Recently Asked Questions

2017 Kuskokwim River Sonar

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Alaska Department of Fish and Game has started a new sonar project on the mainstem Kuskokwim River in an attempt to provide fisheries managers and advisory groups with accurate estimates of daily and total abundance of salmon and whitefish species passing the Bethel area. Development of this new project has resulted in numerous questions raised by stakeholders throughout the Kuskokwim River. This document is intended to provide basic information about the Kuskokwim River Sonar project: past; present; and future. Responses are not intended to be exhaustive. Feel free to contact Nicholas Smith or Zachary Liller if you have questions or would like additional information. Information about sonar technology and other statewide sonar projects can also be found at: **http://www.adfg.alaska.gov/index.cfm?adfg=sonar.main**

General Questions about Sonar:

1. **What is sonar?**
   Sonar is a technology that uses sound waves to locate objects in the water. Sound waves bounce off of objects in the water in a similar way that a flashlight beam reflects off of shiny objects. The sonar transducer sends a cone-shaped beam of sound waves through the water and records the strength of all the echoes that bounce back from fish (or any other objects) swimming through the beam. The distance and direction of each fish swimming through the beam can be determined using measurements of the returned echoes.

2. **Can the sonar tell the difference between types of fish swimming through the beam?**
   No, the Kuskokwim River sonar project can only provide a count of fish. Sonar is typically combined with some type of test fishery to determine what proportion of the total count is made up by each species.

3. **Does the sonar harm fish?**
   No, peer-reviewed research has determined that sonar operating at the power levels and frequencies used at this site does not damage a fish's organs or hearing.

4. **Is sonar used to manage salmon runs in Alaska?**
   Yes, sonar technology has been used for many years to help manage salmon runs in Alaska. For example, sonar is used on the Yukon, Kenai, Susitna, Copper, and Nushagak rivers to name a few.

5. **Why use sonar instead of other types of assessment projects?**
   Our goal is to provide timely information about the abundance of each salmon species passing through the lower Kuskokwim River. Sonar has some particular advantages compared to other

assessment methods like test fisheries, mark–recapture, weirs, and aerial surveys. Test fisheries provide timely information, but the results are only an index of abundance which can be difficult to interpret. A sonar program estimates the actual abundance in numbers of fish. Mark–recapture projects can also produce estimates of abundance, but those estimates are not available until the season is over. A sonar program produces daily estimates inseason during the time when fishery decisions are made. Weirs and aerial surveys require that an observer can actually see individual fish, which is not possible in the mainstem Kuskokwim River. Sonar uses sound waves instead of visible light to count fish, and a sonar program can be operated efficiently in large turbid rivers like the Kuskokwim River.

General Questions about Kuskokwim River Sonar:

6. **Has ADF&G tried using sonar on the Kuskokwim before?**
   Yes, ADF&G has had an irregular history of using sonar to count fish in the lower portion of the Kuskokwim River. In 1980 and 1981, a feasibility study was conducted at a site 5 miles upstream from Bethel, but results were inconclusive and a full-scale project was not developed. From 1988 to 1990, a feasibility project was operated near the same location, and from 1991 to 1995 the project produced daily passage estimates. The project did not operate from 1996 through 1998 due to staffing shortages. A three-year feasibility study was initiated in 1999 at a new site, 16 miles upstream from Bethel, but only operated for a single season due to staffing shortages. Most recently, a three-year feasibility study was conducted from 2014 to 2016, which lead to the current project.

7. **Why does ADF&G think sonar will be successful this time?**
   Advances in sonar technology and study methods have increased the likelihood of a successful sonar program on the Kuskokwim River. In addition, the Arctic-Yukon-Kuskokwim (AYK) Regional Sonar Program is now well established and includes: numerous experienced staff; relationships with sonar technology companies to aid in equipment maintenance; and backup infrastructure to prevent delays due to equipment problems.

8. **Have the sonar methods been peer reviewed?**
   The Kuskokwim River sonar project is modeled after the Yukon River sonar project operated at Pilot Station. The Pilot Station sonar project has operated since 1986. The methods used at the Kuskokwim River and Pilot Station sonar projects were developed by ADF&G staff members who oversee the AYK Regional Sonar Program. These staff members are regarded as experts in the field of acoustics (sonar). Many of the specific project methods used at both sites are documented in peer-reviewed journals.

9. **Will the sonar methods stay the same moving forward?**
   The basic study design will stay the same, but specific aspects may be improved as we gain more experience with this project. For example, the numbers of fish passing the site will always be an estimate instead of a true count, and those estimates will always require a two-step process of sonar counts and drift gillnetting. However, the exact placement of the sonar equipment and drift gillnet procedures could change annually to accommodate slight changes in the river. Over the long-term we hope to improve our understanding of the most likely fish sizes that will be caught

in different size mesh gillnets. This information would be used to improve the estimates of what species are passing the sonar. There are other reasons that methods might change such as advances in sonar technology.

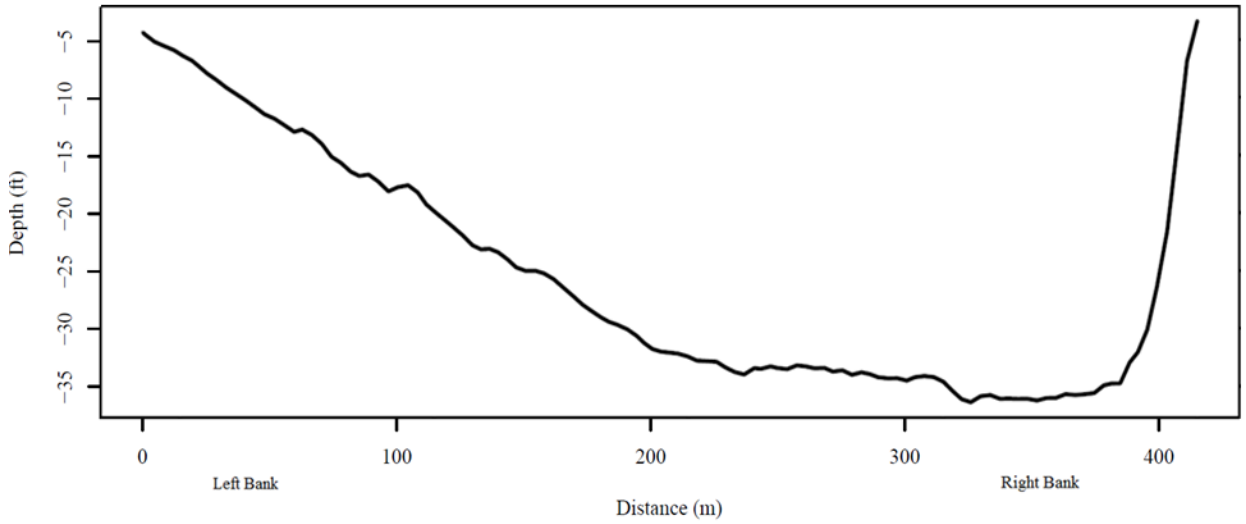
10. **What steps does ADF&G take to make sure the project operates smoothly?**
    Several steps have been taken by ADF&G to make sure the project operates smoothly. Three years of feasibility research was conducted to locate and test an optimal site in the lower Kuskokwim River. Prior to each field season, project leaders work with regional sonar coordinators to update operational plans, field manuals, and develop detailed staff training plans. All sonar equipment is inspected and calibrated by the regional sonar coordinator at the start of the field season. Prior to data collection, the sonar is installed by project leaders, inspected by regional sonar coordinators, and all staff receives hands on training in sonar and test fish operations. The project leader and crew leader remain onsite daily to oversee field operations and conduct routine maintenance of the sonar equipment. Finally, rigorous inseason and post-season quality control practices are employed to maintain data accuracy.

Specific Questions about Kuskokwim River Sonar:

11. **Where is the sonar project located?**
    The sonar project is located along the main river channel about 20 miles upriver from Bethel between the entrance of Church Slough and Napaskiak Slough. The main camp is along the right bank (looking downriver). Sonar equipment is located along both banks. A tan weather port tent is used to protect the sonar located on the left bank opposite the main camp.

12. **When does the sonar operate?**
    The sonar operates between June 1 and July 26. This time period spans virtually the entire Chinook salmon run and the majority of the chum and sockeye salmon runs. A proposal has been submitted to continue project operations through the coho salmon season.

13. **How deep is the water at the sonar site?**
    The deepest part of the channel at the sonar site is about 35 feet deep. A figure of the river bottom profile can be seen below. The bottom profile figure is oriented as if you are looking downriver. The left bank has a long gradual slope and the right bank has a steep slope.



Note: Orientation of figure is looking downriver from sonar site.

14. Does the tide affect the sonar counts?

Tidal stage does not affect sonar counts. Local residents have informed us that salmon move towards the middle of the river during high tide and our feasibility research confirmed that this does indeed happen. However, the shift was subtle and the location of salmon during both high and low tide was well within the sonar beam where they could be counted.

15. Does the sonar count every fish that swims past the site?

No, the sonar produces an estimate of passage, not an exact count of fish. The sonar collects data 24 hours a day 7 days a week. To estimate passage, a 30 minute sample from all even hours is counted by trained staff. Counts are then averaged and expanded to daily estimates of abundance. Peer-reviewed research has shown that abundance estimates resulting from data sampled on and off throughout the day is very similar, but much cheaper, when compared to what we would estimate if we counted all data collected over a 24 hour period. In addition, we can only "see" the fish that swim through the sonar beams, and those beams do not cover the entire the river. For example, the sonar beam does not extend to the very deepest part of the channel, nor does it cover the entire water column from bottom to top. Depending on annual river conditions, we expect the sonar beam to cover all but 55 to 120 yards of the deepest parts of the river channel. All data collected at the sonar site to date indicates that the number of fish missed, because they swim outside the sonar beam, is small. However, this is something we will continue to evaluate.

16. What happens to the fish caught in the test fishery?

The test fish drifts are short (<10 minutes) and many of the fish caught are still healthy when the net is pulled into the boat. The few fish that die are distributed to local residents. In 2017, we had arrangements with the community of Kwethluk to assist with fish distribution. Fish were also distributed to local fish camps or given to local residents that stopped by the sonar site. Later in the 2017 season, fish were transported to Bethel and placed in the free fish tote at Brown Slough.

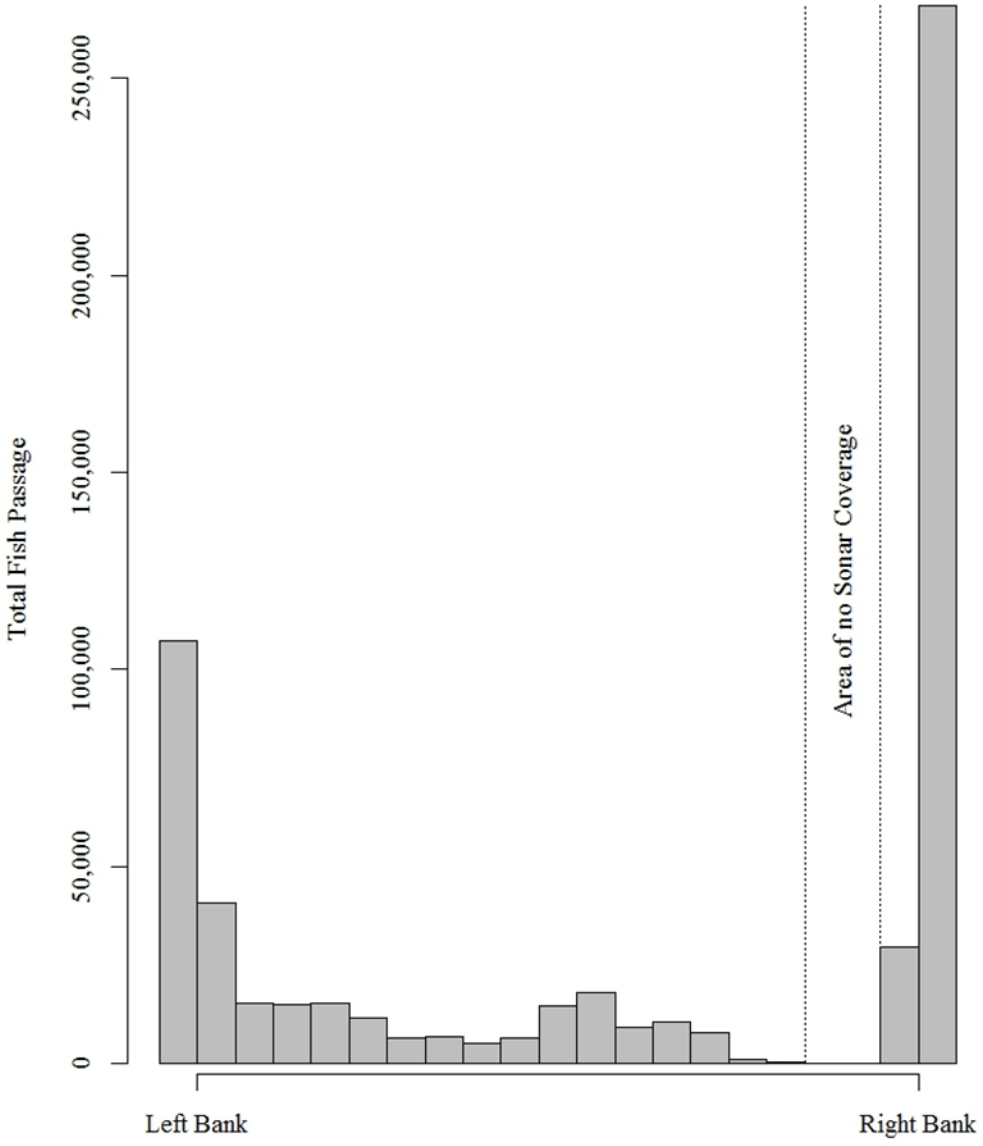
Questions about the 2017 Field Season:

1. **How many fish passed the site in 2017?**
   A total of 2,432,496 fish were estimated to have moved upriver of the sonar site. Preliminary 2017 abundance estimates (with 95% confidence interval) upriver of the sonar site are:

   Chinook salmon 61,458 (95% CI: 45,843–77,073)
   Sockeye salmon 863,403 (95% CI: 759,485–967,321)
   Chum salmon 628,770 (95% CI: 553,400–704,140)

2. **Did the low, clear, and warm water in June and July affect sonar operations?**
   The low, clear, and warm water did not directly affect operation of the sonar equipment; however, the water conditions may have influenced test fishery catches. Inseason, there was quite a bit of speculation that salmon might have changed their behavior by swimming closer to the bottom of the river, in an attempt to find cooler darker water. There was also some speculation that salmon might be able to detect drift nets more than normal, due to the clearer water and slower currents. In both cases, the logic would suggest that test fish catches of all species might have been lower than expected in a year with cooler and siltier water. The test fish catches are what tells us about the composition of the fish species swimming by the sonar, and they are completely independent of the count of fish recorded by the sonar. Low catches in the sonar test fishery can reduce our confidence in the species apportionment, but that would be represented by wider confidence intervals reported for the each species abundance estimate.

3. **Is it possible the sonar missed Chinook salmon in 2017?**
   Yes, it is possible. The left bank sonar array had a late start of June 3 due to damaged equipment. Bethel Test Fish data confirms that Chinook salmon were migrating upriver prior to June 3. It is possible that some salmon swam upriver in the deepest part of the channel, just outside of sonar beam coverage. It is also possible that some Chinook salmon swam near the surface of the water, over top the sonar beam. In 2017, we managed to extend the sonar beam to cover all but 55 yards of the deepest river channel and we added a spreader lens on July 5 to increase the vertical coverage of the sonar beam. However, the abundance of Chinook salmon may have been underestimated if a large proportion of the run was in the deepest channel or swimming very near the surface. At this point we cannot say for certain if the sonar project missed a large number of Chinook salmon, but we think the likelihood is small based on where we observed fish on the sonar and where we caught fish while test fishing. For example, our ability to “see” fish is fairly consistent throughout the entire sonar beam and the following figure shows that most fish were observed near the banks not near deepest part of the channel.



Horizontal distribution of fish passage past the Kuskokwim River sonar site. Area of no sonar coverage delineated by the space between the two dashed lines. Orientation of figure is looking downriver from sonar site.

4. **Why did the sonar indicate that sockeye salmon were the most abundance species when the Bethel Test Fishery indicated chum salmon were the most abundant?**
   The sonar project uses a suite of six gill nets ranging in size from 2.75″ to 8.5″. Bethel Test Fishery uses gillnets with mesh sizes of 5.375″and 8.0″. The difference in the relative abundance of these two projects was largely due to smaller sockeye salmon captured in the small nets. Telaquana Lake, for example, is known to support some very small sockeye salmon. We know from past studies that these very small sockeye salmon are underrepresented in the Bethel Test Fishery.

5. **What is the run timing difference between Bethel Test Fishery and the sonar site?**
   Based on radiotelemetry data, it takes Chinook salmon approximately 2 days to swim between the Bethel Tet Fishery and sonar site. There is currently no telemetry-based run timing data available in the lower Kuskokwim River for chum or sockeye salmon.

6. **Were there any operational challenges in 2017?**
   Yes. The two left bank sonar units were damaged during shipping which lead to a delayed start of June 3. Our ability to detect fish near the surface along the right back was reduced until the spreader lens was installed on July 5. The last equipment issue occurred July 16 when one of the three sonar unit's data transfer cable was severed and we had to rush deliver a spare from the Pilot Station sonar project. Finally, as the salmon season progressed, sonar staff had a difficult time finding local residents willing to take fish that died in the test fishery and fish distribution became very labor intensive.

7. **Was the sonar used for management in 2017?**
   No, this was the first year of operations and the sonar data was not used by ADF&G managers to make management decisions. The Bethel Test Fishery (BTF) remained the primary inseason assessment tool in 2017.

Questions about the Future of the Sonar Program

1. **How will the sonar program be funded?**
   The Kuskokwim River Sonar program is funded with State of Alaska general funds. These funds enable operation of the sonar project between June 1 and July 26 annually. Kuskokwim ADF&G research staff has submitted a proposal to USFW Office of Subsistence Management to extend sonar operations through the end of August. Final decision for this proposal is expected winter 2018.

2. **How will the sonar results be evaluated?**
   Sonar results will be compared to the Bethel Test Fishery, lower river mark–recapture, Chinook salmon run reconstruction model, and weir escapements during the winter of 2017/2018.

3. **Will the sonar replace Bethel Test Fishery?**
   There is currently no plan to replace the Bethel Test Fishery. To fully evaluate the sonar project, a number of years of paired data from the Bethel Test Fishery and the sonar project are needed.

4. **Will the sonar replace the weir program?**
   No, the sonar project is not intended to replace the Kuskokwim River weir program. Weirs provide information on escapement in different places throughout the drainage, a source of data that the sonar project cannot provide to managers.

5. **How can I learn more about the Kuskokwim River sonar project?**
   To learn more about the Kuskokwim River sonar project, please contact Nicholas Smith (nick.smith@alaska.gov). Information about sonar technology and other statewide sonar projects can also be found at: **http://www.adfg.alaska.gov/index.cfm?adfg=sonar.main**