COLORADO RIVER RECOVERY PROGRAM **No: 22-f**
FY-2014-2018 (2016-2017 portion) PROPOSED SCOPE-OF-WORK:

Light trap and drift net sampling for razorback sucker and Colorado pikeminnow larvae

Reclamation Agreement number *[if applicable & known]*: R14AP00001
Reclamation Agreement term *[if applicable & known]*: Oct. 1, 2014 – Sep. 30, 2018

Lead Agency: Larval Fish Laboratory

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Category:
__ Ongoing project
X Ongoing-revised project
__ Requested new start
__ Unsolicited

Expected Funding Source;
X Annual funds
_____ Capital funds
_____ Other (explain)

Revised date:

I. Title of Proposal: Interagency standardized monitoring assessment of endangered fish reproduction in relation to Flaming Gorge operations in the Middle Green and Lower Yampa rivers.

II. Relationship to RIPRAP:

See RIPRAP at http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recovery-action-plan.html

Green River Action Plan: Mainstem

I. Provide and protect instream flows--habitat management.
.A. Green River above Duchesne River.
.1. Initially identify year-round flows needed for recovery while providing experimental flows.
I.A.2.a. Summer/fall flow recommendations.
I.A.3. Deliver identified flows.
I.A.3.a. Operate Flaming Gorge pursuant to the Biological Opinion to provide summer and fall flows.
I.A.3.d. Operate Flaming Gorge Dam to provide winter and spring flows and revised summer/fall flows, if necessary.
I.B. Green River below the Duchesne River.
I.B.1. Initially identify year-round flows needed for recovery while providing experimental flows.
I.B.2. State acceptance of initial flow recommendations.
I.B.2.a. Review scientific basis.
II. Restore habitat--habitat development and maintenance.
II.A. Restore and manage flooded bottomland habitat.
II.A.1. Conduct site restoration.
II.A.1.a. Old Charlie Wash.
II.A.1.a.(3) Monitor and evaluate success.
II.C. Enhance water temperatures to benefit endangered fishes.
II.C.1. Identify options to release warmer water from Flaming Gorge Reservoir to restore native fish habitat in the Green River.
V. Monitor populations and habitat and conduct research to support recovery actions--research, monitoring, and data management.
V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

Green River Action Plan: Yampa and Little Snake Rivers
I. Provide and protect instream flows--habitat management.
I.D. Yampa River below Little Snake River.
I.D.1. Initially identify year-round flows needed for recovery.
I.D.2. Evaluate need for instream flow water rights.
I.D.2.a. Review scientific basis.

Green River Action Plan: Yampa and Little Snake Rivers
V.A.1. Conduct standardized monitoring.
V.B.2. Conduct appropriate studies to provide needed life history information.

III. Study Background/Rationale, and Hypotheses:

The goal of the Flaming Gorge flow and temperature recommendations (Muth et al., 2000) was to improve the status and prospects for recovery of endangered fish populations in the Green River. A major emphasis of those recommendations was to enhance the reproductive and recruitment success of endangered fishes in the middle Green River, in particular razorback sucker and Colorado pikeminnow. The primary means to achieve enhanced populations was to pattern flows after a more natural hydrograph, the timing and duration of which will be based on anticipated annual hydrologic conditions and the biology of the fish. Because of vagaries in timing and runoff patterns within and among various hydrologic scenarios, and uncertainties in anticipated effects of flow and temperature recommendations on endangered fishes, Muth et al. (2000) suggested that real-time data be gathered to guide and fine tune operation of

Flaming Gorge Dam each year. This proposal extends past sampling conducted to monitor timing of reproduction and abundance of early life stages of endangered razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius.*

Razorback sucker sampling in spring.--A key objective of spring flow recommendations is to provide flood plain habitat for early life stages of razorback suckers in the Jensen-Ouray reach of the Green River. Flood plain inundation should provide relatively warm and food-rich habitat for early life stages of fish that may enhance recruitment success of razorback suckers. Originally, Green River flows released from Flaming Gorge Dam were timed to coincide with high spring flows from the Yampa River to ensure maximal habitat availability. However, success of flood plain inundation to enhance recruitment of razorback suckers depends on matching the timing of appearance of larvae in the river with availability of flood plain habitat. Real-time sampling of razorback sucker larvae with light traps during spring and early summer will ensure that flows are released at the correct time and for a sufficient duration to promote recruitment. Presence of catostomid larvae in samples collected from the Green River facilitated decisions regarding timing, level, and duration of flows to inundate flood plain habitat in spring and early summer 1997, 1999, 2005, 2006, and 2011-2014. Continued flow management under the Larval Trigger Study Plan demands use of presence of razorback sucker larvae in the middle Green to trigger flow releases from Flaming Gorge Dam (LaGory et al. 2012). Sampling conducted under this program will provide the real-time data to guide flow management each spring.

Additional information from light trap sampling of razorback suckers includes a measure of reproductive success of stocked razorback suckers that are now of sufficient size and age to reproduce. Wild adult razorback suckers in the Green River Basin were very rare by year 2000 and the few remaining fish present at that time may have succumbed (Bestgen et al. 2002). Thus, all reproduction observed is likely by adults that were stocked. The level of reproduction is an important metric to determine reproductive success of stocked fish in the Green River and their progress toward recovery. For example, the trend over time for captures since about 2000 has been increasing, and high numbers of razorback sucker larvae were captured, especially recent years (e.g., 2007, n = 2133; 2013 n = 7376). This indicated that hatchery fish have been successfully reproducing (Bestgen et al. 2011, final report on flood plain inundation related to razorback sucker reproduction; Bestgen et al. 2012, razorback sucker monitoring program). The timing of presence of larvae in the system also permits evaluation of whether timing of flow releases from Flaming Gorge Dam coincides with the peak number of razorback sucker larvae in the Green River.

Another use of light trap sampling information was to further evaluate results of experimental releases of marked larvae and subsequent entrainment into floodplain wetlands. That work was conducted in 2004, 2005, and 2006. Batches of marked larvae were released at the spawning bar during different levels of flow. Batch marks associated with releases allowed identification of which release and flow level a captured and marked larvae came from. That information was being used to evaluate what flow level and time was most effective to entrain released marked larvae into the floodplain wetlands.

Colorado pikeminnow sampling in summer.--An objective of Flaming Gorge Dam base flow recommendations in summer is to provide backwater habitat in the middle and lower Green River for early life stages of Colorado pikeminnow. The time of year that base flows are achieved in summer and the flow level will be generally dependent upon the annual hydrologic condition. However, onset of reproduction of Colorado pikeminnow in the Yampa River is variable from year to year as is the timing of peak production of larvae (Bestgen et al. 1998). More precise information on timing and extent of reproduction of Colorado pikeminnow could be used to fine tune when the summer base flow period begins and the level of summer base flows from Flaming Gorge Dam. Timing of reproduction of Colorado pikeminnow and abundance of larvae has been used since 1990 to justify decisions regarding onset of summer baseflows from Flaming Gorge Reservoir. In addition, presence and abundance of pikeminnow larvae in the Yampa River was used to make decisions regarding timing, duration, and magnitude of 1998 summer flows released from Flaming Gorge Reservoir when inflows dramatically exceeded expectations. If proposed summer base flow enhancements occur in the Green River for Colorado pikeminnow, presence of larvae captured in this study may be used to trigger timing of such flows as well (Bestgen and Hill draft report, Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, Utah and Colorado, 1979-2012).

Presence of Colorado pikeminnow in the Yampa River is also a means to evaluate if Flaming Gorge flow releases in summer comply with the criteria that Green River temperatures be no more than about 5°C different than the Yampa River. Compliance with the recommendation ensures that the potential of cold shock of Colorado pikeminnow larvae drifting from the warm Yampa River into the cooler Green River is reduced.

Additional information provided by drift-net sampling of Colorado pikeminnow larvae is an index of annual reproduction by the adult population that congregates in the lower Yampa River each year. This area represents one of two main spawning areas for Colorado pikeminnow and sampling of early life stages may provide an index of adult abundance and spawning success. We are also using an index of annual reproductive success to relate to annual recruitment success of young-of-year Colorado pikeminnow in downstream backwaters of the Green River in the Jensen-Ouray reach. Collectively, that information will be useful to investigate hypotheses regarding the apparent decline of recruitment of young Colorado pikeminnow in backwaters of the Green River, and the effects it may be having on the adult population in the Green River Basin (Bestgen 2015; Bestgen and Hill in review).

Other associated research being enabled via this work.

1). Additional razorback sucker sampling.--The presence of razorback sucker larvae at several key locations will provide the bulk of the information used to regulate timing and level of flows from Flaming Gorge Dam in spring. Such areas presently include Cliff Creek, Stewart Lake/drain, Greasewood Corral, and Sportsman's drain and beginning in 2011, the White River. Although these areas support the most consistent capture locations for larvae, even those locations vary substantially from year to year depending on flow and other conditions. Additional sampling areas that are known to support early life stages of razorback suckers within the middle Green River would give managers better estimates of the timing and duration of the spawning season. Drift-net sampling in spring 2004 associated with a release of marked hatchery-produced razorback sucker larvae and beads also revealed substantial downstream transport of wild razorback sucker larvae.

2). Flow regulation of annual recruitment of Colorado pikeminnow.--A key difference between flow recommendations made in the 1992 opinion and new recommendations is that summer base flow level will be dictated by the prevailing hydrologic condition rather than being fixed at a single level of 51 m^3/sec. Thus, in wetter years base flows will be higher and in drier years base flows will be lower. The expected biological response by Colorado pikeminnow to this action is unknown. Thus, it is important to evaluate the response of these fish to new summer base flow conditions. One possible response is altered recruitment levels, which may be detectable from autumn ISMP sampling designed to estimate young-of-year (yoy) pikeminnow abundance in backwaters. Because this measure of fish abundance, which is presumably correlated with habitat suitability, could be confounded with variable levels of reproduction, drift sampling that continues throughout the summer reproductive season is needed to correctly interpret those data. For example, near absence of age-0 Colorado pikeminnow in the middle Green River in 1994 would have been difficult to interpret given that habitat conditions, including relatively low flow levels and warm water temperatures, seemed suitable for recruitment. Drift data from the Yampa River at Echo Park demonstrated that recruitment failure in the middle Green River in low flow summers like 1994, 2007, and 2012 was likely due to very low levels of drift of larvae measured in the Yampa River downstream of the spawning area.

The complexity of recruitment processes for Colorado pikeminnow needs to be more clearly defined so that effects of re-regulation of Flaming Gorge Dam can be ascertained. Minimally this would involve more certain estimates of yoy recruitment, perhaps through abundance estimation. Better resolution of the link between recruitment of age-0 pikeminnow and older age-classes may also better define what other conditions are needed for successful recruitment to older life stages. For example, an analysis of existing ISMP data for Colorado pikeminnow (Muth et al. 2000) suggested that successful recruitment to age-1 may be associated with successive low water years. Such information would be useful to link flow recommendations across years, and presumably, benefit pikeminnow recruitment. Such an analysis of backwater habitat and relationships to pikeminnow abundance are ongoing and will be completed in 2015.

3). Inter-annual recruitment patterns of Colorado pikeminnow.--Another means that altered patterns of recruitment could be manifest is through changes in within season recruitment patterns. For example, if flow induced backwater conditions are not suitable for survival of Colorado pikeminnow larvae early in the season, one should expect few such larvae to recruit to fall. Alternatively, poor conditions in backwaters later in the season may similarly limit recruitment of late-hatching larvae. A means to examine such recruitment patterns would be through comparative analysis of distributions of hatching dates derived from otoliths of larvae and juveniles captured later in fall. An expectation of such an analysis would be that distributions of hatching dates for each life stage would be similar, with large cohorts of larvae responsible for relatively large portions of the juveniles produced. Absence of juveniles hatched during times when relatively large numbers of larvae were produced may signal recruitment loss during those periods. Examination of the environmental conditions (flow level, water temperatures) present during such periods would assist in determining reasons for recruitment variation and whether such conditions were attributable to operation of Flaming Gorge Dam. Such a technique has successfully used in the past to understand recruitment patterns of pikeminnow in the Green River (Bestgen et al. 2006)

IV. Study Goals, Objectives, and End Product:

Goal

The goal of this project is to detect timing of reproduction by razorback sucker and Colorado pikeminnow, and determine patterns of presence of larvae and their relative abundance downstream of potential spawning sites in the middle Green River system. A second goal is to monitor temperature regimes of the Green and Yampa rivers in order to comply with Flaming Gorge flow recommendations. The data gathering for this aspect will be accomplished by personnel from the U. S. Fish and Wildlife Service.

Objectives

1). To determine timing and duration of spawning by razorback suckers and presence and abundance of larvae in the Green and White river as measured by capture of larvae in light traps or seines.

2). To determine timing and duration of spawning by Colorado pikeminnow and presence and abundance of larvae in the system as measured by capture of larvae downstream of spawning areas in the lower Yampa River.

3). Determine presence and abundance of larvae and early juveniles of razorback sucker in floodplain wetlands in the summer post-connection period to determine their presence. This sampling will support research to evaluate the use of a larval trigger to determine timing of flow spring releases from Flaming Gorge Reservoir.

End Products

A summary data report will be submitted at the end of each fiscal year to the monitoring program coordinator and the database coordinator. Data will also be provided as needed to provide for real-time management of flows from Flaming Gorge Dam. A summary analysis of razorback sucker data collected since 1992 has been prepared and was approved in summer 2011 (Bestgen et al. 2011), and an analysis of the pikeminnow data is underway. Data gathered will be useful to update such analyses in the future to ensure we are meeting goals of flow and temperature management activities via operation of Flaming Gorge Dam.

V. Study Area:

Razorback sucker.--The study area for razorback sucker sampling is the middle Green River from the Escalante reach spawning area to near Sand Wash, and the White River, Utah. Several specific sampling sites are located within the reach and were chosen because of documented presence of larval razorback sucker in the past. Most of these sites are associated with off-channel habitats such as tributary streams, washes, backwaters, or flooded bottomlands and are in the vicinity of the Escalante spawning bar (RM 301.7 - 319.4), Jensen (RM 276.9 - 301.7), and Ouray (RM 248.1 - 276.9).

Additional sampling may be conducted in other locations within the middle Green River of the White River if suitable habitat is found and if the budget allows. Additional sampling will be conducted in middle Green River wetlands in summer just post-connection with the Green River to determine presence of entrained larvae. Field crews have flexibility to change sites or sample additional sites based on discharge, accessibility, and habitat conditions at each site.

Colorado pikeminnow sampling.--A single site, the lower Yampa River, will be sampled in FY-2016 to 2017. This locality was sampled as part of the Flaming Gorge studies program because it is downstream of a known spawning area for Colorado pikeminnow. Data obtained from samples will provide information on timing and relative abundance of Colorado pikeminnow larvae being transported from spawning areas and into potential nursery habitats and will also provide real-time data with which to manage flows from Flaming Gorge Dam. Another site is being considered in the lower Green River, similar to the site and methods used to monitor early life stages of Colorado pikeminnow from 1992-1996, and 1999.

VI. Study Methods/Approach:

Razorback sucker.--Approaches for sampling razorback sucker larvae in the Green River system were outlined in recommendations by Muth (1995, Bestgen et al. 2012, monitoring plan), which were based on comprehensive literature and data reviews. Sites with documented high captures of larval razorback sucker will be targeted for sampling, although additional sampling will be conducted to explore other areas for larvae, including the White River. An additional task will be to sample wetlands in the middle Green River just after spring flow connections with the Green River ceases, with a goal of detecting presence of entrained larvae. Light-trap sampling at night in low-velocity nursery habitats will be the primary technique for monitoring. Additionally, fine-mesh seines (1.6-mm or 3.2-mm mesh) will be used on a limited basis during daylight (also possibly at night) to document relative abundance of sympatric species not captured by light traps. Sampling will be conducted at each site twice weekly during at least early/mid May-mid June, and wetland sampling may extend into late July depending on the duration of high flows. The sampling period will be adjusted based on timing and duration of spring flows, onset of main channel water temperatures of 14^{o}C, and temporal occurrence of larvae. Each habitat on each sampling occasion will be sampled with at least three light traps; seine sampling is sometimes used to supplement light trap sampling. If possible, light traps will be set in or near emergent vegetation at dusk and retrieved before sunrise. Larger fish identifiable in the field will be counted and measured on site and released alive. Other fish will be euthanized with an overdose of tricaine methanesulfonate (MS-222), preserved in 100% ethanol, and returned to the Larval Fish Laboratory for processing. Unit of effort will be hours each light trap is set during darkness and area sampled by each seine haul. These approaches and considerations were revised based on comments from the Biology Committee and other researchers, and discussions with Monitoring Program Coordinators. Monitoring was always coordinated with other sampling in the past such as ISMP, evaluations of levee-removal strategies (Lentsch et al. 1995), investigations at Old Charlie Wash, and evaluations of experimental stockings such as for floodplain entrainment investigations. The Larval Fish Laboratory (LFL) will be responsible for larval fish identification and processing, coordinating monitoring activities, integrating results/reports of sampling efforts, and preparing overall annual reports.

Colorado pikeminnow.--Passive drift-net sampling is an effective and proven method for capturing Colorado pikeminnow larvae. Sampling can provide a reasonable estimate of annual reproductive output from spawning areas. Colorado pikeminnow in the Colorado River Basin spawn on the descending limb of the hydrograph when water temperature is increasing (Nesler et al. 1988; Tyus and Karp 1989, Bestgen et al. 1998, Anderson 1999, Trammel and Chart 1999). Sampling for Colorado pikeminnow larvae will be initiated based on those data and stream-flow conditions prior to sampling (probable start date in most years is mid-late June). Duration of the sampling period will depend on number of larvae collected in late-season samples, past data, and stream-flow conditions (probable end date is early-mid August).

Colorado pikeminnow larvae are most consistently captured in drift-net samples at dawn, and nearshore and midstream nets capture roughly equivalent numbers of fish/unit volume of water sampled (Haynes et al. 1984; Nesler 1986, Bestgen 1997, unpublished data). Therefore, at each station three plankton nets will be set near the shore, daily at dawn for 1-2 h, from end of June through early August. Some diel sampling should also be conducted at each site. This should include samples collected at dawn, noon, dusk and midnight and should be collected on 5-6 d spread throughout the sampling season. Nets will be attached to rectangular steel frames (0.15 m^2) and staked into the stream substrate adjacent to the shore in water 0.5-1.0 m deep. A removable collection bucket for trapping filtered material and fishes will be attached to the cod end of each net. Flow meters for measuring velocity will be suspended inside the mouth of each net, and net sets will be timed to determine volume of water sampled. Duration of each set will be 1-2 h depending on debris load. Samples will be fixed and preserved in 95-100% ethanol (for subsequent otolith-ageing work if needed). Fishes will be picked from debris in the field, returned to the LFL, identified, measured to the nearest 0.1 mm total length, and enumerated.

VII. Task Description/Schedule (FY 2016 and 2017)

I). Collect light trap and seine samples for razorback suckers in the Green and White rivers and in Green River floodplain wetlands. The CRFP office in Vernal will be responsible for this task.

II). Collect drift net samples for Colorado pikeminnow. The Larval Fish Laboratory will be responsible for this task.

III). Preliminary identification of light trap and drift net samples. Preliminary identifications will be conducted by the responsible sampling entity, with assistance from the LFL, as samples are collected to provide real-time data. Final specimen identification and curation will be conducted by the LFL under Project 15.

IV). Continue otolith analyses of razorback suckers to understand timing of spawning and hatching and to document growth rate differences of larvae each year.

V). Summarize specimen data collection in an annual report.

VIII. FY-2016-2017 Work: Summarize data and incorporate into report.

-Description of Work: Tasks I-IV.

See above

-Deliverables

A key feature of data collected is to be able to provide information to managers who need to make decisions about stream flows in real-time. A report will also be submitted by end of the fiscal year that summarizes data collected to date.

Travel: Travel costs for field work based on estimated per diem rates for Colorado State University for the area we are working in. Mileage is based on the standard rate for Motor Pool vehicles, which varies depending on age and size of the vehicle. We will use $ 0.50 per mile for 2016. Meeting costs include three nights of hotel, per diem, and mileage to travel to meetings. These include costs for two people.

Personnel: Salaries include 25% fringe rate, an estimate for 2016, plus overhead. Overhead is calculated on all items (including salary plus fringe rate) at 17.5%, per our agreement with BOR.

Supplies: Supplies are used in the conduct of field sampling and lab analysis of specimens and otoliths. Containers and preservatives are to hold field specimens and to curate specimens in the laboratory; preservative are formalin and ethanol for preservation of samples. Camping gear includes tents, kitchen supplies for field camping, and coolers. Nets include seines and trammel nets, disposable goods that need replacements due to attrition. Fyke nets are stationary gear for pike sampling and need to be replaced due to attrition. Tools for repairs include hammers, pitons, rock bags, wrenches, and other hand tools to assist with sampling and gear repair in the field. Raft gear includes personal flotation devices, straps and other rigging for rafts, oars, frame repair or replacement, and flooring. Estimated costs based on current prices procured from various online sources (local vendors for camping supplies, NRS rafting supplies, Christiansen Inc, for net supplies, Fischer Scientific for preservatives, sample jars, slides, slide folders, other lab supplies).

Budget notes: LFL reduced costs for Project 22F in 2014. This was accomplished by reducing some supply costs and eliminating one-time increases to purchase light traps in 2013, and decreasing costs for otolith analyses; budget was mostly static from 2011-2013. Increases in other years will be needed to support mandated raises for personnel and if additional funds are available, increased sample costs should be added.

FY-2016 Budget

USFWS, Vernal FY 16-20 budget
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2016 Labor and Administration	Rate	Hours	Cost
GS-5 Fisheries Tech	$24.96	480	$11,981
GS-8 Fisheries Tech	$38.72	196	$7,589
GS-9 Administrative Officer	$39.19	116	$4,546

GS-7 Biologist	$28.44	320	$9,101
GS-12 Supervisory Fish Biologist	$55.14	80	$4,411
Replacement glow sticks for traps	$0.79	500	$395
Ethanol for preserving larvae	$91.04	4	$364
Sample containers (1 case-20mL glass scintillation vials)	$62.53	2	$125
Equipment (light traps, waders, lab supplies, etc.)-based on prior years' expenses			$1,000
Travel (60 mi./day x 60 days x 0.31/mi)			$1,116
GSA vehicle lease ($313/mo x 2 trucks x 2 mo)	$313.00	4	$1,252
Access fee for sampling on private property	$1,000.00		$1,000
Total			**$42,880**

2017 **Labor and Administration**	**Rate**	**Hours**	**Cost**
GS-5 Fisheries Tech	$25.70	480	$12,336
GS-8 Fisheries Tech	$39.74	196	$7,788
GS-9 Administrative Officer	$39.98	116	$4,637
GS-9 Biologist	$35.36	320	$11,314
GS-12 Supervisory Fish Biologist	$56.25	80	$4,500
Replacement glow sticks for traps	$0.81	500	$403
Ethanol for preserving larvae	$92.86	4	$371
Sample containers (1 case-20mL glass scintillation vials)	$63.78	2	$128
Equipment (light traps, waders, lab supplies, etc.)-based on prior years' expenses			$1,000
Travel (60 mi./day x 60 days x 0.32/mi)			$1,152
GSA vehicle lease ($320/mo x 2 trucks x 2 mo)	$320.00	4	$1,280
Access fee for sampling on private property	$1,000.00		$1,000
Total			**$45,910**

2018 **Labor and Administration**	**Rate**	**Hours**	**Cost**
GS-5 Fisheries Tech	$26.48	480	$12,710
GS-8 Fisheries Tech	$40.53	196	$7,945
GS-9 Administrative Officer	$40.78	116	$4,730
GS-11 Biologist	$42.93	320	$13,738
GS-12 Supervisory Fish Biologist	$57.38	80	$4,590
Replacement glow sticks for traps	$0.82	500	$411
Ethanol for preserving larvae	$94.72	4	$379
Sample containers (1 case-20mL glass scintillation vials)	$65.06	2	$130

Equipment (light traps, waders, lab supplies, etc.)-based on prior years' expenses			$1,000
Travel (60 mi./day x 60 days x 0.33/mi)			$1,188
GSA vehicle lease ($325/mo x 2 trucks x 2 mo)	$325.00	4	$1,300
Access fee for sampling on private property	$1,000.00		$1,000
Total			**$49,122**

2019	**Rate**	**Hours**	**Cost**
Labor and Administration			
GS-5 Fisheries Tech	$27.27	480	$13,090
GS-8 Fisheries Tech	$41.35	196	$8,105
GS-9 Administrative Officer	$41.60	116	$4,826
GS-11 Biologist	$43.79	320	$14,012
GS-12 Supervisory Fish Biologist	$58.52	80	$4,682
Replacement glow sticks for traps	$0.84	500	$419
Ethanol for preserving larvae	$96.61	4	$386
Sample containers (1 case-20mL glass scintillation vials)	$66.36	2	$133
Equipment (light traps, waders, lab supplies, etc.)-based on prior years' expenses			$1,000
Travel (60 mi./day x 60 days x 0.34/mi)			$1,224
GSA vehicle lease ($332/mo x 2 trucks x 2 mo)	$332.00	4	$1,328
Access fee for sampling on private property	$1,000.00		$1,000
Total			**$50,204**

2020	**Rate**	**Hours**	**Cost**
Labor and Administration			
GS-5 Fisheries Tech	$28.09	480	$13,483
GS-8 Fisheries Tech	$42.17	196	$8,265
GS-9 Administrative Officer	$42.43	116	$4,922
GS-11 Biologist	$44.67	320	$14,293
GS-12 Supervisory Fish Biologist	$59.69	80	$4,775
Replacement glow sticks for traps	$0.86	500	$428
Ethanol for preserving larvae	$98.54	4	$394
Sample containers (1 case-20mL glass scintillation vials)	$67.68	2	$135
Equipment (light traps, waders, lab supplies, etc.)-based on prior years' expenses			$1,000
Travel (60 mi./day x 60 days x 0.35/mi)			$1,260
GSA vehicle lease ($338/mo x 2 trucks x 2 mo)	$338.00	4	$1,352

Access fee for sampling on private property	$1,000.00	$1,000
Total		**$51,307**

Larval Fish Laboratory, FY 2016-20 budget

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FY-2016
Task 2, collect samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	25	594.104		$14,853
Senior technician (d)	45	239.7634		$10,789
Technician (d)	132	153.8305		$20,306
			subtotal	$45,948
Travel				
Per diem (d)	122	20		$2,440
Mileage (miles)	8800	0.5		$4,400
			subtotal	$6,840
Supplies				
Preservative (gals)	55	11		$605
Jars/vials	800	0.45		$360
Tents	2	225		$450
Flow meter and repair	2	640		$1,280
field kitchen gear	1	240		$240
Misc sampling gear	1	200		$200
			subtotal	$3,135
			Total	$55,923

Task 3, Identify light trap and drift net samples

Item			Cost
Labor	Units	Cost/unit	
Principal investigator (d)	30	594.104	$17,823
Senior technician (d)	96	239.7634	$23,017

Technician (d)	60	153.8305		$9,230
			subtotal	$50,070
Supplies				
Preservative (gals)	10	11		$110
Jars/vials	350	0.4		$140
microscope repair	1	225		$225
microscope slides, folders	1	90		$90
			subtotal	$565
			Total	$50,635

Task 4, otolith work

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	3	594.104		$1,782
Senior technician (d)	10	239.7634		$2,398
Technician (d)	5	153.8305		$769
microscope slides, folders	1	148		$148
			subtotal	$5,097

Task 5, annual; report preparation

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	14	594.104		$8,317
Senior technician (d)	15	239.7634		$3,596
Technician (d)	5	153.8305		$769
			subtotal	$12,683
Travel				
Meeting	2	500		$1,000
			subtotal	$1,000
			Total	$13,683

			total tasks 2-5	$125,338

FY-2017
Task 2, collect samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	25	611.92712		$15,298
Senior technician (d)	45	246.9563		$11,113
Technician (d)	132	158.44542		$20,915
			subtotal	$47,326
Travel				
Per diem (d)	122	20		$2,440
Mileage (miles)	8800	0.5		$4,400
			subtotal	$6,840
Supplies				
Preservative (gals)	55	11		$605
Jars/vials	800	0.45		$360
Tents	2	225		$450
Flow meter and repair	2	640		$1,280
field kitchen gear	1	240		$240
Misc sampling gear	1	200		$200
			subtotal	$3,135
			Total	$57,301

Task 3, Identify light trap and drift net samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	30	611.92712		$18,358
Senior technician (d)	96	246.9563		$23,708
Technician (d)	60	158.44542		$9,507
			subtotal	$51,572
Supplies				
Preservative (gals)	10	11		$110
Jars/vials	350	0.4		$140

microscope repair	1	225		$225
microscope slides, folders	1	90		$90
			subtotal	$565
			Total	$52,137

Task 4, otolith work

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	3	611.92712		$1,836
Senior technician (d)	10	246.9563		$2,470
Technician (d)	5	158.44542		$792
microscope slides, folders	1	148		$148
			subtotal	$5,246

Task 5, annual; report preparation

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	14	611.92712		$8,567
Senior technician (d)	15	246.9563		$3,704
Technician (d)	5	158.44542		$792
			subtotal	$13,064
Travel				
Meeting	2	500		$1,000
			subtotal	$1,000
			Total	$14,064
			total tasks 2-5	$128,747

FY-2018

Task 2, collect

samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	25	630.28493		$15,757
Senior technician (d)	45	254.36499		$11,446
Technician (d)	132	163.19878		$21,542
			subtotal	$48,746
Travel				
Per diem (d)	122	20		$2,440
Mileage (miles)	8800	0.5		$4,400
			subtotal	$6,840
Supplies				
Preservative (gals)	55	11		$605
Jars/vials	800	0.45		$360
Tents	2	225		$450
Flow meter and repair	2	640		$1,280
field kitchen gear	1	240		$240
Misc sampling gear	1	200		$200
			subtotal	$3,135
			Total	$58,721

Task 3, Identify light trap and drift net samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	30	630.28493		$18,909
Senior technician (d)	96	254.36499		$24,419
Technician (d)	60	163.19878		$9,792
			subtotal	$53,120
Supplies				
Preservative (gals)	10	11		$110
Jars/vials	350	0.4		$140
microscope repair	1	225		$225
microscope slides, folders	1	90		$90
			subtotal	$565
			Total	$53,685

Task 4, otolith work

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	3	630.28493		$1,891
Senior technician (d)	10	254.36499		$2,544
Technician (d)	5	163.19878		$816
microscope slides, folders	1	148		$148
			subtotal	$5,398

Task 5, annual; report preparation

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	14	630.28493		$8,824
Senior technician (d)	15	254.36499		$3,815
Technician (d)	5	163.19878		$816
			subtotal	$13,455
Travel				
Meeting	2	500		$1,000
			subtotal	$1,000
			Total	$14,455
			total tasks 2-5	$132,259

FY-2019
Task 2, collect samples

Item			Cost
Labor	Units	Cost/unit	
Principal investigator (d)	25	649.19348	$16,230
Senior technician (d)	45	261.99594	$11,790

Technician (d)	132	168.09474		$22,189
			subtotal	$50,208
Travel				
Per diem (d)	122	20		$2,440
Mileage (miles)	8800	0.5		$4,400
			subtotal	$6,840
Supplies				
Preservative (gals)	55	11		$605
Jars/vials	800	0.45		$360
Tents	2	225		$450
Flow meter and repair	2	640		$1,280
field kitchen gear	1	240		$240
Misc sampling gear	1	200		$200
			subtotal	$3,135
			Total	$60,183

Task 3, Identify light trap and drift net samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	30	649.19348		$19,476
Senior technician (d)	96	261.99594		$25,152
Technician (d)	60	168.09474		$10,086
			subtotal	$54,713
Supplies				
Preservative (gals)	10	11		$110
Jars/vials	350	0.4		$140
microscope repair	1	225		$225
microscope slides, folders	1	90		$90
			subtotal	$565
			Total	$55,278

Task 4, otolith work

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	3	649.19348		$1,948
Senior technician (d)	10	261.99594		$2,620
Technician (d)	5	168.09474		$840
microscope slides, folders	1	148		$148
			subtotal	$5,556

Task 5, annual; report preparation

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	14	649.19348		$9,089
Senior technician (d)	15	261.99594		$3,930
Technician (d)	5	168.09474		$840
			subtotal	$13,859
Travel				
Meeting	2	500		$1,000
			subtotal	$1,000
			Total	$14,859
			total tasks 2-5	$135,876

FY-2020
Task 2, collect samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	25	668.66929		$16,717
Senior technician (d)	45	269.85582		$12,144
Technician (d)	132	173.13758		$22,854
			subtotal	$51,714
Travel				
Per diem (d)	122	20		$2,440

Mileage (miles)	8800	0.5		$4,400
			subtotal	$6,840
Supplies				
Preservative (gals)	55	11		$605
Jars/vials	800	0.45		$360
Tents	2	225		$450
Flow meter and repair	2	640		$1,280
field kitchen gear	1	240		$240
Misc sampling gear	1	200		$200
			subtotal	$3,135
			Total	$61,689

Task 3, Identify light trap and drift net samples

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	30	668.66929		$20,060
Senior technician (d)	96	269.85582		$25,906
Technician (d)	60	173.13758		$10,388
			subtotal	$56,354
Supplies				
Preservative (gals)	10	11		$110
Jars/vials	350	0.4		$140
microscope repair	1	225		$225
microscope slides, folders	1	90		$90
			subtotal	$565
			Total	$56,919

Task 4, otolith work

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	3	668.66929		$2,006
Senior technician (d)	10	269.85582		$2,699
Technician (d)	5	173.13758		$866

microscope slides, folders	1	148		$148
			subtotal	$5,718

Task 5, annual; report preparation

Item				Cost
Labor	Units	Cost/unit		
Principal investigator (d)	14	668.66929		$9,361
Senior technician (d)	15	269.85582		$4,048
Technician (d)	5	173.13758		$866
			subtotal	$14,275
Travel				
Meeting	2	500		$1,000
			subtotal	$1,000
			Total	$15,275
			total tasks 2-5	$139,602

IX. Budget Summary: two years

	LFL	USFWS	total
FY16	$125,338	$42,880	$168,218
FY17	$128,747	$45,910	$174,657

5 year totals

	LFL	USFWS	total
FY16	$125,338	$42,880	$168,218
FY17	$128,747	$45,910	$174,657
FY18	$132,259	$49,122	$181,381
FY19	$135,876	$50,204	$186,080
FY20	$139,602	$51,307	$190,909
	$661,822	$239,423	$901,245

X. Reviewers

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