## Acoustic Consistency: Intensive Surveys of Juvenile Herring

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**Introduction.** Hydroacoustic surveys of juvenile herring nursery areas in Prince William Sound have been conducted during fall and late-winter for the last several years. The objectives of this effort have been to improve understanding of habitat utilization by juvenile herring, especially age 0, and to help identify candidate sites that could be potentially used for supplementation efforts. The surveys have also been a focus for other studies on juvenile herring energetics, disease and predation. The number of locations surveyed have varied from 5-9, including the 4 Sound Ecosystem Assessment (SEA) bays. However, each seasonal effort has conducted only a single night survey in each of these locations. Thorne (2010) examined seasonal changes from fall 2006 to spring 2009. He showed that apparent overwinter mortality of age 0 herring appeared to be greatest in Simpson Bay and least in Whale Bay. However, he also pointed out that the differences over winter could also be the result of emigration. Not only might age 0 herring move among bays during the winter, but movement into and out of bays may be progressive during a season. It is possible the overwintering component of age 0 may not be fully recruited into a bay at the time a single fall survey, or may have began spring movement out of bays prior to any given late-winter survey. Another potential source of variability could be the stage of the moon. Ambient light is known to affect fish distributions. On many occasions, age 0 concentrations were readily identified by their distinct distribution: a diffuse layer near surface, near shore and near the heads of bay. On other occasions, this distinctive distribution was absent even though age 0 herring were present. The change might have been the result of different ambient light regimes.

**Objectives.** The objectives of this study are:

1. to improve the accuracy of both annual and seasonal comparisons from single-night surveys by intensively sampling throughout a fall and spring season
2. estimate the level of immigration and emigration of age 0 herring between bays

**Methods.** We propose to address these uncertainties with an intensive fall and late winter/spring intensive survey. The fall series will start mid-October 2014 and extend to the first week of December. The late winter/spring series will begin the 3$^{rd}$ week of February 2015, and extend into the 2$^{nd}$ week of April. We propose to conduct the surveys in two bays sufficiently adjacent to cover each bay each night, such as Simpson Bay, Port Gravina, Windy Bay or St. Mathews Bay. We will conduct four surveys per season spaced at 2 week intervals. Each of the two bays will be surveys in three consecutive nights. Such a design will address daily, weekly and monthly variability, including moon phase. In addition to the hydroacoustic surveys, we propose a single night of direct capture effort in each location for each of the survey weeks (See Bishop, this proposal). The survey design will follow the historic zig zag transects run by Thorne since 1993 in order to remain consistent with that sampling design and to put the long term fall and spring surveys into context. Such information is especially critical if hydroacoustic surveys are needed to provide an index of future age 0 herring abundance.

## Use of concurrent trawls to validate acoustic surveys for Pacific Herring

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**Introduction**

Acoustic surveys provide a relatively low-cost, remote sensing tool to estimate species-specific fish biomass and abundance. Interpreting acoustic data requires ground truthing (Simmonds et al. 1992). The main source of information used to validate interpretation of echograms is net catches. Pelagic trawls are the recommended method for validating species composition and for obtaining relatively unbiased information on length frequency distribution, age, and other biological information (Simmonds et al. 1992, McClatchie et al. 2000, Adams et al. 2006).

In Prince William Sound (PWS), juvenile herring acoustic surveys have been conducted at the beginning (November) and end (March) of every winter since March 2007. A variety of methods have been used with limited success to ground truth acoustic surveys in PWS. Small midwater trawls used during fall 2007 and fall 2009 cruises failed to catch fish. In most cases, these trawls were towed 1 day after the acoustic survey and always from a different vessel. Trawling speeds were typically 2-3 knots, producing a high level of net avoidance by the targeted fish.

Variable mesh gill nets as well as cast nets have also been used to validate acoustic surveys. Gillnets, however, select for faster swimming fish (Thorne et al. 1983) and in PWS, gillnet deployments have resulted in very small catch rates of juvenile herring. Cast nets were successful in collecting sufficient numbers of juvenile herring for the fitness and energetics study, but not as a method to validate acoustic data.

Here we propose to use a low-resistance, light-weight midwater trawl capable of increased towing speeds (up to 4 knots) as a method to ground truth acoustic surveys for juvenile and adult herring. These surveys will take place as part of three studies in the herring program: These include: a) juvenile herring biomass estimate (years 2-5); 2) intensive spatial and temporal study of juvenile herring biomass in two select bays (year 3); and, 3) expanded adult herring biomass surveys (years 2-5). In addition to ground truthing acoustic surveys, in year 1 we will use the trawl to collect juvenile herring during the 9-month intensive juvenile herring energetics study.

**Objectives**

The objectives of our study include:

1) Improve capture methods used for ground truthing acoustic surveys.

2) Increase the sample size for identification, quantification, and measurement of juvenile (0+, 1+, 2+) and adult (3+ and older) herring schools as well as other fish schools in survey areas.

3) Provide data on species composition and length frequency to aid in the interpretation of current and historical acoustic surveys.

4) Provide adult herring samples to Alaska Department of Fish and Game for the adult herring age-structure-analyses model.

5) Provide juvenile herring samples to researchers investigating juvenile herring fitness and disease.

**Methods**

We will tow a midwater trawl simultaneous with acoustic surveys for herring and from the same research vessel. Our trawl measures 12.8 m in total length and is 7.6 m wide by 9.1 m high under tow. The net is designed to be low-resistance and is constructed of high-tensile, lightweight materials (Innovative Net Systems, Milton LA), Mesh sizes (stretched) taper from 57 mm at the forward end to 38 mm at the cod end. The cod end liner is 12 mm mesh. The net will be fished with Jupiter Aluminum doors weighing 28 kg each. The trawl will be equipped with a Simrad PI50 Catch Monitoring System. This system utilizes wireless, trawl-mounted sensors to transmit real-time data on both trawl depth and net fullness. Average trawling speeds will be 3 to 4 kts.

Validation of acoustic echograms relies on ground truthing species composition and length frequency distribution of ensonified fish (McClatchie et al. 2000). We will tow a subsample of each stratified survey area, as designated by the lead acoustician. For each haul, all catch items will be collected. In the case of large hauls, a random sub-sample of the catch will be collected and measured. Species composition and length frequency will be characterized by identifying all fish to species and measuring individual fork length, standard length, and weight. Juvenile herring of age 0+ and 1+ can be reliably aged based on length (Norcross et al. 2000, Kline unpubl. data), however, herring >150 mm will be aged using scale conventions developed by Alaska Department of Fish and Game (ADF&G). Adult herring captured during expanded spring surveys will be measured, sexed, aged, and assessed for spawning condition. Adult herring samples will be processed in collaboration with the Cordova office of ADF&G so that data can be incorporated into the ADFG herring age-structure-analysis model. All herring scales will be archived with ADF&G.