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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Study of Fish Distribution and Abundance in the Middle and Lower Susitna River Study
Study Plan Section 9.6

Initial Study Report
Part C: Executive Summary and Section 7

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants Inc.
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Golder Associates Inc.

June 2014

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EXECUTIVE SUMMARY

Study of Fish Distribution and Abundance in the Middle and Lower Susitna River (9.6)	
Purpose	The goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous fish species as well as freshwater rearing life stages of anadromous salmonids in the Middle and Lower Susitna River. Seven specific objectives have been developed for this study and include multiple tasks. Data collected as part of this study will be used to provide a baseline characterization of fish assemblages in the Susitna River, to identify and evaluate potential Project-induced effects on fish assemblages, and inform development of any necessary protection, mitigation, and enhancement measures.
Status	Data collection is complete for the first year of this multiyear study. Initial database quality assurance and quality control was completed to compile preliminary summary statistics and preliminary data analysis for the Initial Study Report. Database quality assurance and quality control, data analysis, and coordination with interdependent studies are ongoing iterative processes. Data collection is planned for 2014 and 2015.
Study Components	Major study components include the following seven objectives: • Objective 1: Describe the seasonal distribution, relative abundance, and fish habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes. • Objective 2: Describe seasonal movements of juvenile salmonids and selected fish species such as rainbow trout, Dolly Varden, humpback whitefish, round whitefish, northern pike, Arctic lamprey, Arctic grayling, and burbot, with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem of the Susitna River. • Objective 3: Describe early life history, timing, and movements of anadromous salmonids. • Objective 4: Document winter movements and timing and location of spawning for burbot, humpback whitefish, and round whitefish. • Objective 5: Document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type. • Objective 6: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike). • Objective 7: Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Fish Genetic Baseline Study (Study 9.14).

2013 Variances	AEA implemented the methods as described in the Study Plan with the exception of the following variances. The significance of these variances is discussed within the ISR. • adjustments to Focus Area locations (Section 4.1.7.1); • adjustments to rotary screw trap, PIT array, radio telemetry fixed receiver, winter sampling, early life history sampling, and fish distribution and abundance sampling locations (Section 4.1.7); • adjustments to the number of fixed receiver and winter sampling locations (Section 4.1.7);adjustments to the timing of fish distribution and sampling efforts(Section 4.2.1);grouping select Middle and Lower River macrohabitat classifications (Sections 4.1.7.2 and 4.4.4.3); • adjustments to sample unit lengths (Section 4.4.4.1); • adjustments to gear type applications (e.g., numbers of passes, soak times; Section 4.4.4.2); • refinements to estimating the detection efficiency of PIT tag interrogation systems (Section 4.5.3.1); • adjustments to the timing of radio-tag implementation and aerial survey methods for tracking resident fish (Sections 4.5.3.2 and 4.5.3.3; and • utilizing size instead of age to evaluate habitat associations of juvenile anadromous and resident fish (Section 4.8.1).
Steps to Complete the Study	The Study of Fish Distribution and Abundance in the Middle and Lower Susitna River will be completed through a combination of sampling activities in the mainstem Susitna River and select tributaries in 2014 and 2015. AEA plans to complete the study as described in the Study Plan except for the following modifications: • Combine main channel, split main channel, and multi-split main channel into one strata for the purposes of GRTS site selection in the Middle River. • Reduce the sample unit length from 500 to 200 meters for main channel and side channel sites when using techniques other than boat electrofishing or drift gillnetting. • Abandon multiple-pass sampling efforts for relative abundance in favor of consistent and rigorous single pass sampling for generating meaningful CPUE estimates. • Operate three rotary screw traps in the Middle River and one trap in the Lower River. The location of select rotary screw traps will be adjusted to improve catch. • PIT tagging of target species will continue to occur during Fish Distribution and Abundance Sampling within Focus Areas, at rotary screw traps, and during all sampling activities in close proximity to PIT interrogation antennas. AEA plans to continue to PIT tag fish at capture locations until 4,000 tags (1,000 tags x four PIT antennas) have been allocated per target species in the entire Middle/Lower

	River segments. The location of PIT interrogation antenna sites will be adjusted to improve catch. • Biotelemetry studies will continue and fish will be radio tagged during non-spawning periods and prior to important spawning, overwintering, or foraging periods so that tags are active during these times.
Highlighted Results and Achievements	In 2013, sixteen species were captured in the Middle and Lower Susitna River. In the Middle River, over 43,500 fish were observed during three seasonal surveys at over 160 sites covering 4 tributaries above Devils Canyon and approximately 84.7 miles of the Susitna River. Juvenile coho salmon, threespine stickleback, adult pink salmon, and sculpin were the most abundant species. Both the total number of species and the relative abundance of all species except Arctic grayling and Dolly Varden were notably higher downstream of Devils Canyon. In the Lower River, over 11,900 fish were observed during three seasonal surveys at 44 sites representing 70.1 miles of the Lower Susitna River. Threespine stickleback was the most abundant species comprising over 35 percent of all fish observations. Northern pike were not observed in the Middle River. Northern pike were observed only in Geomorphic Reach LR-4 of the Lower River (PRM 32.3-PRM 44.6). Over 5,600 fish were tagged for biotelemetry studies of fish movement in both the Middle and Lower River. Sampling in 2013 met all first-year study goals and objectives.

7. COMPLETING THE STUDY

7.1. Proposed Methodologies and Modifications

To complete this study, AEA will implement the methodologies in the Study Plan except as described in section 7.1.2. These activities include:

- Salmon early life history sampling to support AEA's efforts to:
    - describe the seasonal distribution, relative abundance (as determined by catch per unit effort (CPUE), fish density, and counts), and fish-habitat associations of resident fishes, juvenile anadromous salmonids, and the freshwater life stages of non-salmon anadromous species (Study Objective 1);
    - describe seasonal movements of juvenile salmonids and selected fish species such as rainbow trout, Dolly Varden, humpback whitefish, round whitefish, northern pike, Arctic lamprey, Arctic grayling and burbot with emphasis on identifying foraging, spawning, and overwintering habitats within the mainstem of the Susitna River (Study Objective 2);
    - describe early life history of anadromous salmonids (Study Objective 3); and
    - characterize the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type (Study Objective 5).
- Fish distribution and abundance sampling activities in the mainstem Susitna River and select tributaries in the Study Area to support AEA's efforts to:
    - describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of resident fishes, juvenile anadromous salmonids, and the freshwater life stages of non-salmon anadromous species (Study Objective 1);
    - describe seasonal movements of juvenile salmonids and selected fish species such as rainbow trout, Dolly Varden, humpback whitefish, round whitefish, northern pike, Arctic lamprey, Arctic grayling and burbot with emphasis on identifying foraging, spawning, and overwintering habitats within the mainstem of the Susitna River (Study Objective 2);
    - characterize the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type (Study Objective 5); and
    - document the seasonal distribution, relative abundance, and habitat associations of invasive species (lake trout and northern pike) (Study Objective 6).
- AEA will continue to operate four rotary screw traps in the Middle/Lower River Study Area to support describing seasonal movements of juvenile salmonids and selected fish species with emphasis on identifying foraging, spawning, and overwintering habitats within the mainstem of the Susitna River (Study Objective 2).

- Biotelemetry including PIT and radio-tagging, PIT interrogation antenna sites, fixed radio telemetry sites, and aerial surveys will continue to support AEA's efforts to:
    - describe seasonal movements of juvenile salmonids and selected fish species such as rainbow trout, Dolly Varden, humpback whitefish, round whitefish, northern pike, Arctic lamprey, Arctic grayling and burbot with emphasis on identifying foraging, spawning, and overwintering habitats within the mainstem of the Susitna River (Study Objective 2);
    - document the winter movements and timing and location of spawning for burbot, humpback whitefish, and round whitefish (Study Objective 4); and
    - document the seasonal distribution, relative abundance, and habitat associations of invasive species (lake trout and northern pike) (Study Objective 6).
- Tissue samples collection to support the Fish Genetic Baseline Study (Study 9.14).
- Winter Fish Studies will continue to support AEA's efforts to:
    - describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of resident fishes, juvenile anadromous salmonids, and the freshwater life stages of non-salmon anadromous species (Study Objective 1);
    - describe seasonal movements of juvenile salmonids and selected fish species such as rainbow trout, Dolly Varden, humpback whitefish, round whitefish, northern pike, Arctic lamprey, Arctic grayling and burbot with emphasis on identifying foraging, spawning, and overwintering habitats within the mainstem of the Susitna River (Study Objective 2);
    - document the winter movements and timing and location of spawning for burbot, humpback whitefish, and round whitefish (Study Objective 4); and
    - characterize the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type (Study Objective 5).

7.1.1. Decision Points from Study Plan

There were no decision points in the FERC-approved study plan to be evaluated for this study following completion of 2013 work.

7.1.2. Modifications to the Study Plan

AEA will implement the methods as described in the Study Plan with the exception of the following modifications.

7.1.2.1. Salmon Early Life History Study Sites

The Study Plan specified salmon Early Life History (ELH) sampling at six sites in each of five Middle River Focus Areas (IP Section 5.5). However, with the addition of FA-113 (Oxbow I)

following Implementation Plan development, sampling took place at six sites in each of six Focus Areas (ISR Table 5.1-1). Furthermore, when AEA adopted the FERC recommendation of seasonal sampling in mid-July and late August/early September and late September/early October in the Middle and Lower River, additional ELH sampling locations were added in tributaries and lakes upstream of Devils Canyon and the tributaries and sloughs in the Lower River to gather information on juvenile salmon life history during the period from ice break-up to July 1. AEA plans a similar level of sampling effort to 2013 for Salmon Early Life History. Based on 2013 study effort and spawning surveys, AEA will select optimal locations downstream of spawning areas and known rearing areas within tributaries above Devils Canyon, Middle River Focus Areas, and off-channel habitats and tributaries in the Lower River.

7.1.2.2. Fish Distribution and Abundance Sampling Sites

The Revised Study Plan and Implementation Plan were filed prior to designation of the tenth Focus Area in the Middle River. The Adjustments to Middle River Focus Areas Tech Memo filed in May 2013, placed the tenth Focus Area in Geomorphic Reach MR-7 (AEA 2013b). This change added six sites to sampling targets within Focus Areas for fish abundance sampling and moved one tributary mouth site previously outside of a Focus Area in MR-7 into FA-113 (Oxbow I) (ISR Section 4.1.7.2). AEA plans to resample the 2013 study sites in 2015.

Land ownership and accessibility influenced fish sampling in discrete areas of the Middle River in 2013. Access was not permitted for Middle River tributary and upland slough sites on Cook Inlet Regional Working Group (CIRWG) and Alaska Railroad Corporation lands. In total, fifteen Middle River sites were not sampled because of access restrictions and could not be replaced with oversample sites (ISR Section 4.1.7.2). CIRWG land ownership affected sampling at Unnamed Tributary 184, Devil Creek, Cheechako Creek and lands between Portage Creek (PRM 152.3) and the proposed Watana Dam site (PRM 187.1) including an inaccessible corridor through Devils Canyon and along the Susitna River above OHWM extending several miles from both the right and left bank. Alaska Railroad Corporation lands influenced site selection for Middle River tributaries and upland slough sites along the river left (east) bank of the Susitna River between PRM 107.7 and 140.0. In most cases, GRTS oversamples were used to replace sites on Alaska Railroad Corporation lands. However one tributary and one upland slough site could not be accessed or replaced and were not sampled (Table 4.1-3). AEA plans to sample all locations that could not be sampled in 2013 during the 2014 and 2015 study years.

The SPD recommended that AEA sample mainstem habitats using separate strata for main channel, split main channel and multi-split main channels. However, based on licensing participants' recommendations during the study plan development and ongoing discussions in the Fish and Aquatic TWG meetings regarding the potential to extend an unbalanced effort in these habitats, these three channel forms were sampled as a single strata designated as main channel. AEA plans to continue the lumping of main channel habitat types into a single strata for GRTS site selection purposes (see ISR Section 4.1.7.2).

7.1.2.3. Rotary Screw Trap and PIT Interrogation Sites

FERC's April 2013 Study Plan Determination provided for rotary screw traps to be operated in Indian River, the mainstem Susitna River at Curry Station, the mainstem Susitna River at

Talkeetna Station (p. B-143) and in Montana Creek (p. B-161). During the Fisheries Technical Workgroup on March 20, 2014, AEA presented modifications to rotary screw trap locations in the Middle/Lower River to improve catch and the quality of data collection (R2 Resources Consultants 2014a). The rotary screw trap in the Susitna River at Curry Station had substantially lower catch rates than the other rotary screw traps in 2013 (see ISR Section 5.2.1). As a modification to the Study Plan, AEA plans to move the rotary screw trap located on the mainstem Susitna at Curry Station to the mainstem Susitna below Portage Creek between PRM 151.3-152.3. Moving this trap location could provide: a) increased trapping efficiency and catch rates, b) better coverage of fish emigrating from Portage Creek, a major spawning tributary, and c) increased catch of fish originating upstream of Devils Canyon. Secondly, AEA plans to seek an alternative location for the Montana Creek trap. The only suitable and permissible trapping location for the 2013 study year was 2.2 miles upstream of the Susitna River confluence. As a modification to the Study Plan, AEA plans to move the trap to a suitable location in the mainstem Lower Susitna River in the vicinity of Montana Creek. This is consistent with the Study Plan Determination which stated that FERC staff were "not opposed to AEA moving the proposed screw trap location at Montana Creek should it elect to do so in consultation with the TWG prior to the start of the study season." (SPD p. B-161) A mainstem trap location may be more informative for evaluating potential Project effects and better complement data collection under Objective 1, the River Productivity Study (ISR 9.8), and the Fish and Aquatics Instream Flow Study (ISR 8.5). AEA is planning to operate three rotary screw traps in the Middle River and one trap in the Lower River in accordance with the approved Study Methods.

AEA will also reevaluate PIT antenna locations. The Indian and Montana Creek antenna locations were prone to flooding and damage resulting in intermittent operation. As a modification to the Study Plan, AEA plans to relocate these antennas near the new mainstem screw trap location or to another location in proximity to a source of PIT tagged fish (e.g., between two broadcast sampling sites).

7.1.2.4. Biotelemetry

7.1.2.4.1. Fixed Radio Receiver Sites

Specific telemetry sites were discussed in Section 5.8.2.1 of the Implementation Plan. Lack of access to CIRWG land necessitated a number of changes to the quantity and location of telemetry fixed stations in the Middle River during 2013. Fixed stations planned for the Portage Creek, Cheechako station, Chinook Creek, and Fog Creek were not installed due to a lack of land access (see ISR Section 4.1.7.4). In 2013, the Slough 21 station (PRM 144) was moved to a new location slightly upstream (Powerline, PRM 146) (ISR Figure 4.1-3). Use of the Powerline station in place of the Slough 21 station and elimination of the Slough 11 and Fog Creek stations will be continued as modifications to the Study Plan. Telemetry efforts during 2014 will include a fixed receiver station at Devils Island (PRM 166.9) (see Section 7 of ISR Study 9.7). In 2015, fixed stations will follow the Study Plan with the exception of the modifications described above.

7.1.2.4.2. PIT Tagging

The Study Plan provided that up to 1,000 fish per target species be PIT-tagged in proximity to each PIT interrogation antenna and rotary screw trap site (RSP Section 9.6.4.3.2). PIT tagging of target species will continue to occur during Fish Distribution and Abundance Sampling within Focus Areas, at rotary screw traps, and during all sampling activities in close proximity to PIT interrogation antennas. Tagging goals of 1,000 fish per target species in proximity to an interrogation antenna are likely to be reached in 2015. However, AEA plans to continue to PIT tag fish at capture locations until 4,000 tags (1,000 tags x four PIT antennas) have been allocated per target species in the entire Middle/Lower River segments instead of capping the number of fish tagged at 1,000 within five or ten miles of an antenna site. Using a multi-segment wide target will allow for the tagging of more individuals if they are not evenly distributed among antenna sites. Increasing the number of tags deployed will improve AEA's ability to meet study objectives.

7.1.2.5. Winter Sampling Approach

Development of recommendations for winter sampling for winter 2013/14 and 2014/15 was based on the 2013 Winter Pilot Study Technical Memorandum (Appendix C) in accordance with the Study Plan. Recommendations were shared with stakeholders in the February 3, 2014 draft Initial Study Report (R2 Resource Consultants and LGL Alaska 2014) and Fisheries Technical Workgroup meeting March 20, 2014 (R2 Resource Consultants 2014c). AEA implemented the proposed sampling approach. Study efforts included one November 2013 sampling trip prior to mainstem freeze-up and three collaborative interdisciplinary sampling trips between early February and mid-April 2014. Data entry, Quality Control, and Analysis from these efforts are ongoing. AEA will summarize the findings of the 2013/14 winter efforts and develop plans for completing the study, including proposed methodologies and modifications in a *Study 9.6 Fish Distribution and Abundance in the Middle and Lower Susitna River: Winter Fish Studies 2013/14 Technical Memorandum* to be filed with the FERC.

7.1.2.6. Fish Distribution and Abundance Sampling Field Methods

7.1.2.6.1. Sample Unit Length

In 2013, Fish Distribution and Abundance sampling unit lengths for main channel, side channel, side channel complex, and bar island complex habitat types along transects and in GRTS locations was 500 m (0.3 mi) when boat electrofishing or drift-netting was feasible as recommended in the April 2013 Study Plan Determination. However, the level of effort required to effectively sample units 500 m (0.3 mi) in length using techniques other than boat electrofishing or drift-netting was deemed to not be practical in the field. Therefore, when these techniques were not feasible, AEA implemented a variance to the Study Plan so that sampling units were shortened to 200 m (656 ft) for main and side channel units (see ISR Section 4.4.4.1). AEA plans to carry this variance forward as a modification to the Study Plan and continue using 200-meter sample lengths for main and side channel units when gear types other than boat electrofishing and drift gill nets are used. Analysis of sampling sufficiency using species accumulation curves indicates that the sampling unit lengths employed in 2013 were able to capture 92-100 percent of the species present in each geomorphic reach in the Middle River

within the first 3 to 9 sites sampled (Table 7.1-1; Figure 7.1-1). Therefore, the 5 to 12 sites sampled per geomorphic reach were more than adequate to characterize fish distribution, despite the shortened sampling lengths in main channel habitats with select gear types. Similarly, in the Lower River, 92 percent of species were observed despite the presence of less common species like Bering cisco (Table 7.1-1; Figure 7.1-2). Shortened sampling reaches in main and side channel habitats when gear types other than boat electrofishing and drift gill nets are used will not compromise AEA's ability to meet study objectives.

7.1.2.6.2. Multiple Pass Sampling

In the Revised Study Plan (RSP Section 9.6.4.3.1), AEA proposed that relative abundance sampling would include multiple-pass sampling when electrofishing, snorkeling, and minnow trapping were employed. However due to ADF&G permit stipulations limiting electrofishing efforts to one pass, the April 2013 FERC SPD recommendation that minnow traps be set for 24-hrs, and the extensive level of effort involved in three pass snorkeling 200 m (656 ft) long sampling units, single-pass sampling was conducted (see ISR Section 4.4.4.2). AEA plans to carry this variance forward as a modification to the Study Plan and continue to use a single pass sampling approach for both fish distribution and abundance sampling. Limiting sampling duration facilitates sampling a larger number of sites across seasonal sampling periods and supports AEA's ability to characterize fish distribution and abundance. Sufficiency analysis of fish distribution and abundance sampling using species accumulation curves, as described in Sections 7.1.2.6.1, supports the adequacy of the single-pass methods used in 2013 for characterizing fish assemblages. Single-pass sampling will not compromise AEA's ability to meet study objectives.

7.1.2.6.3. Fish Handling

The RSP stated that each time sampling gear was checked, a random sample of 25 individuals per species, life stage, and site would be measured for fork length (FL) and weighed (IP Section 5.1.5). However, the FERC April 2013 SPD interpreted AEA's study plan as proposing to measure and weigh all fish and no modifications were recommended (SPD p. B-130). The sample size of 25 measurements per species, per life stage, per gear was consistent with collecting the data necessary to evaluate length frequency distributions and condition factor for sampled fish. AEA plans to carry forward the sampling protocol used in 2013 as a modification of the Study Plan. Twenty-five fish per species and life stage, per gear will be weighed, measured for length and PIT tagged if appropriate. AEA plans to randomly select and measure the first 25 sculpin for length (no weight) regardless of lifestage.

7.2. Schedule

In general, the schedule for completing the FERC-approved Study Plan is dependent upon several factors, including Project funding levels authorized by the Alaska State Legislature, availability of required data inputs from one individual study to another, unexpected weather delays, the short duration of the summer field season in Alaska, and other events outside the reasonable control of AEA. For these reasons, the Study Plan implementation schedule is subject to change, although at this time AEA expects to complete the FERC-approved Study

Plan through the filing of the Updated Study Report by February 1, 2016, in accordance with the ILP schedule issued by FERC on January 28, 2014.

With regard to this specific study, AEA is planning the following activities for 2014:

- Salmon Early Life History sampling (Section 7.1.2.1)
- Fish distribution and abundance sampling activities in the mainstem Susitna River and select tributaries in the Study Area. Sampling will include three seasonal sampling events in the following locations not sampled in 2013 (Section 7.1.2.2):
    - Susitna River habitats that were inaccessible in 2013, and
    - Tributaries on CIRWG lands that were not sampled in 2013 including Devil and Cheechako creeks and Unnamed Tributary 184.
- Biotelemetry: A single fixed radio telemetry site at Devils Island Station (PRM 166.9) will be monitored for resident fishes and aerial surveys will be conducted January through June (Section 7.1.2.4).
- Fish tissue collection will continue (no modification from RSP Section 9.6.4.3.7).
- Winter Sampling will continue (Section 7.1.2.5).

In 2015, AEA plans to complete all remaining data collection and analysis for this study.

7.3. Conclusion

AEA expects that the combination of 2013 study efforts including variances (as described in ISR Section 4), the planned work for completing the study including modifications (as described in ISR Section 7.1.2), and the integration with other studies will fully achieve the Study Plan Objectives (as described in RSP Section 9.6.1).

7.4. Literature Cited

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7.5. Tables

Table 7.1-1. Summary of species accumulation analyses for main channel GRTS sites in the Middle River and main channel habitats in Lower River transects in 2013.

Reach	Number of 2013 Main Channel Sample Sites/Transects	SR[a]	Site/Transect when SR first observed	TSR_{H-T}[b]	Site/Transect when TSR_{H-T} -1 first observed	TSR_{H-T} minus SR	Percent of TSR observed
MR-1	10	6	6	6.56	5	0.56	91%
MR-2	10	6	7	6.57	3	0.57	91%
MR-5	5	10	3	10.61	3	0.61	94%
MR-6	12	12	3	12.05	2	0.05	100%
MR-7	12	12	5	12.28	3	0.28	98%
MR-8	12	14	9	15.00	9	1.00	93%
Lower River segment	10	17	7	18.39	7	1.39	92%

[a] Observed species richness - the total number of species found in a Geomorphic Reach [b] Horvitz-Thompson estimate (Cochran 1977) of the true species richness in a Geomorphic Reach/ river segment.

7.6. Figures

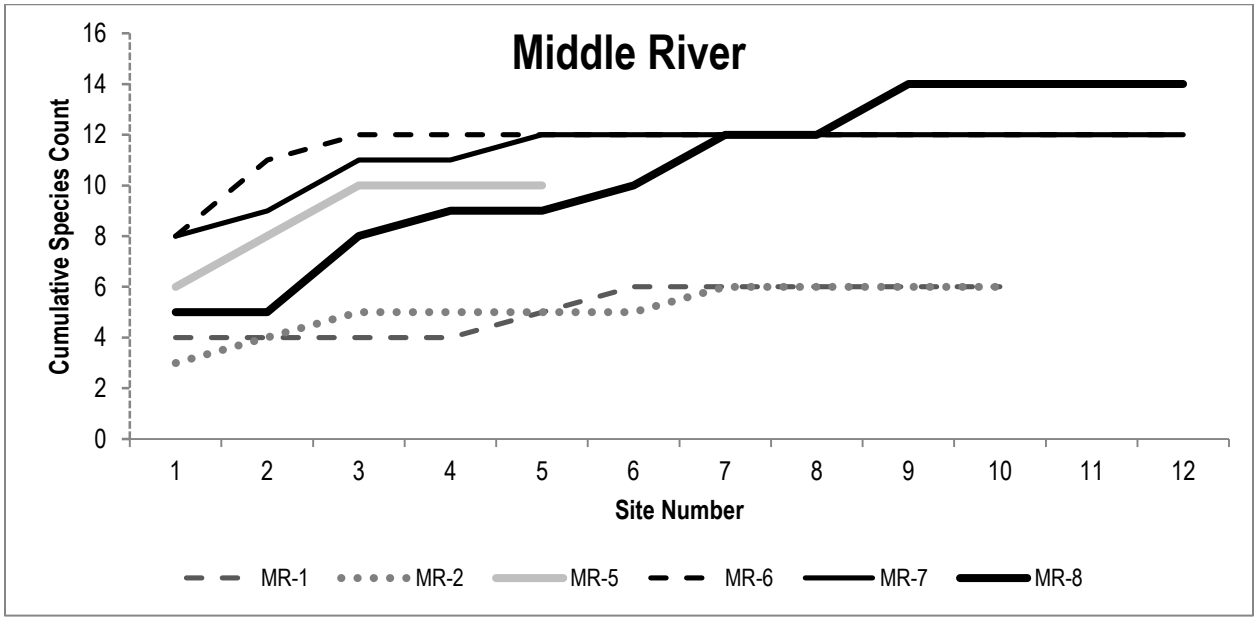

Figure 7.1-1. Species accumulation across Middle River mainstem GRTS sampling sites in 2013.

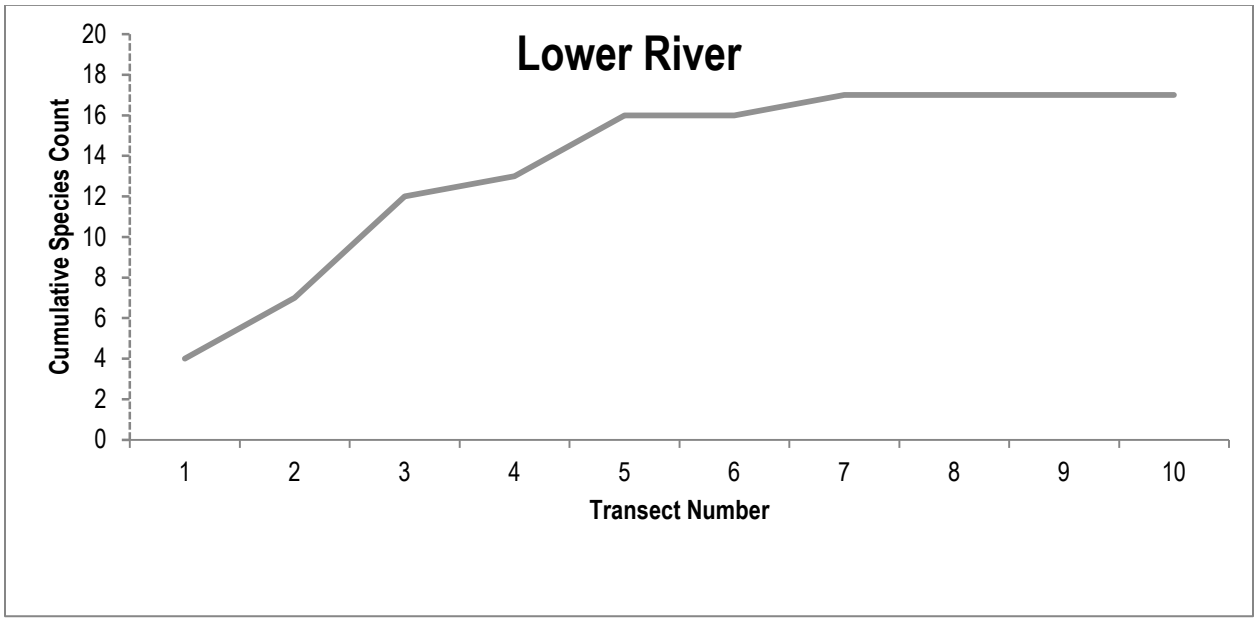

Figure 7.1-2. Species accumulation across Lower River transects in 2013.