ATTACHMENT C ***EVOSTC Annual Project Report Form***

Form Rev. 10.3.14

*Please refer to the Reporting Policy for all reporting due dates and requirements.

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

15120111-G

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

PWS Herring Program – Juvenile Herring Intensive Surveys

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

Pete Rand

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

1 February 2015 to 31 January 2016

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

February 2016

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

http://pwssc.org/research/fish/pacific-herring/

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

Project Summary – Overview

The overall objective of this project was to conduct repeated acoustic and midwater trawl surveys to characterize the distribution, abundance and habitat utilization of juvenile Pacific herring during the fall and winter periods in Simpson Bay and Windy Bay in eastern Prince William Sound. Sampling years included 2013 and 2014.

As a first step in exploring this data set (no previous annual reports have been submitted for this project), we examined the relationship between trawl captures and fish densities derived from acoustic data collected along a transect. We provide below a brief description of the analytical methods used and some preliminary results and discussion.

Acoustic Analysis Methods

Juvenile herring were surveyed acoustically along cross-bay transects. Samples were obtained with a Biosonics 120 kHz split-beam hydroacoustic transducer (Biosonics DT-X system) fixed to a towfin towed alongside the *R/V Montague*. Midwater trawls were conducted synoptically to provide information on total catch, species and size structure of acoustic targets. Depths that the trawl sampled were measured using pressure sensors (Star Oddi) fixed to the headrope of the trawl.

Acoustic data for these surveys were manually inspected and post-processed in Echoview 7.1 (Sonar Data Pty., Ltd.). An analysis threshold of -60.00 dB was applied to the volume backscattering (S_V) data in addition to a bottom detection algorithm to remove reverberation and unwanted acoustic backscatter (eg. benthic habitat, air bubbles, etc.). Additional manual inspections removed any remaining undesired

data and the echograms were binned into 10m horizontal by 5m depth analysis cells. For this analysis, we limited the depth bins to those corresponding to the volume sampled by the midwater trawl as measured by the pressure sensors on the trawl (Figure 1). By following this protocol, we assume all remaining backscatter in the acoustic data set was from Pacific herring in the water column.
Acoustic fish density estimates were calculated by using the backscattering cross-section ($\sigma_{bs;}$ MacLennan *et al.*, 2002) and Target Strength (TS) as calculated using standard linear regression equations for TS derived for Pacific herring by Thomas (Thomas *et al*, 2002). To fit the equation, the average length of herring caught by trawling in each bay was used. The area backscattering coefficient, s_a [$s_a = \int_{z1}^{z2} Sv * dz$], was then used to calculate fish densities (fish m^{-2}) in a transect as described in MacLennan *et al.*, 2002 (Eq.2).

$\sigma_{bs} = 10$^$^{(TS/10)}$ (Eq. 1)

Fish $m^{-2} = s_a / \sigma_{bs}$ (Eq. 2)

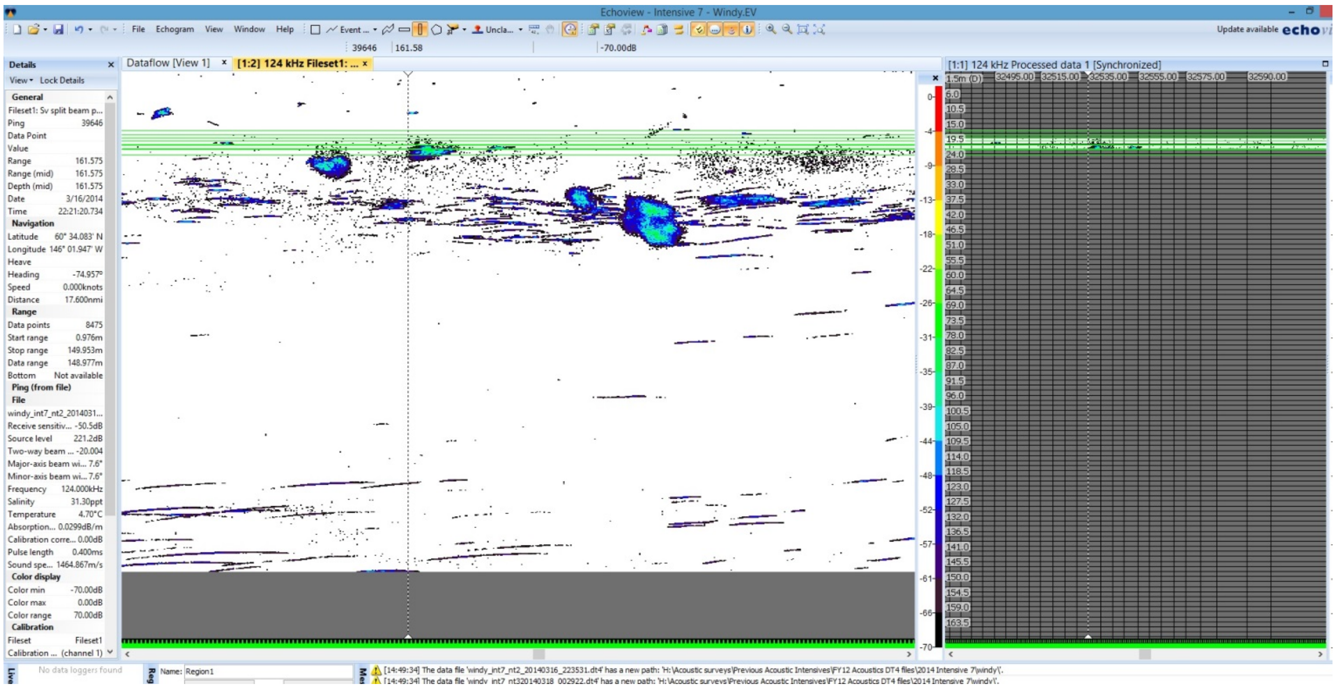

Figure 1. A screen shot of Echoview 7.1 to illustrate the process of subsetting the acoustic data to include only the backscatter from the depths sampled by our midwater trawl. The green horizontal bars envelope the acoustic data included in our estimates of fish density.

Preliminary results & discussion

We present results of acoustic density and trawl captures for the two years for which we had coupled data. We found a weak but statistically significant ($p<.05$) correlation between the number of herring captured in the trawl and the measure of acoustic fish density along the transect. We present results graphically for Simpson Bay (Figure 2). It is not surprising the correlation is weak considering in some cases the trawl was sampling near the top edge of the fish schools encountered and parsing the acoustic data to include only the volume of water swept by the trawl is highly uncertain (see Figure 1).

The slope of the regression (4304 herring captured along a transect for each increment in acoustic fish density) appears to roughly conform to expectations. Given a trawl opening of approximately 10 m, a tow speed of approximately 1 meter per second (2 knots), and a trawl duration of 10 minutes, the area swept by the trawl would be approximately 6000 m^2. Given some level of trawl avoidance by herring, our estimated slope appears reasonable, and thus this provides some assurance that these two survey methods corroborate each other.

We are now in the process of deriving density and biomass estimates using acoustic data from the entire water column. Results from this analysis will be produced for the final report in April 2016.

Table 1. Summary of coupled acoustic and trawl capture data from intensive surveys during the fall-winter periods of 2013 (Intensives #1-4) and 2014 (Intensives #5-8). Data set excludes transects with zero herring catch.

Intensive	Event	Bay	Density (fish/m^2)	Acoustic Catch (g)	Trawl Mass (g)	Trawl Herring Caught
1	6	Simpson	0.04750	21.726	8.25	3
1	9	Simpson	0.03104	73.654	44.5	5
1	3	Windy	0.00895	40.880	87	6
1	12	Windy	0.00380	32.234	23.25	1
2	3	Simpson	0.00070	2.084	11	2
2	5	Simpson	0.00587	49.908	47.25	9
2	18	Simpson	0.00187	5.225	63.25	7
2	20	Simpson	0.00138	2.722	52.75	13
2	28	Simpson	0.00857	65.741	58.25	7
2	30	Simpson	0.00292	11.410	40	9
2	8	Windy	0.00106	2.133	5.25	1
2	10	Windy	0.00116	17.574	25	1
3	3	Simpson	0.03460	326.699	4376	559
3	5	Simpson	0.10072	1090.201	3376.8	417
3	17	Simpson	0.18010	673.125	5399.55	1038
3	19	Simpson	0.16083	197.857	4110	549
3	22	Simpson	0.02626	260.870	40.25	7
3	24	Simpson	0.13347	750.013	771.25	125
3	8	Windy	0.00151	3.917	26.5	4
3	12	Windy	0.00098	5.021	6.75	1
3	14	Windy	0.00038	1.703	15.75	2
3	27	Windy	0.00810	64.438	10.75	2
3	29	Windy	0.00717	73.970	27	5
4	3	Simpson	0.00090	12.905	309.5	17
4	5	Simpson	0.00224	47.818	166	6
4	21	Simpson	0.00122	16.743	377	20
4	36	Simpson	0.00089	13.816	148.75	11
4	38	Simpson	0.00108	14.409	21	2
4	8	Windy	0.00044	1.739	7	1
4	15	Windy	0.00259	80.581	329	5
4	19	Windy	0.00081	1.766	4.25	1
4	29	Windy	0.17741	144.128	11.75	2
4	31	Windy	0.00821	42.245	3.5	1
5	3	Simpson	0.00023	7.187	935.25	23
5	5	Simpson	0.00069	3.677	373.75	19
5	13	Simpson	0.00004	3.094	69	1
5	15	Simpson	0.00061	1.396	5.5	1
5	34	Simpson	0.00024	1.255	141	13
5	36	Simpson	0.00107	24.508	966	18
6	3	Simpson	0.00072	26.321	25126	479
6	5	Simpson	0.00155	42.628	18.75	1
6	15	Simpson	0.00024	1.682	451.75	29
6	17	Simpson	0.00094	19.641	863	36
6	19	Simpson	0.00192	34.667	2804	55

6	34	Simpson	0.00463	46.677	7484	305
6	8	Windy	0.00007	11.999	1211	9
6	22	Windy	0.00011	18.168	47	1
6	24	Windy	0.00003	2.062	180	1
7	3	Simpson	0.00075	4.365	183.5	17
7	5	Simpson	0.02930	130.420	80.75	7
7	7	Simpson	0.01677	58.747	2063	118
7	21	Simpson	0.00288	9.885	2090	151
7	23	Simpson	0.00347	15.792	164.25	9
7	25	Simpson	0.00007	1.185	42.5	3
7	10	Windy	0.00022	2.559	16.5	1
7	15	Windy	0.00056	43.060	198261	1917
8	3	Simpson	0.00223	22.677	304	81
8	7	Simpson	0.00985	124.601	5981	324
8	24	Simpson	0.00176	13.495	1637	85
8	26	Simpson	0.00190	18.851	5122.6	211
8	31	Simpson	0.02432	26.600	3547.9	1124
8	33	Simpson	0.00883	41.245	244.8	51
8	35	Simpson	0.07407	27.356	4722.5	1457
8	10	Windy	0.00271	82.318	905.6	9
8	17	Windy	0.00046	19.137	4413.5	36
8	21	Windy	0.00071	18.468	47.6	1

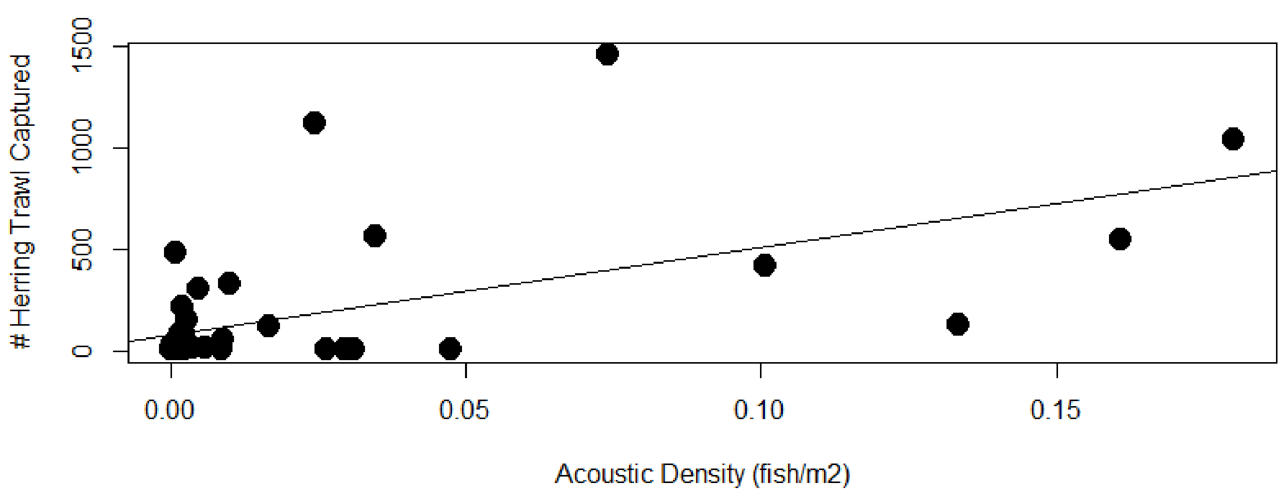

Figure 2. Relationship between the number of juvenile herring captured along a transect and the average fish density derived from acoustic data for transects in Simpson Bay. The cruises were conducted during November-December 2013 and February-April 2014.

8. Coordination/Collaboration: *See*, Reporting Policy at III (C) (8).

We collaborated with FIU (Kevin Boswell and Aubree Zenone) for this project. These cruises were coordinated with several other EVOS HRM PIs, including Mary Anne Bishop and Kristen Gorman. Bishop led the midwater trawl surveys for acoustic validation, and subsamples of herring were measured, preserved on the vessel, and transferred to Gorman for energetic and isotope analyses.

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

All acoustic data collected as part of this project has been uploaded to the AOOS website.

10. Response to EVOSTC Review, Recommendations and Comments: *See*, Reporting Policy at III (C) (10).

This represents the first report on this project submitted to EVOSTC.

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

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$0.0	$21,000.0	$30,100.0	$4,700.0	$0.0	$55,800.0	$ 38,574
Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$ 9
Contractual	$0.0	$0.0	$1,000.0	$100.0	$0.0	$1,100.0	$ 10,301
Commodities	$0.0	$0.0	$2,000.0	$0.0	$0.0	$2,000.0	$ 1,376
Equipment	$46,000.0	$0.0	$0.0	$0.0	$0.0	$46,000.0	$ 45,886
Indirect Costs (*will vary by proposer*)	$0	$6,300	$9,600	$1,400		$17,300.0	$ 14,780
SUBTOTAL	$46,000.0	$27,300.0	$42,700.0	$6,200.0	$0.0	$122,200.0	$110,926.0
General Administration (9% of	$4,140.0	$2,457.0	$3,843.0	$558.0	$0.0	$10,998.0	
PROJECT TOTAL	$50,140.0	$29,757.0	$46,543.0	$6,758.0	$0.0	$133,198.0	
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

Spending on personnel is behind because of a change in P.I. in 2015. Funding is being shifted from personnel to contractual to allow for contracting with Kevin Boswell at Florida International University to assist in data collection and processing.

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