown

Diet: benthic (sea floor) and epibenthic (above the sea floor) invertebrates, such as amphipods

Behavior: Gray whales are frequently observed traveling alone or in small, unstable groups, although large aggregations may be seen in feeding and breeding grounds

1696

1697 Habitat

1698 Gray whales are found mainly in shallow coastal waters in the North Pacific Ocean.

1699 Distribution

1700 There are two geographic distributions of gray whales in the North Pacific: the eastern North
1701 Pacific stock, found along the west coast of North America, and the western North Pacific stock,
1702 found along the coast of eastern Asia. Most of the eastern North Pacific stock gray whales
1703 spend the summer feeding in the northern Bering and Chukchi Seas, but some feed along the
1704 Pacific coast during the summer, in waters off of Southeast Alaska, British Columbia,
1705 Washington, Oregon, and northern California.

1706 Population Trends

1707 NOAA Fisheries estimates the population size (also called a stock) for gray whales in its stock
1708 assessment reports.

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1709 Threats

1710 Gray whales are at high risk of becoming entangled in fishing gear. Collisions with all sizes and
1711 types of vessels are one of the primary threats to marine mammals, particularly large whales.
1712 Whale watching has become an important recreational industry in several communities along
1713 the North American coast from British Columbia, Canada, to the gray whale wintering lagoons
1714 of Baja California, Mexico.

1715 Regulatory Overview

1716 The western North Pacific stock of gray whales has not recovered. It is listed as endangered
1717 under the ESA and depleted under the MMPA.

1718 Taxonomy

1719 Kingdom: Animalia
1720 Phylum: Chordata
1721 Class: Mammalia
1722 Order: Cetartiodactyla
1723 Family: Eschrichtiidae
1724 Genus: *Eschrichtius*
1725 Species: *robustus*

1726

1727

1728 4.6 Humpback Whale

1729 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/humpback-whale>

1730 Status

1731 Humpback whales are protected under both the [Endangered Species Act](#) and the [Marine](#)
1732 [Mammal Protection Act](#).

1733 Species Description

Weight: Approximately 80,000 pounds

Length: Up to 60 Feet

Appearance: Humpback whales' bodies are primarily black, but individuals have different amounts of white on their pectoral fins, their bellies, and the undersides of their flukes (tails)

Lifespan: 80 to 90 Years

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Diet: Humpback whales filter-feed on small crustaceans (mostly krill) and small fish, consuming up to 2,000 pounds of food per day

Behavior: Humpback whales are a favorite of whale watchers, as they can be found close to shore at certain times of year and are commonly active at the surface, for example breaching (jumping out of the water), or slapping the surface with their pectoral fins and tails

1734

1735 **Habitat**

1736 Humpback whales live throughout the world's major oceans. They can travel great distances
1737 during their seasonal migration with some animals migrating 5,000 miles between high-latitude
1738 summer feeding grounds and winter mating and calving areas in tropical waters. In the North
1739 Pacific, some humpback whales migrate from Alaska to Hawaii, they can complete the 3,000
1740 mile trip in as few as 36 days. While calving, they prefer shallow, warm waters commonly near
1741 offshore reef systems or shores. Humpback whale feeding grounds are generally in cold,
1742 productive waters.

1743 At least four humpback whale populations occur in the North Pacific:

1744 The Mexican population, which breeds along the Pacific coast of Mexico and the Revillagigedo
1745 Islands, transits the Baja California Peninsula, and feeds across a broad range from California to
1746 the Aleutian Islands (Alaska).

1747 The Central American population, which breeds along the Pacific coast of Central America,
1748 including off Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua, and feeds
1749 off the West Coast of the United States and southern British Columbia.

1750 The Hawaii population, which breeds in the main Hawaiian Islands and feeds in most of the
1751 known feeding grounds in the North Pacific, particularly Southeast Alaska and northern British
1752 Columbia.

1753 The Western North Pacific population, which breeds in the areas of Okinawa, Japan, and the
1754 Philippines, and feeds in the northern Pacific, primarily in the West Bering Sea and off the
1755 Russian coast and the Aleutian Islands. There is also evidence for the existence of a fifth
1756 breeding area in the western North Pacific.

1757 In the North Atlantic, two populations of humpback whales feed during spring, summer, and fall
1758 throughout a range that extends across the Atlantic Ocean from the Gulf of Maine to Norway.

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1759 These two populations migrate south during the winter to calve and mate in the West Indies
1760 and Cape Verde (off the coast of Africa), and possibly in other areas.

1761 Seven populations of humpback whales are found in the Southern Hemisphere, all of which
1762 feed in Antarctic waters.

1763 Distribution

1764 Humpback whales live throughout the world's major oceans. They can travel great distances
1765 during their seasonal migration with some animals migrating 5,000 miles between high-latitude
1766 summer feeding grounds and winter mating and calving areas in tropical waters.

1767 Population Trends

1768 Broad habitat areas and long migrations make it difficult to estimate population size. Of the 14
1769 distinct populations, 12 are estimated to number more than 2,000 humpback whales each and
1770 two are estimated to number fewer than 2,000. Some populations (such as those off eastern
1771 and western Australia) are believed to number in excess of 20,000 animals—a remarkable
1772 recovery given that the same populations were almost eradicated by whaling almost sixty years
1773 ago. By contrast, the smallest known population is one which inhabits the Arabian Sea year-
1774 round and may number as few as 80 individuals.

1775 Three humpback whale stocks in U.S. waters are designated as depleted under the Marine
1776 Mammal Protection Act (as of the 2018 stock assessment reports).

1777 Threats

1778 Entanglement in fishing gear, Vessel strikes, Vessel-based harassment, Underwater noise,
1779 Habitat Impacts.

1780 Regulatory Overview

1781 Commercial whaling severely reduced humpback whale numbers from historical levels. The
1782 United States listed all humpback whales as endangered under the Endangered Species
1783 Conservation Act in 1970, and then under the Endangered Species Act in 1973. NOAA Fisheries
1784 worked worldwide to identify and apply protections for humpback whales. The International
1785 Whaling Commission's whaling moratorium, in effect since 1985, played a major role in the
1786 recovery of humpback whales. Currently, four out of the 14 distinct population segments are
1787 still protected as endangered, and one is listed as threatened (81 FR 62259, September 2016).

1788 Taxonomy

1789 Kingdom: Animalia
1790 Phylum: Chordata
1791 Class: Mammalia
1792 Order: Cetacea

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1793 Family: Balaenopteridae

1794 Genus: *Megaptera*

1795 Species: *novaeangliae*

1796

1797

1798 4.7 Pacific White-Sided Dolphin

1799 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/pacific-white-sided-dolphin>

1800 Status

1801 Pacific white-sided dolphins in the United States are not endangered or threatened, but they
1802 are protected under the Marine Mammal Protection Act.

1803 Species Description

Weight: 300 to 400 pounds

Length: 5.5 to 8 Feet

Appearance: These dolphins have a robust body, short rostrum (snout), and large dorsal fin compared to their overall body size. Their back, fluke (tail), and lips are black; their sides, dorsal fin, and flippers are gray; and their belly is white. They have a white or light gray stripe along their sides that extends from the eye to the tail, sometimes referred to as "suspenders."

Lifespan: 30 to 40 Years

Diet: Pacific white-sided dolphins feed on a variety of prey, such as squid and small schooling fish (capelin, sardines, and herring).

Behavior: Humpback whales are a favorite of whale watchers, as they can be found close to shore at certain times of year and are commonly active at the surface, for example breaching (jumping out of the water), or slapping the surface with their pectoral fins and tails

1804

1805 Habitat

1806 Pacific white-sided dolphins are pelagic, meaning they live in the open ocean and nearshore
1807 waters, but are unlikely to be found close to shore. They live in the temperate waters of the
1808 North Pacific Ocean.

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1809 Distribution

1810 In the United States, they are found off the coast of California, Oregon, Washington, and
1811 Alaska. Worldwide, they are found in the southern Bering Sea (around the Aleutian Islands), Sea
1812 of Okhotsk, Sea of Japan, and Yellow and East China Seas to the south of Japan.

1813 Population Trends

1814 NOAA Fisheries estimates the population size for Pacific white-sided dolphins in its stock
1815 assessment reports. In all, there are three stocks of Pacific white-sided dolphins in U.S. waters.
1816 Population trends for the North Pacific stock off the coast of Alaska are unknown. A survey of
1817 the two stocks off the coasts of Washington, Oregon, and California from 2008 to 2014 found a
1818 population of more than 21,000 dolphins.

1819 Threats

1820 Entanglement in fishing gear, Ocean noise.

1821 Regulatory Overview

1822 All Pacific white-sided dolphins are protected under the MMPA.

1823 Before the United Nations issued a moratorium that banned large-scale drift nets in 1933,
1824 Japanese fisheries often captured Pacific white-sided dolphins. The MMPA was later enacted in
1825 1972 to protect all marine mammals, severely reducing the amount of “taken” animals. This
1826 species is now no longer commercially hunted in the United States, though some Pacific white-
1827 sided dolphins are still harvested for food in Japan's coastal fisheries.

1828 Taxonomy

1829 Kingdom: Animalia
1830 Phylum: Chordata
1831 Class: Mammalia
1832 Order: Cetacea
1833 Family: Delphinidae
1834 Genus: *Lagenorhynchus*
1835 Species: *obliquiden*

1836

1837

1838 4.8 Common Bottlenose Dolphin (*Tursiops truncatus*)

1839 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin>

1840 Status

1841 Common Bottlenose Dolphins, like all marine mammals, are protected under the MMPA.

1842 Species Description

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Weight: 300 to 1,300 pounds

Length: 6 to 13 feet

Appearance: They are generally gray in color. They can range from light gray to almost black on top near their dorsal fin and light gray to almost white on their belly.

Lifespan: 40 - 60 years

Diet: Bottlenose dolphins can thrive in many environments and feed on a variety of prey, such as fish, squid, and crustaceans (e.g., crabs and shrimp).

Behavior: Bottlenose dolphins may travel alone or in groups, and the groups continually break apart and reform. Their travel is characterized by persistent movement in a consistent direction. When they are resting, it may appear that they are traveling. Resting is often characterized by tight group formations, slow movement, and intervals of methodical breathing.

1843

1844 Common bottlenose dolphins are found throughout the world in both offshore and coastal
1845 waters, including harbors, bays, gulfs, and estuaries of temperate and tropical waters. They are
1846 one of the most studied and well-known marine mammals in the wild.

1847 Bottlenose dolphins may travel alone or in groups, and the groups continually break apart and
1848 reform. Their travel is characterized by persistent movement in a consistent direction. When
1849 they are resting, it may appear that they are traveling.

1850 Bottlenose dolphins are found in temperate and tropical waters around the world. They inhabit
1851 a wide variety of habitats, including harbors, bays, gulfs, and estuaries, as well as nearshore
1852 coastal waters, deeper waters over the continental shelf, and even far offshore in the open
1853 ocean. In the United States, bottlenose dolphins are found along the West Coast off California,
1854 Oregon, and Washington, and in the Hawaiian Islands. They are also found in coastal and
1855 offshore waters along the East Coast from New York to Florida, throughout the Gulf of Mexico,
1856 and in the Caribbean.

1857 Bottlenose dolphins can live at least 40 years, with some females outliving males at 60 years or
1858 more. They generally begin to reproduce when they are between 5 and 15 years old, with the
1859 exact age varying by population.

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1860 Population Trends

1861 NMFS Stock Assessment Reports (SARs) include [estimated population sizes for U.S. stocks](#).

1862 Threats

- 1863 • "bycatch" in fishing gear, specifically in gillnets and trawls as well as herring weirs (in
1864 Canada)

1865 Regulatory Overview

1866 This species is protected under the Marine Mammal Protection Act of 1972 as amended.

1867 Taxonomy

1868 Kingdom: Animalia
1869 Phylum: Chordata
1870 Class: Mammalia
1871 Order: Cetartiodactyla
1872 Family: Delphinidae
1873 Genus: *Tursiops*
1874 Species: *truncates*

1875

1876

1877 4.9 Northern Fur Seal

1878 Content as published by NOAA at: <https://www.fisheries.noaa.gov/species/northern-fur-seal>

1879 Status

1880 Northern Fur Seals, like all marine mammals, are protected under the MMPA.

1881 Species Description

Weight: Up to 140 pounds (females) to 600 pounds (males)

Length: 5 feet (females) to 7 feet (males)

Appearance: Northern fur seals have a stocky body, small head, very short snout, and extremely dense fur (46,500 fibers/cm²) that ends at the wrist lines of their flippers.

Lifespan: Up to 18 years (males) to 27 years (females)

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Diet: Northern fur seals are described as generalist or opportunistic foragers, consuming a wide variety of midwater shelf fish and squid species.

Behavior: Northern fur seals are a highly pelagic (live in the open ocean), are thought to be mostly solitary at sea, nocturnal species. They are known to be aggressive on land, especially during the breeding season.

1882 [Habitat](#)

1883 Northern fur seals primarily inhabit two types of habitat: open ocean and rocky or sandy
1884 beaches on islands for resting, reproduction, and molting.

1885 [Distribution](#)

1886 Adult northern fur seals spend more than 300 days per year (about 80 percent of their time) at
1887 sea. During the summer and autumn, they intermittently fast while on land and feed at sea.
1888 During the winter and spring, they are pelagic, occupying the North Pacific Ocean as well as the
1889 Bering and Okhotsk Seas. In the open ocean, concentrations of northern fur seals may occur
1890 around oceanographic features—such as eddies, convergence-divergence zones, and frontal
1891 boundaries—because of the availability of prey in those places. In the winter, the southern
1892 boundary of the northern fur seal range extends across the Pacific Ocean, between southern
1893 California and Honshu Island, Japan, but they are found as far north as the Bering Sea. In the
1894 spring, most northern fur seals migrate north to breeding colonies in the Bering Sea. Territorial
1895 adult male northern fur seals leave their breeding colonies in August and are thought to spend
1896 most of their time in the Bering Sea and North Pacific Ocean along the Aleutian Islands.
1897 Pregnant adult females begin their winter migration in November and generally travel to either
1898 the central North Pacific Ocean or to offshore areas along the west coast of North America to
1899 feed. Some northern fur seals may spend all year in the waters around San Miguel Island,
1900 California.

1901 [Population Trends](#)

1902 The California Stock is significantly smaller than the eastern Pacific stock. Estimated at 14,050
1903 northern fur seals in 2016, it is smaller than either of the populations on the Pribilof Island of St.
1904 George or Bogoslof Island. Trends in abundance since the designation of the eastern Pacific
1905 stock are different for individual islands and even breeding areas.

1906 [Threats](#)

1907 Changes in available food, Entanglement, Habitat degradation, Illegal taking, Oil spills.

1908 [Regulatory Overview](#)

1909 Northern fur seals are protected under the Marine Mammal Protection Act and the Fur Seal
1910 Act. About 50 percent of northern fur seals breed on the Pribilof Islands. The Pribilof Islands'

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1911 northern fur seal population was listed as depleted in June 1988 under the MMPA, meaning
1912 that this stock is below its optimum sustainable population level.

1913 Taxonomy

1914 Kingdom: Animalia
1915 Phylum: Chordata
1916 Class: Mammalia
1917 Order: Carnivora
1918 Family: Otariidae
1919 Genus: *Callorhinus*
1920 Species: *ursinus*

1921
1922

1923 5. SECTION 5: TYPE OF INCIDENTAL TAKE AUTHORIZATION 1924 REQUESTED AND THE METHOD OF INCIDENTAL TAKING 1925

1926 A Letter of Authorization (LOA) for the incidental taking of marine mammals is requested by
1927 the IEP under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

1928 The term “take”: means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture
1929 or kill any marine mammal, as defined in Section 3 (13) of the MMPA. In addition,
1930 “Harassment” was further defined in amendments to the MMPA with two levels, “Level A”
1931 (potential non-serious injury) and “Level B” (potential disturbance).

1932 The IEP requests a LOA to authorize potential lethal and non-lethal injury incidental takes
1933 during planned fisheries and ecology monitoring and research. The requested numbers of
1934 authorized serious injury and lethal takes and non-serious injury (Level A) takes will be
1935 described in Section 6. Serious injury and lethal take are rare with IEP activities but is
1936 possible. For this reason, the IEP requests that an LOA authorize a small number of
1937 incidental, non-intentional, takes for injury and mortality of marine mammals due to the
1938 potential they might occur, in spite of the monitoring, avoidance and mitigation efforts
1939 described in Sections 11, 13, and 14.

1940 As described in Section 1, the IEP is engaged in fisheries and ecology monitoring and
1941 research that includes the use of gear that has the potential to take marine mammals.
1942 Gears include midwater, otter, and Kodiak trawls (trawls), gill nets, trammel nets, and
1943 Lampara nets (nets), fyke traps (fykes) and setlines and longlines (setlines).

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1944 Possible take is likely to occur by 1) accidental entanglement of mesh in trawls and nets, 2)
1945 by entrapment within a fyke, and 3) hooking by setlines. Per NOAA NMFS staff, contact of
1946 marine mammal with vessels or gear without injury is not take. Take is only for
1947 entanglement, entrapment, or hooking in which the animal is injured or suffers mortality,
1948 such as:

- 1949 • Resulting in non-serious injury would be “Level A Harassment”.
- 1950 • or
- 1951 • Resulting in serious injury or mortality would be “Mortality”.
- 1952 “Level B Harassment”, which involves potential disturbance to the species, is not
- 1953 anticipated.

1954

1955 This application is being pursued as observations of and interactions with marine mammals has
1956 increased for IEP studies in recent years. Accidental unintentional entanglement is possible
1957 when marine mammals are present, and the risk increases when marine mammals target fish
1958 sampling gears used by the IEP, notably those engaged in sampling of adult salmonids and
1959 sturgeon and other fishes (e.g. Striped Bass, Pacific Herring). Increased risk of accidental
1960 entanglement is a function of a) marine mammal populations doing well as numbers have
1961 increased and distribution of animals is widespread, and b) some animals (pinnipeds) have
1962 become long-term residents within the Estuary and are habituated to targeting sampling gear.
1963 Observations and entanglement of pinnipeds have occurred as far inland as Knights Landing,
1964 CA, north of Sacramento, CA, a distance of 224 river kilometers inland from the Golden Gate
1965 Bridge.

1966

1967

1968 6. SECTION 6: POTENTIAL TAKE ESTIMATES OF MARINE 1969 MAMMALS

1970 Activities listed in this application can potentially result in take via entanglement in trawl and
1971 net mesh, entrapment in large fykes, and hooking by setline resulting in minor injury “Level A
1972 Harassment” or “Mortality/Serious Injury”. The following is a description of historical
1973 interactions with marine mammals used to estimate the number of potential take later in this
1974 section. There is no intentional capture of marine mammals. Note, there was no take of
1975 northern elephant seal or harbor porpoise during this period.

1976

1977 As stated previously, take could potentially occur through means: 1) accidental entanglement
1978 of mesh in trawls and nets, 2) by entrapment within a large fyke, or 3) hooking by setlines.

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1979

1980 *Table 6-1 Historical number of marine mammal interactions by study and year for the period*

1981 *2006-2021 including number released alive and number of mortality.*

Study Name (Study Number)	Year	Protected Species Taken	Gear	# Killed	# Released Alive	Total # of Animals
Adult Striped Bass Population Estimates (1)	2008	California Sea Lion	Fyke	1 ^b	0	1
Adult Sturgeon Population Estimates (3)	2006	California Sea Lion	Trammel Net	1	1	2
Adult Sturgeon Population Estimates (3)	2006	Harbor Seal	Trammel Net	2	0	2
Adult Sturgeon Population Estimates (3)	2011	California Sea Lion	Trammel Net	1	0	1
Adult Sturgeon Population Estimates (3)	2016	Harbor Seal	Trammel net	0	1 ^a	1
Estuarine and Marine Fish Abundance and Distribution Survey (4)	2012	California Sea Lion	Trawl	0	3 ^c	3 ^c
Estuarine and Marine Fish Abundance and Distribution Survey (4)	2021	California Sea Lion	Trawl	1	0	1
Yolo Bypass Fish Monitoring Program Survey (5)	2021	California Sea Lion	Fyke	1	0	1
Delta Juvenile Fish Monitoring Program (6)	2016	California Sea Lion	Trawl	0	1	1
Delta Juvenile Fish Monitoring Program (6)	2014	California Sea Lion	Trawl	0	2	2
Delta Juvenile Fish Monitoring Program (6)	2015	California Sea Lion	Trawl	0	1	1
Delta Juvenile Fish Monitoring Program (6)	2017	California Sea Lion	Trawl	0	3 ^d	3
Mossdale Spring Trawl (9)	2015	California Sea Lion	Trammel Net	0	1	1

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Enhanced Delta Smelt Monitoring (15)	2017	California Sea Lion	Trawl	0	1	1
CDFW Central Valley Salmon and Steelhead Monitoring (16)	2016	California Sea Lion	Fyke	2	0	2
Pacific Herring Trawl and Gillnet Survey (17)	2010	Harbor Seal	Gill Net	0	1	1
Total		California Sea Lion		5	13	20
Total		Harbor Seal		2	2	4

^a Animals entangled and freed have not shown evidence of injury, but ultimate fate of the animals are unknown.

^b On September 20, 2011, in San Pablo Bay, a Sea Lion was discovered dead in the net upon retrieval. The sea lion was not observed swimming near the net or the boat during fishing.

^c In 2008, one sea lion was found dead in the fyke trap.

^d Same California sea lion swam into nets 3 times in one day, entangled only once and was released alive and unharmed. Swam into both midwater trawl and otter trawl nets. Sea lion caught in midwater trawl, then staff opened cod end to allow it to swim away.

In addition to these incidents of take, there has been many more observed interactions with pinnipeds that do not result in take. The Adult Sturgeon Tagging Study during 2007-2016 recorded observations of pinnipeds within 50 m of gear and vessels and “raids-on-net” with pinnipeds removing fish from gear that might have resulted in contact but not take entanglement with nets (see Appendix B.5). These observations show an extremely low rate of entanglement per the high rate of observations near nets and raids on nets with up to one per trammel set with raids occurring 30-60% of the sets. The extremely low entanglement rate with high observation rate is evidence of effective avoidance measures carried out by field crews during sampling. High rates of observation and net raids suggest that a study such as Adult Sturgeon could potentially exceed take limits during one survey session. To mitigate take exceedance, it is recommended that each study has the ability to share take among other studies.

The interactions that have resulted in observed take were mostly non-injury, although some mortality has occurred. The majority of mammal and gear encounters (contact with gear) have not resulted in take and they appeared to be non-injurious. We believe that when take does occur the majority is non-injurious as we see the animals return to pursue the gear with no evidence of injury, but the ultimate fate of the animal is not known. These patterns were summarized in Table 6.2 to illustrate a pattern to be cast forward for a 5 year request for take. Gears such as nets and trawls are used most frequently and throughout the upper estuary, thus have had the most interactions with marine mammals. Fykes are used only in a few areas and

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setlines have rarely been used in the period 2003-2017. Patterns of interactions with nets and trawls will be used to help inform take requests for lesser used gears (e.g. setlines).

California Sea Lions and Harbor Seals are most numerous marine mammals upstream of San Pablo Bay and attracted to sampling gears such as trammel nets, gill nets, fykes, and setlines that target large fishes including, but not limited to Salmon, Striped Bass, and Sturgeon. Marine mammals have become habituated to raiding gear and are often observed feeding on salmon caught in nets. Prior to 2006, there is little information on the take of marine mammals in the 50+ year history of this program. However, observations suggest that the abundance of seals and sea lions in San Francisco Bay, the Delta, and major river systems has increased in recent years, which correlates with population trends in the overall populations of these species in California. Therefore, we expect increased interactions with these mammals during our sampling operations in the future as their populations increase, assuming their desired prey (primarily Chinook salmon) continue to be present in sufficient numbers. The before mentioned interaction summary along with reported observations of marine mammals was used by individual study elements to inform a take request from individual program elements by gear type.

Non-lethal efforts to deter sea lions and seals from consuming highly desirable prey items (e.g., salmon) are rarely successful (R. Brown, pers. Comm.; NOAA website), and certain methods (e.g., underwater firecrackers) are restricted due to an internal program directive, so this document will address measures that are feasible (logistically and financially) and have a reasonable chance of minimizing the possibility of marine mammal entanglement and subsequent mortality. Although not entangled by IEP gears to date, observations of juvenile northern elephant seal in Rio Vista, CA in and in Clifton Court Forebay have warranted consideration of risk and need to request take coverage due to the range of activities.

Some IEP studies have sought guidance from NMFS on permissible deterrent methods for sea lions and harbor seals interfering with sampling activities. Application and testing of deterrent methods has not resulted any effective or lasting result. It is believed that some of the pinnipeds that have been entangled, have been so repeatedly due to their habituation to gear.

Several studies have no historical record of take therefore it is difficult to estimate the appropriate level of coverage. In those instances where take is likely to not occur, but the protected mammal species may be present, IEP has requested 1 per species when the location and gear type match the potential range of the species. Studies with historical data to suggest that take is likely to occur have requested 5 per gear type, but this request is also species specific as reflected in Table 6.2 below.

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2051 *Table 6-2 The potential number of animals for each marine mammal species that could be taken by Level A Harassment or Serious*
 2052 *Injury/Mortality estimated for the next 5 years (2021-2025) by individual IEP activities and gear categories. Take estimates are for*
 2053 *gear categories based on specific gear types currently used and those not currently used (e.g. setlines) but might be used in the*
 2054 *period of this application.*

Study Number	Program Element Title	PEN	Gear Category	Gear Types	Take Request for 5 Year Period			
					California Sea Lion (<i>Zalophus californianus</i>)	Harbor Seal (<i>Phoca vitulina</i>)	Northern Elephant Seal (<i>Mirounga angustirostris</i>)	Harbor Porpoise (<i>Phocoena phocoena</i>)
1A	Adult Striped Bass Population Estimates	002	Fyke	Large Fyke	5	5	1	0
1B	Adult Striped Bass Population Estimates	002	Net	Gill Net	5	5	1	0
2	Fall Midwater Trawl Survey	003	Trawl	Midwater Trawl	1	1	1	0
3A	Adult Sturgeon Population Estimates	005	Net	Trammel Net	5	5	1	0
3B	Adult Sturgeon Population Estimates	005	Setline	Longline/Setline	5	5	1	0
4	Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)	011	Trawl	Midwater Trawl, Otter Trawl	5	1	1	1
5A	Yolo Bypass Fish Monitoring Program	047	Fyke	Large Fyke	1	0	0	0
5B	Yolo Bypass Fish Monitoring Program	047	Net	Gill Net	1	0	0	0
6	Delta Juvenile Fish Monitoring Program (Chippis, Sac, and Mossdale Trawls)	053	Trawl	Surface Trawl, Kodiak Trawl	5	1	0	0
7	Spring Kodiak Trawl	088	Trawl	Kodiak Trawl	1	1	0	0
8	UCD Suisun Marsh Fish Monitoring	093	Trawl	Otter Trawl	1	0	0	0
9	Mossdale Spring Trawl - CDFW Region 4	071	Trawl	Kodiak Trawl	1	0	0	0

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10	Gear Efficiency Evaluations	249	Trawl	Midwater Trawl, Otter Trawl, Kodiak Trawl	1	0	0	0
11	Investigation of the Distribution and Abundance of Longfin Smelt in the SFE	296	Trawl	Otter Trawl	1	1	0	0
12A	FRP Tidal Wetland Monitoring Pilot Study Phase 4	311	Trawl	Otter Trawl	1	0	0	0
12B	FRP Tidal Wetland Monitoring Pilot Study Phase 4	311	Net	Lampara Net, Gill Net	1	0	0	0
15	Enhanced Delta Smelt Monitoring	325	Trawl	Kodiak Trawl	5	1	1	0
16	CDFW Central Valley Salmon and Steelhead Monitoring (Mainstem Sacramento River Mark-Recapture Project)	N/A	Fyke	Large Fyke	5	1	0	0
Total	Total - Programmatic Request				50	27	5	1

2055

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2056 Summary of total proposed takes by gear

2057
2058 *Table 6-3 Summary of potential number of animals for each marine mammal species that could*
2059 *be taken by Level A Harassment or Serious Injury/Mortality over the next 5 years (2021-2025) by*
2060 *IEP activities.*

2061

Gear Category	Take as Minor Injury (Level A) and Serious Injury/Mortality for 5-year period			
	California Sea Lion (<i>Zalophus californianus</i>)	Harbor Seal (<i>Phoca vitulina</i>)	Northern Elephant Seal (<i>Mirounga angustirostris</i>)	Harbor Porpoise (<i>Phocoena phocoena</i>)
Trawl	22	6	4	3
Net	12	10	3	1
Fyke	11	6	1	0
Setline	5	5	1	0
Total programmatic	50	27	5	1

2062
2063
2064

2065 7. SECTION 7: THE ANTICIPATED IMPACT OF THE ACTIVITY ON 2066 THE SPECIES

2067 The anticipated impact of the activity to the species and stock of marine mammals is
2068 expected to be of negligible impact. The majority of activities included in this application
2069 have been conducted for decades. During this time, populations of marine mammals have
2070 increased, and expansion inland has occurred into the freshwater regions of the Estuary. It
2071 is the case that a few individual marine mammals have been entangled over time. Of those
2072 that have been entangled, the majority have been released and appeared to suffer no
2073 obvious injury. There have been some cases of mortality. It is the case that some
2074 entanglements and entrapment have resulted in mortality via drowning. These events are
2075 rare and have been used to inform avoidance and mitigation measures to reduce such
2076 incidents. We recognize that entanglement will always be possible as mammals increase in
2077 number and are targeting fish that are also sampled by monitoring programs. Observations
2078 are that some mammals have become habituated to raiding nets and have been
2079 encountered repeatedly (chasing boats and gear). The same animals have been observed
2080 chasing vessels within seasons and across years. In summary, there is likely to be no impact
2081 to survivorship or disruption of important behaviors at the population level or for the

2082 majority of individuals encountered. The size and scale of monitoring activities likely pose
2083 no risk to the status of the stocks.

2084

2085

2086 **8. SECTION 8: THE ANTICIPATED IMPACTS OF THE ACTIVITY ON**
2087 **THE AVAILABILITY OF THE SPECIES FOR SUBSISTENCE USES**

2088 Not applicable for the IEP application. The activities conducted by the IEP occur in California
2089 and none will be near traditional Arctic subsistence hunting areas. This issue is only
2090 applicable in Alaska.

2091

2092

2093

2094 **9. SECTION 9: THE ANTICIPATED IMPACTS OF THE ACTIVITY ON**
2095 **THE HABITAT OF THE MARINE MAMMALS**

2096 There is no anticipated impact on the habitat of the marine mammal populations from the
2097 studies included in this application. Fish sampling and monitoring by the IEP has been
2098 conducted for decades and during this time the marine mammal populations have
2099 increased in the Estuary. IEP fish monitoring programs, notably the fykes and trammel nets,
2100 are conducting tag and release activities so there is no net loss of adult fish as prey.

2101

2102

2103

2104 **10. SECTION 10: THE ANTICIPATED IMPACTS OF LOSS OR**
2105 **MODIFICATION OF THE HABITAT ON MARINE MAMMALS**

2106 The activities described in this application are not anticipated to result in loss or
2107 modification to marine mammal habitats. Therefore, these activities are not expected to
2108 have any adverse impacts on marine mammals as there is not expected to be loss or
2109 modification of habitat.

2110

11. SECTION 11: THE AVAILABILITY AND FEASIBILITY OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING ACTIVITIES WITH THE LEAST PRACTICABLE ADVERSE IMPACT UPON MARINE MAMMALS

IEP studies employ a variety of avoidance and mitigation measures while conducting sampling to avoid entanglement and to minimize adverse impact of entanglement in gears used by the program. Avoiding and minimizing take is important for the safety of field crews, marine mammals, and equipment. Watch for marine mammals occurs prior to deployment and during use of gears to minimize the potential for inadvertent capture.

General guidance for use of trawls and nets deployed from vessels:

- (1) At least one staff member shall survey the intended sampling area and immediate vicinity prior to gear deployment.
- (2) At least one staff member will actively watch for the approach or entanglement of marine mammals while trawls, nets, and setlines are deployed.
- (3) The crew should check their gear often. Due to the typical dive duration of sea lions, the risk of drowning for any incidentally captures animals' increases dramatically for trawl deployments longer than 10 minutes in duration to make sure that no marine mammals are present in the net.
- (4) Gear will not be deployed if there is believed risk of capture of marine mammals. Because marine mammals are ubiquitous and highly mobile, there is always some risk such that in this context the gear will not be deployed if there is 'heightened' risk (e.g., the marine mammal appears naïve or immobile).
- (5) Moving to alternate sampling sites to avoid capture will be applied when feasible, although some areas have fixed sites to meet regulatory requirements.
- (6) If a marine mammal becomes entangled, (a) the gear will be recovered immediately and (b) the crew will facilitate the safe removal of the animal from the gear. The crew's supervisor will notify the IEP permit coordinator so to notify NOAA Fisheries as soon as possible within two days of the incident.
 - To report a stranding or injured mammal contact Marine Mammal Center at Phone: (415) 289-7325
- (7) If a marine mammal dies while entangled, the crew will stop work immediately and the crew's supervisor will notify the IEP permit coordinator so to notify NOAA staff as soon as possible.
 - For dead animal response contact Cal Academy of Sciences at Phone: (415) 379-5381
- (8) For the safety of the field crew and any entangled mammals, field staff will pursue on-going training to develop expertise at removal of entangled marine mammals.

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2150 General guidance for use of fykes and setlines with long soak periods:

- 2151 (1) At least one staff member shall survey the intended sampling area and
2152 immediate vicinity prior to gear deployment.
- 2153 (2) At least one staff member will actively watch for the approach or entanglement
2154 of marine mammals while fykes and setlines are deployed.
- 2155 (3) Crews will check fykes and setlines once daily, raising submerged gear so to
2156 ensure no marine mammals have been entrapped.
- 2157 (4) If a marine mammal becomes entrapped, (a) the gear will be recovered
2158 immediately and (b) the crew will facilitate the safe removal of the animal from
2159 the gear.
 - 2160 ▪ The field crew will follow the "Incident Reporting" process in Section 13.
 - 2161 ▪ The crew's supervisor will notify the IEP permit coordinator so to notify
2162 NOAA Fisheries as soon as possible within two days of the incident.
 - 2163 ▪ To report a stranding or injured mammal contact Marine Mammal Center
2164 at Phone: (415) 289-7325
- 2165 (5) If a marine mammal dies while entrapped or hooked, the crew will stop work
2166 immediately and the crew's supervisor will notify the IEP permit coordinator so
2167 to notify NOAA staff as soon as possible.
 - 2168 ▪ For dead animal response contact Cal Academy of Sciences Phone: (415)
2169 379-5381

2172 These IEP efforts are informed by decades of State and Federal agency fish sampling experience
2173 operating around marine mammals. Short of drastic measures such as hazing the animals
2174 (NOAA Deterrence Methods), there are no means to avoid the pinnipeds, because the
2175 pinnipeds seek out the gear (individuals have become habituated to fishing gear). The
2176 extremely low entanglement rate with high observation rate is evidence of effective avoidance
2177 measures carried out by field crews during sampling.

- 2178 • Most gears have a low observation rate and even lower entanglement rate.
- 2179 • Trammel nets are gears with the highest encounter rates
- 2180 • There has been an increase in pinniped observations over time by the CDFW Sturgeon
2181 Tagging Study use of trammel nets during 2007-2016.
- 2182 • Notably in recent years, observation rates now match or exceed one per trammel set
2183 with raids on nets occurring 30-60% of the sets.

2185 Additional measures employed by gillnet survey in San Francisco Bay to avoid marine mammal
2186 take. This study targets fish that are prey of several marine mammal species so additional
2187 avoidance measures are applied.

2188 12. SECTION 12: THE ARCTIC PLAN OF COOPERATION - WHERE
2189 THE PROPOSED ACTIVITY WOULD TAKE PLACE IN OR NEAR A
2190 TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND/OR
2191 MAY AFFECT THE AVAILABILITY OF A SPECIES OR STOCK OF
2192 MARINE MAMMAL FOR ARCTIC SUBSISTENCE USES
2193

2194 Not applicable for the IEP application. The activities conducted by the IEP occur in California
2195 and none will be near traditional Arctic subsistence hunting areas. IEP activities will not
2196 have a relevant effect on availability of marine mammals for subsistence uses.
2197

2198 13. SECTION 13: MONITORING AND REPORTING PLAN

2199 Monitoring

2200 IEP staff are on watch for marine mammals as part of our ongoing fisheries research
2201 activities. Watch for marine mammals occurs prior to deployment and during use of trawls
2202 and nets to minimize the potential for inadvertent capture. The Adult Sturgeon Population
2203 Study has recorded observation data that would be used as a model for other IEP studies.
2204 The observations of the watch would be recorded including the following types of data for
2205 every station visit and deployment of gear:

- 2206 • Observation of number of marine mammal species within 50 yards of gear and/or
2207 vessel during deployment and use of gear
- 2208 • Number of contacts of marine mammals with sampling gear without entanglement
2209 (raids on net with no mammal take)
- 2210 • Reporting of contact resulting in inadvertent capture (entanglement)
2211 ○ Entanglement will be reported separately as an incident report
2212

2213 The observation and raid on gear data is intended to provide encounter rates of marine
2214 mammals that do not result in take by entanglement so to understand effectiveness of
2215 avoidance and mitigations measures applied by sampling activities. California sea lions and
2216 harbor seals are curious and will often swim up to boats and gear. Information recorded
2217 would include date, time, location, species, and number near gear and number of contacts
2218 with gear. An example of fields that could be added to data sheets includes:
2219

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Date	Time	Location	Number near net: Harbor Seals / Sea Lions	Number of contacts with gear: Harbor Seals / Sea Lions	Comments
			/	/	

*Note, Elephant Seals and Harbor Porpoise are very rare in the geographic scope of most IEP studies and could be added to the data fields as needed.

Reporting of Monitoring Data

IEP staff will continue to report to NMFS any incidents that result in entanglement in gear by marine mammals. In addition, IEP could provide data so to report observations of marine mammals near and interacting with sampling gear that does not result in entanglement. Data from individual studies will be provided annually to the CDFW IEP ESA Administrator to compile for the program to understand its mitigations measures and take levels and to share findings with NMFS staff. A summary of the 5-year permit will also be produced at the end of the LOA. This information is intended to help inform our understanding of marine mammal presence and interactions with fish monitoring activities in the San Francisco Estuary.

Incident Reporting

Process to report occurrence of an inadvertent entanglement:

IEP Process to Report Inadvertent Capture of Marine Mammals

The National Marine Fisheries Service issued permit 1440-3R to the Interagency Ecological Program on February 16, 2021 to authorize capture of federally listed salmonids and sturgeon by long-term monitoring studies, permit is currently in the renewal process with NMFS. Permit conditions include instructions to report immediately the inadvertent capture of any marine mammal, the immediate release of any marine mammal and informing NMFS's Protected Resources Division as soon as possible, within 48 hours.

Process: Upon inadvertent capture of marine mammal, sampling activity will cease and all efforts to free animal will be taken as quickly and safely as possible for the crew and animal. Upon freeing the animal, the incident will be reported.

1. Staff will report the situation with following details:
 - a. Study name, IEP program element number
 - b. Gear type and vessel name
 - c. Species or description of animal

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- 2249 d. Location (region/landmarks and/or specific like GPS coordinates)
2250 e. Date and time last seen
2251 f. Approximate size of the animal (length and weight)... take photo with phone if
2252 possible
2253 g. Condition of animal (alive, dead, wounded, entangled, bleeding, no injury, etc.)
2254 h. Human interactions/description of entanglement (evidence of ship strike,
2255 entangled, shooting, etc.)
2256 i. Tags or branding on animal
2257 j. Name and contact number for the person reporting the incident
2258 2. Staff to report to the IEP permit administrator immediately
2259 3. IEP ESA administrator will contact NOAA NMFS staff of issue within 48 hours, call
2260 immediately
2261 4. File report on NMFS APPS describing incident

2262

2263 Contact information for the IEP ESA administrator

2264 **Jeffrey Holt**

2265 Interagency Ecological Program
2266 California Department of Fish and Wildlife
2267 2109 Arch Airport Road, Suite 100
2268 Stockton, CA 95206
2269 Phone: (209) 639-2338
2270 jeffrey.holt@wildlife.ca.gov
2271

2272 Contact at NOAA regarding IEP salmonid permit and reporting is:

2273 **Shivonne Nesbit**

2274 *Fish Biologist*
2275 *Protected Resources Division*
2276 *NOAA Fisheries West Coast Region*
2277 *1201 NE Lloyd Blvd Suite 1100, Portland, OR 97232*
2278 *503.231.6741*
2279 shivonne.nesbit@noaa.gov
2280

2281

14. SECTION 14: COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE

The IEP has a substantial monitoring and research program obligations for fisheries, invertebrates, and water quality. The mission of the IEP is to monitor the impacts of State and Federal water project operations in the Delta on the fish, wildlife, zooplankton, and water quality of the upper San Francisco Estuary so to inform resource agency management decision making. This application includes proposed addition of marine mammal observational data among relevant IEP studies that could generate information of use to NMFS for marine mammal management. It is expected that as marine mammal populations continue to increase in the SF Estuary so will interactions between marine mammals and sampling gears. The summary of observation data by the Adult Sturgeon Population Estimates Study is an example of observation rates and is useful to set the contextual experience that IEP activities face working with marine mammals present. This information is intended to help inform our understanding of marine mammal presence and interactions in the Estuary.

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APPENDIX A. Interagency Ecological Program Gear Descriptions.

This summary is a highlight of various gear types used by the Interagency Ecological Program that have potential for incidental take via entanglement of marine mammals. Gear category summaries used in this application are based on the following highlights from Fisheries Techniques, 3rd edition (Zale et al. 2012)

Gear Category - Nets

Passive Capture Techniques

- Entanglement Gears

- Gill Nets

- Trammel Nets

Gear Category – Fykes

Passive Capture Techniques

- Entrapment Gears

- Fykes

- Pot Gears

- Minnow Traps

- Crab Pots

- Rotary-Screw Traps

Gear Category – Baited Setlines

- Angling Gears

- Longlines and Setlines (large fish)

Gear Category – Trawls

Active Capture Techniques - Trawls

- Trawls (Funnel shaped nets towed along bottom, through water column, or at surface)

- Variations

- Beam Trawls

- Otter Trawls

- Midwater Trawls

- Midwater Net

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- 2354
 - Kodiak Net
- 2355
 - Larval fish D-frames
 - 2356
 - Townet
 - 2357
 - 20-mm Net
 - 2358
 - SLS (Egg and Larval) Net
- 2359
 - Zooplankton nets
 - 2360
 - Meso-zooplankton (Clark-Bumpus)
 - 2361
 - Macro-zooplankton (Mysid and amphipod)
- 2362
 - Dredges
 - 2363
 - Scallop Dredge
 - 2364
 - Clam Dredge
- 2365
 - Surrounding or Encircling Nets
 - 2366
 - Beach Seine
 - 2367
 - Purse Seine
 - 2368
 - Lampara Net
- 2369
 - Other Active Sampling Gears
 - 2370
 - Push Nets
 - 2371
 - Lift Nets
 - 2372
 - Pop Nets
 - 2373
 - Dip Nets
 - 2374
 - Cast Nets
 - 2375
 - Drop Nets
 - 2376
 - Continuous Recorder

2377 Electrofishing

- 2378
 - Electrofishing Boats
- 2379
 - Backpack Unit

2380

2381

2382 References

- 2383 Zale, A. V., D. L. Parrish, and T. M. Sutton, editors. 2012. Fisheries Techniques, 3rd edition. American
2384 Fisheries Society, Bethesda, Maryland.

2385

2386

2387

APPENDIX B. IDENTIFICATION AND REPORTING FORMS

Appendix B.1. Marine Mammal Identification Information Available from NMFS

The following could be used by IEP field staff for the identification of the marine mammals listed in this application. The following content was adapted or copied from NOAA fisheries websites as listed for each animal.

California Sea Lion Identification Tips

ID: Adult males have pronounced sagittal crest, or bump on forehead; no gap between molars in upper jaw

Size: Average male is 7.5 feet and between 700-1,000 pounds, females are 6 feet and 240 pounds

Color: Adult males dark brown to black; Adult females and juveniles are golden brown to blonde

Snout: long and narrow

Ears: Visible external ear flaps

Flippers: Long and mostly hairless, broad foreflippers

Claws: 3-5 on hind flippers

Genitals: External testes, 1-2 pair of teats



2408 [http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/calif](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/california_sea_lion_id.html)
2409 [ornia sea lion id.html](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/california_sea_lion_id.html)

2410

2411

2412 Harbor Seal Identification Tips

2413 **ID:** spotted pelage; fore flippers small

2414 **Size:** Males and Females range from 4-6 ft. and a maximum of 310 pounds.

2415 **Color:** gray with white spots or white with gray spots

2416 **Ears:** No external ear flaps; a true seal

2417 **Genitals:** Internal testes, 1-2 sets of teats

2418 **Behavior:** Seal pups are temporarily left on shore while their mother forages for food. If you see
2419 a seal pup alone on the beach, it is not abandoned! The best thing to do is stay 100 yards away
2420 from the animal, harbor seal mothers are shy and will not return if there are disturbances
2421 around the pup. A required 48 hour observation time is necessary to determine if the pup is
2422 being attended by the mother or if it has been abandoned.

2423 **Sleep:** Haul out at night and during the day; they have the ability to sleep underwater and come
2424 up for air once every 30 minutes, they are unable to sleep at the surface of the water.

2425 **Locomotion:** On land harbor seals are very awkward, they are unable to move their hind limbs
2426 forward to create a "walking" motion, and instead it is a "caterpillar" motion. Locomotion on
2427 land is accomplished by wriggling undulations using mainly the front flippers, the hindlimbs
2428 cannot be rotated forward and are dragged behind. This does not mean they are injured.

2429 Look for tags or signs of human interactions:

- 2430 • seals are tagged on their rear flippers (blue=male; yellow=female; red=rehab animal)
- 2431 • entanglements? shot?



2432

2433 [http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/har](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/harbor_seal_id.html)
2434 [bor_seal_id.html](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/harbor_seal_id.html)

2435

2436

2437 Northern Elephant Seals Identification Tips

2438 **ID:** Males grow elongated snout (proboscis), female snout extends just beyond the mouth;
2439 Black whiskers; Broad V-shaped hind flippers

2440 **Size:** Adult males 12-16 ft, weigh ~ 5,000 lb.; adult females 7-12 ft, weigh ~ 2,000 lb.

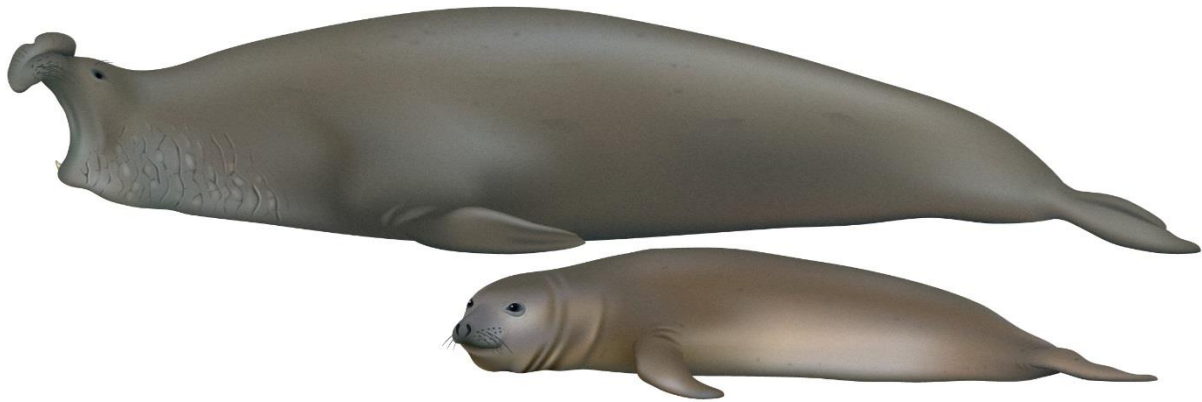
2441 **Color:** Pups born black, molt to silver coat at one month, adults light brown to black

2442 **Ears:** No external ear flaps

2443 **Fore flippers:** small

2444 **Genitals:** Internal testes, 1-2 sets of teats

2445 **NOTE:** This species will haul out during molting season and may stay in the same area for weeks
2446 at a time. When they are molting they look like they are in very poor shape, but this is normal.
2447 Please do not pour water on these animals or attempt to approach!



2448

2449 [http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/north](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/north_hern_elephant_seals_id.html)
2450 [hern_elephant_seals_id.html](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/pinnipeds/north_hern_elephant_seals_id.html)

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2452

2453 Harbor Porpoise Identification Tips

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2455 **ID:** stocky, small pointed flippers, no beak

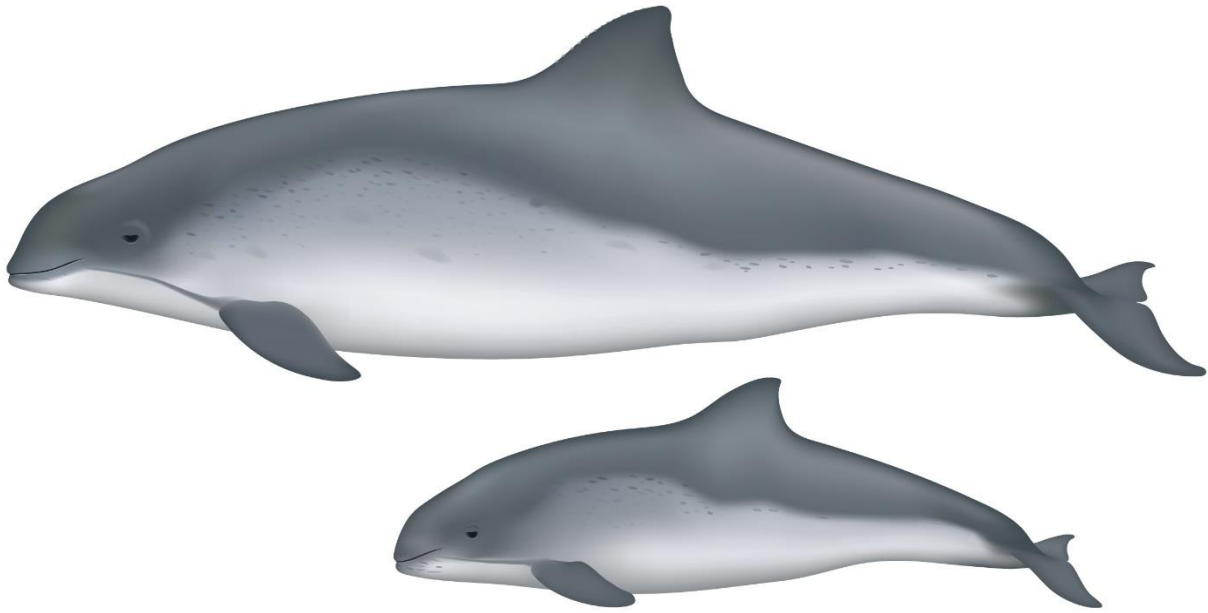
2456 **Size:** average adult 5 ft and ~150 lb

2457 **Color:** dark gray to black on top with white underside

2458 **Dorsal fin:** small, triangle shaped fin and uniform in color

2459 **Group size:** 2-5 animals

2460 **Behavior:** Do not make a splash, shy and tend to avoid boats



2461

2462 [http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/cetaceans/har](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/cetaceans/harbor_porpoise_id.html)
2463 [bor_porpoise_id.html](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/cetaceans/harbor_porpoise_id.html)

2464

2465

2466 **Common Bottlenose Dolphin Identification Tips**

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2468 **ID:** leaner body, short, thick snout (rostrum)

2469 **Size:** average adult length 6 to 13 ft

2470 **Color:** generally grey in color, range from light gray to almost black near dorsal fin, with gray to
2471 almost white belly.

2472 **Dorsal fin:** curved or hooked dorsal fin

2473 **Group size:** alone or in groups

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2476

2477 <https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin>

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2480 **Pacific White-Sided Dolphin Identification Tips**

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2482 **ID:** short, thick snout (rostrum) and large dorsal fin

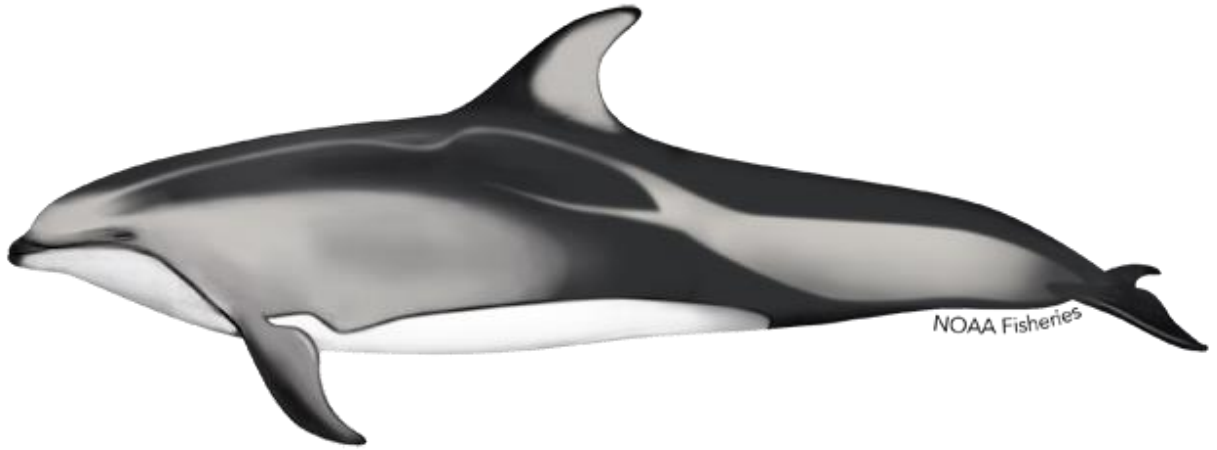
2483 **Size:** average adult length 5.5 to 8 feet long

2484 **Color:** Their back, fluke (tail), and lips are black; their sides, dorsal fin, and flippers are gray; and
2485 their belly is white.

2486 **Dorsal fin:** curved or hooked dorsal fin

2487 **Group size:** Groups between 10 and 100 animals

2488



2489

2490

2491 <https://www.fisheries.noaa.gov/species/pacific-white-sided-dolphin>

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2495 Appendix B.2. NOAA Marine Mammal Handling and Release Guidelines

2496

2497 The following is a listing of how to handle and release available from NOAA Fisheries.

Marine Mammal Handling and Release Guidelines

Have an identification guide and paper available in case of a marine mammal interaction.

Small Whales and Dolphins



1. Make sure the crew is ready to help.
2. Move the boat carefully, stop the boat, and put the transmission in neutral when the animal is close.
3. If the far side of the mainline is within reach, use gaffs to grab only the line. This will keep any remaining gear in the water from pulling on the line and the animal. Do NOT use gaffs or sharp objects to grab an animal.
4. Slowly bring the animal next to the boat.
5. Avoid sudden actions that may scare the animal.

If the animal is tangled in line:

1. Grab the far side of the mainline and tie the mainline to the boat.
2. Use a long-handled line cutter to cut as much line off the animal as you can.

If the animal is hooked:

1. Use a dehooker to remove the hook.
2. If the hook cannot be removed, use a long-handled line cutter to cut the line as close as you can to the hook.
3. Remove as much line as possible from the animal. Do not use ropes or other lines to tie the animal to the boat.

Large Whales

If a large whale is alive and hooked or entangled in fishing gear, immediately call the Disentanglement Hotline at **1-888-256-9840** or the U.S. Coast Guard on VHF Ch. 16 for instructions.

If a large whale is dead and hooked or entangled in fishing gear, immediately call the U.S. Coast Guard on VHF Ch. 16 for instructions.

For All Interactions



Write down as much information as possible to describe the animal, and its injuries.

- How long was the animal?
- What did the animal look like (did it have stripes, spots, or different colors)?
- Was there any fishing gear still on the animal when it was released?
If so, where, what kind, how much?
- Did you see any tags on the animal? If yes, can you see any letters or numbers on the tag?

After an interaction with a marine mammal, get the rest of your fishing gear out of the water. Then record all the information about the interaction on your Marine Mammal Injury / Mortality Reporting Form, even if you had an observer aboard. Mail the form when you get to port.

If you have a marine mammal interaction, you could have another if you keep fishing in the same area. Move away from the area, and call other fishermen to warn them. If you stay in the same area, wait 2 days before setting your gear to avoid more interactions.

Questions? Call Pacific Islands Regional Office,
Sustainable Fisheries Division at (808) 944-2200

NOAA FISHERIES SERVICE, PACIFIC ISLANDS REGION: IDENTIFICATION, HANDLING, AND RELEASE OF PROTECTED SPECIES - rev. 09/2010 10

2498

2499 Appendix B.3. Online information regarding NOAA West Coast Marine Mammal
2500 Stranding Network

2501

Reporting a Stranding

First of all determine if this animal is truly stranded. Evaluate the behavior, many seals and sea lions haul out and rest on land. Monitor the animal(s) condition for 24 hours and help minimize disturbances if possible. Educate the public to stay 100 yards away, especially with pets, and be aware of hazards or rising tides.

To report a dead, injured or stranded marine mammal, please call: **1-866-767-6114**

For law enforcement, harassments, and other violations, please call: **1-800-853-1964**

For entangled marine mammals, please call: **1-877-SOS-WHALE or 1-877-767-9425**
or hail the U.S. Coast Guard on VHF Ch. 16

To report derelict gear, please call: **1-855-542-3935**

What Information To Report?

1. Species or description of animal
2. Location (region/landmarks and/or specific like GPS coordinates)
3. Date and time last seen
4. Approximate size of the animal (length and weight)...
take photo with phone if possible
5. Condition of animal (alive, dead, wounded, entangled, bleeding, etc.)
6. Human interactions (evidence of ship strike, entangled, shooting, etc.)
7. Tags or branding on animal
8. Name and contact number for the person reporting the incident

When Should I Call?

Any live cetacean on the beach or entangled cetacean in the water... YES!

Live pinniped on the beach for more than 24 hours... YES!

Obviously sick or injured animal that has been hauled out less than 24 hours... YES!

ALL dead marine mammals... YES!

Health Guidelines

Zoonotic diseases are diseases that can be transmitted from animals to humans. There are known zoonotic diseases that come from marine mammals and have been transmitted to people working with them. So please remember the following:

1. Please stay >100 yards/meters away!
2. Keep dogs away at all times!
3. Do not disturb, move, touch, or feed a marine mammal!

All marine mammals are protected under the Marine Mammal Protection Act and it is illegal for unauthorized persons to harass, handle, or feed them. Learn more at [Share the Shore](#).

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2506 Appendix B.4. The following information was used to inform how to report a
2507 stranded or injured marine mammal as provided by NOAA Fisheries.
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2509 California - Live Animal Response
2510

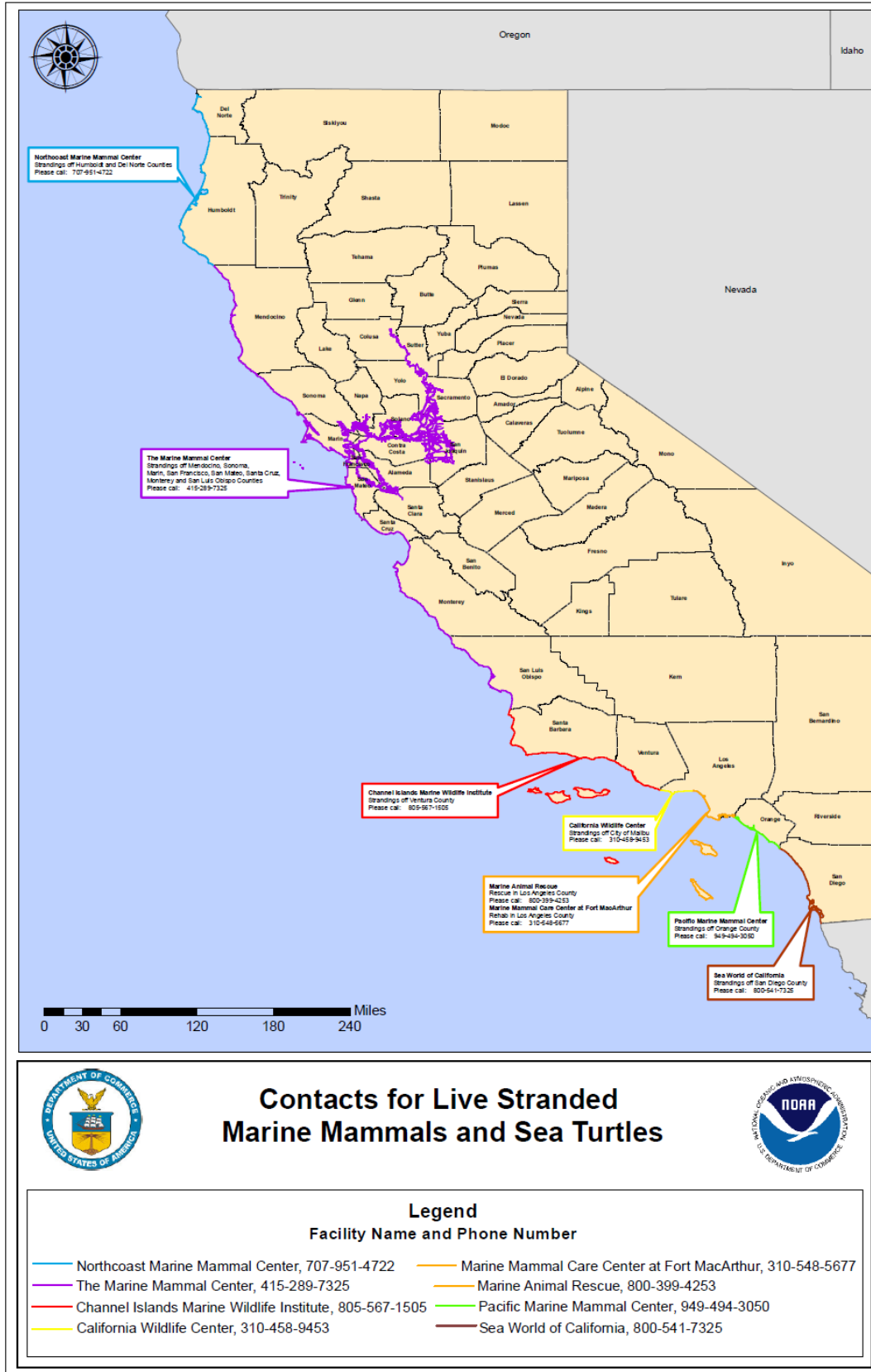
2511 **The Marine Mammal Center**

2512 Counties served: Mendocino, Sonoma, Napa, Marin, Solano, Contra Costa, Alameda, Santa Clara, San
2513 Francisco, San Mateo, Santa Cruz, Monterey, and San Luis Obispo

2514 Phone: (415) 289-7325

2515 <https://www.fisheries.noaa.gov/report#west-coast-california---live-animal-response>
2516

CDFW IEP Application for MMPA LOA



CDFW IEP Application for MMPA LOA

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2519

2520 California - Dead Animal Response

2521

2522 **California Academy of Sciences**

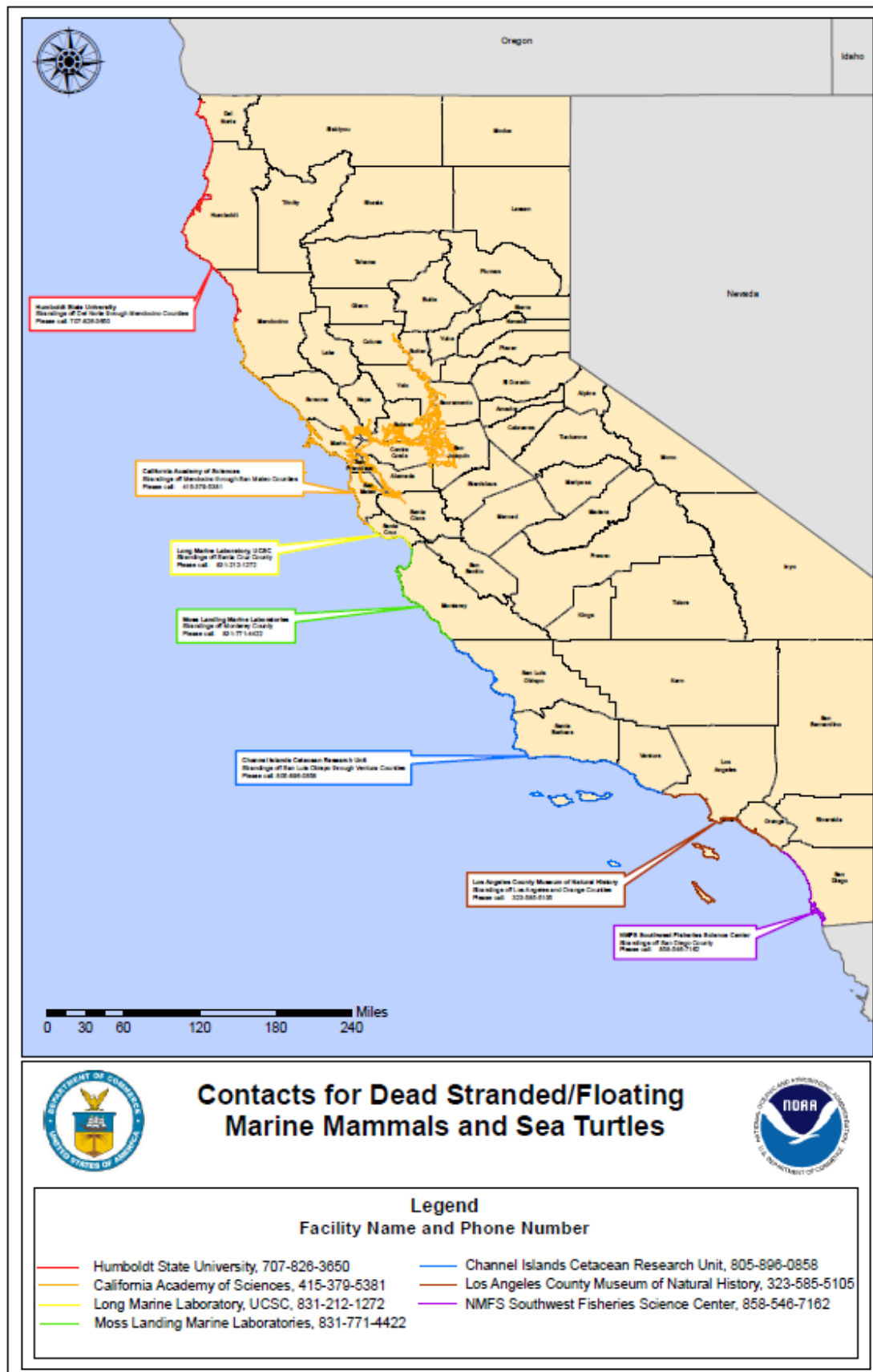
2523 Counties served: Southern Mendocino, Sonoma, Napa, Marin, Solano, Contra Costa, Sutter, San Joaquin,

2524 Alameda, Santa Clara, San Francisco, and San Mateo

2525 Phone: (415) 379-5381

2526 <https://www.fisheries.noaa.gov/report#west-coast-california---dead-animal-response>

2527



CDFW IEP Application for MMPA LOA

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2534 [Appendix B.5. CDFW Sturgeon Tagging Observation Rates](#)

2535

2536 The following is a summary of pinniped observations by the Adult Sturgeon Population Estimates study.

CDFW Sturgeon Tagging Study Pinniped Observation Rates 2007-2016

January 31, 2017

2537

Background and Methods

- The CDFW Sturgeon Tagging Study uses a drift trammel net to collect adult sturgeon, but also capture adult Chinook Salmon, Striped Bass, Leopard Shark, and other fishes as bycatch.
- The CDFW Sturgeon Tagging Study encounters pinnipeds (mostly California Sea Lions and some Pacific Harbor Seals) while sampling. Pinnipeds will attempt to remove fish from (raid) the net, particularly Chinook Salmon.
- The CDFW Sturgeon Tagging Study continues two major alterations to sampling methodology began in 2007, implemented to decrease interactions with pinnipeds and improve the condition of captured fish, which include: (1) reduced length of net in the water from 200 fathoms (~366 m) to 100 fathoms (~183 m) and (2) decreased soak time from about 45 minutes to about 30–35 minutes.
- The deployed net is continuously monitored to detect snags, tangles, and observe for pinniped interactions, as well as to avoid conflicts with other vessels, channel markers, and other hazards.
- The nets were set as many times as possible (usually 4-6) in a given workday per vessel.
- Data collected during each net set included (1) the time of the start and end of the net set/retrieve, (2) the latitude/longitude of the start and end of the net set/retrieve, (3) the water temperature, (4) the number of pinnipeds observed within 50 meters of the net and instances of raiding the net, (5) any vessel interactions, and (6) the weather conditions (based on the Beaufort scale).

2538

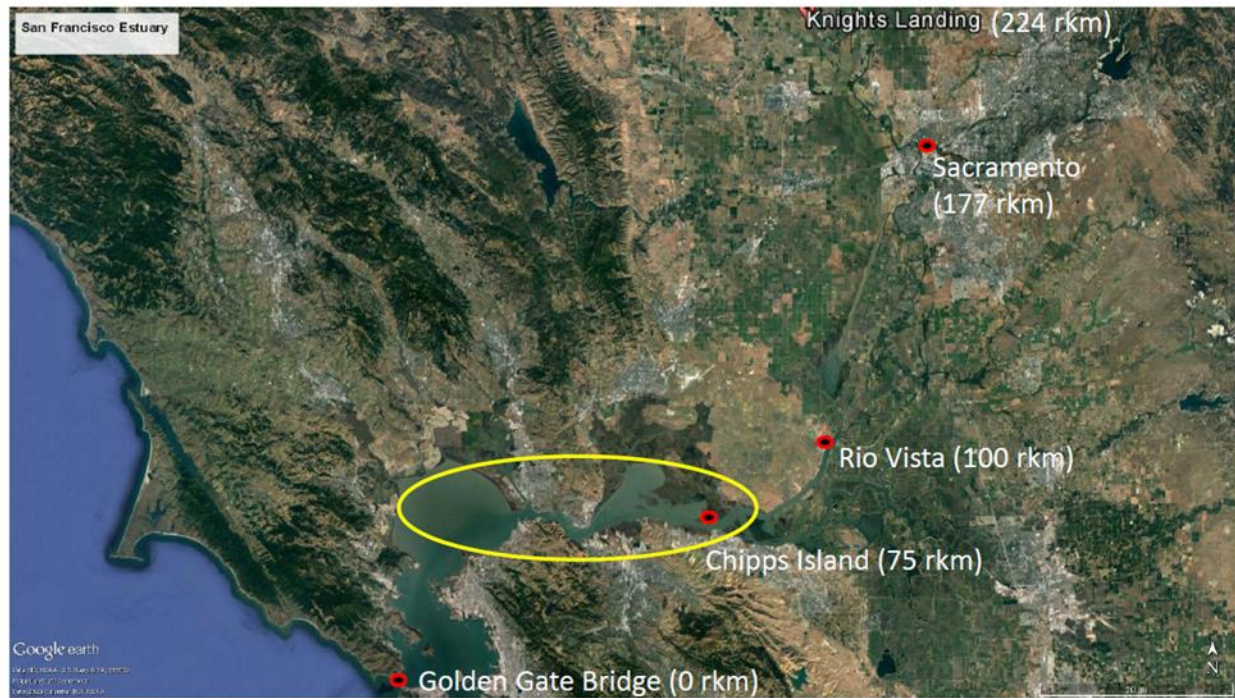
2539

Drifting Trammel Net (highlighted yellow)



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River Kilometer (rkm) Distances from the Golden Gate Bridge



CDFW Adult Sturgeon Tagging Study operates in San Pablo Bay upstream through the Confluence, primarily in Suisun and Grizzly bays. Sea Lions have been seen as far inland as Knights Landing, CA on the Sacramento River a distance of 224 rkm from the Golden Gate Bridge.

2541

Avoidance Measures

The Sturgeon Tagging study employs a variety of avoidance and mitigation measures while conducting sampling to avoid entanglement and to minimize adverse impact of entanglement in the drift trammel net used by the study.

- (1) At least one dedicated staff member will actively survey for the approach or entanglement of marine mammals while the trammel net is deployed.
- (2) The trammel net will not be deployed if there is believed risk of capture of marine mammals. Because marine mammals are ubiquitous and highly mobile, there is always some risk such that in this context the gear will not be deployed if there 'heightened' risk (e.g., the marine mammal appears naïve or immobile).
- (3) If a marine mammal becomes entangled, (a) the trammel net will be recovered immediately and (b) to speed recovery of the net, fish will be removed from the net in real time but any additional processing of fish will not delay recovery of the net.
- (4) If a marine mammal dies while entangled, the crew will not again deploy a net that day and the crew's supervisor will notify the IEP permit coordinator (Steven Slater) so to notify NOAA staff as soon as possible.
- (5) Staff will pursue on-going training to develop expertise at removal of entangled marine mammals.

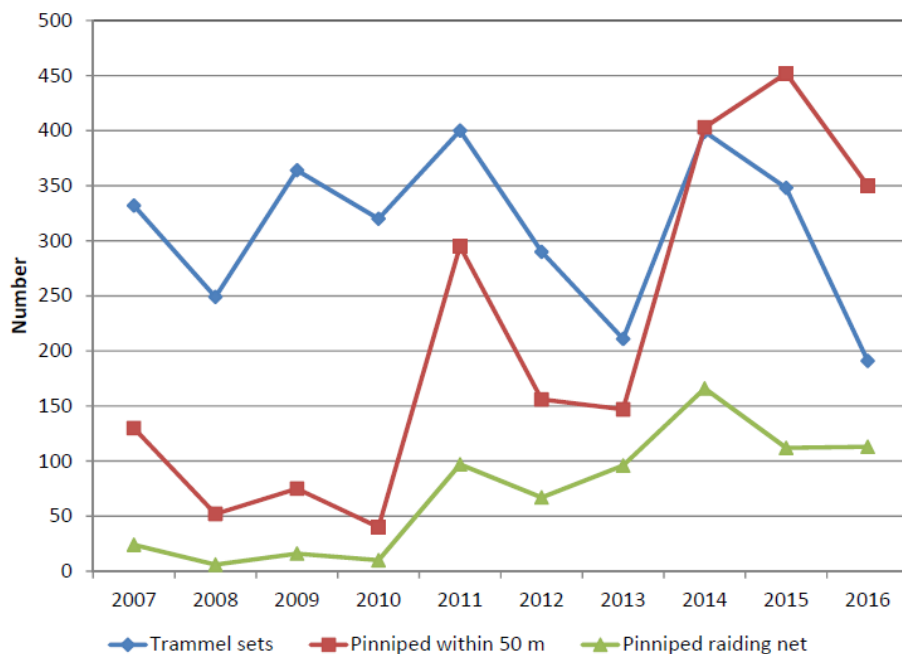
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Results

- The following slides are a summary of pinniped observations during the CDFW Sturgeon Tagging Study sampling conducted August-October. Observations of pinnipeds during sampling has been recorded since 2007, but the study has been conducted most years since 1967.
- Observations include up to 3 pinnipeds raiding a net at roughly the same time, and this sort of behavior has been increasing since we started recording observations 2007. This has led to a high rate of pinniped observations near the nets and an increase in pinnipeds removing fish from the net.

2543

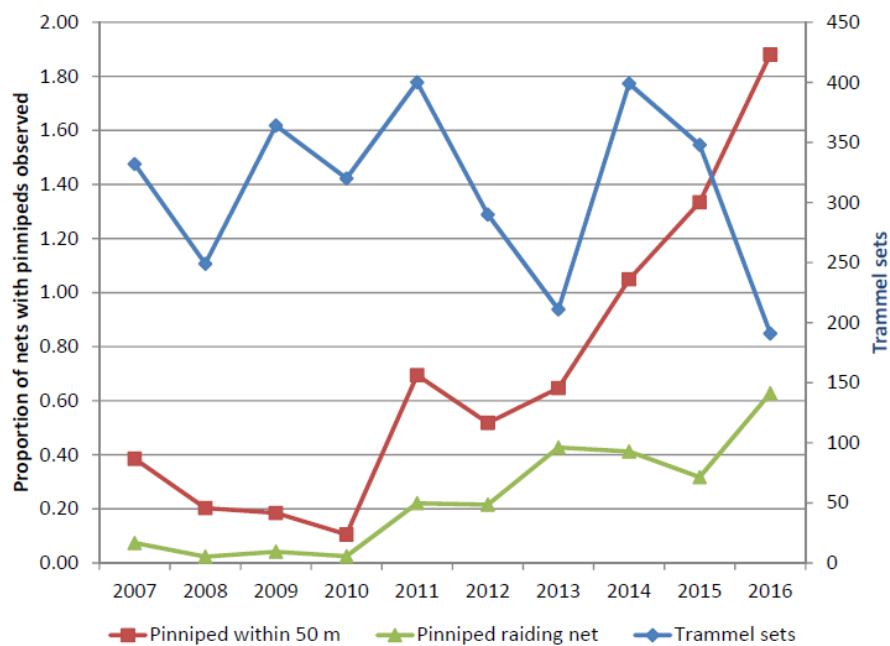
CDFW Adult Sturgeon Tagging Study 2007-2016



Number of CDFW Adult Sturgeon Tagging Study trammel net deployments (sets) and number of pinnipeds observed near the trammel net and raids on nets while sampling during years 2007-2016. Sturgeon Tagging occurs August-October.

2544

CDFW Adult Sturgeon Tagging Study 2007-2016



Number of CDFW Adult Sturgeon Tagging trammel net deployments (sets) and proportion of nets with pinnipeds observed near the trammel net and raids on nets while sampling during years 2007-2016. Sturgeon Tagging occurs August-October.

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Number of CDFW Adult Sturgeon Tagging Study trammel net deployments (sets) and proportion of nets with pinnipeds observed near the trammel net and raids on nets observed while sampling during 2007-2016. Sturgeon tagging occurs August-October. Note extremely low rate of entanglement per the high rate of observations near nets and raids on nets.

Years	Trammel sets	Pinniped within 50 m	Pinniped raiding net	Entanglement
2007	332	0.39	0.07	?
2008	249	0.20	0.02	0
2009	364	0.18	0.04	0
2010	320	0.11	0.02	0
2011	400	0.69	0.22	1 ^a
2012	290	0.52	0.22	0
2013	211	0.65	0.43	0
2014	399	1.05	0.41	0
2015	348	1.33	0.32	0
2016	191	1.88	0.63	1 ^b
Grand Total	2913	0.55	0.19	2

^a On September 20, 2011, in San Pablo Bay, a Sea Lion was discovered dead in the net upon retrieval. The sea lion was not observed swimming near the net or the boat during fishing

^b On September 20, 2016, a Harbor Seal was found entangled in the trammel net while the net was being retrieved and the duration between detection of entanglement by staff to being freed from the net was approximately 5 minutes. Harbor Seal was freed alive and did not appear injured.

Summary

- There has been an increase in pinniped observations over time by the CDFW Sturgeon Tagging Study during 2007-2016.
- Notably in recent years, observation rates now match or exceed one per trammel set with raids on nets occurring 30-60% of the sets.
- The extremely low entanglement rate with high observation rate is evidence of effective avoidance measures carried out by field crews during sampling.
- Short of drastic measures such as hazing the animals (NOAA Deterrence Methods), there are no means to avoid the pinnipeds, because the pinnipeds seek out the gear (habituated) and it is not possible to control the meanderings of the drifting net.