Research Pre-Proposal

EVALUATION OF ADULT PACIFIC LAMPREY PASSAGE SUCCESS AT MCNARY AND LOWER SNAKE RIVER DAMS - 2007

Study Code: ADS-P-00-8

To
U.S. Army Corps of Engineers, District
Walla Walla, Washington

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Project Summary

A. Goal

To evaluate passage of adult Pacific lamprey *Lampetra tridentata* at McNary and the four Lower Snake River dams and through associated reservoirs. The study proposed here would collect baseline information on passage success and potential obstacles to migrating adult lamprey.

B. Objectives - 2007

1. Develop adult lamprey collection, tagging and release operations at McNary and Ice Harbor Dams.

2. Monitor movements and behavior of adult lamprey migrating at McNary and the four lower Snake River dams.

3. Test feasibility to monitor adult lamprey movement behavior in the vicinity of the Snake and Columbia rivers confluence using acoustic telemetry.

C. Methods

During 2007, we propose to collect additional information on passage performance and behavior of adult lamprey at McNary and the Snake River dams and to further refine use of the HD PIT monitoring systems. To date in 2006, we have tracked fish moving between McNary, Ice Harbor and Lower Monumental dams. As such we are exploring extending the half-duplex passive integrated transponder (HD PIT) monitoring upstream of Ice Harbor Dam. Fish would be collected at McNary and Ice Harbor dams, implanted with HD PIT tags and released downstream from the dams and monitored as they approach and ascend the projects. Passage evaluations will be based on proportions of fish that successfully pass each segment of the fishway(s). A sub-sample of lamprey will be tagged with both HD PIT and radio transmitter to test the effectiveness of HD PIT detectors and to detect lamprey at more locations in and around the fishways. Proportions of radio-tagged fish known to have passed HD PIT detectors will be used to correct passage efficiencies determined from HD PIT detections, if necessary.

Based on fish counts, relatively few of the lamprey that pass McNary Dam pass Ice Harbor Dam. For 2007, we propose to conduct a pilot evaluation on the use of acoustic telemetry to monitor lamprey movements as they approach the Columbia and Snake rivers confluence. We hope to determine if this technique can be used to identify when and where adult lamprey commit to entering the Snake River and what set of conditions are associated with that decision.

D. Relevance

This project will address concerns raised by Tribal agencies, the U. S. Army Corps of Engineers (COE), and the Northwest Power Planning Council in section 7.5F of the 1994 Columbia River Basin Fish and Wildlife Program, related to effects of FCRPS Projects on passage of Pacific lamprey in the Columbia and Snake rivers. The loss of Pacific lamprey as a cultural resource has raised concerns among Columbia River tribes (Close et al. 2002). Improving lamprey passage at Columbia River hydropower dams was identified as the highest priority for lamprey recovery by the Columbia Basin Pacific Lamprey Technical Workgroup. In addition, in 2002 the U.S. Fish and Wildlife Service received a petition to list Pacific lamprey as a federally-endangered or threatened species. Lamprey are currently not listed but interest and desire by multiple groups is increasing to improve the productivity of this endemic species within the Columbia River system.

Project Description

A. Background

Declining returns of pre-spawning adult Pacific lamprey *Lampetra tridentata* to the Columbia River highlight the need to document juvenile and adult passage at dams (Close et al. 1995; Jackson et al. 1996). Pacific lamprey are anadromous and must pass up to eight or nine dams and reservoirs, four each in the lower Columbia and Snake rivers and five in the mid-Columbia River, to reach upstream spawning areas historically used by the species.

Studies evaluating lamprey passage and methods to improve passage at dams were initiated in 1997 at Bonneville Dam. We found that passage efficiency of lamprey approaching Bonneville Dam was less than 50% in all years (Moser et al. 2002). Passage efficiency for lamprey that approached The Dalles Dam was consistently higher than at Bonneville Dam, while passage efficiency at John Day Dam was usually lower than at Bonneville Dam. Of particular concern is the poor performance of lamprey at fishway entrances, through collection channels/transition areas, and past vertical slot fishways at the top of the fishways at Bonneville Dam (Moser et al. 2002). From tests conducted in an experimental fishway channel we determined what conditions were and were not conducive to lamprey passage (Daigle et al. 2005). Information from these studies were incorporated into fishway improvements and the ongoing development and testing of structures to collect and bypass adult lamprey at passage restrictions. Results on the utility of bypassing lamprey have been encouraging and we believe these efforts, which to this point have been focused at Bonneville Dam, can be applied to upstream passage facilities.

Impeding passage of lamprey below dams may subject them to increased predation pressure and other sources of loss. Difficult passage conditions may also decrease recruitment to upstream populations. This project is being initiated to gain information on migration behavior of adult lamprey, and to determine what factors affect their passage at McNary Dam and the four lower Snake River dams. During the 2005, the first year of this study at McNary and Ice Harbor dams, we found passage of adult lamprey was only about 60% for those fish that reached McNary Dam, but median passage times for those fish were relatively short, about 1 d. Passage for the small number of lamprey released at Ice Harbor Dam was les than 50%. A small number of fish that had not passed McNary Dam in 2005 have since been recorded at the project in 2006. We are currently monitoring lamprey at McNary and Snake River dams using radiotelemetry and HD PIT systems. To date we have tracked individual fish moving from McNary to Ice Harbor and Lower Monumental dams. Modifications to the trapping procedure attempted for 2006 have not been as successful as hoped but we have identified where improvements can be made for future collection efforts.

This project was developed in response to a preliminary request for proposals issued by the USACE in June of 2004, and it addresses concerns raised by the USACE and the Northwest Power Planning Council in section 7.5F of the 1994 Columbia River Basin Fish and Wildlife Program. Operational or structural changes at dams intended to improve lamprey passage success must also address RPA 119 of the 2000 NMFS Biological Opinion that “alterations to fish ladders and adult passage facilities to accommodate Pacific lamprey passage do not adversely affect salmonids passage timing and success”. This proposal was developed via consultation with the USACE, and in response to the high priority assigned to adult passage research in the Columbia and Snake rivers by the former Fish

Research Needs and Priorities subcommittee of the Fish Passage Development and Evaluation Program, and the current Anadromous Fish Evaluation Program.

B. Objectives - 2007:

1. Develop adult lamprey collection, tagging and release operations at McNary and Ice Harbor Dams.

2. Monitor movements and behavior of adult lamprey migranting at McNary and the four lower Snake River dams.

3. Test feasibility to monitor adult lamprey movement behavior in the vicinity of the Snake and Columbia rivers confluence using acoustic telemetry.

C. Methods

C.1. Develop adult lamprey collection, tagging, and release operations at McNary and Ice Harbor Dams.

Fish collection and tagging. Fish to be used for this study would be collected primarily from the Oregon (south) fishway at McNary Dam using a trap installed during 2005 and a second trap developed and tested during 2006. The second (portable) trap was not effective at collecting lamprey in 2006. Based on our observations, the trap will be modified and should improve the number of lamprey collected for 2007 studies. We anticipate using up to 200 to 300 fish total for 2007 studies, 100 to 200 each at McNary and Ice Harbor dams. Trapping will occur only at night, when lamprey are most active and salmon are not. To eliminate potential impacts on salmonid passage, traps will be removed from the fishway during the day. Any lamprey collected would be transferred to a water-filled and aerated cooler and transported by truck to the tagging station at the juvenile facility. Each morning, collected fish will be anaesthetized, counted, weighed and measured. Fish will then receive a half-duplex passive integrated transponder (HD PIT) tag (23 x 4 mm), surgically inserted into the body cavity. Following a recovery period (typically that evening), most tagged fish will be released to the tailrace of McNary Dam.

Lamprey typically pass McNary Dam for about a 3-month period between mid-July until mid-October (Figure 1). This is also the period of warmest water temperatures and when relatively few salmon are passing the dam. We propose to tag a total of up to 200 to 300 fish with HD PITs throughout the period from July to October. A portion of these fish will be released near Ice Harbor Dam (see below). A subsample of 60 individuals will also be surgically outfitted with radio transmitters and released with the fish bearing only an HD PIT, 30 fish at each dam. These radio-tagged fish will allow verification of the detection efficiency of the HD PIT detectors and will provide information on the fates of fish that do not re-appear at the project. Methods to be used to implant transmitters have been developed over several years during passage evaluations at Bonneville Dam (Moser et al. 2001) and will be the same as those used during 2006. Close et al. (2003) found that surgically implanted transmitters had no effects on the physiology (plasma glucose, ventilation rates) and swimming performance for adult Pacific lamprey. Thus we believe this to be a safe and effective method to assess swimming behavior and passage performance for lamprey. Telemetry monitoring would be conducted using existing telemetry equipment at the dams.

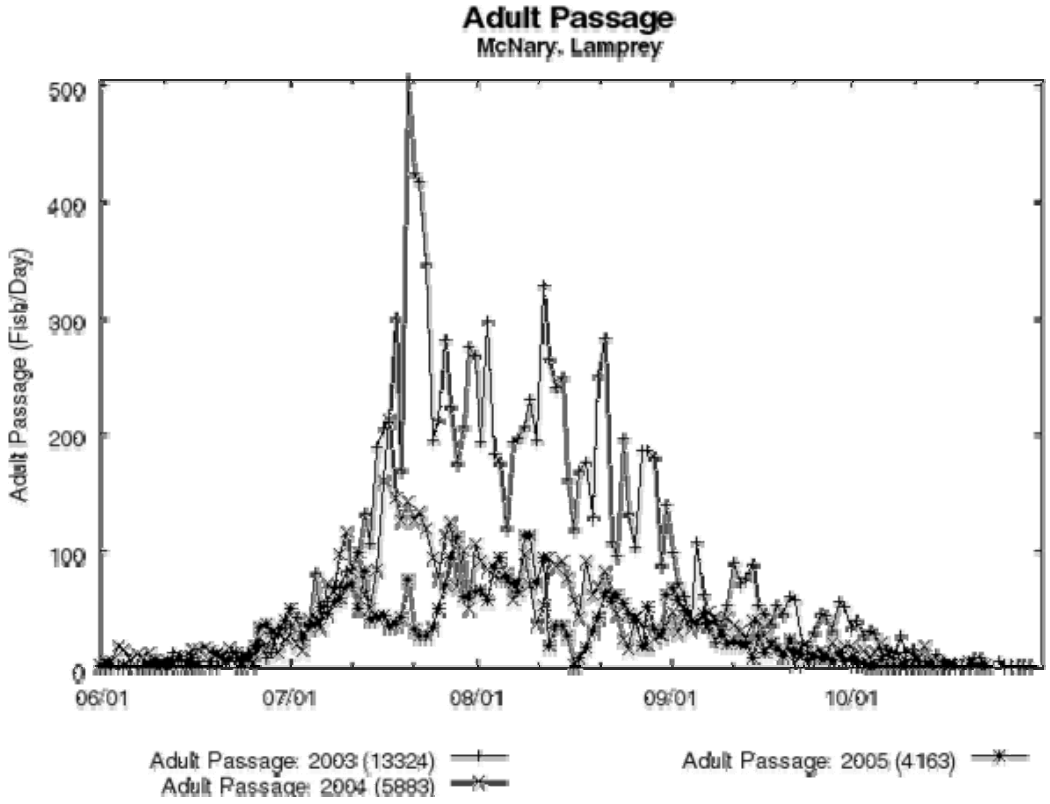

Figure 1. Lamprey counted at McNary Dam, 2003, 2004, and 2005.

C.1. Monitor movements and behavior of adult lamprey migranting at McNary and the four lower Snake River dams.

Half-duplex detectors alternately transmit and rest at ten cycles per second. It is during the resting stage that detectors can receive and decode a signal from a HD transponder. Half duplex systems have comparable or larger read ranges than currently possible with full duplex (FDX) systems and HD PIT tags will not interfere with full-duplex (ISO) PIT readers. However, the smallest HD tags currently available are about twice the size (23 x 4 mm) of the standard FDX tags (12 x 2 mm). Components of HD systems include a reader, data logger, antenna tuner, and antenna. Antennas consist of a loop of low gauge electrical wire that can be placed near or surround a passage area or portal. Antenna cables (1 cm diameter) will be placed so as to avoid interfering with salmon and other fish passage in fishways. A multiplexor is available that allows monitoring up to four antennas per reader, with each added antenna being scanned sequentially. So, with four antennas in use, each would be scanned 2.5 times per second.

During 2005 we installed HD PIT reader sites at the two main entrances at McNary and Ice Harbor dams (WFE & SFE), within fishways near the base of ladders (transition pools) and at fishway exits. Multiple antennas were used when possible in order to determine directionality of movement. Radio telemetry antennas were positioned to overlap or bracket HD antenna sites (Figure 2). We utilized variety of antenna configurations including flat-panels which contained the antenna cable imbedded in epoxy and the panel bolted to

fishway walls and floors, loops of cable in plastic conduit that encircled submerged weir orifices or whole entrance areas, and antennas in rigid frames placed into existing bulkhead slots. During 2005, it was determined that HD and FD PIT systems can interfere with each other under certain conditions. Because of this, we developed and tested antenna shielding designs to alleviate potential interference problems and these were used at affected sites in 2006. Use of aluminum frames shield the HD antenna from electrical interference and minimizes magnetic coupling with nearby ferrous metals such as the bulkhead slots and rebar reinforced concrete. Antenna shielding proved to be effective although some improvements are possible for 2007, such as incorporating the next generation data loggers in current readers. We are also exploring the potential to add HD PIT readers and antennas to Lower Monumental and upstream dams. Minimal setup would cover the main ladder entrances and exits at each dam. Prior testing will be conducted in cooperation with NMFS, PSMFC, and Corps biologists to assure that new installations will not interfere with existing juvenile and adult FDX PIT interrogators. Depending on the winter de-watering schedule, some antenna maintenance and installations may require SCUBA dive support.

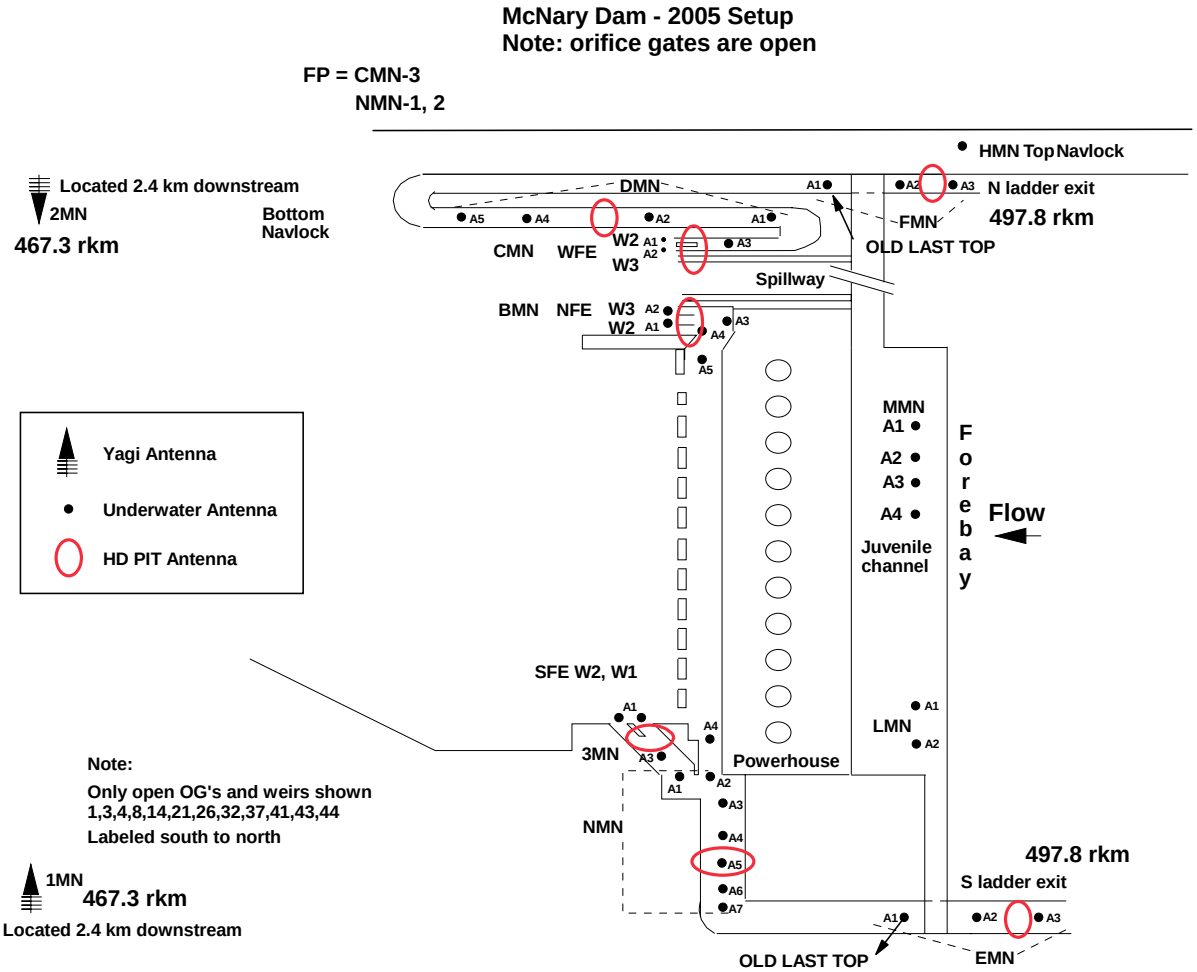

Figure 2. Schematic of radio and half-duplex PIT antenna placement for monitoring passage of adult lamprey at McNary Dam. A similar arrangement is in place at Ice Harbor Dam.

HD PIT and radiotelemetry receiver sites will be downloaded at regular intervals by transferring data to a portable computer. Internal times on all receivers and readers will be

synchronized to assure comparability between data collected with the two systems and between different sites. Data will be loaded to a database operated on an SQL server. PIT and telemetry data will be processed separately and the results will be compared. Telemetry records will be screened to remove obvious error (noise) records and detections that occur before fish were released. Screened records will be processed to identify specific fish behaviors, such as approaches, entrances, and exits to the fishways, using an automated computer program. Coded records will then be inspected for accuracy and imported to spreadsheets for analyses. We will summarize numbers and proportions of fish that successfully navigate segments of the fishways at McNary Dam; those that return to the dam and approach an entrance, enter a fishway, reach and pass through transition pools, ascend the ladders, traverse flow control sections at tops of ladders, and exit to the forebay. Passage times for each segment will be calculated and compared to similar data among projects. Entrance efficiency will be defined as the number of fish that successfully enter divided by the number that approach a given entrance (X 100).

Data from HD PIT detectors will be compiled to a database so that similar passage summaries can be made. Specifically, we will evaluate the proportion of fish that approach and then successfully enter each fishway entrance, reach and ascend ladders, and exit to the forebay at each dam. Data from the two systems will be compared to evaluate the effectiveness of the HD PIT equipment to accurately characterize lamprey behavior.

C3. Test feasibility to monitor adult lamprey movement behavior in the vicinity of the Snake and Columbia rivers confluence using acoustic telemetry.

Based on count data, numbers of adult Pacific lamprey passing Ice Harbor Dam have been just 8 to 14% of the numbers crossing McNary Dam over the past five years. It is unknown what guides adult lamprey to spawning areas but there is evidence that lamprey as a group may not home to natal streams as do anadromous salmonids (Bergstedt and Seeley 1995). While we do not know what may attract (or repel) lamprey to enter the Snake River, one determinant could be the temperature differential between the Columbia and warmer Snake River during the lamprey migration. Another contributing factor could be the presence or absence of attractive pheromones from conspecifics in the drainage. Currently fish tagged with radio transmitters or HD PIT tags can be detected at McNary and Ice Harbor dams to determine actual conversion rates between the two projects. But we lack information on the detailed route-selection behavior that occurs as lamprey approach the Columbia-Snake confluence area. Such information would be useful to discern what factors are associated with selection/rejection of the Snake River by adult lamprey migrants. Because lamprey tend to move close to the substrate, and because of recent advances in receivers and transmitters, acoustic telemetry appears to be an ideal method to collect this information. To test the feasibility of this, we propose to conduct a small-scale trial in 2007 to evaluate the utility for acoustic telemetry to monitor movements of adult lamprey in a large river system. This evaluation would primarily involve conducting range and efficiency tests of stationary and mobile tracking equipment from several vendors using test transmitters, and by conducting trial tracking of a small number (5 to 10) of tagged lamprey. For this component, individual tagged fish will be released from a boat and tracked using simultaneously operating telemetry systems to determine which produces best results. Fish would be collected from McNary Dam studies.

Acoustic equipment currently available to test for this trial are from Lotek Wireless, VEMCO, and HTI. All three companies produce autonomous receivers that can be used as stationary sites. Lotek and VEMCO also produce specialized receivers designed for mobile-

tracking fish from a boat. We believe the HTI autonomous node receiver can be adapted for use as a mobile-tracking unit as well. All receiver equipment needed to conduct this trial are currently available. USGS personnel from the Columbia River Research Laboratory would partner with us to deploy and test the HTI systems for this objective. Other acoustic systems can be added to this trial as available.

D. Facilities and Equipment

HD PIT tag detection equipment will be purchased and assembled by UI personnel prior to the winter de-watering schedule for McNary and Ice Harbor dams. Maintenance and installation of equipment will occur during the period when fishways are dewatered whenever possible. Radiotelemetry equipment used during 2007 will be similar to that used in 2006. No additional receivers will be needed. The required number of PIT tags and transmitters will be ordered by late 2006 after consultation with USACE personnel to insure delivery for the 2007 field season. Computers and vehicles will be supplied by the researchers as needed on a rental basis. Installation of new antennas and repairs to existing antennas will be made during the winter maintenance periods at dams, and will be completed prior to commencement of tagging in summer of 2007.

E. Impacts of study on USACE projects and other activities

Division or district USACE personnel will be needed to provide technical review of research proposed for 2006.

Assistance from project personnel will be requested as follows:

1. Access to AC power at McNary and Ice Harbor and potentially other Snake River dams for electronics equipment in the fishways and tailrace areas during 2006.
2. Access to fishways to install, repair, and test electronic and trapping equipment. Some dive and crane support may be needed to install antennas in and near fishways.
3. Regular access to tailrace and fishways for downloading of radio and PIT receivers.
4. Access to fishways to trap adult lamprey at McNary Dam.
5. Space at the juvenile facility to process, hold, and tag adult lamprey and access to AC power and a supply or river water to hold lamprey prior to and following tagging.

All research activities will be coordinated with USACE project biologist. We do not anticipate the outlined work will interfere with project operations. We will work closely with NMFS and PSMFC to reduce potential interference with salmon FDX PIT monitoring.

F. Biological Effects:

Fish for studies outlined here would be collected and tagged at McNary Dam during 2007. Tagging will take place 7 days a week. Fish will be trapped at night from the fishway, selected for tagging, anesthetized, fitted with HD PIT tags and/or transmitters, and released approximately 1 km downstream from the two dams after a suitable recovery period, typically that evening. Indirect effects on lamprey from tagging are a delay for fish to re-ascend the 1 km of river and reenter a fishway at the two dams. Based on past experience we anticipate few to no mortalities associated with lamprey sampling for this evaluation. In 2003, over 13,000 lamprey were counted passing the McNary Dam. During 2004 and 2005,

5,888 and 4,167 lamprey were counted at McNary. The 200 to 300 fish proposed for tagging could be 2 to 7% of the run in 2007.

We will coordinate with other researchers conducting radio telemetry studies with lamprey and salmon to enhance coverage and avoid duplicate use of frequencies and codes of transmitters in the system.

G. Reporting Schedule

Information and analyses from this study will be provided regularly to managers via reports and verbal presentations.

Progress reports and presentations of results will be provided at up to three meetings, as requested by the POC, and an oral presentation summarizing 2007 field effort and providing results from preliminary analyses will be provided at the Annual AFEP Review, November 2007. Additional information, updates, summaries, etc., will be provided for other managers as needed and when time allows.

The draft report of 2007 monitoring results will be provided no later than December 2007. A draft final report should be completed in January 2007. Regular progress reports will provided during the ongoing research field work. Information that is appropriate will be published in peer-reviewed journals.

H. Key Personnel

Project planning, administration, final reporting:
Principle investigators, C. A. Peery, ICFWRU, M. L. Moser, NOAA Fisheries

Work plan preparation, protocols, computer programs, permits:
C. Peery, S. Lee, B. Daigle, M. Jepson ICFWRU, M. Moser NOAA Fisheries

Equipment specifications and purchase:
K. Tolotti, S. Lee, ICFWRU, J. Simonson, M. Moser, NOAA Fisheries

Tagging of fish
T. Dick ICFWRU, M. Moser, NOAA Fisheries

Installation and maintenance of receivers equipment at dams and downloading data
K. Tolotti, T. Dick, S. Lee, B. Daigle, ICFWRU, M. Moser NOAA Fisheries.

Mobile tracking and gathering of recapture information:
C. Boggs, Technician ICFWRU, Noah Adams, USGS

Data coding/processing:
M. Jepson, ICFWRU, D. Ogden, NOAA Fisheries

Telemetry Database management
B. Burke, K. Frick, NOAA Fisheries

Analysis of data and preparation of report segments and presentations
C. Peery, ICFWRU, M. Moser, NOAA Fisheries

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