

EVOSTC Annual Project Report Form

1. Project Number: *See*, Reporting Policy at III (C) (1).

17120111-B

2. Project Title: *See*, Reporting Policy at III (C) (2).

PWS Herring Research & Monitoring: Annual Herring Migration Cycle

3. Principal Investigator(s) Names: *See*, Reporting Policy at III (C) (3).

Mary Anne Bishop, Ph.D., Prince William Sound Science Center

4. Time Period Covered by the Report: *See*, Reporting Policy at III (C) (4).

February 1, 2017 – January 31, 2018

5. Date of Report: *See*, Reporting Policy at III (C) (5).

February 1, 2018

6. Project Website (if applicable): *See*, Reporting Policy at III (C) (6).

<http://pwssc.org/tracking-seasonal-movements-of-adult-pacific-herring/>

7. Summary of Work Performed: *See*, Reporting Policy at III (C) (7).

This study began in FY17. Objectives of this study are to:

- 1) Document location, timing, and direction of Pacific herring seasonal migrations between Prince William Sound (PWS) and the Gulf of Alaska.
- 2) Relate large-scale movements to year class and body condition of tagged individuals.
- 3) Determine seasonal residency time within PWS, at the entrances to PWS, and in the Gulf of Alaska.

2017 Field Work and Preliminary analyses

For this FY17 report, we summarize the April 2017 tagging work as well as preliminary results from detection data uploaded remotely from VR4 receivers at Hinchinbrook and Montague Strait in September 2017. Please note that data will be uploaded from all acoustic arrays at the entrance to PWS, including the southwest passages during the annual maintenance cruise scheduled for February 2018. Data from the acoustic arrays in Port Gravina will be uploaded, and receivers redeployed in April 2018.

April 2017 Tagging at Port Gravina.

In April 2017, herring spawned at Port Gravina, primarily around RedHead and Knowles Bay from 13-16 April, and on 19 and 21 April. We captured and acoustically tagged herring in Port Gravina on April 9, 11, 15, and 16. A total of 124 herring were captured and released in 9 cohorts (Table 1).

Table 1. Numbers of herring tagged by release date, April 2017, Port Gravina.

Cohort	Release date	Tagged	“Buddies”
1	4/9/17	15	22
2	4/9/17	3	4
3	4/11/17	12	100
4	4/11/17	1	35
5	4/15/17	40	30
6	4/15/17	1	5
7	4/16/17	3	22
8	4/16/17	1	19
9	4/16/17	48	150

The 2017 spawning population was dominated by 3-year olds (53%) and 4-year olds (22%) (S. Haught, Alaska Department of Fish and Game, unpub. data). In order for fish to physically accommodate the tags, we attempted to tag fish ≥ 195 mm standard length (SL; $x = 215.0 \pm 12.3$ mm; min = 195, max = 254), and over 100 g ($x = 122.5 \pm 20.6$ g; min = 94, max = 175), the average weight of a 5-year old herring in 2017 (S. Haught, Alaska Department of Fish and Game, unpub. data). In all, five fish were tagged that weighed <100 g (range 94-99 g).

Table 2. Standard length (SL; mm) and mass (g) of acoustic-tagged herring by sex at Port Gravina, April 2017.

Sex	n	SL (mm) \pm 1sd	Mass (g) \pm 1sd
Male	62	214.8 \pm 11.8	121.6 \pm 19.7
Female	59	214.7 \pm 12.6	123.3 \pm 22.0
Unknown	3	225.7 \pm 16.3	127.0 \pm 9.5

When we compared weights from 2013 and 2017 tagging efforts of larger, tagged herring (range = 230 – 254 mm; est. age ≥ 6 yr), herring in 2017 weighed significantly less than herring in 2013 (Fig. 1; t-test, $t = 6.4$, $p < 0.0001$).

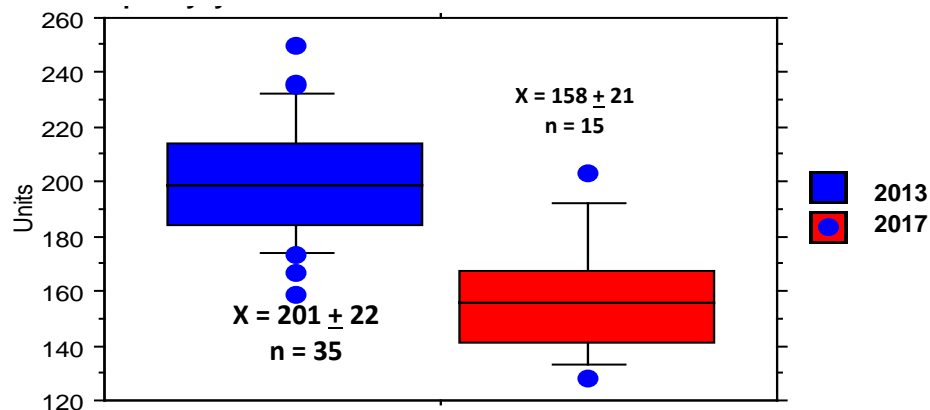


Fig. 1. Comparison of 2013 and 2017 average weights (± 1 sd) for tagged herring with a standard length (SL) >230 mm.

Preliminary acoustic telemetry results from Port Gravina

Just south of Hell's Hole in Port Gravina, we deployed an acoustic array consisting of Vemco VR2W (n = 9), and VR2AR (n = 1) receivers on 8 April 2017 (Fig. 2). We retrieved the three shallowest receivers (Grav_1, 5, and 6) on 13 June 2017 because of concerns that these receivers would be lost to sport and commercial fishers over the summer. In April 2018, the remaining seven receivers will be uploaded and all 10 receivers redeployed.

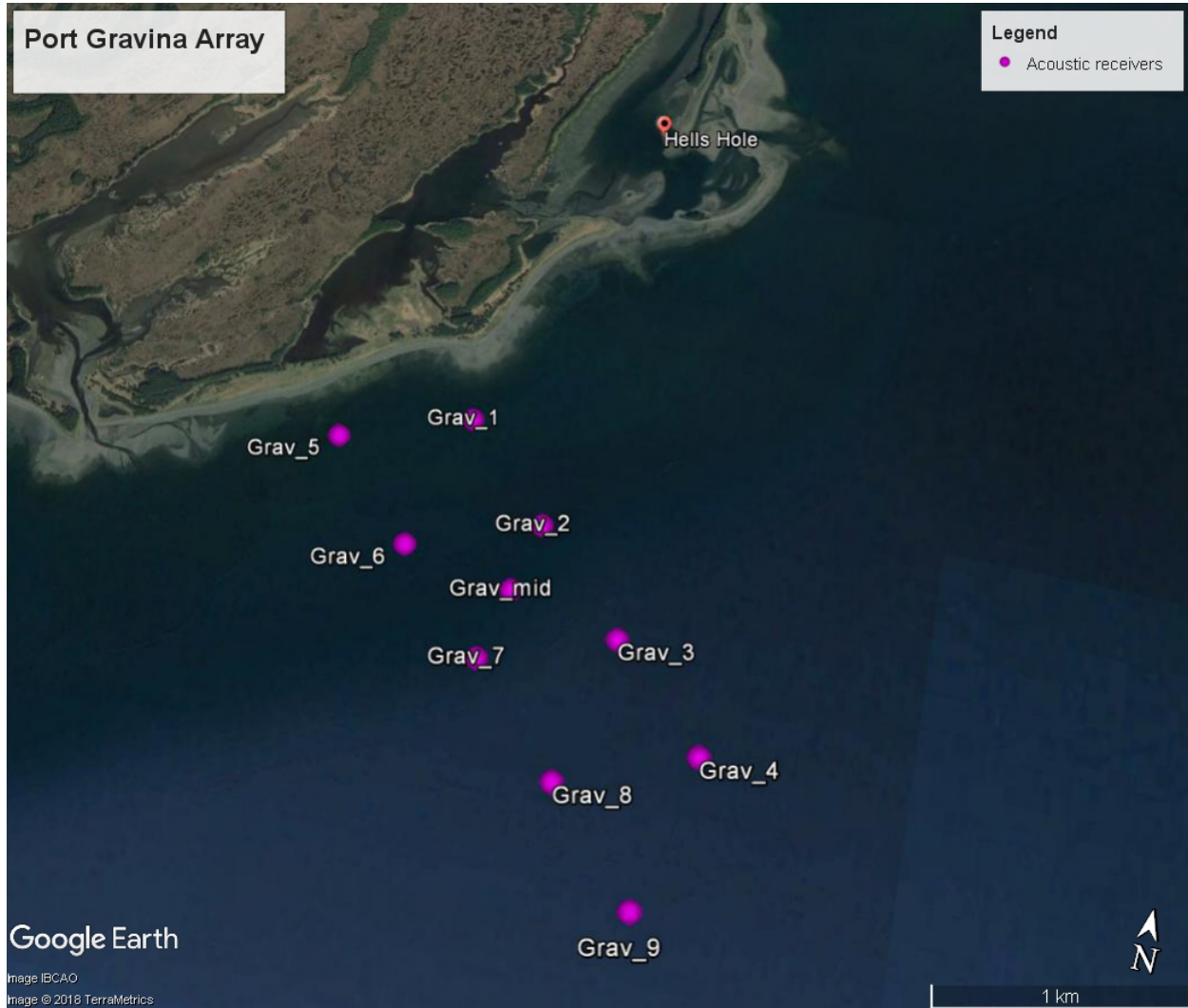


Fig. 2. Map of the receiver array at Port Gravina.

We detected 97% (120/124) of the tagged herring on the three receivers that were retrieved on 13 June 2017. Interestingly, between 1-13 June, some 5-6 weeks post-spawn, a total of nine tagged fish were detected at Port Gravina. Of the nine, all but one were later detected at either Hinchinbrook Entrance or Montague Strait.

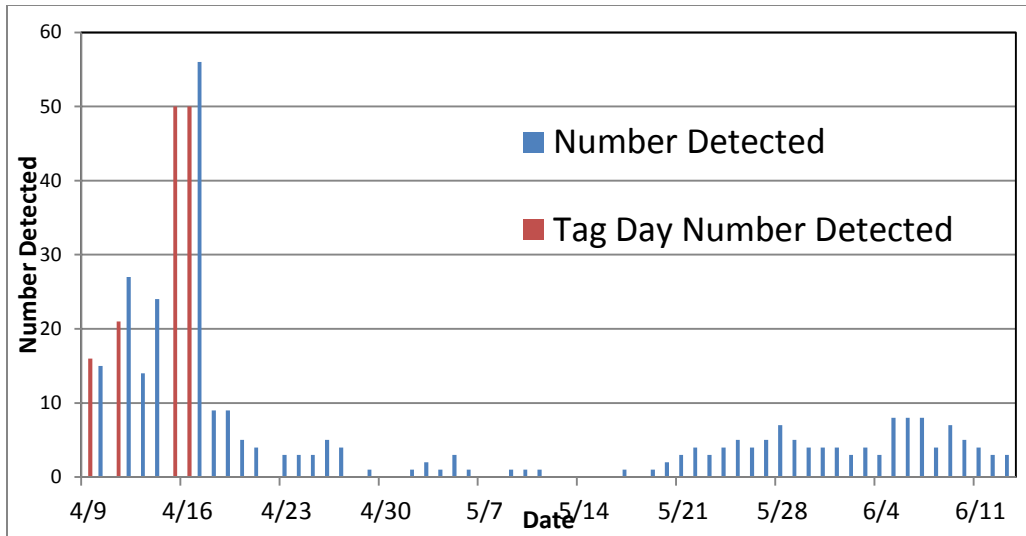


Fig. 3. Number of tagged fish detected by day at Port Gravina. Spawning occurred at Port Gravina area between 13 and 21 April. The following data are based on three receivers (Grav_1, 5, and 6) retrieved on 13 June 2017. Seven receivers remain in the water and will be retrieved, uploaded, and redeployed in April 2018.

Detections at Hinchinbrook Entrance and Montague Strait 20 April through 9-10 September 2017

We uploaded receivers at Hinchinbrook Entrance and Montague Strait on 9 and 10 September 2017, respectively. At Hinchinbrook Entrance, all data was uploaded from 20 receivers, while at Montague Strait, 2 of 15 receivers could not be accessed remotely so were not uploaded. Similarly, none of the receivers at the southwest passages were uploaded as they require retrieval and redeployment.

A total of 58 of 124 tagged herring were first detected at either Hinchinbrook Entrance (n = 44) or Montague Strait (n = 14; Table 2, Fig. 4). Similar to 2013, we observed a high number of movements to Montague Strait by fish first detected at Hinchinbrook Entrance (14 of 44), while only one fish moved from Montague Strait to Hinchinbrook Entrance. First detection at Hinchinbrook Entrance occurred on 20 April while at Montague Strait, the first occurred 19 days later, on 9 May (Table 2, Fig. 5).

Receiver tilting

During the September 2017 upload, we noted that some receivers had consistent tilts of 80-90 degrees. We believe that the tilts may be due to biofouling. In particular, the tilting appeared to effect the detections at Montague Strait receiver 11, where 145 detections occurred compared with 2028 detections at the receiver immediately to the south. We plan to remedy the situation by replacing the receiver at M11, as well as one at receiver 2 at Hinchinbrook Entrance.

Future work

Data will be uploaded from all acoustic arrays at the entrances to PWS during February 2018 and from acoustic arrays in Port Gravina during April 2018. The February 2018 upload will include retrieving receivers, uploading data, and redeploying the receivers not uploaded during September 2017 (14 receivers at southwest passages and 2 receivers at Montague Strait).

Up to 210 herring will be tagged on the spawning grounds in April 2018. In addition to tagging fish around Port Gravina, if herring spawn at a second site (for example Canoe Pass, Port Fidalgo, or northern Montague Island), we will tag herring at the second site too. We will also deploy an array around the second spawning site. If herring do not spawn at a second site (the past two years, the only site in addition to Port Gravina has been Canoe Pass), we will capture and tag ~105 herring in fall 2018.

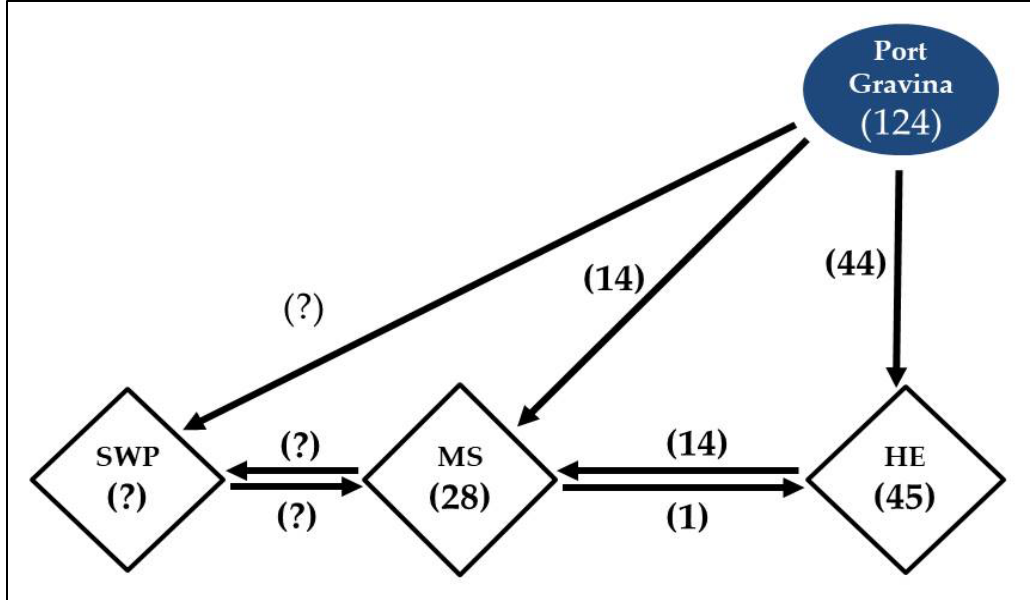
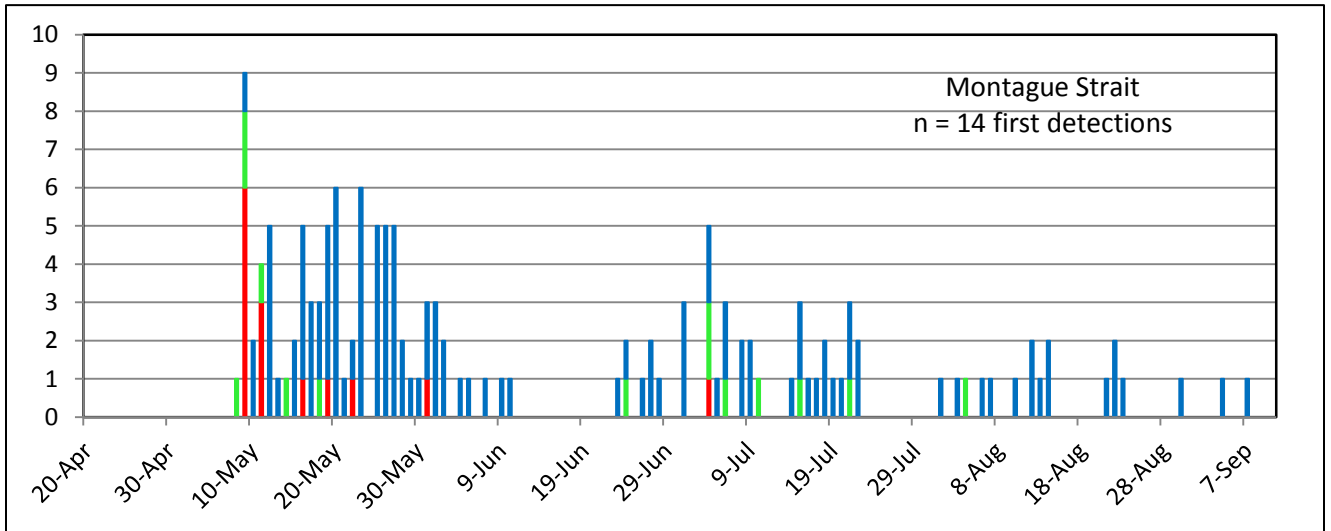
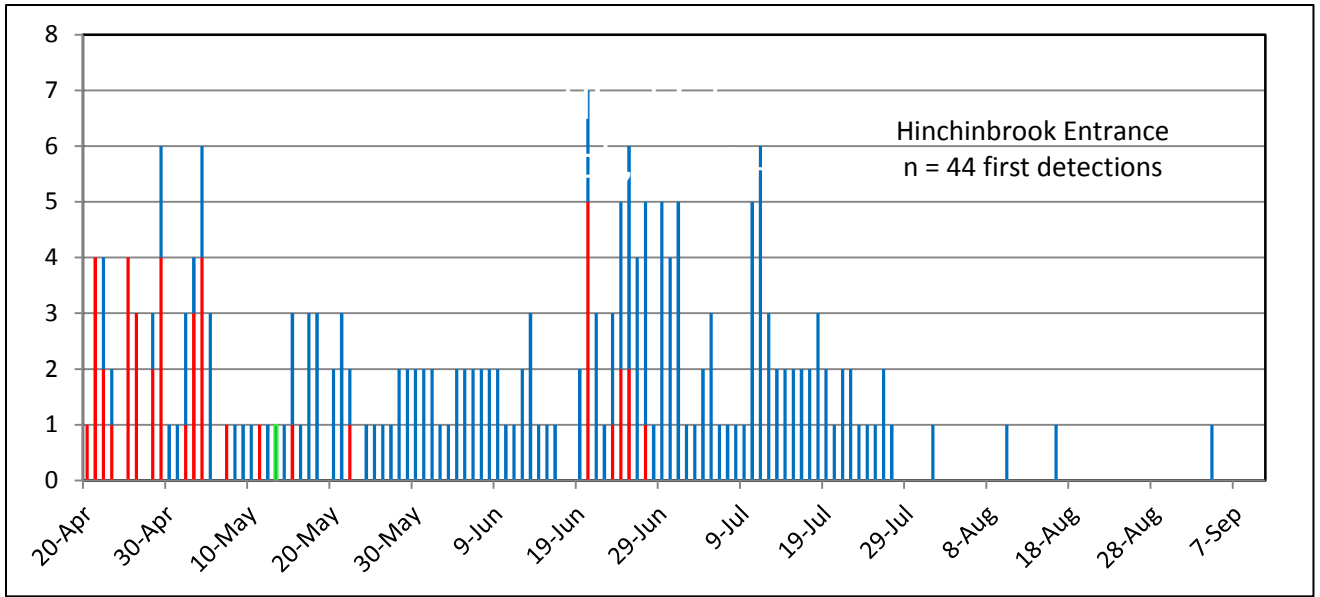


Fig. 4. Schematic showing movements by tagged fish from their spawning grounds at Port Gravina to Hinchinbrook Entrance (HE) and Montague Strait (MS), April through 10 September 2017. Receivers in the southwest passages (SWP) will be retrieved and uploaded during the February 2018 array maintenance cruise.

Table. 2. Number of first detections of tagged fish by entrance and date based on a data uploads of 9-10 September 2017. Data from the four southwest passages has not yet been uploaded.

Entrance	n	$\bar{x} \pm 1 \text{ sd (d)}$	Range
Hinchinbrook	44	12 May \pm 25 d	20 Apr – 27 Jun
Montague	14	17 May \pm 15 d	9 May – 4 Jul



First detection at Entrance



First detection for fish moving HE to MS (n = 14) or MS to HE (n = 1)

Fig. 5. Number of tagged fish detected per day (y axis), and showing first detections at entrances and first movements between entrances.

Milestones/Deliverables

No milestones were scheduled to be complete in FY17.

8. Coordination/Collaboration:

Within the Herring Research and Monitoring (HRM) program

Herring age, sex, and size collection Alaska Department of Fish and Game (ADF&G), P.I.s Moffit/Haught: During April 2017, we received critical information on timing and location of herring spawn. We also received seined herring for possible tagging from PI Haught while he was onboard the *RV Solstice*.

Herring hydroacoustic surveys PWSSC, PI Rand.

In April 2017, we received information from PI Rand's project on adult school locations.

Herring age at reproductive maturity PWSSC, P.I. Gorman.

In November 2017, we assisted Gorman with adult herring captures at Port Gravina, and in the lab with sample processing.

With Gulf Watch Alaska

We provided information to the Pelagic Program on the timing of herring movements observed during fall 2013 to help them select the dates for the GWA Pelagic Component's Integrated Predator-Prey surveys. In addition, the Humpback Whale component provided us with a map and herring biomass estimate from December 2017 around northwest Montague Island. This was important information on where some herring are overwintering.

With Trustee or Management Agencies

We worked closely with Stormy Haught at the Cordova office of ADF&G. Our project relied on information from Stormy's program in 2017 to help locate adult herring schools in spring for capture and tagging. We also received age, weight, and length data from ADF&G that has helped us with aging the herring we captured during 2017. Information learned about herring migrations will be shared with ADF&G.

Collaborations With Other Organizations

This project synergizes with efforts of the Ocean Tracking Network (OTN; Fred Whoriskey, Ph. D. Executive Director, Dalhousie University) and with the Alaska Ocean Observing System (Molly McCammon, Executive Director). In March 2013, OTN installed two, large-scale arrays including one across the mouth of Hinchinbrook Entrance and one across Montague Strait, and four small arrays at the southwest PWS passages of Latouche, Elrington, Prince of Whales, and Bainbridge. With FY16 EVOSTC funding, in February 2017, PWSSC expanded the OTN array. Currently PWSSC maintains the array for OTN on an annual basis. OTN maintains a database with detections from their worldwide network. Our data is archived in the OTN databases, as per their guidelines. Beginning in 2017, Alaska Ocean Observing Network has provided money to cover the costs of maintaining the OTN arrays. Funding will be for five years.

9. Information and Data Transfer: See, Reporting Policy at III (C) (9).

Bishop, M.A. and J. H. Eiler. 2018. Migration patterns of post-spawning Pacific herring in a subarctic sound. *Deep-Sea Research Part II*. <http://dx.doi.org/10.1016/j.dsr2.2017.04.016>

Workshops attended by P.I. Bishop:

AOOS Animal Telemetry Workshop, Dec 5-6, 2017. Anchorage, Alaska

Data generated during February 1, 2017 – January 31, 2018

A tagging log with accompanying age, sex, and length of each herring tagged along with a unique tag ID number. These data were recorded in April 2017 and have been uploaded to the project workspace.

Preliminary detection data were uploaded from receivers at Hinchinbrook Entrance and Montague Strait during September 2017. These files include detections of the unique tag ID numbers at each receiver with the accompanying time and date.

Tilt data were examined following the September 2017 cruise. The receivers record this information every 14 days.

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comments and Responses on Revised FY17-21 Proposal, September 2016

This appears to be a very productive project, in terms of acquiring valuable observations about herring movements in PWS. The original proposal was both well-presented and interesting. This generated questions from the Panel – which were addressed in detail. The Panel thanks the PI for detailed and thorough response to Panel interest and concerns, which put both her work and the proposal at large into broader perspective. We also appreciate the PI adjusting sampling based on Panel comments.

PI response: NA

Science Panel Comments and Responses on Revised FY18 Proposal, September 2017

The Panel is once again very pleased with the quality of this proposal. These results are relevant and important; the PI has answered the questions that were asked.

PI response: Thank you

11. Budget: See, Reporting Policy at III (C) (11).

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROGRAM PROJECT BUDGET PROPOSAL AND REPORTING FORM**

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$121.5	\$139.9	\$135.6	\$138.1	\$0.0	\$535.0	\$ 80.4
Travel	\$1.2	\$1.2	\$1.2	\$1.2	\$0.0	\$4.6	\$ 0.4
Contractual	\$23.6	\$46.3	\$47.6	\$2.8	\$0.0	\$120.3	\$ 17.4
Commodities	\$118.7	\$80.5	\$5.0	\$0.1	\$0.0	\$204.3	\$ 25.6
Equipment	\$5.9	\$0.0	\$0.0	\$0.0	\$0.0	\$5.9	\$ 17.1
Indirect Costs (<i>will vary by proposer</i>)	\$ 79.5	\$ 80.3	\$ 56.8	\$ 42.6	\$0.0	\$259.3	\$ 37.2
SUBTOTAL	\$350.3	\$348.1	\$246.2	\$184.7	\$0.0	\$1,129.4	\$178.1
General Administration (9% of subtotal)	\$31.5	\$31.3	\$22.2	\$16.6	\$0.0	\$101.6	N/A
PROJECT TOTAL	\$381.9	\$379.5	\$268.3	\$201.4	\$0.0	\$1,231.0	
Other Resources (Cost Share Funds)	\$15.0	\$15.0	\$15.0	\$15.0		\$60.0	
COMMENTS:							
The PWS Science Center will provide in-kind equipment (9 VR2-W acoustic receivers and 9 acoustic releases) for an array that will be deployed around the tagging site. The value of this equipment is estimated at \$63k. This project also uses the Ocean Tracking Network, a series of acoustic arrays installed at the entrances to PWS (in place at Hinchinbrook Entrance, Montague Strait, and 4 southwestern Prince William Sound passages). The current value of these Ocean Tracking Network acoustic arrays is estimated at \$337k (not including the FY16 additions funded by EVOS). This project also piggy-backs on the annual Ocean Tracking Network maintenance cruise (funded by AOOS beginning in FY17) which includes 5d@\$3/k day.							

Please note that acoustic tags for the 2018 field season have been ordered, but not yet delivered, and these tags account for a major portion of the remaining funds.



*We appreciate your prompt submission
and thank you for your participation.*