

Interagency Ecological Program 2021 Annual Work Plan



Photo: Courtesy of California Department of Water Resources



Interagency
Ecological Program
COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

March 4, 2021

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A few comments from the IEP Lead Scientist on the 2021 Annual Work Plan

It seems as though a shoe is about to fall. We've had quite a challenging year in 2020, but the IEP continues to break new ground, keep to commitments, and fulfill our mandated requirements in the face of unprecedented change and pandemic. To be honest, we've pulled off some pretty amazing things given what we've been up against. As we come to the end of the year and offer up our plan for Program Elements over the next 12 months, it is again (as it was in 2020) with a sense of anxiety that we do so.

We have had some continuing discussions about what the IEP will be responsible for given the new Record of Decision/Biological Opinions/Incidental Take Permit issued by the regulatory agencies. These new and revised interagency responsibilities provide entry points for discussion of the management and financial arrangements that underpin the IEP data collection enterprise. Pressure to reduce the costs of the sampling program under simultaneously increasing demands for information are vexing and seem to be dependent upon managerial decisions more than scientific need more so now than in any previous era over my time associated with the IEP. We're doing some pretty innovative and revealing reviews of our long-term data collection enterprise, but it's not clear to me how the outcomes of these reviews (whether nearly complete or scheduled for the future) will be incorporated into future IEP Annual Work Plans or contract discussions.

Nonetheless, we have pivoted to several new ways of doing our business, and we will have to live with Director-level evaluations of how it is we did, and how we will be supported to continue. We've moved to an all-virtual, on-line way of meeting and holding seminars, including our Annual IEP Workshop – groundbreaking in its own right for helping to prove our ability to continue scientific communication and information exchange in the ear of contactless meetings and seminars. We've explored a hybrid internal/external review approach to evaluating our long-term surveys and monitoring efforts and hope to find support to maintain this approach as we work through all long-term data collection efforts over the next several years. And the Program Support Team has helped lead our way to all-virtual Director, Coordinator, and Science Management Team quarterly or monthly get-togethers. With a bit of luck and a lot of hard work we will have a newly organized and supported IEP web site home to great us soon.

Safety and personal health have been on our minds a lot this year, and I hope we can all take some time to appreciate the hardships our field crews and laboratory staff have endured to keep the IEP mostly on schedule and mostly functioning. COVID-19 and regional wildfires have contributed to make this one of the most difficult field survey years I can remember – THANK YOU! – to all our crews and staff for staying on the job and doing the hard work behind the scenes that is the true heart of the Interagency Ecological Program.

Please take some time to recognize for yourselves all that you do for each other – and be safe and well while you do so. I'm grateful for all that we do together.

Steven Culberson, Ph.D.

IEP Lead Scientist

What is the Interagency Ecological Program?

The Interagency Ecological Program (IEP) is a consortium of three state agencies, the California Department of Fish and Wildlife (CDFW), California Department of Water Resources (DWR), and the California State Water Resources Control Board (SWRCB) and six federal agencies, the U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), and the U.S. Geological Survey (USGS). Member agencies have been conducting cooperative ecological investigations in the Bay-Delta since the 1970s. The mission of the IEP is to provide and integrate relevant and timely ecological information for management of the Bay-Delta ecosystem and the water that flows through it, accomplished through collaborative and scientifically sound monitoring, research, modeling, and synthesis efforts for various aspects of the aquatic ecosystem. The IEP addresses high priority management and policy science needs to meet the purposes of, and fulfill responsibilities under, State and Federal regulatory requirements, and relies upon multidisciplinary teams of agency, academic, non-governmental organizations and other scientists to accomplish this mission.

What does the Work Plan represent?

This Work Plan reflects the annually planned work by IEP agencies to be conducted as part of the consortium within the Bay-Delta ecosystem during the calendar year. The authorities, responsibilities, and management needs for implementing (and funding) of projects and programs included in this plan are generally guided by, and in some cases are defined by, various regulatory requirements, such as the biological opinions, incidental take permits, and water rights decisions that cover the operations of the State Water Project (SWP) and the Central Valley Project (CVP). It is intended that this annual plan reflect a finer-scale focus for planning encompassed within a higher level of planning (3 to 5 years and beyond) outlined by the IEP Science Strategy.

What's included?

Monitoring, research, and synthesis focused on the Bay-Delta aquatic ecosystem that meets the IEP mission and vision and fulfills one or more of the IEP's goals and objectives as outlined in the Science Strategy, are eligible for inclusion in the Work Plan.

This draft includes six broad categories:

- **Compliance** – Agencies that run the federal and State water projects (DWR and USBR, respectively) or implement other actions (e.g., ACOE) are obligated to implement "compliance monitoring" of fish populations and water quality to satisfy requirements (e.g., permits, licenses, orders, settlements, and agreements) issued by the resource and regulatory agencies (e.g., CDFW, USFWS, NMFS, SWRCB) for the operation of the water projects.
- **Baseline Status and Trends** – The federal and State agencies provide information on the long-term status and trends of fish populations, invertebrates, and water quality that are potentially affected by water diversions, contaminants, invasive species, and other stressors on the Bay-Delta ecosystem over time.

- **Synthesis, Modeling and Reviews** – These elements provide synthesis and analysis of trend information, study and research results, and activities necessary to update conceptual models that are the basis of regulatory requirements. This category also includes reviews of current studies and programs to improve methods, the value of data collected, and the contextual setting of IEP environmental monitoring.
- **Directed Studies** – Directed Studies are those studies proposed and funded by one or more IEP Agencies to inform a specific management-articulated information need or specifically-identified data gap. The request for a Directed Study can come from within a particular agency or from any IEP Governance entity but must be funded in order to be included in an Annual IEP Work Plan. Directed Studies typically address specific scientific questions and areas of critical uncertainty regarding species of interest, natural communities, and landscape- scale processes to inform management actions.
- **Program Management** – These activities are necessary to implement the program, including staff time and expenses in each agency responsible for IEP activities (program and project management, data management, etc.).
- **Project Work Teams, Technical Teams, and Workshop** – A summary to capture the variety and scope of venues to communicate and coordinate monitoring and research of IEP and related efforts. The annual workshop facilitates sharing of IEP findings with the larger estuary science community.
- **Solicited Research** –These studies can be funded from a common, competitive pool that may result from solicitation for proposals if funding is available beyond what is needed for Compliance Monitoring, Baseline Status and Trends, Directed Studies, or Synthesis, Modeling and Reviews.

What's not included?

The IEP Work Plan does not reflect all monitoring, studies, research, and synthesis work occurring in the Estuary. Specifically, it does not reflect work conducted by other independent programs that are not directly part of the collaborative effort. Similarly, some efforts, such as support for project work teams (PWTs), workshops, or regulatory staff, may not be explicitly defined in the Work Plan because they are variable in time or extent, or are subsets of included elements, such as on-going synthesis.

How is the Work Plan developed?

The IEP member agency staff initiate, lead, and actively engage in collaborative science and adaptive management teams to consider shared priorities between the member agencies and the larger science community to inform development of the Work Plan. The IEP Work Plan development follows general guidance by the IEP Directors provided during the development period to:

- Pursue goals and strategies in the IEP Strategic Plan, Governance Framework, and Science Strategy, and consider actions in the Delta Stewardship Council's Delta Science Plan and related Science Action Agenda.

- Seek implementation of compliance monitoring, enhancement of long-term baseline data sets, continuation of studies necessary to understand the ecosystem within a watershed context, and the need for science in the overarching categories identified by the IEP Directors.
- Follow a strategy to integrate priorities into work planning by focusing on (a) leadership, (b) scientific investigations, (c) fiscal responsibility, and d) integration with other priorities.
- Capitalize on the experience and perspectives of Project Work Teams (PWTs) and IEP Stakeholders to establish candidate priority monitoring and research.

2021 IEP Work Plan – Summary

Category Overview and Summary	Amount (\$1,000)#
<i>Category I. Compliance and Monitoring</i>	
A. Compliance	\$17,554
B. Baseline Status and Trends	\$1,620
Subtotal	\$19,174
<i>Category II. Special Study Elements</i>	
A. Synthesis, Modeling and Reviews	\$906
B. Directed Studies	\$12,600
Subtotal	\$13,506
<i>Category III. Program Support Elements</i>	
A. Program Management	\$1,207
Subtotal	\$1,207
<i>Category IV. Teams and Outreach</i>	
A. Project Work Team (PWT)	\$0
B. Technical Team (TT)	\$0
C. Workshop	\$0
Subtotal	\$0
Total	\$33,887

Category I. Compliance and Monitoring

Sub Category A. Compliance

Element	Title	PI	Amount (\$1,000)#
2021-003	Fall Midwater Trawl Survey (FMWT)	S. Slater, CDFW	\$725
2021-007	Summer Towntnet Survey (STN)	T. Malinich, CDFW	\$725
2021-011	Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)	K. Hieb, CDFW	\$882
2021-012	Bay Shrimp and Crab Abundance and Distribution Surveys (Bay Study)	K. Hieb, CDFW	\$234
2021-029	San Francisco Bay Salinity and Temperature Monitoring	M. Downing-Kunz, USGS	\$325
2021-030	Delta Flows Network	C. Ruhl, USGS	\$833
2021-033	20-mm Delta Smelt Survey (20 mm)	T. Tempel, CDFW	\$680
2021-053	Juvenile Salmon Monitoring (DJFMP)	G. Steinhart, USFWS	\$3,452
2021-059	Coleman Nat. Fish Hatchery Late-Fall-Run Production Tagging	K. Niemela, USFWS	\$220
2021-071	Mossdale Spring Trawl (Mossdale)	S. Tsao, CDFW	\$197
2021-072	Environmental Monitoring Program	S. Lesmeister, DWR	\$5,000
2021-073	San Joaquin River Dissolved Oxygen Monitoring	S. Lesmeister, DWR	\$73
2021-074	Central Valley Juvenile Salmon and Steelhead Monitoring (Knights Landing)	M. Kilgour, CDFW	\$765
2021-077	Upper Estuary Zooplankton Sampling	A. Barros, CDFW	\$462
2021-088	Spring Kodiak Trawl (SKT)	A. Chorazyczewski, CDFW	\$450
2021-093	UCD Suisun Marsh Fish Monitoring	T. O'Rear, UC Davis	\$250
2021-096	Smelt Larva Survey (SLS)	A. Chorazyczewski, CDFW	\$350
2021-301	Juvenile Salmon Emigration Real Time Monitoring (DJFMP)	G. Steinhart, USFWS	\$221
2021-311	Tidal Wetland Monitoring Pilot Study	C. Bowles, CDFW	\$1,710
		Subtotal	\$17,554

Sub Category	B. Baseline Status and Trends		
Element	Title	PI	Amount (\$1,000)#
2021-002	Adult Striped Bass Population Estimates	J. Hobbs, CDFW	\$345
2021-005	Adult Sturgeon Population Estimates	J. Hobbs, CDFW	\$345
2021-047	Yolo Bypass Fish Monitoring Program (YBFMP)	B. Schreier, DWR	\$810
2021-279	Liberty Island Fish Survey (DJFMP)	B. Mahardja, USFWS	\$120
2021-303	Salmon Survival Studies (DJFMP)	B. Matthias, USFWS	\$0
Subtotal			\$1,620

Category II. Special Study Elements

Sub Category	A. Synthesis, Modeling and Reviews		
Element	Title	PI	Amount (\$1,000)#
2021-043	Estimation of Pelagic Fish Population Sizes	Lara Mitchell, USFWS	\$150
2021-208	Statistical Support (DJFMP)- Delta Smelt Life Cycle Model	Lara Mitchell, USFWS	\$232
2021-249	Gear Efficiency in Support of Delta Smelt Modeling Efforts	Lara Mitchell, USFWS	\$0
2021-327	Status, Trends and Distribution of Cypriniform Fishes Native to the Sacramento-San Joaquin Delta, CA	B. Mahardja, USFWS	\$20
2021-334	Flow Alteration (FLOAT) Synthesis: Update Including 2018 and 2019	L. Brown, USGS	\$370
2021-336	Synthesis of IEP Zooplankton Sample Methodologies and Variation in Zooplankton Communities across Habitats	S. Bashevkin, DSP	\$0
2021-337	Forecasting Nutria Invasion in the Sacramento-San Joaquin Delta	V. Tobias, USFWS	\$0
2021-339	Landscape-Scale Analysis of Aquatic Vegetation Response to Treatment	S. Khanna, CDFW	\$0

Category II. Special Study Elements

Sub Category A. Synthesis, Modeling and Reviews

Element	Title	PI	Amount (\$1,000)#
2021-340	Understanding Climate Change Tools for San Francisco Estuary Analyses and Investigation of Thermal Refugia in Warming Waters	L. Brown, USGS	\$0
2021-341	Feasibility of Improving Juvenile Chinook Salmon Monitoring in the upper San Francisco Estuary through Enhanced Delta Smelt Monitoring	B. Mahardja, USFWS	\$80
2021-343	Patterns of Biodiversity and Biotic Homogenization of the Sacramento-San Joaquin Delta	R. Mckenzie, USFWS	\$54
Subtotal			\$536

Sub Category B. Directed Studies

Element	Title	PI	Amount (\$1,000)#
2021-062	Quantitative Analysis of Stomach Contents and Body Weight for Pelagic Fishes	C. Burdi, CDFW	\$184
2021-281	North Delta Flow Action: Role of Improved Yolo Bypass Flows on Delta Food Web Dynamics	L. Twardochleb, DWR	\$750
2021-322	Estimating Abundance of Juvenile Winter-run Chinook Salmon Entering and Exiting the Delta (SAIL)	B. Matthias, USFWS	\$1,357
2021-323	Synthesis of Juvenile Salmon Growth, Condition, and Delta Habitat Use Among Extreme Hydrologic Conditions	R. Johnson, UCD	\$581
2021-325	Enhanced Delta Smelt Monitoring (EDSM)	C. Johnston, USFWS	\$2,700
2021-326	Effect of Outflow Alteration upon Delta Smelt Habitat, Condition and Survival	A. Schultz, USBR	\$2,500
2021-329	Extracting Better Information from Long-Term Monitoring Data: Estimating Occupancy and Abundance of Near-		

Shore Fishes in the Sacramento-San
Joaquin River Delta

B. Mahardja, USFWS \$360

Sub Category B. Directed Studies

Element	Title	PI	Amount (\$1,000)#
2021-330	Aquatic Habitat Sampling Platform: Platform Utility and Delta Implementation Studies	J. Merz, CFS	\$390
2021-333	Enhanced Acoustic Tagging, Analysis, and Real-Time Monitoring	C. Michel, UCSC/NMFS	\$800
2021-335	Suisun Marsh Salinity Control Gate Study	R. Hartman, DWR	\$630
2021-345	Predation Dynamics Across Reach- Specific Gradients in Juvenile Salmon Survival	F. Feyrer, USGS	\$350
2021-346	Using Delta Smelt Enclosures to Support Species Recovery	B. Schreier, DWR	\$479
2021-347	Survey Design Review for IEP Long-term Monitoring Efforts, Year 1 (smelts)	S. Culberson, IEP	\$0
2021-348	Ecosystem Engineering Impacts of Water Primrose (Ludwigia spp.) in the Delta	E. Hestir, UCM	\$952
2021-349	Endangered winter-run Chinook salmon entrainment prediction tool: a machine learning approach to inform management	J. Gaeta, CDFW	\$0
2021-350	Assessing prevalence, pathways, and impacts of selenium exposure for fish species of concern in the Sacramento-San Joaquin Bay-Delta	F. Feyrer, USGS	\$567
Subtotal			\$12,600

Category III. Program Support Elements

Sub Category A. Program Management

Element	Title	PI	Amount (\$1,000)#
2021-OAC	IEP Oversight and Coordination	S. Fong, CDFW	\$1,207
Subtotal			\$1,207

Category IV. Teams and Outreach

Sub Category A. Project Work Team (PWT)

Element	Title	PI	Amount (\$1,000)#
2021-T03	Sturgeon PWT	A. Seesholtz, DWR J. Kelly, CDFW	\$0
2021-T04	Estuarine Ecology Team PWT	B. Herbold, DSC K. Kayfetz, DSC	\$0
2021-T05	Biotelemetry PWT	K. Clark, DWR	\$0
2021-T06	Spring Run Salmon PWT	F. Cordoleani, NOAA H. Brown, NOAA, M. Johnson, CDFW	\$0
2021-T07	Resident Fishes PWT	B. Mahardja, USFWS, M. Young, USGS	\$0
2021-T09	Tidal Wetland Monitoring PWT	S. Sherman, CDFW	\$0
2021-T11	Winter Run Salmon PWT	E. Meyers, CDFW	\$0
2021-T12	Juvenile Monitoring PWT	B. Poytress, USFWS	\$0
2021-T13	Central Valley Salmonid Hatchery PWT	K. Niemela, USFWS J. Smith, USFWS	\$0
2021-T14	Aquatic Vegetation PWT	S. Khanna, CDFW N. Rasmussen, DWR	\$0
2021-T15	Steelhead PWT	J. Nelson, CDFW	\$0
2021-T16	Upper Sacramento River Salmon PWT	J. Smith, USFWS	\$0
2021-T17	Contaminants PWT	K. Hoffmann, DWR	\$0
2021-T18	Flow Alteration PWT	L. Brown, USGS, A. Schultz, USBR	\$0
2021-T22	Predation PWT	A. Schultz, USBR, T. Pilger, FISHBIO	\$0
2021-T23	Water Quality and Nutrients PWT	S. Lesmeister, DWR, J. Cooke, CVRWCB	\$0

2021-T24	Genetics PWT	M. Baerwald, DWR E. W. Carson, USFWS J. Rodzen, CDFW	\$0
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		Subtotal	\$0
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Sub Category B. Technical Team (TT)

Element	Title	PI	Amount (\$1,000)#
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2021-T20	IEP Data Utilization Work Group	R. Hartman, DWR S. Culberson, DSC	\$0
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2021-T21	Central Valley Fish Facilities Review Team	J.C. Dealy, USBR	\$0
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		Subtotal	\$0
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Sub Category C. Workshop

Element	Title	PI	Amount (\$1,000)#
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2021-T01	2021 IEP Annual Workshop	S. Fong, CDFW	\$0
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		Subtotal	\$0
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		Program Total	\$33,887
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Footnotes:

“\$0”: This active or pending element does not have current year or carry over funding included in this work plan. These are typically time-only extensions during the publication phase, no cost studies, work pending future phases or implementation.

“#”: For planning purposes, rough cost estimates are provided for each work plan element as described with the assumption that required and optional study components will be implemented, although actual effort may be somewhat less depending upon factors such as the information needs of the agencies, funding availability, field conditions and outcomes of earlier studies. It is important to recognize that expenditures are actually planned and implemented in the budgets of the participating agencies, not through the IEP as a separate agency.

“1”: USBR and CDFW initiated an expedited review process so that potential improvements can be implemented as soon as possible. The survey redesign effort is being done by CDFW to satisfy a term in the 2021 cooperative agreement USBR has with CDFW to provide monitoring services that fulfill USBR permit requirements. Any changes approved through the redesign effort could modify the monitoring design, monitoring data produced, and the budget of surveys described in the 2021 IEP workplan that was approved by the IEP Directors in December 2020. In addition, the redesign effort may result in adjustments to the IEP Survey Design Review for Long-term Monitoring Efforts

(workplan number 2021-347). IEP member agencies acknowledge these changes may occur and that changes to monitoring designs would likely require modifications to this workplan. The IEP Coordinators Team will keep the IEP Directors Team informed about progress of the redesign effort and IEP Directors will be provided the opportunity to act on any potential changes to the IEP 2021 Workplan.

Superscript “1” has been attached to the following IEP elements:

2021-003 Fall Midwater Trawl Survey¹ FMWT S. Slater, CDFW, page 12

2021-007 Summer Townet Survey (STN)¹ T. Malinich, CDFW, page 13

2021-088 Spring Kodiak Trawl (SKT)¹ A. Chorazyczewski, CDFW, page 20

2021-033 20-mm Delta Smelt Survey (20 mm)¹ T. Tempel, CDFW, page 16

2021-096 Smelt Larva Survey (SLS)¹ A. Chorazyczewski, CDFW, page 21

2021-347 Survey Design Review for IEP Long-term Monitoring Efforts, Year 1 (smelts)¹
S. Culberson, IEP, page 35

“2”: Nexus information in this column is provided for convenience by Department of Water Resources and State Water Board staff.

2021 IEP Work Plan – Element Details

I. Compliance and Monitoring Elements

A. Compliance

2021-003 Fall Midwater Trawl Survey¹ (FMWT) S. Slater, CDFW

The Fall Midwater Trawl Survey was initiated by the California Department of Fish and Wildlife (CDFW) to determine the relative abundance and distribution of age-0 Striped Bass (*Morone saxatilis*) in the San Francisco Bay/Sacramento-San Joaquin estuary. Sampling has been conducted annually since the project's inception in 1967, with the exceptions of 1974 and 1979. While initiated for the purpose of sampling Striped Bass, the survey is designed to sample pelagic species and the data has been routinely used for other upper estuary pelagic species, including Delta Smelt (*Hypomesus transpacificus*), Longfin Smelt (*Spirinchus thaleichthys*), American Shad (*Alosa sapidissima*), and Threadfin Shad (*Dorosoma petenense*). These species, along with Striped Bass, are considered important indicators of estuary health and all have suffered substantial population declines in recent decades. The Delta Smelt and Longfin Smelt are of particular importance because the former is listed and managed under both the United States and California Endangered Species Acts (ESA), while the latter is listed and managed by the state of California ESA. As a result, continuation of the FMWT survey is mandated by a federal Delta Smelt Biological Opinion for the coordinated operation of the Central Valley Project and the State Water Project. FMWT survey data are used to determine the allowable number of Delta Smelt (i.e., take of Delta Smelt) that can be entrained in the state and federal export facilities in the southern Sacramento-San Joaquin Delta.

Compliance with the following:

2018 USFWS BO	RPA 1,5
2020 CDFW ITP	Table 3.13-1; 3.13.7, 8.1.5.2, 8.3.3, and 8.5.2
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²

May also inform or follows up on:

2010 POD Work Plan – Expanded Monitoring
Central Valley Project Improvement Act (CVPIA)
FLOAT

Funding Agency	Amount in thousands of dollars
DWR	\$358
USBR	\$367
Total	\$725

2021-007 Summer Towntnet Survey¹ (STN) T. Malinich, CDFW

Summer Towntnet Survey (STN) is a long-term effort to monitor young pelagic fishes in the upper San Francisco Estuary. Since 1959, STN has sampled fixed locations from eastern San Pablo Bay to Rio Vista on the Sacramento River, and to Stockton on the San Joaquin River, and a single station in the lower Napa River. The study area was expanded in 2011 to include the Sacramento Deep Water Ship Chanel and Cache Slough. Currently, 40 stations are sampled every other week June through August using a conical, fixed-frame net, which is pulled obliquely through the water column 2 to 3 times at each station. Data collected at 31 stations are used to calculate annual relative abundance indices for age-0 Striped Bass and Delta Smelt. The remaining 8 stations are sampled to increase our understanding of juvenile fish abundance and distribution in the lower Napa River and the north Delta. In 2005, STN added a zooplankton net to assess fish food resources at each station and a subset of the fish collected are retained for diet analysis by CDFW researchers (see element # 062). The STN also measures water temperature, water clarity and specific conductivity. Managers and researchers use the data collected by STN to inform decisions and improve our understanding of the health of the upper San Francisco Estuary.

Compliance with the following:

2018 USFWS BO	RPA 5
2020 CDFW ITP	Table 3.13-1; 3.13.7
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²

May also inform or follows up on:

Delta Smelt Resilience Strategy (DSRS)
Suisun Marsh Salinity Control Gate Managed Flow Actions
North Delta Food Web Managed Flow Actions

Funding Agency	Amount in thousands of dollars
DWR	\$358
USBR	\$367
Total	\$725

2021-011 Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study) K. Hieb, CDFW

The San Francisco Bay Study (Bay Study) is conducted by CDFW and was implement in 1980 to determine the water quality needs of fish, crabs, and shrimp downstream of the delta. The Bay Study currently samples 52 stations monthly from South San Francisco Bay to the lower Sacramento and San Joaquin rivers with an otter trawl and midwater trawl, which are towed from a research vessel. The study is designed to sample young (age-0) fishes and crabs and juvenile and adult shrimp from open water, soft bottom habitats deeper than 3 meters. Note that shrimp are the focus of the companion program element "Shrimp Abundance and Distribution Survey". For the fish and crab program element, the Bay Study calculates and reports annual abundance

indices and abundance trends for 30+ species of fish and 5 species of crabs. We also track and reports seasonal abundance patterns and annual and seasonal distributional patterns for these species. Ultimately, the abundance trends and distributional patterns are related to physical factors - primarily freshwater outflow, but also ocean and estuarine water temperature, ocean upwelling, and ocean climate indices, such as the Pacific Decadal Oscillation and North Pacific Gyre Oscillation. The goal is to determine what factors may control recruitment and distribution of important estuarine and marine fishes and crabs that rear and reside in the San Francisco Estuary.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1; 3.13.7 and 8.1.5.2
D-1485	Terms 10a, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2, C-3 ²

May also inform or follows up on:

2018 USFWS BO

Funding Agency	Amount in thousands of dollars
DWR	\$441
USBR	\$441
Total	\$882

**2021-012 Bay Shrimp and Crab Abundance and Distribution Surveys
(Bay Study) K. Hieb, CDFW**

The San Francisco Bay Study (Bay Study) is conducted by CDFW and was implement in 1980 to determine the water quality needs of fish, crabs, and shrimp downstream of the delta. The shrimp program element is a companion to the "Estuarine and Marine Fishes and Crabs Abundance and Distribution Survey" element. The Bay Study currently samples 52 stations monthly from South San Francisco Bay to the Sacramento and San Joaquin rivers with an otter trawl and midwater trawl, which are towed from a research vessel. The study is designed to sample young (age-0) fishes and crabs and juvenile and adult shrimp from open water, soft bottom habitats deeper than 3 meters. For the shrimp program element, the Bay Study calculates and reports annual abundance indices and abundance trends for 6 common species of shrimp. We also track and report seasonal abundance patterns and annual and seasonal distributional patterns for these species. Ultimately, the abundance trends and distributional patterns are related to physical factors - primarily freshwater outflow, but also ocean and estuarine water temperature, ocean upwelling, and ocean climate indices, such as the Pacific Decadal Oscillation and North Pacific Gyre Oscillation. The goal is to determine what factors may control recruitment and distribution of the most important estuarine and marine shrimp that rear and reside in the San Francisco Estuary.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1; 3.13.7 and 8.1.5.2
D-1485	Terms 10a, 10c

D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2, C-3 ²
Funding Agency	Amount in thousands of dollars
DWR	\$117
USBR	\$117
Total	\$234

**2021-029 San Francisco Bay Salinity and Temperature Monitoring
M. Downing-Kunz, USGS**

Freshwater outflow from the Central Valley to the estuary is highly modified by water diversions and flood control. This in turn alters the distribution of salinity, temperature, and associated habitat in the estuary. This study collects data to observe the spatial variability of temperature and salinity throughout the estuary. Data are collected every 15 minutes at six sites; in most cases, sites have sensors at two depths to observe vertical variations. These data improve our understanding of water quality and transport processes, provide ancillary data that support the calibration of numerical models including those used to simulate habitat, pollutant transport, dredged material disposal, and wetland restoration. This project is an ongoing monitoring study designed to identify long term trends.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11a
USBR BA/ROD	Adaptive Management Program Monitoring, Table C-3 ²
Funding Agency	Amount in thousands of dollars
DWR	\$304
USGS	\$21
Total	\$325

2021-030 Delta Flows Network C. Ruhl, USGS

The US Geological Survey, Bay Delta Hydrodynamics Program has been collecting water level, velocity, and flow data in the Sacramento-San Joaquin Delta since 1978. Today, the flow network includes 35 stations throughout the Delta and in some cases have expanded to include water quality data collection as well. The data collected at these stations are critical for understanding the circulation and mixing patterns in the complex and interconnected channels that comprise the Delta region. Understanding Delta hydrodynamics is imperative to documenting current conditions and to understanding the impacts of proposed major infrastructure projects and regulatory actions being taken to protect threatened and endangered species in the Delta.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
D-1485	Term 10a, 10b, 10c
D-1641	Term 11a, Table 5, Figure 4

May also inform or follows up on:
2018 USFWS BO
POD

Funding Agency	Amount in thousands of dollars
DWR	\$757
USGS	\$76
Total	\$833

2021-033 20-mm Delta Smelt Survey¹ (20 mm) T. Tempel, CDFW

The 20-mm Survey samples the upper San Francisco Estuary every other week from March through July at 47 fixed stations to determine the distribution and abundance of juvenile Delta and Longfin Smelt. Results from this survey are provided in near-real time to assess the entrainment risk.

Compliance with the following:

2020 USFWS BO	RPA 5
2020 CDFW ITP	Table 3.13-1; 3.13.7 and 8.4.2
D-1485	Term 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²

Funding Agency	Amount in thousands of dollars
DWR	\$340
USBR	\$340
Total	\$680

2021-053 Juvenile Salmon Monitoring (DJFMP) G. Steinhart, USFWS

This element will conduct weekly beach seining (year-round) within the lower Sacramento River and Delta and the lower San Joaquin River, and bi-weekly seining (year-round) in San Francisco Bay and San Pablo Bay to monitor the relative abundance and distribution of juvenile Chinook Salmon in unobstructed near-shore habitats. In addition, year-round surface trawling is conducted at Chipps Island and Sacramento to monitor juvenile Chinook Salmon abundance entering and exiting the Delta, and surface trawling at Mossdale from July to March to monitor the abundance and temporal distribution of juvenile Chinook Salmon entering the Delta. The surface trawling at Mossdale is conducted in cooperation with the California Department of Fish and Wildlife who monitor at Mossdale from April to June. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program and was combined with element 302 (Resident Fish Survey) for 2021).

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
2009 NMFS BO	11.2.1.3(8) d. pg. 586
D-1485	Terms 10a, 10b, 10c

D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²
USBR BA/ROD	Real-time Monitoring Table C-1 ²
Funding Agency	Amount in thousands of dollars
DWR	\$1,800
USBR	\$1,652
Total	\$3,452

**2021-059 Coleman Nat. Fish Hatchery Late-Fall-Run Production Tagging
K. Niemela, USFWS**

This element consists of coded-wire tagging of all Coleman National Fish Hatchery late fall-run production to ensure proper race identification during subsequent recovery of fish at Delta export facilities, and in juvenile and adult sampling programs. Approximately 1,100,000 late fall-run Chinook Salmon will be marked and tagged each year. Recovery of tagged late-fall run fish is also part of the spring-run recovery plan. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program.)

Compliance with the following:

2020 CDFW ITP	8.6.1 and 8.6.4
2009 NMFS RPA	2011 amendments (Action IV.3)
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in thousands of dollars
DWR	\$119
USBR	\$101
Total	\$220

2021-071 Mossdale Spring Trawl (Mossdale) S. Tsao, CDFW

The Mossdale Trawl occurs two miles downstream of Mossdale Landing County Park (river miles 56), and upstream of the Old River confluence. Timing and production (indices and estimates) for the out-migrating fall-run Chinook salmon smolts has been monitored at this location since 1987. Additionally, this trawl captures coded wire tagged Chinook smolts and is the primary capture site for these fish being used to estimate survival of Chinook smolts in the river system. Results from this project, therefore document information on the out-migration timing, survival, and the magnitude of non-marked smolt production from the San Joaquin Basin passing into the South Delta. The trawl also captures steelhead outmigrants and provides an index of these outmigrants for the entire San Joaquin River Basin.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1; 3.13.2
2009 NMFS BO	11.2.1.3-5, 11.2.1.3-8

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²
USBR BA/ROD	Real-time Monitoring Table C-1 ²
Funding Agency	Amount in thousands of dollars
DWR	\$167
CDFW	\$30
Total	\$197

2021-072 Environmental Monitoring Program S. Lesmeister, DWR

The Environmental Monitoring Program’s (EMP) monitoring and reporting requirements are described in Water Right Decision 1641 (D-1641). D-1641 requires that the EMP conduct a comprehensive environmental monitoring program to determine compliance with the water quality standards. The EMP is also mandated in the Incidental Take Permit for operation of the State Water Project. The EMP collects monthly discrete water quality, nutrients, phytoplankton, zooplankton and benthic samples and continuous water quality data throughout the San Francisco Bay Delta. The program objectives are to 1) document compliance with Bay-Delta water quality objectives; 2) maintain a long-term baseline record and provide a record of trends; 3) develop and improve predictive tools to assess changes within the Bay-Delta; 4) provide accurate and validated water quality information on a timely basis in a format appropriate for a variety of users; and 5) respond to the findings of ongoing monitoring, changing conditions within the Bay-Delta, and the needs of management with special studies.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1; 3.13.7
D-1641	Terms 3, 11a, 11c, 11d, and 11e, Table 5, Figure 4
USBR BA/ROD	Status and Trends Table C-2 ²

May also inform or follows up on:

FLOAT
POD

Funding Agency	Amount in thousands of dollars
DWR	\$2,500
USBR	\$2,500
Total	\$5,000

2021-073 San Joaquin River Dissolved Oxygen Monitoring S. Lesmeister, DWR

The EMP monitors dissolved oxygen levels in the Stockton Deep Water Ship Channel to ensure the water quality objectives are being met and to document long term trends. The EMP has a continuous water quality station near Rough and Ready Island (RRI) that records dissolved oxygen data every 15-minutes at three separate depths. If daily dissolved oxygen values remain below a threshold (5.5 or 6.5 mg/L) for three

consecutive days in a row, then additional monitoring is initiated to gather dissolved oxygen values upstream and downstream the RRI station.

Compliance with the following:

D-1641 Terms 11a, 11b, Table 5, Figure 4

Funding Agency Amount in thousands of dollars

DWR \$73

Total \$73

2021-074 Central Valley Juvenile Salmon and Steelhead Monitoring (Knights Landing) M. Kilgour, CDFW

The Middle Sacramento River Juvenile Salmon and Steelhead Monitoring Project at Knights Landing operates a monitoring site near the town of Knights Landing (rkm 144), consisting of paired, 8-foot rotary screw traps leashed together and anchored in river. Monitoring begins as water temperatures decrease in the fall allowing for the safe handling of trap captured fish, usually occurring mid to late August, and will continue until the end of June, as water temperatures increase, and safe handling of trap captured fish becomes a concern. Salmonid emigration data collected at this site provides an early warning of fish emigrating toward the Delta and allows for real-time adaptive management of CVP/SWP water operations. Trap catch is counted, identified to species, measured, and weighed. For salmonids specifically, data collection includes enumeration by race, life stage designation, fork length measurement and wet weight for assessing condition of individual fish. Daily catch and environmental conditions are summarized and made publicly available on the CalFish website at: <https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/SacramentoValleyTributaryMonitoring/MiddleSacramentoRiverSalmonandSteelheadMonitoring.aspx>.

Compliance with the following:

2020 CDFW ITP Table 3.13-1; 7.5.2

D-1485 Terms 10a, 10b, 10c

D-1641 Term 11b

USBR BA/ROD Real-time Monitoring Table C-1²

Funding Agency Amount in thousands of dollars

DWR \$378

USBR \$387

Total \$765

2021-077 Upper Estuary Zooplankton Sampling A. Barros, CDFW

The Zooplankton Study has estimated the abundance of zooplankton taxa in the upper San Francisco Estuary since 1972, as a means of assessing trends in fish food resources and is part of a D-1641 mandate to monitor water quality and related parameters. Sampling with three gear types occurs monthly at 22 stations located throughout San Pablo Bay, Suisun Marsh, Suisun Bay and the delta.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
D-1641	Term 11a, Table 5, Figure 4
USBR BA/ROD	Status and Trends Table C-2 ²

May also inform or follows up on:

FLOAT

Funding Agency	Amount in thousands of dollars
DWR	\$231
USBR	\$231
Total	\$462

2021-088 Spring Kodiak Trawl¹ (SKT) A. Chorazyczewski, CDFW

The Spring Kodiak Trawl targets adult Delta Smelt during their spawning season. The trawl samples 40 fixed stations throughout the upper San Francisco Estuary and is conducted monthly from December through May. Reproductive stage is determined for all Delta Smelt caught during this survey to approximate when and where spawning is occurring. Reproductive timing, abundance, and spatial and temporal distribution results are reported in near-real time to resource managers to evaluate Delta smelt entrainment risk at water export facilities.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1; 3.13.7, 8.1.5.1, and 8.1.5.2
2020 USFWS DS BO	
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²

Funding Agency	Amount in thousands of dollars
DWR	\$225
USBR	\$225
Total	\$450

2021-093 UCD Suisun Marsh Fish Monitoring T. O'Rear, UC Davis

The Suisun Marsh Fish Study, a collaboration among UC Davis, DWR, and volunteers that began in 1980, monitors fish and invertebrate assemblages monthly throughout Suisun Marsh, primarily with otter trawls and beach seines. The main purpose of the study has been to understand environmental and anthropogenic factors affecting the aquatic community, in part by providing baseline data and methods for finer-scale ancillary studies focused on elucidating mechanisms. Aside from papers in peer-reviewed publications and presentations at conferences such as the Bay-Delta Science Conference, the primary conduit of the study's information is the annual report, which is completed each April and is available on either DWR's or UC Davis's websites (e.g., <https://watershed.ucdavis.edu/user/53/library>). Information collected by the study is

crucial for delineating long-term trends, documenting and understanding new species invasions, and gauging restoration and management actions.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
BCDC	4-84(M) Special Condition B
USACE	Permit 1622E58B Special Condition 1
Revised Suisun Marsh Monitoring Agreement (Agreement Number 4600000634)	
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
Funding Agency	Amount in thousands of dollars
DWR	\$250
Total	\$250

2021-096 Smelt Larva Survey¹ (SLS) A. Chorazyczewski, CDFW

The Smelt Larva Survey samples the upper San Francisco Estuary every other week from January through March at 43 fixed stations to determine the distribution and abundance of larval Longfin smelt. Results from this survey are provided in near-real time to assess the entrainment risk during the early life stages of Longfin smelt during their spawning season.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1, 3.13.7 and 8.4.2
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²
Funding Agency	Amount in thousands of dollars
DWR	\$175
USBR	\$175
Total	\$350

**2021-301 Juvenile Salmon Emigration Real Time Monitoring (DJFMP)
G. Steinhart, USFWS**

Beach seining and surface trawling are conducted 3 days/week from October 1st to January 31st near Sacramento to detect the arrival of older juvenile Chinook Salmon entering the Delta. Monitoring data are used to inform Delta Cross Channel Gate closure decisions from October 1st to December 15th in order to minimize the diversion and mortality of emigrating juvenile winter-run sized Chinook Salmon. These data also were and will continue to be used to inform biological opinions, and drought operations planning decisions. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program.)

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
D-1485	Terms 10a, 10b, 10c

D-1641	Term 11b
USBR BA/ROD	Status and Trends Table C-2 ²
USBR BA/ROD	Real-time Monitoring Table C-1 ²
2009 NMFS BO	11.2.1.3 (8) d. pg. 586
Funding Agency	Amount in thousands of dollars
DWR	\$82
USBR	\$139
Total	\$221

2021-311 Tidal Wetland Monitoring Pilot Study C. Bowles, CDFW

The CDFW Fish Restoration Program will collect fish and invertebrate data near existing and planned tidal wetlands. These data will provide information on how fish and invertebrate communities change pre-/post-restoration. A suite of sampling gears will be deployed to capture fish and invertebrates throughout the year to characterize their use, relative abundance, and community compositions at tidal wetlands. Over time, the Fish Restoration Program will assess the effectiveness tidal wetland restoration as it relates to providing food sources and habitat refuge for at-risk native fishes.

Compliance with the following:

2020 CDFW ITP	Table 3.13-1
2019 USFWS BO	

Funding Agency	Amount in thousands of dollars
DWR	\$1,710
Total	\$1,710

B. Baseline Status and Trends

2021-002 Adult Striped Bass Population Estimates J. Hobbs, CDFW

This element tags and releases striped bass, monitors the fishery, monitors the tagged: untagged ratio of Striped Bass, and synthesizes data collected. It provides population metrics such as harvest rate, survival rate, and abundance estimates. This element makes recommendations for management of the Striped Bass population and fishery.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:

- CVPIA
- Striped Bass Settlement
- FLOAT

Funding Agency	Amount in thousands of dollars
DWR	\$345
Total	\$345

2021-005 Adult Sturgeon Population Estimates

J. Hobbs, CDFW

This element tags and releases White Sturgeon, monitors the White Sturgeon fishery, monitors the tagged: untagged ratio of White Sturgeon, and synthesizes data collected. It provides population metrics such as harvest rate, survival rate, and abundance estimates. This element makes recommendations for management of the White Sturgeon population and fishery, including bycatch of Green Sturgeon.

Compliance with the following:

- D-1485 Terms 10a, 10b, 10c
- D-1641 Term 11b

May also inform or follows up on:

CVPIA

Funding Agency	Amount in thousands of dollars
DWR	\$
USBR	\$
Total	\$345

2021-047 Yolo Bypass Fish Monitoring Program (YBFMP) B. Schreier, DWR

The objectives of this interdisciplinary monitoring effort are to collect baseline data in the Yolo Bypass on lower trophic levels (phytoplankton, zooplankton, and aquatic insects), juvenile and adult fish and water quality. Understanding the specific environmental conditions that trigger migrations and enhanced survival and growth of native fishes (esp. salmon and smelt) are of critical importance for restoration efforts, and the Yolo Bypass is a critical linkage in the health of fish populations and the entire bay delta ecosystem. Furthermore, the mechanisms through which lower trophic organisms reach higher abundance in the Yolo Bypass are not well understood. The Yolo Bypass Fish Monitoring Program (YBFMP) will serve to fill in these information gaps. The Yolo Bypass has been identified as a high restoration priority by the National Marine Fisheries Service and US Fish and Wildlife Service Biological Opinions for delta smelt, winter & spring-run Chinook salmon. The YBFMP informs the restoration actions that are mandated or recommended in these plans, provides valuable response data for adaptively managing bypass weirs, and provides critical baseline data on floodplain ecology.

Compliance with the following:

- 2020 CDFW ITP Table 3.13-1

May also inform or follows up on:

- 2009 NMFS BO
- CVPIA
- 2008 USFWS BO
- Delta Smelt Resiliency Strategy (DSRS)

Funding Agency	Amount in thousands of dollars
DWR	\$810
Total	\$810

2021-279 Liberty Island Fish Survey (DJFMP)

B. Mahardja, USFWS

Liberty Island is a restoring wetland that provides important habitat for species of management concern, including delta smelt and Chinook Salmon. This element will currently focus on summarizing data that has been collected previously collected under this project. This includes monthly beach seining, and larval and zooplankton trawls from February through June which provides baseline data and serve as a reference site for future restoration efforts at Liberty Island and in conjunction with BDCP. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program.)

Compliance with the following:

May also inform or follows up on:

Funding Agency	Amount in thousands of dollars
DWR	\$60
USBR	\$60
Total	\$120

2021-303 Salmon Survival Studies (DJFMP)

B. Matthias, USFWS

The objective of this task is to assess juvenile salmon survival in the south Delta, and to determine the relative importance of factors influencing salmon survival as they move through the Delta. The results are used to inform several management groups (i.e., the Collaborative Adaptive Management Team's Salmon Scoping Team workgroup).

Compliance with the following:

May also inform or follows up on:

Funding Agency	Amount in thousands of dollars
DWR	In-kind Contribution
USBR	In-kind Contribution

II. Special Study Elements

A. Synthesis Study Elements

2021-043 Estimation of Pelagic Fish Population Sizes

L. Mitchell, USFWS

Estimates of fish abundance, and corresponding measures of uncertainty, are critical for assessing the status of the population, estimating vital rates such as survival and reproduction, and developing management actions aimed at population recovery and sustainability. This work focuses on advancing abundance estimation methods for multiple life stages of Delta Smelt based on a variety of sampling surveys, including the 20-mm Survey, Summer Townet Survey, Fall Midwater Trawl Survey, Spring Kodiak Trawl Survey, and the Enhanced Delta Smelt Monitoring program. Such abundance estimates serve as input data for models linking environmental covariates and management actions to population dynamics. This work also extends methods that were developed for Delta Smelt to Longfin Smelt, which is another species of management concern.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:
2010 POD Work Plan – On-Going Studies

Funding Agency	Amount in Thousands of Dollars
DWR	\$75
USBR	\$75
Total	\$150

**2021-208 Statistical Support (DJFMP)- Delta Smelt Life Cycle Model
L. Mitchell, USFWS**

The DSLCM is a state-space model for Delta Smelt population dynamics that is fit using long-term fish survey data sets from multiple surveys corresponding to different life stages (e.g., post-larvae, juveniles, sub-adults, and adults). The model is designed to estimate survival rates between life stages and recruitment rates between year-classes, and to establish a quantitative link between these rates and management actions and environmental conditions. The goal of the modeling effort is to provide guidance on effective management actions that would both prevent extinction and lead to a rebuilding of the population contingent on environmental conditions beyond the control of USFWS.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:
FLOAT
POD

Funding Agency	Amount in Thousands of Dollars
DWR	\$116
USBR	\$116
Total	\$232

**2021-249 Gear Efficiency in Support of Delta Smelt Modeling Efforts
L. Mitchell, USFWS**

Gear selectivity evaluations are needed to integrate catch data from multiple trawl surveys to estimate abundance and ultimately to model population dynamics for Delta Smelt and other species of management concern. Data from simultaneous, adjacent deployment of IEP survey gears during the tidal cycle has permitted the estimation of selection curves relating the relative capture probability of Delta Smelt and can be used

for other species of a given size across gears. The selection curves will be used directly within the hierarchical spatial-temporal Delta Smelt model currently being developed. In addition, we hope to quantify bias associated with sampling fishes at fixed sites for Summer Townet, Fall Midwater and Spring Kodiak surveys with random site selection. This work would use current data from the CDFW surveys listed and Enhanced Delta Smelt Monitoring data from the USFWS.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:

POD

Funding Agency	Amount in Thousands of Dollars
USFWS	In-kind Contribution
CDFW	In-kind Contribution

2021-327 Status, Trends and Distribution of Cypriniform Fishes Native to the Sacramento-San Joaquin Delta, CA B. Mahardja, USFWS

Aside from the previously listed Sacramento Splittail (*Pogonichthys macrolepidotus*), little is known about the current status, trends, and distribution of the native cypriniform fish species in the Sacramento-San Joaquin Delta. The historical distributions of Sacramento Pikeminnow (*Ptychocheilus grandis*), Hitch (*Lavinia exilicauda*), and Sacramento Sucker (*Catostomus occidentalis*) cover a fairly broad geographic area in the San Francisco Estuary. However, there has been no systematic investigation of the abundance and distribution trends for these cypriniform species and there is some evidence suggesting that these native species today exist only in scattered, small populations around the Delta. This effort will address knowledge gaps associated with these species.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
DWR	\$10
USBR	\$10
Total	\$20

2021-334 Flow Alteration (FLOAT) Synthesis: Update Including 2018 and 2019 L. Brown, USGS

In water year of 2018, we have an opportunity to study the response of Delta Smelt and their ecosystem to two major flow alteration actions intended to improve the status of Delta Smelt: Suisun Marsh Salinity Control Gate Operation in Summer and the North

Delta Food Web Action in the Summer-Fall. Also, 2019 was a wet year and wet years are hypothesized to be beneficial for the Delta Smelt population. There is a need to assess the data collected before, during, and after these events to assess their effects on the Delta Smelt population.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
DWR	\$184
USBR	\$137
ICF	\$15
DSC	\$15
USGS	\$12
MWD	\$7
Total	\$370

2021-336 Synthesis of IEP Zooplankton Sample Methodologies and Variation in Zooplankton Communities across Habitats S. Bashevkin, DSP

The objective of this IEP Synthesis project is to assess and describe the variation in sampling and lab processing methodologies used for zooplankton across different IEP monitoring programs and special studies. Our project is to review the various field collection, lab processing, and organism identification methodologies employed by different programs, and to devise methodologies to better integrate datasets. An integrated dataset will be produced that may be useful for performing comparative analyses that are not possible using data from single surveys. We hope to use the integrated dataset to explore variation in zooplankton communities across habitat types, environmental covariates, and Delta regions.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
DSP	In-kind Contribution
DWR	In-kind Contribution
CDFW	In-kind Contribution
USGS	In-kind Contribution

2021-337 Forecasting Nutria Invasion in the Sacramento-San Joaquin Delta V. Tobias, USFWS

Nutria (*Myocastor coypus*) are an invasive species that were recently discovered in the southern San Joaquin River watershed. This project will help the IEP agencies to

identify impacted and at-risk habitats and to quantify the rate of advancement in the Delta. To do this, this program element will identify habitat and forecast distributions of nutria in the Delta. This synthesis project uses existing data to produce models and maps, with the goal of informing plans for detection and eradication.

Funding Agency	Amount in Thousands of Dollars
USFWS	In-kind Contribution
CDFW	In-kind Contribution

2021-339 Landscape-Scale Analysis of Aquatic Vegetation Response to Treatment S. Khanna, CDFW

Floating, submerged and emergent invasive plant species are now ubiquitous in the Delta, and may have profound effects on physical habitat as well as food web dynamics for fish species of management concern. This study is an IEP Synthesis effort that will integrate a historical and ongoing dataset of the Delta IAV coverage and DBW IAV treatment records for the past 14 years. It seeks to determine if treatment efficacy differs across space (e.g., different habitat types) and time. It will assess the impact of IAV control effort on the distribution, growth rate, spread and persistence, and species richness and community composition of the IAV communities.

May also inform or follows up on:
Delta Smelt Resiliency Strategy (DSRS)

Funding Agency	Amount in Thousands of Dollars
CDFW	In-kind Contribution
DWR	In-kind Contribution
DSP	In-kind Contribution
OTHER	In-kind Contribution

2021-340 Understanding Climate Change Tools for San Francisco Estuary Analyses and Investigation of Thermal Refugia in Warming Waters L. Brown, USGS

This element will form an IEP Climate Change Project Work Team, which will conduct a synthesis of completed research relevant to climate change and an assessment of available modeling tools for future research. In a quantitative effort, a sub-team of the Project Work Team will analyze spatial and temporal patterns in water temperature using continuously collected data. The latter effort will include assessments of water temperature conditions as they relate to individual species' physiology and identify areas that may offer thermal refugia while other areas may exceed thermal thresholds for heat stress or lethal limits.

Funding Agency	Amount in Thousands of Dollars
DWR	In-kind Contribution

2021-341 Feasibility of Improving Juvenile Chinook Salmon Monitoring in the upper San Francisco Estuary through Enhanced Delta Smelt Monitoring B. Mahardja, USFWS

This study aims to evaluate the extent to which the Enhanced Delta Smelt Monitoring (EDSM) data can complement concurrent monitoring of juvenile salmonids in the upper San Francisco Estuary. A synthesis of juvenile Chinook Salmon data collected from the EDSM and other IEP long-term monitoring programs will be conducted to better understand the species' migration in the estuary and their behavioral diversity. Results from this synthesis effort will allow us to better understand juvenile salmon outmigration in the estuary and may help inform the development of future salmon monitoring program.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:

SAIL

Funding Agency	Amount in Thousands of Dollars
DWR	\$40
USBR	\$40
Total	\$80

2021-343 Patterns of Biodiversity and Biotic Homogenization of the Sacramento-San Joaquin Delta R. Mckenzie, USFWS

Habitat alteration and introduction of alien species have substantially changed communities and food webs of the Sacramento-San Joaquin Delta. This study will evaluate how fish community diversity of the Delta has changed over time and assess whether fish communities in the various regions within the Delta have become more homogeneous in recent years.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
DWR	\$40
USBR	\$14
Total	\$54

B. Directed Studies

2021-062 Quantitative Analysis of Stomach Contents and Body Weight for Pelagic Fishes C. Burdi, CDFW

The Diet and Condition study has provided information on the food habits of pelagic fishes in the estuary since 2005. We focus on the temporal and spatial differences in diet composition and feeding success of Delta Smelt, Striped Bass, Threadfin Shad, Longfin Smelt, Mississippi Silversides, and American Shad.

Compliance with the following:

D-1485 Terms 10a, 10b, 10c
D-1641 Term 11b

May also inform or follows up on:

Delta Smelt Resiliency Strategy (DSRS)
Directed Outflow Project
Suisun Marsh Salinity Control Gate
North Delta Food Web

Funding Agency	Amount in Thousands of Dollars
DWR	\$91
USBR	\$93
Total	\$184

2021-281 North Delta Flow Action: Role of Improved Yolo Bypass Flows on Delta Food Web Dynamics L. Twardochleb, DWR

In a collaborative effort between CA Department of Water Resources, US Bureau of Reclamation, CA Department of Fish and Wildlife, US Fish and Wildlife Service, United States Geological Survey and San Francisco State University, this project monitors and evaluates the effects of augmented summer and fall flows in the Yolo Bypass and North Delta areas on lower trophic food web dynamics and benefits to listed fish species. Using both continuous and discrete sampling approaches, this study will relate hydrologic patterns to chlorophyll-a, nutrients and primary productivity rates, plankton densities and composition (phytoplankton and zooplankton), contaminant concentrations, as well as water quality parameters such as electrical conductivity, turbidity, and dissolved oxygen.

Compliance with the following:

D-1485 Terms 10a, 10b, 10c
D-1641 Term 11b

2019 USFWS BO
2020 CDFW ITP

May also inform or follows up on:

Delta Smelt Resiliency Strategy (DSRS)
IEP FLOAT MAST

Funding Agency	Amount in Thousands of Dollars
DWR	\$750
Total	\$750

2021-322 Estimating Abundance of Juvenile Winter-run Chinook Salmon Entering and Exiting the Delta (SAIL) B. Matthias, USFWS

This is a continuation of a five-year project funded by DWR and CDFW and the Central Valley Project Improvement Act (CVPIA) in 2017. The objective of the project is to improve estimates of population abundances for fall, winter and spring run juvenile Chinook Salmon at Sacramento and Chipps Island by improving trawl efficiency estimates using data from releases of coded wire tags (CWT), acoustic tags (AT), and by genetically sampling the trawl catch in 2020 and 2021. The project will (1) develop statistical models for estimating trawl efficiencies using 2016-2020 data for paired AT-CWT releases of winter run and fall-run Chinook Salmon; (2) use 2016-2020 genetic sampling of trawl catch in combination with efficiency estimates to estimate population abundances of fall, spring and winter run at Sacramento and Chipps Island for 2016-2020; (3) implement trawl efficiency studies for multiple salmon runs in 2020-2021 informed by the 2016 and 2017 results and in coordination with hatcheries for inclusion of AT fish with existing CWT releases; and (4) combine trawl efficiencies with genetic samples of trawl catch to provide estimates of fall, spring and winter-run salmon abundance (with estimated precision) entering and exiting the Delta in 2016-2021.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
DWR	\$600
USBR (CVPIA)	\$757
Total	\$1,357

2021-323 Synthesis of Juvenile Salmon Growth, Condition, and Delta Habitat Use Among Extreme Hydrologic Conditions R. Johnson, UCD

This study aims to fill critical data gaps regarding the use of the Sacramento-San Joaquin Delta by juvenile Chinook salmon in 2014-2021, primarily to determine the annual outmigrant portfolio (proportion of different populations and life stages) entering and leaving the Delta, and the relative success of Delta vs. natal rearing (inferred by rearing duration, growth rate, diet and condition). This project quantifies the extent to which Delta rearing contributes to salmon population resiliency under different environmental conditions, including drought (2014-15) and flood (2017, 2019), and provides baseline data to provide insights into population-level responses to future habitat restoration and climate change.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
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D-1641

Term 11b

May also inform or follows up on:
Delta Smelt Resiliency Strategy (DSRS)
2008 USFWS BO

Funding Agency	Amount in Thousands of Dollars
DSP	\$372
USFWS	\$127
Other	\$82
Total	\$581

2021-325 Enhanced Delta Smelt Monitoring (EDSM) C. Johnston, USFWS

The primary objective of the Enhanced Delta Smelt Monitoring program (EDSM) conducted by the U.S. Fish and Wildlife Service is to enhance the data available for calculating life stage-specific estimates of abundance and distribution for Delta Smelt at management-relevant time scales. The EDSM program employs a stratified random sampling design that includes multiple crews trawling concurrently at multiple sites in pre-defined strata in the San Francisco Estuary. EDSM sampling occurs year-round via Kodiak trawls and 20 mm gear. Daily catch summaries and weekly abundance reports are distributed to managers and stakeholders. Catch data on smelt and salmonids are also made available to the Smelt Monitoring Team and Salmon Monitoring Team as part of their risk assessment processes.

Compliance with the following:

2019 USFWS BO	
2020 CDFW ITP	3.13.1, 3.13.6, 8.1.5.1, 8.1.5.2, and 8.5.2
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b
USBR BA/ROD	Real-time Monitoring Table C-1 ¹
Funding Agency	Amount in Thousands of Dollars
USBR	\$2,700
Total	\$2,700

2021-326 Effect of Outflow Alteration upon Delta Smelt Habitat, Condition and Survival A. Schultz, USBR

The Directed Outflow Project (DOP) is a continuing collaborative effort among a dozen state, federal and non-governmental groups, which will employ a focused spatial and temporal approach to evaluate the benefit of outflow alteration for Delta Smelt and its habitat in the fall resulting from the summer Delta outflow and Yolo Bypass Toe Drain actions. Paired data collections (same location and time) of abiotic and biotic habitat constituents will be used to test specific hypotheses that will assist in avoiding shortcomings of using data collected for different studies/hypotheses and/or across variable spatial/temporal scales. Sampling will occur during the Delta Smelt juvenile

rearing-stage, a period known to be associated with the location of the low salinity zone. Results from this and other related studies will inform evaluations on which particular outflow-related action or group of actions provides the most benefit for Delta Smelt.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
USBR	\$2,500
Total	\$2,500

**2021-329 Extracting Better Information from Long-Term Monitoring Data:
Estimating Occupancy and Abundance of Near-Shore Fishes in the
Sacramento-San Joaquin River Delta B. Mahardja, USFWS**

The purpose of this study is to expand IEP monitoring and inference to other dominant near-shore, littoral habitats not sampled by beach seines through the use of boat electrofishing. To accomplish this, we will sample key littoral fish species across various near-shore habitats in order to determine how best to estimate abundance, occupancy, capture probabilities, and related environmental drivers.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
USFWS	\$360
Total	\$360

**2021-330 Aquatic Habitat Sampling Platform: Platform Utility and Delta
Implementation Studies Joe Merz, Cramer Fish Sciences**

The Aquatic Habitat Sampling Platform (Sampling Platform) is a 26-ft boat, with adjustable concentrator net and smaller drift net attached to an adjustable sample chamber, containing cameras, water sampling equipment, and water quality sensors integrated with fish finder, GPS, and other data recording equipment. Depth of net opener brace can be adjusted. Images of organisms that pass through the live box are recorded via high definition, binocular video camera to facilitate enumeration, species identification and estimation of organism length. These organisms then re-enter the water column via the stern of the boat without physical handling. The Sampling Platform is an integrated aquatic species and habitat sampling system that can effectively sample fish and invertebrates and reveal habitat associations while having minimal or no "take" of sensitive species. The sampling apparatus is suspended by hydraulic arms allowing fine-scale adjustments to sampling depth during operation. Additionally, the sampling apparatus frame is attached via bolt and shear pin system to allow the frame

to "break-free" if something solid is encountered. Wheels attached to the net frame bottom allow the frame to roll over obstacles, reducing impact and facilitating continued sampling across variable habitats. Deployment of this versatile sampling system expands data collection to shallow and off-channel habitat, while offering the capability to transition to deeper and open water habitats, providing for reliable estimates of sampling efficiency and "catch" per unit effort and improving our knowledge about populations, habitat associations and major stressors of key organisms.

Funding Agency	Amount in Thousands of Dollars
DWR	\$390
Total	\$390

**2021-333 Enhanced Acoustic Tagging, Analysis, and Real-Time Monitoring
C. Michel, UCSC/NMFS**

Understanding the movement and survival rates of out-migrating salmonids in real-time is critical for resource managers to make informed decisions. Through the development of a website and deployment of real-time acoustic receivers, detections of acoustically tagged fish can be displayed in real-time at multiple locations in the Sacramento River, Delta and SF Bay (<https://calfishtrack.github.io/real-time/index.html>). Movement and survival rates are estimated between receiver sites and route selection is predicted at critical junctions in the Delta. ESA listed salmonids will be acoustic tagged and released at different locations during the winter and spring to track movement and survival rates in different regions, and relate survival to environmental factors such as flow, temperature and turbidity.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform of follows up on:
2009 NMFS BO

Funding Agency	Amount in Thousands of Dollars
USBR	\$800
Total	\$800

2021-335 Suisun Marsh Salinity Control Gate Study R. Hartman, DWR

The Suisun Marsh Salinity Control Gate (SMSCG) has been identified as a management tool to improve habitat conditions for Delta Smelt in summer-fall. The proposed effort is the scientific evaluation of the project. Much of the evaluation will be based on existing IEP surveys and instrumentation (e.g., Environmental Monitoring Program, Summer Towntnet Survey, Fall Midwater Trawl, Enhanced Delta Smelt Monitoring), but we will include some additional evaluation tools such as the deployment of hatchery Delta Smelt in custom cages at strategic locations during the SMSCG action.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

May also inform or follows up on:

Delta Smelt Resiliency Strategy (DSRS)

Funding Agency	Amount in Thousands of Dollars
DWR	\$630
Total	\$630

2021-345 Predation Dynamics Across Reach-Specific Gradients in Juvenile Salmon Survival F. Feyrer, USGS

The overarching goal of this project is to determine if predation by piscivorous fishes is an important explanatory driver of survival of juvenile Chinook Salmon emigrating through the north Delta. To achieve this goal, we seek to determine if variation in reach-specific characteristics of predation dynamics covary with survival of acoustic-tagged juvenile Chinook Salmon collected during the study period. This will be accomplished by comparing reach-specific characteristics of the piscivore community and its observed and modeled consumption of juvenile Chinook Salmon across a range of environmental conditions.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
USGS	\$350
Total	\$350

2021-346 Using Delta Smelt Enclosures to Support Species Recovery B. Schreier, M. Baerwald, DWR

Very little is known about the ability of captive-born Delta Smelt to survive under a range of field conditions, yet there are plans to use cultured Delta Smelt to evaluate management actions and support species recovery through population supplementation. Therefore, it is essential to determine under what circumstances they can be held in enclosures in the field. A critical related question regarding supplementation is if, and to what extent, levels of domestication of captive-born Delta Smelt affect their ability to survive in the wild.

Compliance with the following:

2019 USFWS BO	
2020 CDFW ITP	3.13.5
D-1485	Terms 10a, 10b, 10c

D-1641 Term 11b

May also inform or follows up on:
Suisun Marsh Salinity Control Gates

Funding Agency	Amount in Thousands of Dollars
DWR	\$479
Total	\$479

2021-347 Survey Design Review for IEP Long-term Monitoring Efforts, Year 1 (smelts)¹ S. Culberson, IEP

In 2020 a pilot effort was conducted to evaluate the feasibility, develop analytical tools, and establish procedures for more routinely evaluating the usefulness and applicability of core IEP long-term fish and environmental surveys. The pilot effort is focusing on community-based survey design and existing dataset characterization more so than ecological interpretation. A draft pilot project report on the initial effort was due in October 2020; a final report to the IEP Directors is planned for December 2020. In 2021 we propose to continue our review efforts as a regular and routine feature of the IEP Annual Work Plan, targeting core Delta and Longfin Smelt surveys.

Compliance with the following:

May also inform or follows up on:
IEP Science Strategy

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-348 Ecosystem Engineering Impacts of Water Primrose (*Ludwigia spp.*) in the Delta E. Hestir, UCM

The goal of this project is to determine whether the growth strategy of water primrose, its allelopathic properties, or factors related to plant community structure are the cause of marsh loss following water primrose invasion in the Delta. As part of our study, we will identify and map the marshes most vulnerable to loss and quantify the spatial trajectory of marsh loss during the past 15 years. The project will collect data in the field on polyphenols to test for allelopathy, and plant traits to compare terrestrial and aquatic life forms of the species. Field, drone, and archival remote sensing image data will be analyzed in the lab to test which of the above factors have been instrumental in the invasion success of this species.

Compliance with the following:

May also inform or follows up on:
Delta Science Plan

Funding Agency	Amount in Thousands of Dollars
CDFW	\$952
Total	\$952

**2021-349 Endangered winter-run Chinook salmon entrainment prediction tool:
a machine learning approach to inform management
J. Gaeta, CDFW**

The purpose of this project is to inform Science Requirement 7.5.3 of the 2020 CDFW Incidental Take Permit for State Water Project operations (California Department of Fish and Wildlife 2020b). More specifically, we propose developing a suite of statistical models that provide the Salmon Monitoring Team with predicted winter-run Chinook salmon detection in salvage given current or hypothetical conditions in the San Francisco Estuary. The primary deliverable of this effort will be an interactive web-tool that provides the Salmon Monitoring Team with a time-series estimating the probability of winter-run Chinook salmon salvage given current and recent conditions in the San Francisco Estuary as well as a scenario tool predicting winter-run Chinook salmon salvage given a user selected suite of near-future conditions. Ultimately, the goal of this effort is to increase our understanding of endangered winter-run Chinook salmon ecology and support the Salmon Monitoring Team’s efforts to provide water to the State of California while meeting the conservation need of minimize endangered species entrainment.

Compliance with the following:

2020 CDFW ITP	7.5.3 and 8.6.6
D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
CDFW	In-Kind Contribution

**2021-350 Assessing prevalence, pathways, and impacts of selenium exposure
for fish species of concern in the Sacramento-San Joaquin Bay-Delta
F. Feyrer, USGS**

Dynamic river-estuary ecosystems provide invaluable habitat for fish and wildlife. Yet, they are under threat from a range of stressors including climate change, eutrophication, freshwater diversions, invasive species, and contaminants. River-estuary environments are arguably among the most challenging systems in which to evaluate and manage contaminant risk due to complexities of physical transport in a tidal environment, movement of species between interconnected habitats, biogeochemical gradients, and competing resource needs of fish and wildlife with economic development. Selenium (Se) is both an essential element and potent teratogen and its contamination is strongly tied to core economic activities (e.g., agriculture, mining, and energy production). In the Sacramento-San Joaquin Bay-Delta, Se is concentrated primarily through the import of agriculturally irrigated salinized soils containing high levels of geologically derived Se in the San Joaquin Valley and within estuary point-source loading from oil refining and wastewater treatment effluents leading to elevated levels in fish and wildlife. How the movements of fish across the

landscape influence Se exposure at different points during their life history has been difficult to resolve due to the complexity of the system and the diverse sources of Se.

Compliance with the following:

D-1485	Terms 10a, 10b, 10c
D-1641	Term 11b

Funding Agency	Amount in Thousands of Dollars
USGS	\$567
NMFS	In-Kind Contribution
Total	\$567

III. Program Support Elements

A. Program Management

2021-OAC IEP Oversight and Coordination S. Fong, CDFW

The Lead Scientist, Coordinator Chair and Program Management staff provide support to participants in the areas of program governance, administration, and oversight to facilitate: Strategic leadership for the program and the guidance of science with collaboration and outreach to stakeholders, science forums and agency programs; Annual work planning of collaborative studies with introduction development, schedule, element descriptions, summaries, budget and nexus, and tracking of deliverables; Program analysis, reviews, documentation and recordation for governance, strategic planning and outreach including updates to program documents and MOUs; Internal and external communication of IEP priorities, activities, information, events; Science Strategy with overarching priorities, options and background; Scheduling, agenda, materials, facilitation, and notes for Science Management Team, Coordinator Team and Director meetings as well as team workshops, and offsite meetings as well as registration, hosting, poster session and mentoring of an annual workshop; and ESA permits (NMFS, USFWS) with adaptive management and reporting of species "take".

Compliance with the following:

1971 IEP MOU Formal Management Structure
 1992 IEP MOU Statement of Work 1,2
 1985 IEP MOU VIII. Program Coordination and Review
 2015 Business Practices Review

Funding Agency	Amount in Thousands of Dollars
DWR	\$425
USBR	\$408
DSP	\$201
CDFW	\$161
CDFW	\$12
Total	\$1,207

IV. Teams and Outreach

A. Project Work Team (PWT)

2021-T03 Sturgeon PWT A. Seesholtz, DWR and J. Kelly, CDFW

The Sturgeon Project Work Team encourages, facilitates, and coordinates sturgeon monitoring, research, and information dissemination, and provides a technical forum for Central Valley sturgeon issues. The objectives of the Sturgeon Project Work Team are to 1) Encourage, facilitate, and assist development of research on life history, distribution, population dynamics, abundance, and ecology of Central Valley sturgeon, 2) Encourage, facilitate, and assist development of monitoring and research to evaluate the effects of water development/management and other stressors on Central Valley sturgeon, 3) Identify research questions and data gaps, 4) Provide technical review of sturgeon research, monitoring, and restoration proposals and recommendations on technical issues related to the protection, restoration, and management of sturgeon, 5) Promote dissemination of project updates, research results, and current literature among scientists, resource managers, restoration specialists, and constituent organizations, and 6) Promote sustainable management of California's sturgeon species. The Sturgeon PWT meets twice a year, with occasional special sessions or subcommittee meetings, as needed.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T04 Estuarine Ecology Team (EET) PWT B. Herbold and K. Kayfetz, DSC

The Estuarine Ecology Team (EET) is an interdisciplinary forum to improve understanding of the Bay-Delta ecosystem, by fostering communication and collaboration among scientists. The purpose of the group is to provide a forum for emerging scientific ideas and problems and improve scientific communication. There are many other project work teams in the IEP landscape, generally focused on specific species, habitats, or management actions. The EET is a place to take on broader ecological issues with an interdisciplinary group. Some characteristics that make EET unique are that it explicitly makes connections with ecosystems upstream and downstream of the Delta, considers linkages and interactions between species across trophic levels, and fosters interdisciplinary partnerships.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T05 Biotelemetry PWT K. Clark, DWR

The mission of the IEP Biotelemetry PWT is to provide a conduit for communication and coordination among scientists engaged in biotelemetry activities in the Central Valley, Delta, Estuary and near shore Pacific Ocean. This communication entails regular meetings, identification and discussion of current and future projects, and proposal review as solicited to facilitate collaboration, standardization of methods and

technologies where possible and the leveraging of resources. The purpose of the Biotelemetry PWT is to coordinate Biotelemetry Projects taking place in the Central Valley and provide a forum for collaboration between Biotelemetry projects within the Central Valley (sharing equipment, tagged fish, etc.). In the coming year, the Biotelemetry PWT will focus on communicating the need for stable funding for the Core 69 khz receiver array and soliciting volunteers to help maintain some 69 khz receivers at core locations. The Biotelemetry PWT meets twice per year.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T06 Spring Run Salmon PWT F. Cordoleani, H. Brown, NOAA, and M. Johnson, CDFW

Since 1999 Central Valley spring-run Chinook (CVSC) salmon ESU is state and federally listed as a threatened species and is currently faced with three primary threats: (1) loss of most historic spawning habitat; (2) degradation of the remaining rearing and migration habitats; and (3) genetic introgression with the Feather River Fish Hatchery spring-run Chinook salmon strays (NMFS 2014). While a large amount of monitoring occurs in the Central Valley, the understanding of CVSC dynamics is still very data limited, and the existing CVSC salmon monitoring programs seem to be fragmented and lack a common thread. Therefore, the goal of the IEP spring-run Chinook salmon PWT is to provide a venue for scientists from diverse agencies/groups to coordinate and synthesize findings, which will in turn inform research and monitoring needs in the future. Key roles and activities include: 1) coordination on in-season status and trend monitoring updates, 2) technical guidance to IEP Lead Scientist, Coordinators and Directors on science priorities, 3) development, coordination, and technical review of management-relevant research and studies for IEP and other partners (e.g., modeling, manipulation, and monitoring). The PWT meet twice a year, in the spring and the fall of each year. Sub-teams that will potentially be created to tackle a specific PWT question will meet on a more regular basis (not determined yet) and report their conclusions to the PWT during the bi-annual meeting.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T07 Resident Fishes PWT B. Mahardja, USFWS, and M. Young, USGS

The IEP Resident Fishes Project Work Team (PWT) is a forum for information exchange, discussion, synthesis, and exploring and recommending next steps in research and monitoring activities related to populations of resident fishes in the San Francisco Estuary. Resident fishes are defined rather loosely to include fishes spending all or part of their life cycle as residents in the San Francisco Estuary. This definition will exclude salmonids and sturgeons because PWTs dedicated to these taxa already exist; however, we encourage members of these salmonid and sturgeon PWTs to share their information with the Resident Fishes PWT as certain topics are likely to be of interest to both groups. In the upcoming year, a few members of the Resident Fishes PWT is

planning to initiate a synthesis study on the native cypriniform fish species of San Francisco Estuary that have received little attention in the past. The Resident Fishes PWT will serve as an avenue for feedback and information/data exchange for this particular study. In addition to the continual update of the native cypriniform synthesis study, the Resident Fishes PWT will continue to highlight any important or management-relevant work on resident fish species that are not covered by the IEP workshop or other PWTs. The Resident Fishes PWT meets anywhere between 3-4 times a year depending on need and availability of presenters.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T09 Tidal Wetland Monitoring PWT S. Sherman, CDFW

The IEP Tidal Wetland Monitoring Project Work Team (TWM PWT) facilitates collaboration in the design of monitoring and research programs to evaluate the effectiveness of tidal wetland restoration in providing habitat and food web resources to native fishes, particularly Delta Smelt and juvenile Chinook Salmon. The geographic focus of the team’s work is the Sacramento-San Joaquin Delta and Suisun Marsh, but we strive to coordinate and collaborate with scientists who work in other areas of the estuary or watershed and with those who focus on non-fish aspects of wetland ecology. TWM PWT membership is open to all and currently includes experts in a wide variety of wetland-related disciplines as well as representatives of many agencies, universities, non-profits, and private interests. The team acts as a forum for the discussion of monitoring and research proposals and for presentation of preliminary results. The full team currently meets approximately quarterly, with sub-team meetings called as needed.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T11 Winter Run Salmon PWT E. Meyers, CDFW

The Winter-run Project Work Team coordinates research, monitoring and management activities for the state and federally listed endangered Sacramento River winter-run Chinook salmon. The team facilitates communication and information exchange on technical issues among the agencies and stakeholders. The team also provides advice, peer review, and recommendations on technical issues related to the protection, restoration, and management of winter-run Chinook. Each year the PWT submits a recommendation letter to the National Marine Fisheries Service for the calculation of the Winter Run Juvenile Production and Central Valley Project and State Water Project Take Estimates.

Team members currently include staff from the California Departments of Fish and Wildlife and Water Resources, The Metropolitan Water District of Southern California, National Marine Fisheries Service, Bureau of Reclamation, the U.S. Fish and Wildlife Service and other Stakeholders. The team meets bi-monthly or as needed.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T12 Juvenile Monitoring PWT B. Poytress, USFWS

The Juvenile Monitoring Project Work Team (JMPWT) is a satellite team of the Central Valley Salmonid Project Work Team. The goal of the JMPWT is to bring together biologists to collaborate in a manner that will benefit juvenile monitoring activities in the Central Valley. The specific objectives of the group include, but are not limited to increase the quality and utility of juvenile monitoring data, standardize sampling techniques (where applicable), improve methods for analyzing and presenting monitoring data, identify research questions and data gaps, provide expert recommendation and/or review of issues affecting juvenile salmonids, and collaborate on data compilation projects in an effort to expand the knowledge of fisheries biology within the Central Valley of California. Team members currently include staff from the California Department of Fish and Game and Water Resources, East Bay Municipal Utility District, United States Fish and Wildlife Service and Bureau of Reclamation, and various private consulting groups. Team meetings are held quarterly throughout the year.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T13 Central Valley Salmonid Hatchery PWT K. Niemela, USFWS, and J. Smith, USFWS

The Central Valley Hatchery Project Work team, a satellite team of the Central Valley Salmonid Project Work Team, facilitates communication and information exchange related to the propagation, marking and tagging, distribution, research, and monitoring of Chinook salmon and steelhead from Central Valley Hatcheries, including Livingston Stone National Fish Hatchery, Coleman National Fish Hatchery, Feather River Hatchery, Nimbus Fish Hatchery, Mokelumne River Hatchery, Merced River Hatchery, and the San Joaquin Conservation Hatchery. The team provides a forum for interagency coordination among hatchery managers and supervisors, and between hatchery managers and agency and stakeholder biologists involved in the management of Central Valley fisheries and recovery of listed stocks. The team will review issues related to Central valley hatchery production and discuss recommendations for improved hatchery management.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T14 Aquatic Vegetation PWT S. Khanna, CDFW and N. Rasmussen, DWR

The IEP Project Work Team (PWT) for Aquatic Vegetation formed to address a gap within the IEP science program for coordination of science efforts related to aquatic

vegetation, and the lack of a consistent monitoring program for aquatic vegetation coverage. The goals of the PWT are to provide a forum for research and monitoring activities, help guide and evaluate management efforts, and support development of work plans for new studies. In 2018, key activities include (1) development of a monitoring framework that, if implemented, would provide information that would address key management questions regarding aquatic vegetation and their ecology; (2) producing draft technical reports or manuscripts that synthesize current knowledge of aquatic vegetation ecology in the Delta, to accompany conceptual model schematics created in Winter 2016-2017; (3) provide feedback for ongoing research activities in the Delta, including support of the Delta Smelt Resiliency Strategy's action for enhanced control of aquatic vegetation in Delta Smelt habitat. The Aquatic Vegetation PWT meets on quarterly basis, with subcommittee meetings (e.g., Monitoring Framework Subcommittee) occurring more frequently.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T15 Steelhead PWT Ryon Kurth, CDFW and Mike Beakes, USBR

The primary goal of the Steelhead PWT is to serve as an open forum for information exchange, discussion, synthesis, and exploring and recommending next steps in research and monitoring activities related to coastal rainbow trout/steelhead populations in the Central Valley. Specific objectives include Identifying research questions and data gaps, standardizing sampling techniques and data collection, serving as technical advisory group to IEP, CVPIA, and other enhancement programs, collaborating on data compilation projects in an effort to expand the knowledge of fisheries biology within the Central Valley of California Team members currently include staff from the California Department of Fish and Wildlife and Water Resources, East Bay Municipal Utility District, United States Fish and Wildlife Service and Bureau of Reclamation, and various private consulting groups and partners.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T16 Upper Sacramento River Salmon PWT J. Smith, USFWS

The Upper Sacramento River Monitoring Project Work Team mission statement is "to meet on an annual basis to facilitate communication and information exchange among the agencies monitoring Chinook salmon and steelhead in the Upper Sacramento River Basin." The team traditionally meets in March to coordinate exchange of study plans prior to the upcoming field season. Since its formation, we have extended data sharing to include Green Sturgeon studies and ecological monitoring in the Upper River. In more recent years, at least half of the annual meeting has focused on informal oral presentations of the results of the monitoring activities conducted in previous years. The annual meeting chair rotates each year among US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife, National Marine Fishery Service, US Bureau of Reclamation, and the California Department of Water Resources. The year-to-year

primary contact for the PWT is James G. Smith - USFWS, Red Bluff Fish and Wildlife Office.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T17 Contaminants PWT K. Hoffmann, DWR

Although the IEP POD CWT was originally formed to investigate the role of contaminants in the POD, more recently, it has evolved to primarily be a forum for contaminant issues (including meetings to give input to the ISB for their Water Quality Review and to develop partnerships for developing grant proposals). The group continues to be a place to vet study ideas and share study results from various contaminant-related studies in the Delta. Subcommittees from the group have organized a biomarker workshop and contributed to the Tidal Wetland PWT's conceptual model.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T18 Flow Alteration PWT L. Brown, USGS, and A. Schultz, USBR

The main objective of the Flow Alteration (FLOAT) Project Work Team is to facilitate strong study design, data collection, data quality, data analysis, and communication with regard to flow alterations being considered by management agencies to improved conditions for Delta Smelt. FLOAT-MAST (Management Analysis and Synthesis Team) has been organized to Analyze and synthesize data and information through 2017. The FLOAT-PWT serves as a review body for FLOAT-MAST and as the main conduit of communication to the IEP community. The FLOAT-PWT meets approximately bimonthly. The FLOAT-MAST and sub teams within it will meet monthly or more frequently as needed.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T22 Predation PWT A. Schultz, USBR, and T. Pilger, FISHBIO

The intent of the Predation Project Work Team is to provide a forum to examine impacts of predators on native fish species. A Project Work Team can provide guidance on collaboration and coordination of predation studies, so existing work can become more productive and can better inform fisheries management. Specific functions of the team include the following: 1) provide a forum for discussion of current or planned projects related to predation upon fishes, 2) provide guidance on the development of work plans and studies, and 3) foster collaboration among different organizations currently working on predation studies.

Funding Agency	Amount in Thousands of Dollars
Other	In-kind contributions

2021-T23 Water Quality and Nutrients PWT S. Lesmeister, DWR, and J. Cooke, CVRWCB

The IEP Water Quality and Nutrients PWT will provide a venue for scientists from diverse agencies and groups to coordinate and synthesize data and information that will inform IEP research and monitoring needs for water quality and nutrients in the future.

Funding Agency Amount in Thousands of Dollars
Other In-kind contributions

2021-T24 Genetics PWT M. Baerwald, DWR, E. W. Carson, USFWS and J. Rodzen, CDFW

The Genetics PWT will provide a venue to communicate and coordinate current and proposed genetic activities in the SFE. Previously, a salmonid genetics PWT met to focus on coordinating research and monitoring of Central Valley salmon and steelhead genetics. Herein we propose to redirect and broaden the scope of the Salmon Genetics PWT to include genetic research and monitoring for any species found, at any point in its life cycle, in the San Francisco Estuary (SFE). Genetic analysis is a powerful and well-established tool that can be used to enhance the information content provided by existing monitoring programs and directly inform managers of biological effects from proposed and existing activities, such as restoration actions and modifications to water operations.

Funding Agency Amount in Thousands of Dollars
Other In-kind contributions

B. Technical Team (TT)

2021-T20 IEP Data Utilization Work Group (DUWG) R. Hartman, DWR and S. Culberson, DSC

The Data Utilization Workgroup (DUWG) is a multi-agency technical team established to address the IEP's data management needs by setting internal procedures and guidelines, defining and implementing shared data standards across member agencies, facilitating data sharing in a timely manner, and coordinating with other data management teams in the Delta science community. Studies that are included in the IEP Work Plan would follow any guidelines set up by DUWG; studies conducted by IEP partners could use these guidelines as they see fit. The DUWG's activities include (1) developing data standards and best practices, including minimum standards for data descriptions, definitions, and documentation, (2) increasing efficiency and openness of data sharing and interoperability among datasets, and (3) providing support for IEP member agencies. Membership in the DUWG is limited to individuals representing IEP member agencies and affiliated groups.

Funding Agency Amount in Thousands of Dollars
Other In-kind contributions

2021-T21 Central Valley Fish Facilities Review Team J.C. Dealy, USBR

The main objective of the Central Valley Fish Facilities Review Team is to review, coordinate activities, and provide oversight for Central Valley fish screen and fish passage projects. The team is comprised of scientists and engineers who generally meet two to three times per year but will meet more frequently if necessary. Meetings are used to introduce and provide guidance for new fish screen related study programs, provide updates for ongoing programs, and disseminate information on new fish screen technologies.

Funding Agency Amount in Thousands of Dollars
TBD In-kind contributions

C. Workshop

2021-T01 2021 IEP Annual Workshop S. Fong, CDFW

The IEP Annual Workshop is an informal event for sharing new research results and technical analyses that advance the understanding of scientific topics important to the IEP and the larger Delta science community. The informal nature of the workshop is intended to encourage and support junior staff participation, sharing of preliminary results, and open discussion. The workshop consists of sessions featuring a panel of speakers, with each panel dedicated to a specific topic of interest to IEP research needs. Priority is given to presentations that are required as “deliverables” in IEP contracts, but relevant work from other researchers working in the Bay-Delta is also featured. The workshop also hosts a substantial poster session, poster and presentation competition, and mentoring luncheon.

Funding Agency Amount in Thousands of Dollars
TBD In-kind contributions