Susitna-Watana Hydroelectric Project Document
ARLIS Uniform Cover Page

Title: Freshwater fish distribution and abundance in the middle and lower Susitna River	**SuWa 141**
Author(s) – Personal:	
Author(s) – Corporate: Alaska Energy Authority	
AEA-identified category, if specified: Aquatic and fish resources study requests	
AEA-identified series, if specified:	
Series (ARLIS-assigned report number): Susitna-Watana Hydroelectric Project document number 141	**Existing numbers on document:**
Published by: [Anchorage] : Susitna-Watana Hydroelectric Project, [2012]	**Date published:** 4/18/2012
Published for:	**Date or date range of report:**
Volume and/or Part numbers:	**Final or Draft status, as indicated:**
Document type:	**Pagination:** 8 p.
Related work(s):	**Pages added/changed by ARLIS:**
Notes:	

All reports in the Susitna-Watana Hydroelectric Project Document series include an ARLIS-produced cover page and an ARLIS-assigned number for uniformity and citability. All reports are posted online at http://www.arlis.org/resources/susitna-watana/

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SUSITNA-WATANA HYDRO

1.1. Freshwater Fish Distribution and Abundance in the Middle and Lower Susitna River

1.2. Requester of Proposed Study

AEA anticipates resource agencies will request this study.

1.3. Responses to Study Request Criteria (18 CFR 5.9(b))

The following sections provide the necessary context and justification for the proposed study.

1.3.1. Describe the goals and objectives of each study proposal and the information to be obtained.

Construction and operation of the Project as described in the Pre-application Document (PAD; AEA 2011a) likely will affect flow, water depth and surface water elevation in the mainstem channel as well as at tributary confluences, side channels, and sloughs, both in the area of the inundation upstream from the Watana Dam site and downstream in the potential zone of project hydrologic influence. The operations of hydroelectric dams often alter the flow, temperature, and sediment regimes in the rivers immediately downstream. Such modifications in a stream's flow, temperature, and sediment can have an adverse effect upon the aquatic communities and fish populations residing in the river. To assess the effects of river regulation on these fish populations, an understanding of existing conditions will be needed, providing baseline information for predicting the likely extent and nature of potential changes that will occur due to Project operational effects on flow and temperature regimes.

The study area encompasses the Susitna River from Cook Inlet (RM 0) upstream to Devils Canyon (RM 150).

The overarching goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous species (e.g., Bering cisco, Dolly Varden, eulachon, humpback whitefish, northern pike, and Pacific lamprey), and freshwater rearing life stages of anadromous fish (fry and juveniles). Specific objectives include:

1. Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of juvenile anadromous salmonids.
2. Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and habitat associations of resident fishes.
3. Describe seasonal movements of selected fish species (rainbow trout, eulachon, Dolly Varden, whitefish, northern pike, Pacific lamprey, and burbot) using biotelemetry (PIT and radio-tags) with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem Susitna River.
4. Document the timing of downstream movement and catch for all fish species using smolt traps.
5. Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike).
6. Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Genetic Analysis study.

1.3.2. If applicable, explain the relevant resource management goals of the agencies and/or Alaska Native entities with jurisdiction over the resource to be studied.

The Alaska Department of Fish and Game (ADF&G) is responsible for the management, protection, maintenance, and improvement of Alaska's fish and game resources in the interest of the economy and general well-being of the state (AS 16.05.020). ADF&G monitors fish populations and manages commercial, sport, personal use, and subsistence fisheries through regulations set by the Board of Fisheries (AS 16.05.251). The Federal Subsistence Board, which comprises representatives of the US Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and US Forest Service, oversees the Federal Subsistence Management Program (57 FR 22940; 36 CFR Parts 242.1–28; 50 CFR Parts 100.1–28), with responsibility for managing subsistence resources on Federal public lands for rural residents.

The ADF&G manages the Susitna River fisheries in accordance with the sustained yield principle. Fisheries are managed based on perceived abundance and Alaska Board of Fisheries approved management plans. ADF&G has emergency order authority (5 AAC 75.003) to modify time, area, and bag/possession limits.

Resident and anadromous fish are important to commercial, sport, personal use, and subsistence fisheries in the Susitna River basin. Pacific salmon and eulachon in the Susitna River basin support commercial fisheries occurring in Upper Cook Inlet (Shields 2010). Sport fisheries occur in the Susitna River basin for the five species of Pacific salmon indigenous to Alaska, as well as Arctic grayling, Dolly Varden, rainbow trout, burbot, and northern pike. Sport fisheries within the Susitna drainage are managed under the Eastside Susitna and Westside Susitna subunits. Pacific salmon, Dolly Varden, rainbow trout, lake trout, eulachon, whitefish, and burbot support subsistence and personal use fisheries (Oslund and Ivey 2010, Fall and Foster 1987).

1.3.3. If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Fisheries resources are owned by the State of Alaska, and the Project could potentially affect these public interest resources.

1.3.4. Describe existing information concerning the subject of the study proposal, and the need for additional information.

Information regarding resident species, non-salmon anadromous species, and the freshwater rearing lifestages of anadromous salmon was collected as part of the studies conducted during the early 1980s. Existing information includes the spatial and temporal distribution of fish species and their relative abundance. The PAD (AEA 2011a) and Aquatic Resources Data Gap Analysis (ARDGA; AEA 2011b) summarized this existing information and also identified data gaps for resident and rearing anadromous fish.

A total of 19 anadromous and resident fish species have been documented inhabiting the Susitna River drainage. To varying degrees, the relative abundance and distribution of these species were determined during the early 1980s studies. For most species, the dominant age classes and sex ratios were also determined and movements, spawning habitats, and overwintering habitats were identified for certain species. Resident species that have been identified in all three reaches of the Susitna River include arctic grayling, Dolly Varden, humpback whitefish, burbot, longnose sucker, and sculpin. Other species that were observed in

the Middle and Lower reaches include Bering cisco, threespine stickleback, arctic lamprey, and rainbow trout. Eulachon are found only in the Lower reach. Other species that have been documented or may occur in the Susitna drainage include northern pike, Alaska blackfish, and Pacific lamprey, though their distributions are more poorly understood.

Non-salmon species that exhibit an anadromous life history in the Susitna River are eulachon and Bering cisco. Dolly varden were assumed to exhibit a resident freshwater life history in the Susitna River (FERC 1984), though anadromous dolly varden are found in many other systems and it is likely that multiple life histories exist in the Susitna River (AEA 2011a). Other species that can exhibit an anadromous life history include humpback whitefish, threespine stickleback, Arctic lamprey, and Pacific lamprey (AEA 2011b). Northern pike are considered an invasive species in the Susitna drainage and have spread throughout the system from the Yenta drainage after being illegally introduced in the 1950s. Alaska blackfish are also considered an invasive species and, while not captured in the Susitna River, may have been introduced to the system (AEA 2011a).

Little is known about the density and distribution of juvenile salmon in the Susitna River drainage. Pacific salmon (all five species) were captured in the lower and middle Susitna River during the 1980s. Juvenile Chinook salmon are the only anadromous species known to rear in the upper Susitna River and tributaries, though the extent of their presence in the upper river has been poorly studied. Coho salmon were found in the lower and middle Susitna River during the 1980s. They typically outmigrated to sea as age 1+ or age 2+ fish. Chum salmon were also present in the middle and lower river. Because chum outmigrated to sea within a few months of emergence, little is known about their environmental dependence on the Susitna River. Sockeye salmon were also found in the middle and lower river. Most age 0+ sockeye salmon outmigrate from the middle river. It has not been determined whether they rear in the lower river or if they go to sea at age 0+. Pink salmon were found in the middle and lower river during the 1980s. However, since they outmigrate soon after emergence, like the chum salmon, little is known about their environmental requirements in the Susitna River.

1.3.5. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Non-salmon anadromous, resident and invasive fish species communities comprise key components of the aquatic ecosystem. Project facilities and operations will modify the flow, thermal, and sediment regimes of the Susitna River, which will alter the composition and distribution of fish habitat. The proposed hydropower operations for the Susitna-Watana Hydropower Project may influence the abundance and distribution of one or more of these fish populations. The degree of impact on the fish communities resulting from hydropower operations will necessarily vary depending on the magnitude, frequency, duration, and timing of flows as well as potential Project-related changes in temperature and turbidity. By investigating the current populations in the lower and middle Susitna River, and applying what is known regarding the impacts of river regulation and hydropower operations on fish communities, this study and its objectives may be able to offer important options for protection, mitigation and enhancement (PM&E) measures. Existing fish and aquatic resource information appears insufficient to address the following issues that were identified in the PAD (AEA 2011a):

F4: Effect of Project operations on flow regimes, sediment transport, temperature, and water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity. The effect of Project-induced changes include stream flow, stream ice processes, and channel morphology (streambed coarsening) on anadromous fish spawning and incubation habitat availability and suitability in the mainstem and side channels and sloughs in the middle river above and below Devils Canyon.

F5: Potential effect of Project flow regime on anadromous fish migration above Devils Canyon. Devils Canyon is a velocity barrier to most fish movement and changes in flows can result in changes in the potential fish movement through this area (approximately RM 150).

F6: Potential influence of the proposed Project flow regime and the associated response of tributary mouths on fish movement between the mainstem and tributaries within the Middle River Reach.

F7: Influence of Project-induced changes to mainstem water surface elevations July through September on adult salmon access to upland sloughs, side sloughs, and side channels.

F8: Potential effect of Project-induced changes to stream temperatures, particularly in winter, changing the distribution of fish communities, particularly invasive northern pike.

Additionally, agency staff have expressed concerns that over time (i.e. 50 years) historic salmon spawning areas downstream of the Watana Dam site may become less productive due to potential changes to habitat conditions, in particular, those affected by sediment transport, gravel recruitment, bed mobilization, and embeddedness.

1.3.6. Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

This study will employ a variety of field methods to build upon the existing information related to the distribution and abundance of resident, non-salmon anadromous fish, and juvenile salmon in the Lower and Middle reaches of the Susitna River drainage. The methods chosen to accomplish this effort are consistent with standard techniques used throughout the fisheries scientific community. However, logistical and safety constraints inherent in fish sampling in a large river in northern latitudes also play a role in selecting appropriate methodologies. The following sections provide brief descriptions of the suite of methods that will be used to accomplish each objective of this study. This study incorporates fish surveys in the lower and middle river but does not include estimates of escapement. This study will occur over two years in order to cover as much habitat as possible. If dramatically different flow conditions occur between these two years, the re-sampling of 20-25% of habitats sampled in year one will be considered in year two.

Objective 1: Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of juvenile anadromous salmonids.

- Collect data using standard sampling techniques (electrofishing, snorkeling, and/or seining) in summer and fall. For winter sampling use PIT tag arrays and/or video systems.

- Based on fish collection data, estimate and compare the relative abundance of juvenile salmon within and across mainstem habitats.
- Determine the periods of use and movement patterns of marked/tagged juvenile salmon between mainstem habitats strategically selected based on an appropriate sampling strategy (i.e., systematic, random, or stratified random design).
- Assess the feasibility to estimate juvenile salmon production of the Susitna River at Whiskers Creek.
- Compare historical data on the relative timing, distribution, and abundance of juvenile salmon in mainstem habitats to that determined from 2012-2014 studies.

Objective 2: Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and habitat associations of resident fishes and the fresh water life stages of non-salmon anadromous species.

- Use systematic scheme for sampling across habitat types and randomize selection of habitat units to sample.
- Use summer fish-habitat association data, historic data, and ground water study results to identify potential habitats and randomize selection among these habitats for winter fish sampling.
- Build upon and use, as appropriate, the 1980s data applicable to non-salmon anadromous, resident, and invasive fish species.
- Establish a seasonal sampling design (including winter where possible) that includes turbid and clear water sampling and that complements the 1980s data collection for these species (as appropriate).
- Sample fish species using appropriate methods for the habitat and season (electrofishing, snorkeling, seining, minnow trapping) in the main channel, side channels, sloughs, and tributary mouths.
- Develop life stage specific periodicity information for the middle and lower river in support of the Instream Flow Study
- Collect additional data to support efforts to determine the timing, distribution, and relative abundance of eulachon in the Lower Susitna River Reach.
- Coordinate with the Synthesis of Existing Fish Population Data Study to summarize and obtain the 1980s study data applicable to non-salmon anadromous, resident and invasive fish species.

Objective 3: Use biotelemetry (PIT and radio-tags) to describe seasonal movements of selected fish species (rainbow trout, Dolly Varden, whitefish, northern pike, Pacific lamprey, burbot) with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem Susitna River.

- Selectively mark individual fish collected during annual surveys conducted under study Objective 2 and Objective 4 with PIT-tags.
- Use PIT tag antenna arrays near the mouths of select tributaries and/or sloughs to determine seasonal habitat utilization (mainstem vs. tributary/slough) and movements of targeted fish species and specifically for rainbow trout in the reach between the Deshka River and the Watana Dam site.

- Coordinate with salmon escapement and fish survey teams to retrieve data from PIT-tag detections and from fish wheel operations related to non-salmon anadromous, resident, and invasive species collected during their studies.
- Collect, radio tag, and track 30 fish from each species listed above. Tag sizes will be chosen to maximize tag life within the constraints of the study fish size. Tracking duration will be determined based on the anticipated life span of the tags chosen.

Objective 4: Document the timing of downstream movement and catch for all fish species via smolt traps.

- Use relative abundance and marking data from Objectives 1 and 2 to determine patterns of movement among mainstem habitats.
- Operate PIT arrays at strategic side channels, sloughs, and the confluence of tributaries to allow for tracking of individual fish among mainstem habitats.
- Use data from inclined plane and/or rotary screw traps in the mainstem to determine the timing of all salmon species emigrating from the Middle Susitna at Whiskers Creek.

Objective 5: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike).

- Coordinate with all fish sampling studies to determine if any invasive fish species such as northern pike were collected and the location of the collections.
- Synthesize existing data collected during the 1980s and subsequent studies on northern pike in the Susitna River along with additional data on northern pike collected from 2012 to 2014 to assess Project effects on northern pike distribution and abundance.

Objective 6: Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Genetic Analysis study.

- Coordinate with the Genetic Analysis study to identify the appropriate target species and genetic sampling protocols to opportunistically collect genetic tissue samples from resident species.
- Coordinate with the Genetic Study to identify the appropriate target species, sampling locations, number of samples per species, and genetic sampling protocols to collect sufficient genetic samples from juvenile salmon.

Data: All data collected in the field will be subjected to QA/QC and delivered to AEA. The data will be entered into the relational database described below, QC'd, and delivered to AEA.

Geospatially-Referenced Relational Database: All data generated during this study will be incorporated into the Susitna Fish Program geospatially-referenced relational database that will be created in 2012; this database will form the basis for additional data collection in 2013-2014. All new field data will be associated with location information collected using a Global Positioning System (GPS) receiver in unprojected geographic coordinates (latitude/longitude) and the WGS84 datum. Naming conventions of files and data fields, spatial resolution, and metadata descriptions will meet the ADNR standards established for the Susitna-Watana Hydroelectric Project.

Spatial Products in ArcGIS Software: The geospatial products will include geodatabases and maps indicating survey area, radio-tagged fish locations by survey, habitat types used by

spawning fish, habitat data, and locations of significant features such as barriers and springs. Naming conventions of files, data fields and metadata descriptions will meet the ADNR standards established for the Susitna-Watana Hydroelectric Project. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and North American Datum of 1983 (NAD 83) horizontal datum consistent with ADNR standards.

Summary of Interim Results: An interim report will be prepared to document the progress of the study efforts in 2013, identify any issues that have occurred, and allow for further refinement of the 2014 studies.

Annual Project Report: A report will be prepared that documents the methods, field effort, results, conclusions, and recommendations from the 2012 study.

Technical Memo: A technical memo summarizing the 2012 results will be presented to resource agency personnel and other licensing participants, along with spatial data products.

Schedule

This is a multi-year study and includes an ongoing study planning component. The schedule for the 2013-2014 components will be refined in coordination with AEA during the 2013-2014 study planning process.

- Proposed Study Plan – July 16, 2012.
- Revised Study Plan – November 14, 2012.
- Summary of Interim Results – September 2013 and 2014.
- QC'd geospatially-referenced relational database – December 2013 and 2014.
- Technical Memorandum on 2013 and 2014 Activities – December 2013 and 2014.

1.3.7. Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

To describe the seasonal distribution, relative abundance, and habitat associations of the various fish species in winter, alternate methods involving snorkel and dive surveys were considered. These alternate methods were dismissed based on safety concerns owing to potentially extreme cold temperatures, remoteness of the sampling locations, and that sampling would most appropriately be conducted at night.

The schedule, staffing, and costs will be detailed as the 2013–2014 Study Plan develops. Total study costs are estimated at $3,000,000.

1.3.8. Literature Cited

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