

Interagency Ecological Program 2020 Annual Work Plan



December 12, 2019

A few words from the IEP Lead Scientist on the 2020 Annual Work Plan

There's a calm before a storm. Planning for Interagency Ecological Program activities for 2020 has certainly felt that way. With the recently issued Biological Assessments and Biological Opinions for the *Reinitiation of Consultation on the Coordinated Operations of the Central Valley Project and State Water Project*, the update of the State Water Resources Control Board *Water Quality Control Plan for the Bay-Delta* (and negotiations for voluntary settlement agreements in that regard), IEP Annual Program planning has had to take plenty of outside activities into account. It's not yet clear what implications these policy/regulatory updates will have on our monitoring enterprise, or upon any of our specific Program Elements. It's even uncertain what changes, if any, these reconsiderations of our monitoring enterprise will require of our membership agencies, even beyond the IEP.

At the moment, we stay the course for IEP's portion of our monitoring enterprise, but we are aware that substantial course correction may be needed soon to keep our programs relevant, reliable, and right-minded. IEP member agency staff are working through what the updated Biological Opinions and Control Plan will mean for our monitoring programs, and how information needs are changing for our agencies as the first quarter of the 21st Century unfolds. Meanwhile, we plan to launch a few important initiatives in 2020:

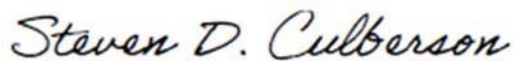
1. **Long-term Monitoring Program Element Review:** This Program Element will be a pilot effort to engage the IEP Science Management Team, independent scientists, and other data users to evaluate the mandates, rigor, effectiveness, and usefulness of several core long-term surveys. We think this review process should be an ongoing feature of the IEP Annual Work Plan, and we anticipate additional resources will be necessary to include meaningful evaluation of our program as an on-going endeavor. We are planning to evaluate most long-term IEP surveys for relevance in this regard over the next five years.
2. **Re-vamped and relocated IEP Website:** It has long been a desire to have a dedicated, self-administered IEP website, and we are moving to a new platform supported by the Department of Fish and Wildlife. We hope to have the new site up and running early in 2020. Watch for announcements!
3. **Remediation of existing Program documents for ADA compliance:** Given additional demands for State Agencies to certify that web-based information is compliant with the Americans with Disabilities Act (ADA), our new web site will be spare compared to what we've had in the past. The new site will initially be only a portion of what we eventually need. A significant number of documents predate ADA and were created with old technology that is not easily transitioned for compliance. Significant resources will need to be identified to help us remediate existing documents to regain their

availability on-line. Data and Program Element descriptions have been among the most called-for features by partners and stakeholders for our web site update/remake.

Along with a few new Directed Action Studies (Patterns of Biodiversity and Potential Biotic Homogenization of the San Francisco Estuary, PEN 2020-343; Developing an eDNA Metabarcoding Protocol to Improve Fish and Mussel Monitoring in the San Francisco Estuary, PEN 2020-344, and; Predation Dynamics Across Reach-specific Gradients in Juvenile Salmon Survival, PEN 2020-345) the 2020 Work Plan continues our compliance science emphasis as we contemplate the long-term trajectory of the Interagency Ecological Program. The Delta Independent Science Board has released a review outlining their perspective of IEP's ability to provide science supporting management of the Delta (a supportive and critical review), as well as two parts of a larger, Delta-wide Monitoring Enterprise Review ([ISB Meeting Agenda for 11/14/2019](#)). We anticipate many discussions in the next year of a broader Bay-Delta monitoring system that includes and builds upon what IEP is already providing to the Bay-Delta monitoring science community.

I hope you will join me in welcoming the challenges that face us as we aim to maintain the modern, management-relevant, robust, and world-class monitoring that the IEP has supported throughout its 50-year history, while grappling with our limited resources and changing needs. 2020 will be a year of much reflection and reconsideration for the Program and for the Bay-Delta at large as we confront climate change and evolving regional resource priorities.

Best wishes to all,

A handwritten signature in black ink that reads "Steven D. Culberson". The script is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Steven Culberson, Ph.D. IEP Lead Scientist January 2020

What is the Interagency Ecological Program?

The Interagency Ecological Program (IEP) is a consortium of three state agencies (California Department of Fish and Wildlife, California Department of Water Resources, State Water Resources Control Board) and six federal agencies (Bureau of Reclamation,

U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, National Marine Fisheries Service, and U.S. Geological Survey). 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 (CDWR 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.

- No funding for Solicited Research is identified for 2020.

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.

Table 1: 2020 IEP Workplan Summary. The workplan contains 71 elements across four categories with 50 of those workplan elements having costs totaling \$32,153,000.

Category Number	Category	Sub-Category	Number of Elements	Elements with Cost	Sub-Category Cost (\$1,000s)	Category Cost (\$1,000s)
1	Compliance and Monitoring Elements	Compliance	21	21	\$16,120	\$18,399
1	Compliance and Monitoring Elements	Baseline Status and Trends	6	6	\$2,279	\$18,399
2	Special Study Elements	Synthesis, Modeling and Reviews	7	6	\$631	\$12,547
2	Special Study Elements	Directed Studies	16	16	\$11,916	\$12,547
3	Program Support Elements	Program Management	1	1	\$1,207	\$1,207
4	Teams and Outreach	Project Work Team (PWT)	17	0	\$0	\$0
4	Teams and Outreach	Technical Team (TT)	2	0	\$0	\$0
4	Teams and Outreach	Workshop	1	0	\$0	\$0

Table 2: 2020 IEP Workplan Compliance and Monitoring Elements (Category 1) Compliance Sub-Category Summary. The workplan sub-category contains 21 elements; all 21 workplan elements have costs totaling \$16,120,000.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-003	12	Fall Midwater Trawl Survey (FMWT)	J. White, CDFW	\$677
2020-007	13	Summer Towntnet Survey (STN)	T. Malinich, CDFW	\$677
2020-011	14	Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)	K. Hieb, CDFW	\$732
2020-012	15	Bay Shrimp and Crab Abundance and Distribution Surveys (Bay Study)	K. Hieb, CDFW	\$204
2020-029	16	San Francisco Bay Salinity and Temperature Monitoring	M. Downing-Kunz, USGS	\$313
2020-030	17	Delta Flows Network	C. Ruhl, USGS	\$833
2020-033	18	20mm Delta Smelt Survey (20mm)	T. Tempel, CDFW	\$730
2020-053	19	Juvenile Salmon Monitoring (DJFMP)	C. Johnston, USFWS	\$2,825
2020-059	20	Coleman Nat. Fish Hatchery Late-Fall-Run Production Tagging	K. Niemela, USFWS	\$231
2020-071	21	Mossdale Spring Trawl (Mossdale)	S. Tsao, CDFW	\$129
2020-072	22	Environmental Monitoring Program	S. Lesmeister, DWR	\$4,800
2020-073	23	San Joaquin River Dissolved Oxygen Monitoring	J. Rinde, DWR	\$74
2020-074	24	Central Valley Juvenile Salmon and Steelhead Monitoring (Knights Landing)	J. Julianne, CDFW	\$568
2020-077	25	Upper Estuary Zooplankton Sampling	K. Hieb, CDFW	\$534
2020-088	26	Spring Kodiak Trawl (SKT)	L. Damon, CDFW	\$450
2020-093	27	UCD Suisun Marsh Fish Monitoring	J. Durand, UCD, T. O'Rear, UCD, and P. Moyle, UCD	\$250
2020-096	28	Smelt Larva Survey (SLS)	L. Damon, CDFW	\$330

2020-104	29	Operation of Thermograph Stations	D. Parker, USGS	\$53
2020-296	30	Longfin Smelt Investigations	M. Eakin, CDFW	\$445
2020-301	31	Juvenile Salmon Emigration Real Time Monitoring (DJFMP)	B.Mahardja, USFWS	\$173
2020-311	32	Tidal Wetland Monitoring Pilot Study - Phase 4	D. Contreras, CDFW	\$1,092

Table 3: 2020 IEP Workplan Compliance and Monitoring Elements (Category 1) Baseline Status and Trends Sub-Category Summary. The workplan sub-category contains 6 elements; all 6 workplan elements have costs totaling \$2,279,000.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-002	33	Adult Striped Bass Population Estimates	J. Hobbs, CDFW	\$339
2020-005	34	Adult Sturgeon Population Estimates	J. Hobbs, CDFW	\$333
2020-047	35	Yolo Bypass Fish Monitoring Program (YBFMP)	B. Schreier, DWR	\$802
2020-279	36	Liberty Island Fish Survey (DJFMP)	B.Mahardja, USFWS	\$217
2020-302	37	Resident Fish Survey (DJFMP)	B. Mahardja, USFWS	\$317
2020-303	38	Salmon Survival Studies (DJFMP)	G. Castillo, USFWS	\$271

Table 4: 2020 IEP Workplan Special Study Elements (Category 2) Synthesis, Modeling and Reviews Sub-Category Summary. The workplan sub-category contains 7 elements; 6 elements have costs totaling \$631,000.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-020	39	Science Advisory Group (SAG)	K. Gehrts, DWR	-
2020-043	40	Estimation of Pelagic Fish Population Sizes	L. Mitchell, USFWS	\$150
2020-208	41	Statistical Support (DJFMP)- Delta Smelt Life Cycle Model	L. Mitchell, USFWS	\$267
2020-249	42	Gear Efficiency in Support of Delta Smelt Modeling Efforts	L. Mitchell, USFWS	-
2020-320	43	Longfin Smelt Conceptual Model Development and Synthesis (MAST)	R. Baxter, CDFW (Retired)	-

2020-327	44	Status, Trends and Distribution of Cypriniform Fishes Native to the Sacramento-San Joaquin Delta, CA	B. Mahardja, USFWS	\$20
2020-334	45	FLoAT Mast Synthesis Effort	L. Brown, USGS	-
2020-336	46	Synthesis of IEP Zooplankton Sample Methodologies and Variation in Zooplankton Communities across Habitats	K. Kayfetz, DSP	-
2020-337	47	Forecasting Nutria Invasive in the Sacramento-San Joaquin Delta	V. Tobias, USFWS	-
2020-339	48	Landscape-Scale Analysis of Aquatic Vegetation Response to Treatment in Terms of Growth Rates, Persistence, Community Composition, and Biodiversity in the Delta	S. Khanna, CDFW	-
2020-340	49	Understanding Climate Change Tools for San Francisco Estuary Analyses and Investigation of Thermal Refugia in Warming Waters	L. Brown, USGS	-
2020-341	50	Feasible of Improving Juvenile Chinook Salmon Monitoring in the upper San Francisco Estuary through Enhances Delta Smelt Monitoring	B. Mahardja, USFWS and G. Castillo, USFWS	\$80
2020-342	51	Spatio-Temporal Community Patterns for Early Life Stages of Fish and their Associations with Zooplankton in the Upper San Francisco Estuary	G. Castillo, USFWS	\$60
2020-343	52	Patterns of Biodiversity and Biotic Homogenization of the Sacramento-San Joaquin Delta	B. Mahardja, USFWS	\$54

Table 5: 2020 IEP Workplan Special Study Elements (Category 2) Directed Studies Sub-Category Summary. The workplan sub-category contains 16 elements; all 16 elements have costs totaling \$11,916,000.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-062	53	Fish Diet and Condition	C. Burdi, CDFW	\$535
2020-089	54	Directed Field Collections	Vacant, CDFW	\$24
2020-281	55	North Delta Flow Action: Role of Improved Yolo Bypass Flows on Delta Food Web Dynamics	B. Davis, DWR	\$750
2020-322	56	Estimating Abundance of Juvenile Winter-run Chinook Salmon Entering and Exiting the Delta (SAIL)	G. Castillo, USFWS	\$1,362
2020-323	57	Reconstructing Juvenile Salmon Growth, Condition, and Delta Habitat Use in 2014-15 Drought and Beyond (SAIL)	A. Sturrock, UCD	\$476
2020-325	58	Enhanced Delta Smelt Monitoring (EDSM)	C. Johnston, USFWS	\$2,652
2020-326	59	Effect of Outflow Alteration upon Delta Smelt Habitat, Condition and Survival	A. Schultz, USBR	\$2,500
2020-328	60	Integrating Measurement of Fish Body Condition within the Delta Juvenile Fish Monitoring Program (DJFMP)	C. Graham, USFWS	\$42
2020-329	61	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	\$85
2020-330	62	Aquatic Habitat Sampling Platform: Standardized Fish Community Sampling Across Habitat Types	J. Merz, Cramer Fish Sciences, and E. Van Nieuwenhuyse, USBR	\$340
2020-331	63	Central Valley Salmonid Coordinated Genetic Monitoring (Year 4)	E. Buttermore USBR, J. Israel, USBR	\$966
2020-333	64	Enhanced Acoustic Tagging, Analysis, and Real-Time	E. Danner, NOAA	\$1,200

		Monitoring		
2020-335	65	Suisun Marsh Salinity Control Gate Study	T. Sommer, DWR	\$400
2020-338	66	Physiological and Behavioral Effects of Domestication on Delta Smelt	B. Davis, DWR	\$43
2020-344	67	Developing an eDNA metabarcoding protocol to improve fish and mussel monitoring in the San Francisco Estuary	A. Schreier, UCD	\$191
2020-345	68	Predation Dynamics Across Reach-Specific Gradients in Juvenile Salmon Survival	F. Feyrer, USGS	\$350

Table 6: 2020 IEP Workplan Program Support Elements (Category 3) Program Management Sub-Category Summary. The workplan sub-category contains one element with costs totaling \$1,207,000.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-OAC	69	IEP Oversight and Coordination	S. Fong CDFW	\$1,207

Table 7: 2020 IEP Workplan Teams and Outreach Elements (Category 4) Project Work Team (PWT) Sub-Category Summary. The workplan sub-category contains 7 elements; none of these workplan elements have costs.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-T03	70	Sturgeon PWT	A. Seesholtz, DWR, and J. Kelly, CDFW	-
2020-T04	71	Estuarine Ecology (EET) PWT	B. Herbold, and K. Kayfetz, DSC	-
2020-T05	72	Biotelemetry PWT	K. Clark, DWR	-
2020-T06	73	Spring Run Salmon PWT	F. Cordoleani, H. Brown,	-

			NOAA, and M. Johnson, CDFW	
2020-T07	74	Resident Fishes PWT	B. Mahardja, USFWS, and M. Young, USGS	-
2020-T09	75	Tidal Wetland Monitoring PWT	S. Sherman, CDFW	-
2020-T11	76	Winter Run Salmon PWT	E. Meyers, CDFW	-
2020-T12	77	Juvenile Monitoring PWT	B. Poytress, USFWS	-
2020-T13	78	Central Valley Salmonid Hatchery PWT	K. Niemala, USFWS, and J. Smith, USFWS	-
2020-T14	79	Aquatic Vegetation PWT	S. Khanna, CDFW and N. Rasmussen, DWR	-
2020-T15	80	Steelhead PWT	J. Nelson, CDFW	-
2020-T16	81	Upper Sacramento River Salmon PWT	J. Smith, USFWS	-
2020-T17	82	Contaminants PWT	K. Hoffmann, DWR	-
2020-T18	83	Flow Alteration PWT	L. Brown, USGS, and A. Schultz, USBR	-
2020-T22	84	Predation PWT	A. Schultz, USBR, and S. Ainsley, FISHBIO	-
2020-T23	85	Water Quality and Nutrients PWT	S. Lesmeister, DWR, and J. Cooke, CVRWCB	-
2020-T24	86	Genetics PWT	M. Baerwald, DWR, E. W. Carson, USFWS and J. Rodzen, CDFW	-

Table 8: 2020 IEP Workplan Teams and Outreach Elements (Category 4) Technical Team (TT) Sub-Category Summary. The workplan sub-category contains two elements; neither of these workplan elements have costs.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-T20	87	IEP Data Utilization Work Group (DUWG)	S. Culberson, DSC and B. Davis, DWR	-
2020-T21	88	Central Valley Fish Facilities Review Team	I.C. Dealy USBR	-

Table 9: 2020 IEP Workplan Teams and Outreach Elements (Category 4) Workshop Sub-Category Summary. The workplan sub-category contains one element without costs.

Element	Page	Title	P.I	Amount (\$1,000s)
2020-T20	89	IEP Data Utilization Work Group (DUWG)	S. Culberson, DSC and B. Davis, DWR	-

Note: For planning purposes, rough cost estimates (**Tables 1 - 9**) 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. Active or pending element without current year or carry over funding included in this work plan are typically time-only extensions during the publication phase, no cost studies, work pending future phases or implementation. The “Drought Operations” Monitoring category has been removed in the 2017 IEP Work Plan because the State Drought Funding expired June 30, 2016.

2020 Work Plan – Element Details

I. Compliance and Monitoring Elements

A. Compliance

2020-003 – Fall Midwater Trawl Survey (FMWT)

P.I. - J. White, 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:
 - 2008 FWS BO: RPA 1,5
 - CDFW LFS ITP: Cond. 8.1
- May also inform or follows up on:
 - 2010 POD Work Plan - Expanded Monitoring
 - CVPIA
 - FLASH
- Funding:
 - DWR: \$342,000
 - USBR: \$335,000
 - Total: \$677,000

2020-007 – Summer Townet Survey (STN)

P.I. - T. Malinich, CDFW

The Summer Townet 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 Channel 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 (*Morone saxatilis*) and Delta Smelt (*Hypomesus transpacificus*). 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:
 - 2008 FWS BO: RPA 5
- May also inform or follow up on:
 - 2010 POD Work Plan - Expanded Monitoring
- Funding:
 - DWR: \$342,000
 - USBR: \$335,000
 - Total: \$677,000

2020-011 – Estuarine and Marine Fish Abundance and Distribution Survey (Bay Study)

P.I. - K. Hieb, CDFW

The San Francisco Bay Study (Bay Study) is conducted by CDFW and was implemented 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 this 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 report on 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:
 - CDFW LFS ITP - Cond. 8.1
 - D-1485 - Term 10a, Term 10c
 - D-1641 - Term 11b
- May also inform or follows up on:
 - 2008 FWS BO
- Funding:
 - DWR: \$366,000
 - USBR: \$366,000
 - Total: \$732,000

2020-012 – Bay Shrimp and Crab Abundance and Distribution Surveys (Bay Study)

P.I. - K. Hieb, CDFW

The San Francisco Bay Study (Bay Study) is conducted by CDFW and was implemented 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 011). 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 and 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:
 - D-1641
- May also inform or follows up on:
 - D-1485
- Funding:
 - DWR: \$102,000
 - USBR: \$102,000
 - Total: \$204,000

2020-029 – San Francisco Bay Salinity and Temperature Monitoring

P.I. - 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 - Term 10a, Term 10c
- Funding:
 - DWR: \$282,000
 - USBR: \$31,000
 - Total: \$313,000

2020-030 – Delta Flows Network

P.I. - 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:
 - D-1485 - Term 10a, Term 10c
- May also inform or follows up on:
 - 2008 FWS BO
 - D-1641
 - POD
- Funding:
 - DWR: \$757,000
 - USBR: \$76,000
 - Total: \$833,000

2020-033 – 20mm Delta Smelt Survey (20mm)

P.I. - 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:
 - 2008 FWS BO: RPA 5
 - CDFW LFS ITP: Cond. 8.1
- May also inform or follows up on:
 - 2010 POD Work Plan - Expanded Monitoring
- Funding:
 - DWR: \$402,000
 - USBR: \$328,000
 - Total: \$730,000

2020-053 – Juvenile Salmon Monitoring (DJFMP)

P.I. - C. Johnston, USFWS

This element will conduct weekly beach seining (year-round) within the lower Sacramento River and Delta, weekly seining in the lower San Joaquin River (January through June), and bi-weekly seining in San Francisco Bay and San Pablo Bay (November through June) 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.)

- Compliance with the following:
 - 2009 NMFS BO: 11.2.1.3 (8) d. pg. 586
- Funding:
 - DWR: \$1,288,000
 - USBR: \$1,537,000
 - Total: \$2,853,000

2020-059 – Coleman Nat. Fish Hatchery Late-Fall-Run Production Tagging

P.I. - K. Niemela, USFWS

This element consists of coded wire tagging of all Coleman National Fish Hatchery late fall-run Chinook 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:
 - 2009 NMFS BO: IV.4, IV.3
- May also inform or follows up on:
 - 2009 NMFS BO
- Funding:
 - DWR: \$130,000
 - USBR: \$101,000
 - Total: \$231,000

2020-071 – Coleman Nat. Fish Hatchery Late-Fall-Run Production Tagging

P.I. - 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 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 nonmarked 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:
 - 2009 NMFS BO: 11.2.1.3 - 5), 11.2.1.3 - 8)
- Funding:
 - DWR: \$66,000
 - USBR: \$63,000
 - Total: \$129,000

2020-072 – Environmental Monitoring Program

P.I. - 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 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:
 - D-1641: Term 1, 3
 - 2008 FWS BO: RPA 5
- May also inform or follows up on:
 - FLASH
 - POD
- Funding:
 - DWR: \$2,400,000
 - USBR: \$2,400,000
 - Total: \$4,800,000

2020-073 – San Joaquin River Dissolved Oxygen Monitoring

P.I. - J. Rinde, 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: Term 1, 3, 11a, 11d, 11e
- Funding:
 - DWR: \$74,000
 - Total: \$74,000

2020-074 – Central Valley Juvenile Salmon and Steelhead Monitoring (Knights Landing)

P.I. - J. Julienne, CDFW

The Middle Sacramento River Juvenile Salmon and Steelhead Monitoring Project at Knights Landing operates a monitoring site near the town of Knights Landing (river km 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 in mid to late August, and continues 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:
 - 2009 NMFS BO: 11.2.1.3 - 5), 11.2.1.3 - 5), IV.1.1, IV
- Funding:
 - DWR: \$287,000
 - USBR: \$281,000
 - Total: \$568,000

2020-077 – Upper Estuary Zooplankton Sampling

P.I. - K. Hieb, 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 mandated by D1641. Three gear types are used at each station to target zooplankton of various sizes. Sampling occurs monthly at 18 to 23 stations located throughout San Pablo Bay, Suisun Marsh, Suisun Bay, and the Delta by DWR in conjunction with their Environmental Monitoring Program Discrete Water Quality Run. Zooplankton samples are preserved and returned to the CDFW laboratory in Stockton for processing. After samples are processed, data is QA/QCd by CDFW, and posted to the ftp site (ftp://ftp.wildlife.ca.gov/IEP_Zooplankton/). Products include data matrices, an annual status and trends report and a brief annual summary on the California Estuaries Portal. IEP management uses this data for synthesis activities (including Flow Alteration Management, Analysis and Synthesis Team) and to assess food web conditions in the upper San Francisco Estuary.

- Compliance with the following:
 - D-1485: Term 10a
 - D-1641: Term 11a
- May also inform or follows up on:
 - FLASH
 - POD
- Funding:
 - DWR: \$267,000
 - USBR: \$267,000
 - Total: \$534,000

2020-088 – Spring Kodiak Trawl (SKT)

P.I. - L. Damon, 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:
 - 2008 FWS BO RPA 1,2,5
 - CDFW LFS ITP Cond. 8.1
- May also inform or follows up on:
 - 2010 POD Work Plan - Expanded Monitoring
- Funding:
 - DWR: \$248,000
 - USBR: \$202,000
 - Total: \$450,000

2020-093 – UCD Suisun Marsh Fish Monitoring

P.I.s - J. Durand, UCD, T. O'Rear, UCD, and P. Moyle, UCD

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 both DWR's and 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:
 - BCDC 4-84(M): Special Condition B
 - ACOE Permit 16223E58B:Special Condition 1
 - Suisun Marsh Salinity Gates 1602
- May also inform or follows up on:
 - D-1485
 - POD
 - Revised SMMA (#600000634)
- Funding:
 - DWR: \$250,000
 - Total: \$250,000

2020-096 – Smelt Larva Survey (SLS)

P.I. - L. Damon, 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:
 - CDFW LFS ITP: 2081-2009-001-03
- May also inform or follows up on:
 - 2010 POD Work Plan Expanded Monitoring
 - D-1485
- Funding:
 - DWR: \$182,000
 - USBR: \$148,000
 - Total: \$330,000

2020-104 – Operation of Thermograph Stations

P.I. - D. Parker, USGS

Water-quality work at these sites consists of continuous monitoring of water temperature at sites 11303500, San Joaquin River at Vernalis, CA and 11389500, Sacramento River below Wilkins Slough near Grimes, CA. Measurements are recorded at fifteen minute intervals during the entire water year. Sediment sampling is conducted at site 11303500 (San Joaquin River at Vernalis, CA). Samples are normally collected once each day by the observer along with recording the water temperature and gage height. Additional sampling is conducted by USGS crews on a regular basis as part of the sampling protocols.

- Compliance with the following:
 - 2009 NMFS BO: I.2.1 (performance measures) I.4, IV
- May also inform or follows up on:
 - 2008 FWS BO
- Funding:
 - DWR: \$5,000
 - USBR: \$48,000
 - Total: \$53,000

2020-296 – Longfin Smelt Investigations

P.I. - M. Eakin, CDFW

This project has two broad objectives: 1) to investigate Longfin Smelt spawner use of lower estuary tributaries and estimate the contribution to the population of each tributary; and 2) to investigate the vertical distribution and migration behavior of Longfin Smelt, and how these factors might influence long-term fish monitoring data interpretation. This work is expected to improve our management and protection of this species.

- Compliance with the following:
 - Longfin Smelt Settlement: Final Study Plan
- Funding:
 - OTHER: \$345,000
 - OTHER: \$100,000
 - Total: \$445,000

2020-301 – Juvenile Salmon Emigration Real Time Monitoring (DJFMP)

P.I. - B.Mahardja, 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:
 - 2009 NMFS BO: 11.2.1.3 (8) d. pg. 586
- Funding:
 - DWR: \$79,000
 - USBR: \$94,000
 - Total: \$173,000

2020-311 – Tidal Wetland Monitoring Pilot Study - Phase 4

P.I. - D. Contreras, 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 of tidal wetland restoration as it relates to providing food sources and habitat refuge for at-risk native fishes. We anticipate reports based on the 2020 study plan will be completed by September 2021 and will begin the process to tease apart how new tidal wetlands restoration sites compare to established tidal wetlands.

- Compliance with the following:
 - 2008 FWS BO: RPA 4, Attachment B Action 6
 - 2009 NMFS BO: RPA Action I.2.6, I.6
 - CDFW LFS ITP: Condition 7.1
- Funding:
 - DWR: \$1,092,000
 - Total: \$1,092,000

B. Baseline Status and Trends

2020-002 – Adult Striped Bass Population Estimates

P.I. - J. Hobbs, CDFW

This element tags and releases Striped Bass, monitors the fishery, monitors the tagged:untagged ratio of Striped Bass, and from these data provides population metrics such as harvest rate, survival rate, and abundance estimates. This information provides the basis for recommendations for management of the Striped Bass population and fishery.

- May also inform or follows up on:
 - CVPIA
 - D-1485
 - FLASH
 - Striped Bass Settlement
- Funding:
 - DWR: \$339,000
 - Total: \$339,000

2020-005 – Adult Sturgeon Population Estimates

P.I. - 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 resulting from these and other efforts. It provides population metrics such as harvest rate, survival rate, and abundance estimates, which are used to make recommendations for management of the White Sturgeon population and fishery, including bycatch of Green Sturgeon.

- May also inform or follows up on:
 - CVPIA
- Funding:
 - DWR: \$170,000
 - USBR: \$163,000
 - Total: \$333,000

2020-047 – Yolo Bypass Fish Monitoring Program (YBFMP)

P.I. - 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.

- May also inform or follows up on:
 - 2009 NMFS BO
 - CVPIA
 - 2008 FWS BO
 - Delta Smelt Resiliency Strategy (DSRS)
- Funding:
 - DWR: \$802,000
 - Total: \$802,000

2020-279 – Liberty Island Fish Survey (DJFMP)

P.I. - 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 conducts beach seining every month, and larval and zooplankton trawls from February through June to provide baseline data and serve as a reference site for future restoration efforts at Liberty Island and in conjunction with the Bay Delta Conservation Plan. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program.)

- Funding:
 - DWR: \$129,000
 - USBR: \$88,000
 - Total: \$217,000

2020-302 – Resident Fish Survey (DJFMP)

P.I. - B. Mahardja, USFWS

This element conducts beach seining weekly or biweekly within the lower San Joaquin River and San Francisco and San Pablo bays to monitor the abundance and distribution of resident fishes in unobstructed littoral habitats. This survey provides status and trends information on fishes occurring within unobstructed littoral habitats. (Note: This is part of the US Fish and Wildlife Service Delta Juvenile Fish Monitoring Program.)

- Funding:
 - DWR: \$145,000
 - USBR: \$172,000
 - Total: \$317,000

2020-303 – Salmon Survival Studies (DJFMP)

P.I. - G. Castillo, 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).

- Funding:
 - USBR: \$271,000
 - Total: \$271,000

II. Special Study Elements

A. Synthesis, Modeling and Reviews

2020-020 – Science Advisory Group (SAG)

P.I. - K. Gehrts, DWR

The IEP Science Advisory Group (SAG) is a standing panel of independent external experts that was established in the 1990s. IEP regularly calls on the SAG to review IEP elements and provide advice on scientific issues. In addition to its permanent members, the SAG often includes additional "special members" with complementary expertise for individual reviews. Funding supports travel and meeting costs for the Science Advisory Group.

****PLACEHOLDER for 2020****

- Funding:
 - TBD: \$0
 - Total: \$0

2020-043 – Estimation of Pelagic Fish Population Sizes

P.I. - 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.

- May also inform or follows up on:
 - 2010 POD Work Plan - On-Going Studies
- Funding:
 - DWR: \$75,000
 - USBR: \$75,000
 - Total: \$150,000

2020-208 – Statistical Support (DJFMP)- Delta Smelt Life Cycle Model

P.I. - L. Mitchell, USFWS

The Delta Smelt Life Cycle Model (DSLCLM) 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 would both prevent extinction and lead to a rebuilding of the population contingent on environmental conditions beyond the control of USFWS.

- May also inform or follows up on:
 - FLASH
 - POD
- Funding:
 - DWR: \$110,000
 - USBR: \$157,000
 - Total: \$267,000

2020-208 – Gear Efficiency in Support of Delta Smelt Modeling Efforts

P.I. - 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.

Resources listed below consist of in-kind personnel time by agency

- May also inform or follows up on:
 - POD
- Funding:
 - DWR:
 - USBR:
 - Total:

2020-320 – Longfin Smelt Conceptual Model Development and Synthesis (MAST)

P.I. - R. Baxter, CDFW (Retired)

The goal of this study is to develop an agreed upon life history conceptual model(s) for Longfin Smelt and then build life stage the model(s) to: 1) identify the environmental drivers, habitat attributes and physical and biological processes influencing Longfin Smelt survival, abundance and distribution in the San Francisco Estuary; 2) identify and evaluate testable hypotheses about the drivers and/or habitat attributes most likely influencing survival or growth at each life stage; and 3) organize, synthesize and publish findings.

Resources listed below constitute in-kind personnel time by agency.

- May also inform or follows up on:
 - Longfin Smelt Settlement
- Funding:
 - CDFW:
 - USGS:
 - USFWS:
 - DSP:
 - OTHER:
 - Total:

2020-327 – Status, Trends and Distribution of Cypriniform Fishes Native to the Sacramento-San Joaquin Delta, CA

P.I. - 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.

- Funding:
 - DWR: \$10,000
 - USBR: \$10,000
 - Total: \$20,000

2020-334 – FLoAT MAST Synthesis Effort

P.I. - 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.

Resources listed below constitute in-kind personnel time by agency.

- Funding:
 - USBR:
 - DWR:
 - CDFW:
 - USGS:
 - USFWS:
 - DSP:
 - OTHER:
 - Total:

2020-336 – Synthesis of IEP Zooplankton Sample Methodologies and Variation in Zooplankton Communities across Habitats

P.I. - K. Kayfetz, 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 (open- water channels, shoals, marsh edges, vegetated areas, etc.) and Delta regions.across habitat types (open-water channels, shoals, marsh edges, vegetated areas, etc.) and Delta regions.

Resources listed below constitute in-kind personnel time by agency.

- Funding:
 - DSP:
 - DWR:
 - CDFW:
 - USGS:
 - Total:

2020-337 – Forecasting Nutria Invasion in the Sacramento-San Joaquin Delta

P.I. - 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 Interagency Ecological Program 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.

Resources listed below constitute in-kind personnel time by agency.

- Funding:
 - USFWS:
 - CDFW:
 - Total:

2020-339 – Landscape-Scale Analysis of Aquatic Vegetation Response to Treatment in Terms of Growth Rates, Persistence, Community Composition, and Biodiversity in the Delta

P.I. - 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 Invasive Aquatic Vegetation (IAV) coverage and Division of Boating and Waterways 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.

Resources listed below constitute in-kind personnel time by agency

- May also inform or follows up on:
 - Delta Smelt Resiliency Strategy (DSRS)
- Funding:
 - CDFW:
 - DWR:
 - OTHER:
 - DSP:
 - Total:

2020-340 – Understanding Climate Change Tools for San Francisco Estuary Analyses and Investigation of Thermal Refugia in Warming Waters

P.I. - 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.

Resources listed below constitute in-kind personnel time by agency

- Funding:
 - DSP:
 - DWR:
 - CDFW:
 - USFWS:
 - Total:

2020-341 – Feasibility of Improving Juvenile Chinook Salmon Monitoring in the upper San Francisco Estuary through Enhanced Delta Smelt Monitoring

P.I.s - B. Mahardja, USFWS and G. Castillo, USFWS

This study aims to evaluate the extent to which the Enhanced Delta Smelt Monitoring (EDSM, PEN-325) 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.

- Funding:
 - DWR: \$10,000
 - USBR: \$70,000
 - Total: \$80,000

2020-342 – Spatio-Temporal Community Patterns for Early Life Stages of Fishes and their Associations with Zooplankton in the Upper San Francisco Estuary

P.I. - G. Castillo, USFWS

This study will generate new understanding on spatial and temporal community patterns for the larval-juvenile fishes and zooplankton in the upper San Francisco Estuary. This study will also help to evaluate potential trophic associations between fish and zooplankton. To accomplish this, the study will primarily make use of the long-term (1995-2017) CDFW 20 mm survey data. Covariates derived from other IEP programs will also be considered to evaluate their influence on fish and zooplankton communities.

- Funding:
 - DWR: \$0
 - USBR: \$60,000
 - Total: \$60,000

2020-343 – Patterns of Biodiversity and Biotic Homogenization of the Sacramento-San Joaquin Delta

P.I. - B. Mahardja, 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 homogenous in recent years.

- Funding:
 - DWR: \$40,000
 - USBR: \$14,000
 - Total: \$54,000

B. Directed Studies

2020-062 – Fish Diet and Condition

P.I. - 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.

- May also inform or follows up on:
 - 2010 POD Work Plan - On-Going Studies
 - FLASH
- Funding:
 - DWR: \$270,000
 - USBR: \$265,000
 - Total: \$535,000

2020-089 – Directed Field Collections

P.I. - Vacant, CDFW

The Directed Field Collections project began during the Pelagic Organism Decline Investigations to provide collaborating researchers access to knowledgeable boat operators and research-capable boats so that they could collect physical and biological samples from the the upper estuary. This element has facilitated on-the-water sampling for investigations of contaminants, zooplankton reproduction, and fish (Delta Smelt) health, growth and diet measures.

- May also inform or follows up on:
 - 2008 FWS BO
 - 2010 POD Work Plan – Expanded Monitoring
 - FLASH
- Funding:
 - DWR: \$12,000
 - USBR: \$12,000
 - Total: \$24,000

2020-281 – North Delta Flow Action: Role of Improved Yolo Bypass Flows on Delta Food Web Dynamics

P.I. - B. Davis, DWR

In a collaborative effort between CA Department of Water Resources, US Bureau of Reclamation, CA Department of Fish and Wildlife, United States Geological Survey and San Francisco State University, this study will investigate the role of augmented summer and fall flows in the Yolo Bypass and North Delta areas on lower trophic food web dynamics and the 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 and turbidity. In addition, caged hatchery Delta Smelt will be monitored to determine the effects of the managed flow action and increased food web productivity on fish survival, growth, and behavior.

- May also inform or follows up on:
 - 2008 FWS BO
 - Delta Smelt Resiliency Strategy (DSRS)
- Funding:
 - DWR: \$750,000
 - Total: \$750,000

2020-322 – Estimating Abundance of Juvenile Winter-run Chinook Salmon Entering and Exiting the Delta (SAIL)

P.I. - G. Castillo, USFW

This is a continuation of a five year project funded by DWR and CDFW and the Central Valley Project Improvement Act 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 2018 and 2019. The project will (1) develop statistical models for estimating trawl efficiencies using 2016-2019 data for paired AT-CWT releases of winter run and fall-run Chinook Salmon; (2) use 2018 and 2019 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 in 2018 and 2019; (3) implement trawl efficiency studies for multiple salmon runs in 2018 and 2019 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 2018 and 2019.

- Funding:
 - USBR: \$757,000
 - DWR: \$605,000
 - Total: \$1,362,000

2020-323 – Reconstructing Juvenile Salmon Growth, Condition, and Delta Habitat Use in 2014-15 Drought and Beyond (SAIL)

P.I. - A. Sturrock, 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.

- May also inform or follows up on:
 - Delta Smelt Resiliency Strategy (DSRS)
 - 2008 FWS BO
- Funding:
 - DWR: \$267,000
 - USFWS: \$127,000
 - OTHER: \$82,000
 - Total: \$467,000

2020-325 – Enhanced Delta Smelt Monitoring (EDSM)

P.I. - 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 Working Group and Delta Operations for Salmonids and Sturgeon technical advisory team as part of their risk assessment processes.

- May also inform or follows up on:
 - 2008 FWS BO
- Funding:
 - USBR: \$2,635,000
 - Total: \$2,635,000

2020-326 – Effect of Outflow Alteration upon Delta Smelt Habitat, Condition and Survival

P.I. - 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.

- Funding:
 - USBR: \$2,500,000
 - Total: \$2,500,000

2020-328 – Integrating Measurement of Fish Body Condition within the Delta Juvenile Fish Monitoring Program (DJFMP)

P.I. - C. Graham, USFWS

The Delta Juvenile Fish Monitoring Program (DJFMP) obtains year-round catch counts and length frequencies of juvenile fish from established beach seine and trawl sites across the San Francisco Bay-Delta. However, the absence of weight measurements precludes the ability to examine more functional and proximate environmental factors driving fish health and survival in the Delta. The goal of this study is to test the utility of using Fulton's Condition Index (K), which is directly affected by food availability and environmental conditions, to assess underlying factors driving fish health and survival. To accomplish this goal, juvenile stages of Chinook Salmon, Sacramento Splittail, and Mississippi Silverside will be collected from DJFMP seines and trawls for lab-based measures of length, weight, and K. Overall, data collected in this study will allow a better understanding of the factors that drive spatial and temporal variability in K in the Delta.

- Funding:
 - DWR: \$21,000
 - USBR: \$21,000
 - Total: \$42,000

2020-329 – Extracting Better Information from Long-Term Monitoring Data: Estimating Occupancy and Abundance of Near-Shore Fishes in the Sacramento-San Joaquin River Delta

P.I. - 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.

- Funding:
 - USBR: \$30,000
 - DWR: \$55,000
 - Total: \$85,000

**2020-330 – Aquatic Habitat Sampling Platform: Standardized Fish Community Sampling
Across Habitat Types**

P.I.s - J. Merz, Cramer Fish Sciences, and E. Van Nieuwenhuyse, USBR

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. 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 bottom of the net frame 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:
 - USBR: \$340,000
 - Total: \$340,000

2020-331 – Central Valley Salmonid Coordinated Genetic Monitoring (Year 4)

P.I.s - E. Buttermore USBR, J. Israel, USBR

The limited accuracy of LAD stock identification is problematic because it compromises the management value of the long-term and annual data collected from standard monitoring programs (IEP SAG 2013). This project will improve the science and management value of the Central Valley salmon monitoring network, supported through IEP and other regional interagency monitoring studies, by accurately determining stock identification of Chinook salmon stocks. Classification tables will be developed to characterize monthly and seasonal accuracy between length-at-date and genetic race assignment at monitoring locations. This multi-year set will be used to evaluate the likelihood of accurate assignment and potential biophysical explanatory variables influencing genetic accuracy.

Additionally, genetic monitoring would be conducted concurrently with monitoring improvements described in another IEP 2017 Work Plan proposal (Brandes et al 2016). The objective of the Brandes et al. proposal (2016) is to accurately estimate juvenile winter-run Chinook salmon abundance at the Chipps and Sacramento trawl locations. The study will develop information necessary to model the likelihood of accurate assignment, which may be useful in assisting decision-making regarding habitat restoration utilization, river and Delta water operations, hatchery releases, and potentially harvest.

- May also inform or follows up on:
 - 2009 NMFS BO
- Funding:
 - USBR: \$483,000
 - DWR: \$483,000
 - Total: \$966,000

2020-333 – Enhanced Acoustic Tagging, Analysis, and Real-Time Monitoring

P.I. - E. Danner, NOAA

Understanding the movement and survival rates of outmigrating 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 San Francisco Bay. Movement and survival rates are estimated between receiver sites and route selection is predicted at critical junctions in the Delta. Endangered Species Act 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.

- May also inform or follows up on:
 - 2009 NMFS BO
- Funding:
 - USBR: \$1,200,000
 - Total: \$1,200,000

2020-335 – Suisun Marsh Salinity Control Gate Study

P.I. - T. Sommer, 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 Townet 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.

- May also inform or follows up on:
 - Delta Smelt Resiliency Strategy (DSRS)
- Funding:
 - DWR: \$400,000
 - Total: \$400,000

2020-338 – Physiological and Behavioral Effects of Domestication on Delta Smelt

P.I. - B. Davis, DWR

This program element aims to provide a better understanding of the effects of domestication on captive Delta Smelt (*Hypomesus transpacificus*) by assessing the refuge population at the Fish Conservation and Culture Laboratory (FCCL) in Byron, CA. Three studies will be conducted exploring if domestication index (i.e. the level of hatchery ancestry) affects the physiological and behavioral performance of Delta Smelt in response to physical handling and climate change stressors.

- Funding:
 - DWR: \$43,000
 - Total: \$43,000

2020-344 – Developing an eDNA metabarcoding protocol to improve fish and mussel monitoring in the San Francisco Estuary

P.I. - A. Schreier, UCD

We propose to develop an eDNA metabarcoding protocol to complement existing IEP monitoring surveys and assess the effects of management activities such as habitat restoration or flow alteration. We will develop a reference sequence database for native and invasive fish, mussels, and other macroinvertebrates present in the San Francisco Estuary (SFE). We will optimize a molecular and computational pipeline for metabarcoding and ground truth the method against three SFE monitoring efforts, each using different sampling gear. We will investigate the relationship between eDNA sequence read count and fish biomass or abundance (EDSM survey). Finally, we will determine the ability of metabarcoding to detect fish and macroinvertebrate assemblages across large and small spatial scales and over time.

- Funding:
 - CDFW: \$191,000
 - Total: \$191,000

2020-345 – Predation Dynamics Across Reach-Specific Gradients in Juvenile Salmon Survival

P.I. - 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.

- Funding:
 - USGS: \$350,000
 - Total: \$350,000

III. Program Support Elements

A. Program Management

2020-OAC – IEP Oversight and Coordination

P.I. - 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 Revi
- Funding:
 - DWR: \$425,000
 - USBR: \$408,000
 - DSP: \$201,000
 - CDFW: \$161,000
 - CDFW: \$12,000
 - Total: \$1,207,000

IV. Teams and Outreach

A. Project Work Team (PWT)

2020-T03 – Sturgeon PWT

P.I.s - 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:
 - OTHER: \$0
 - Total: \$0

2020-T04 – Estuarine Ecology (EET) PWT

P.I.s - A. Herbold, and K. Kayfet, 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:
 - OTHER: \$0
 - Total: \$0

2020-T05 – Biotelemetry PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T06 – Spring Run Salmon PWT

P.I.s - 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:
 - OTHER: \$0
 - Total: \$0

2020-T07 – Resident Fishes PWT

P.I.s - B. Mahardja, USFWS, and M. Young, US

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:
 - OTHER: \$0
 - Total: \$0

2020-T09 – Tidal Wetland Monitoring PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T11 – Winter Run Salmon PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T12 – Juvenile Monitoring PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T13 – Central Valley Salmonid Hatchery PWT

P.I.s - K. Niemala, 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:
 - OTHER: \$0
 - Total: \$0

2020-T14 – Aquatic Vegetation PWT

P.I.s - 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:
 - OTHER: \$0
 - Total: \$0

2020-T15 – Steelhead PWT

P.I. - J. Nelson, CDFW

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:
 - OTHER: \$0
 - Total: \$0

2020-T16 – Upper Sacramento River Salmon PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T17 – Contaminants PWT

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

2020-T18 – Flow Alteration PWT

P.I.s - 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 subteams within it will meet monthly or more frequently as needed.

- Funding:
 - OTHER: \$0
 - Total: \$0

2020-T22 – Predation PWT

P.I.s - A. Schultz, USBR, and S. Ainsley, FISHBI

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:
 - OTHER: \$0
 - Total: \$0

2020-T23 – Water Quality and Nutrients PWT

P.I.s - 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:
 - OTHER: \$0
 - Total: \$0

2020-T24 – Genetics PWT

P.I.s - M. Baerwald, DWR, E.W. Carson, USFWS and J. Rodsen, 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:
 - OTHER: \$0
 - Total: \$0

B. Technical Team (TT)

2020-T20 – IEP Data Utilization Work Group (DUWG)

P.I.s - S. Culberson, DSC and B. Davis, DWR

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:
 - OTHER: \$0
 - Total: \$0

2020-T21 – Central Valley Fish Facilities Review Team

P.I. - 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:
 - OTHER: \$0
 - Total: \$0

C. Workshop

2020-T01 – 2020 IEP Annual Workshop

P.I. - 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.

Chairpersons for the 2019 IEP Annual Workshop are Steve Culberson (DSP) and Ian Smith (USBR).

- Funding:
 - OTHER: \$0
 - Total: \$0