EVOSTC Annual Project Report

Project Number: 10100132-F

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys

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Time Period Covered: October 1, 2010 thru September 30, 2011

Date of Report: April 15, 2012

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Project Website: Shared with Prince William Sound Science Center Herring Survey Program site: http://www.pwssc.org/herringsurvey/

Work Performed: The main tasks accomplished during this period concerned the processing of 2010 field data, establishing a database, working with other herring survey PIs in coordinated project operations and field planning, and completing the second field season for the project. Problems with data collection software (severely prolonging the time needed for editing) and personal illness/family issues of the PI forced the delay of several project objectives including delivery of the fully processed, edited and comprehensive data set, the spatial analysis of predator vs. herring distribution, and attendance at the Marine Science Symposium in January. However, the PI will be attending a herring project planning meeting in Cordova in April and the objectives concerning the distribution, discussions, interpretation and integration of the aerial data set will be completed at that time.

The aerial surveys flown in 2010 and 2011 are listed in Table 1. Project objectives in terms of spatial and temporal coverage of the study area were met both years that will allow a comprehensive comparison of results for both years. A standardized data collection form was created; a copy is attached to this report. The main difference in data collection between the two years was weather with significantly better survey conditions in 2011. Therefore it is likely that effective survey coverage increased in 2011 and this will be a consideration for data analysis and inclusion in models.

As with acoustic data, the examination and analysis of aerial survey data requires that the analytical objectives are clearly defined in terms of spatial and temporal scale since the data can be binned at a variety of temporal and spatial scales. Density is the appropriate number to use for analytical comparisons since the amount of area surveyed varies from year to year and among regions surveyed simply due to logistical complications. A defined bin is required to establish density for the aerial data because it is a function of the quantitative value of the school observations (count, surface area or biomass) over the area surveyed and corrected by the detection function established for these aerial surveys. It is not a trivial task to calculate densities at a series of defined bins and therefore the sooner that concensus can be reached concerning this

issue, the better. The success of the APEX project was largely due to the coordinated efforts of individual PIs collecting field data and modelers who worked very closely making sure the data was being collected at the appropriate temporal and spatial scale to allow a testing of the pre-defined hypotheses. Three bin sizes were defined to be used in the deterministic models and other analyses which helped define the amount of time needed for data preparation. These analytical objectives have not been clearly defined with the broader PWS Herring Survey program and will be a point of discussion at the upcoming PI meeting and over this final field collection year. When the project was originally designed, there was an assumption that modelers would be working with the aerial data and it was highly desirable because it could provide a picture of herring density at a scale that would allow detection of density dependent mortality especially by predation, hypothesized to be a major factor limiting recovery. Combining this larger scale view of density with results from the finer scale vessel surveys and predation modeling efforts would allow modelers to create a sound-wide model that could identify spatial definition in terms of herring recovery and alternatively continued population repression. During the herring program planning process, many hours were spent listing key factors limiting recovery and working toward a list of data needs that would be collected at the appropriate scale to address these scale-dependent factors. Hopefully there will be some guidance as to the future needs for the data since a modeler has been employed to address herring problems. In addition, if the herring population continues to be repressed, it is possible that ADFG will want to start incorporating the juvenile herring survey data in the virtual population modeling they do for management and it would be likely that they would want the data binned to match the sub-regions they have established for adult herring surveys.

In the absence of guidance on the matter of binning for analysis, this PI has provided here a beginning suggestion that provides a comparison of the data at the scale appropriate to the natural age-dependent distribution for herring. During the SEA project, spatial analysis and co-variance structure was defined indicating a break in the contiguous distribution of juvenile herring at approximating a nursery bay (about 6 km). Although adult herring distribution was not analyzed in the same manner due to a lack of distribution data, it is likely given their open water distribution and migratory patterns, the appropriate scale for adults would likely be larger regions similar to the herring sub-regions used by ADFG for data collection and modeling. Over the years of herring management, these sub-regions were established because of differences in spawn timing, age structure and body size among the areas. For herring, ADFG defined 5 regions within the sound and therefore it is appropriate, given the lack of data to prove otherwise, to use these for distribution comparison among years. Suggested bins will be presented at the PI meeting with small bins associated with age 0 and 1 herrring and larger bins associated with adult herring and other forage fish species such as capelin and sandlance. These results can be provided in an amended report after the meeting with the data extracted and presented by bin in map and tabular form based on the discussion and guidance from the larger group. There is also interest from the bird researcher community in using the data for their analyses and it is likely their binning needs will be different from those needed to model herring recovery.

For the purposes of this report, preliminary results of the two years of surveys have been summarized on a regional scale. Figures 1 and 2 illustrate the changes in abundance and distribution of age 0 and 1 herring and other forage fish species between 2010 and 2011. Although the data has not yet been standardized for comparison to historic years (1994-1999),

2010 appears to be an exceptional year and may show the highest densities of age 1 juvenile herring observed of the 7 years of broadscale surveys. Ago 0 herring appeared to be less abundant and this observation carried through to 2011 when much smaller numbers of age 1 herring were observed compared to the previous year. However, in 2011, there did appear to be larger numbers of age 0 herring recruiting to nearshore regions with distributions very different from the surveys in the 90s. The shifts in the main spawning regions may explain the differences in age 0 distribution from the present time to the late 90s with increased spawning in the eastern sound, decreased spawning in the central sound, and a large newly colonized group of spawners that may represent up to 50% of the total population around Wingham Island and northern Kayak Island. The impact of the circulation patterns of PWS and the eastern entrance to the gulf on larval drift could explain the differences in the distribution of age 0 herring observed and will be an interesting point of discussion for the future directions of herring studies in PWS.

An important task to complete if aerial surveys are to be included in long term monitoring is the comparison of acoustics and aerial results to provide an index for comparisons. The two survey methods are like comparing apples to oranges and produce very different index numbers. Within the scope of this project, a comparison was intended, however, the acoustic surveys for the last two years were conducted at a time of year when the schools begin to disappear from the upper surface waters and in locations where fish numbers were relatively low compared to other areas. However, in 2011, the acoustic vessel was using a towed device that could enter and survey shallower water but those data have not yet been compared and it is hopeful this will occur in the future. However, if the comparison to aerial during the recent years do not yield any useful results, comparisons using data from the late 90s may be more valuable. The PI re-examined the data from the SEA project years during which there were many co-occurring acoustic and aerial surveys for comparison. Although the results have not been finalized, it is relatively obvious that the two techniques rarely overlap in school observations. Using synoptic surveys, nearshore and surface schools observed from the air were absent in the acoustic distributions while deeper schools and those stacked on the bottom were not observed from the air. At night, the schools spread out in a diffuse layer that is ideal and preferred for enumeration by acoustics. Therefore, a more useful comparison for establishing an index between aerial and acoustic survey results may be daytime aerial density estimates gauged against nighttime acoustic survey results within a defined region and a 24-48 hour period.

Future Work: The tasked planned for immediate completion before the 2012 field season is the finalization of the database, error checking, and combining this data with the historic data from the late 90s in a single database that can be posted on line at the herring portal and distributed to the interested parties. Following the April PI meeting, the density numbers will be extracted and provided at the appropriate bin size. The establishment of bins also provides a pathway for "transference" of the aerial surveys to the spotter pilot community. For sardines, estimating stock abundance was in part transferred to the spotter pilot community by allowing them to collect the data in a manner they are used to using yet providing a defined georeferenced box within which estimates from all the pilots could be compared. Fish spotters report numbers and sizes of schools as well as biomass estimates but are precise at mapping the exact location of schools. Once a series of standardized bins is established for PWS, it will be relatively easy for spotter pilots to report numbers of schools by categorized sizes (predetermined by training for

scale) and total biomass for a given box during a given survey. This would greatly reduce the amount of data that is needed for coding yet provide a valuable index for the biologists or modelers that are at a temporal and spatial scale useful for them. This transference and training will be, as outlined in the project objectives, a key task for this final field year. This training will be conducted concurrent with the 2012 field data collection which will mirror the data collection during the last two years. The goal will be to train at least 3 spotters over the summer and develop training protocols as well as calibration accomplished by comparing spotter estimates for concurrent flights. Because this is likely to occur during the salmon spotting period among interested pilots who are flying routinely for salmon fishermen, there will be no additional funds needed for charter and there will be no affect on the air charter time devoted to this project's surveys.

Coordination/Collaboration: As in 2010 we coordinated with Rob Campbell who continued to provide some school identification validation using a boom-mounted underwater camera at locations where surface schools were observed that occurred along his zooplankton cruise track. The PI was not able to coordinate with the acoustic cruise because it occurred late in the season after the end of August aerial surveys which end when the surface schools begin to disappearance and occur at deeper distributions.

Community Involvement/TEK & Resource Management Applications: The PI had several meetings with ADFG biologists and one of their aerial surveyors accompanied our flights to learn how those surveys are conducted in case they are allowed to become more involved in the herring research. Currently budget restrictions, an extremely heavy workload, and a shortage of manpower prevent ADFG from becoming more directly involved. It is hopeful this will change in the future. The work with transferring aerial survey oversight to the local fisherman's union (CDFU) with the trained spotter pilots performing the work has already begun as mentioned earlier in this report. The PI has been working closely with the CDFU director who participated and was trained during several aerial surveys over the summer to develop a written protocol and budget for the surveys.

Information Transfer: No publications have been produced for this project. All data collected has been backed up at the PWSSC network and the finalized database will be provided to ADFG and to the Herring Portal Database project after the meeting in April. There have been two requests for the dataset by the bird researcher community and they will be provided with the database as well.

Budget: The project was performed within the total budget allowed in 2011 and there is still an outstanding balance carried over from 2011 due to the tardiness of the annual report and the accompanying billing for the August and September, 2011 project expenses. The April Cordova meeting travel is covered since the PI did not attend the Marine Symposium. No other problems are anticipated and the project is anticipated to be completed within the budget for 2012. No additional funding need is anticipated.

Table 1. Flight log for 2010.

Aerial Survey Flight Log - Prince William Sound 2010

Date	Start Time	End Time	Survey Type	Survey Region	Cloud Cover (%)	Ceiling (ft)	Survey Conditions	Water Visibility
6/13/2010	12:42	18:29	Broadscale	SE and part of NE PWS	100	2000	Good	Fair-Excellent
6/14/2010	10:20	10:45	NA	aborted flight due to weather	100	900	poor	poor
6/19/2010	15:17	18:23	Broadscale	Central Sound Survey - Hinchinbrook and Montague	100	1200	poor	poor-fair
6/20/2010	13:45	18:28	Broadscale	Redo part of Central Sound and SW PWS	80	5000	excellent	good
6/21/2010	14:57	19:10	Broadscale	Western PWS, Knight Island - avoiding large fog bank coming in to sound	variable	variable - fog	excellent	good
6/22/2010	13:27	18:55	Broadscale	Northwestern PWS bays and fjords	50	2500	excellent	good
6/23/2010	14:27	20:30	Broadscale & Catches	North central, northern fjords & bays, NE (Pt Valdez) - vessel drop off	100	2000	good	fair
6/24/2010	14:57	16:45	Broadscale	Copper R flats, Wingham and Kayak Island - Entrance	100	2500	good	poor to fair
7/9/2010	15:04	16:37	Broadscale	CR Delta, Wingham, Kayak,. Hinchinbrook-Entrance	100	variable - fog	good	poor to fair
7/12/2010	11:51	14:45	Broadscale	Northern Hinchinbrook, SE PWS	80	1500	excellent	good
7/14/2010	10:04	19:46	Broadscale & Camera Boat	NE & Eastern Sound - Camera Vessel Work	50	5000	excellent	good
7/15/2010	10:16	13:30	Broadscale	Central Sound and SW Bays	100	variable - fog	poor to fair	fair
7/16/2010	10:31	16:45	Broadscale & Catches	NW and Northern PWS	100	variable - low	poor to fair	fair
7/17/2010	11:19	15:30	Broadscale	Central and SW Bays and Passes	100	variable - low	poor to fair	fair
7/20/2010	13:51	14:09	NA	Attempted NW survey - mechanical and weather problems - aborted	100	fog	poor - fog	poor
7/21/2010	15:03	20:00	Broadscale	NW PWS; fjords, bays and passes	100	variable - fog	poor to fair	poor to fair
7/23/2010	11:00	15:50	Broadscale	Western PWS, Knight Island Passage and Perry Island	100	1100	fair	fair
7/28/2010	11:45	15:45	Broadscale & Catches	North Shore and Perry Island - catch validations	100	variable - fog/drizzle	poor to fair	poor to fair
7/29/2010	11:00	12:45	Broadscale	Central and SW Sound; abbreviated survey	100	varible	fair	fair
8/3/2010	12:30	17:15	Broadscale	SE and Eastern PWS - Wash. Post photojournalist aboard	50	5000	excellent	good
8/6/2010	11:25	16:45	Broadscale & Acoustics	Eastern, NE and Northern PWS - catch validations - repeat surveys over acoustic tracks	100	800 - variable	fair	fair
8/7/2010	11:43	18:55	Broadscale & Acoustics	SE, Central and SW PWS - repeat surveys over acoustic tracks	90	1500	good	fair - good
8/8/2010	9:37	15:30	Broadscale	Central, Western, and NW PWS - last survey	50	2500	excellent	good

Table 2. Flight Log for 2011.

Aerial Survey Flight Log - Prince William Sound 2011

Date	Start Time	End - Break	Start - from Break	End Time	Survey Hours	Survey Type	Survey Region	Cloud Cover (%)	Ceiling (ft)	Survey Conditions
5/31/2011	16:01			18:42	2:41	Broadscale	SE	100	2000	Good
6/2/2011	16:11			19:51	3:40	Broadscale	NW & Western	100	900	poor
6/4/2011	13:30	15:39	16:20	17:39	3:28	Broadscale	NE	100	1200	poor
6/5/2011	10:14	12:02	12:20	12:58	2:26	Validation	SE	80	5000	excellent
6/6/2011	12:35			14:57	2:22	Broadscale	Montague	variable	variable - fog	excellent
6/6/2011	18:01			20:40	2:39	Validation	Montague	50	2500	excellent
6/7/2011	10:31			14:20	2:42	Broadscale & Validation	SW Whale Bay Central Islands	100	2000	good
6/8/2011	10:01	12:23	13:30	14:53	4:06	Validation	Eaglek	100	2500	good
6/10/2011	12:15	15:03	15:49	16:40	3:39	Broadscale	CR Delta, Wingham, Kayak,. Hinchinbrook-Entrance	100	variable - fog	good
6/11/2011	11:47	14:40	15:26	16:42	4:09	Broadscale	NW & Central Sound	80	1500	excellent
6/12/2011	11:50	14:00	14:40	16:15	3:45	Broadscale	SW Passes & SW Western	50	5000	excellent
6/18/2011	10:03			13:45	3:42	Validation Catches	Kayak Island	100	variable - fog	poor to fair
7/6/2011	16:49			18:27	1:38	Broadscale & Validation	Montague Entrance	100	variable - low	poor to fair
7/6/2011	9:39			12:05	2:26	Validation	SE	100	variable - low	poor to fair
7/7/2011	9:55			14:45	4:50	Validation & Broadscale	SW	100	fog	poor - fog
7/8/2011	9:31			13:50	4:19	Broadscale	NW PWS; fjords, bays and passes	100	variable - fog	poor to fair
7/9/2011	11:25	14:00	14:45	16:10	4:00	Broadscale	Western PWS, Knight Island Passage and Perry Island	100	1100	fair
7/11/2011	11:30	13:13	14:58	17:27	4:12	Broadscale & Salmon	1/2 hour salmon survey	100	variable - fog/drizzle	poor to fair
7/13/2011	11:39	13:45	15:01	16:45	3:50	Broadscale	Central and SW Sound; abbreviated survey	100	varible	fair
7/15/2011	9:00	9:24	16:01	18:00	2:23	Transit NE & NE Broadscale	Scott and AUV demo	50	5000	excellent
7/16/2011	12:25			14:50	2:25	Broadscale & Acoustics	Eastern, NE and Northern PWS - catch validations - repeat surveys over acoustic tracks	100	800 - variable	fair
7/20/2011	10:30	13:23	14:04	15:10	3:59	Broadscale & Acoustics	SE, Central and SW PWS - repeat surveys over acoustic tracks	90	1500	good
7/21/2011	15:25			19:05	3:40	Broadscale	Central, Western, and NW PWS - last survey	50	2500	excellent
7/22/2011	10:45	13:20	14:10	15:30	3:55	Broadscale	Southeast and Eastern PWS	0	unlimited	excellent
7/26/2011	12:30	13:30	14:55	16:10	2:15	Broadscale	Northeastern PWS and the North Shore	100	1200-1500	good
7/27/2011	11:00	13:00	13:52	15:38	3:46	Broadscale	Northwestern PWS and the Central Islands	100	1200-2000	good to excellent
7/29/2011	10:50	12:08	13:11	15:30	3:37	Broadscale	Western PWS including Port Nellie Juan	25	unlimited	excellent
7/30/2011	10:50	12:34	17:40	19:12	3:16	Broadscale	Westerm and South Central PWS Islands	0	unlimited	excellent
8/6/2011	11:08	12:54	13:27	15:16	3:35	Broadscale	North Shore and North Central Islands	50	900 to unlimited	good to excellent
8/11/2011	10:30			11:54	1:24	Broadscale	Central Sound but abbreviated due to high winds	0	unlimited	poor due to wind
8/12/2011	12:28	14:31	15:20	16:53	3:36	Broadscale	Southwestern PWS and Montague	10	unlimited	good
8/13/2011	11:35	13:54	15:28	16:29	3:20	Broadscale	Finish Southwestern PWS and Green	100	1200 variable	good
8/15/2011	15:42			18:20	2:38	Broadscale	Southeastern PWS	50	1200 to unlimited	good
8/16/2011	11:08			14:40	3:32	Broadscale	Northwestern PWS and the North Shore	10	unlimited	excellent
8/24/2011	11:18			14:27	3:09	Broadscale & Acoustics	Northeastern PWS and Acoustics in the Southeast	90	variable scattered lows	fair to good; rain

Figure 1. Generalized distribution and abundance of age 1 (solid circles) and age 0 (dashed circles) observed from aerial surveys in 2010. Circles are sized by total school surface area observed in the region.

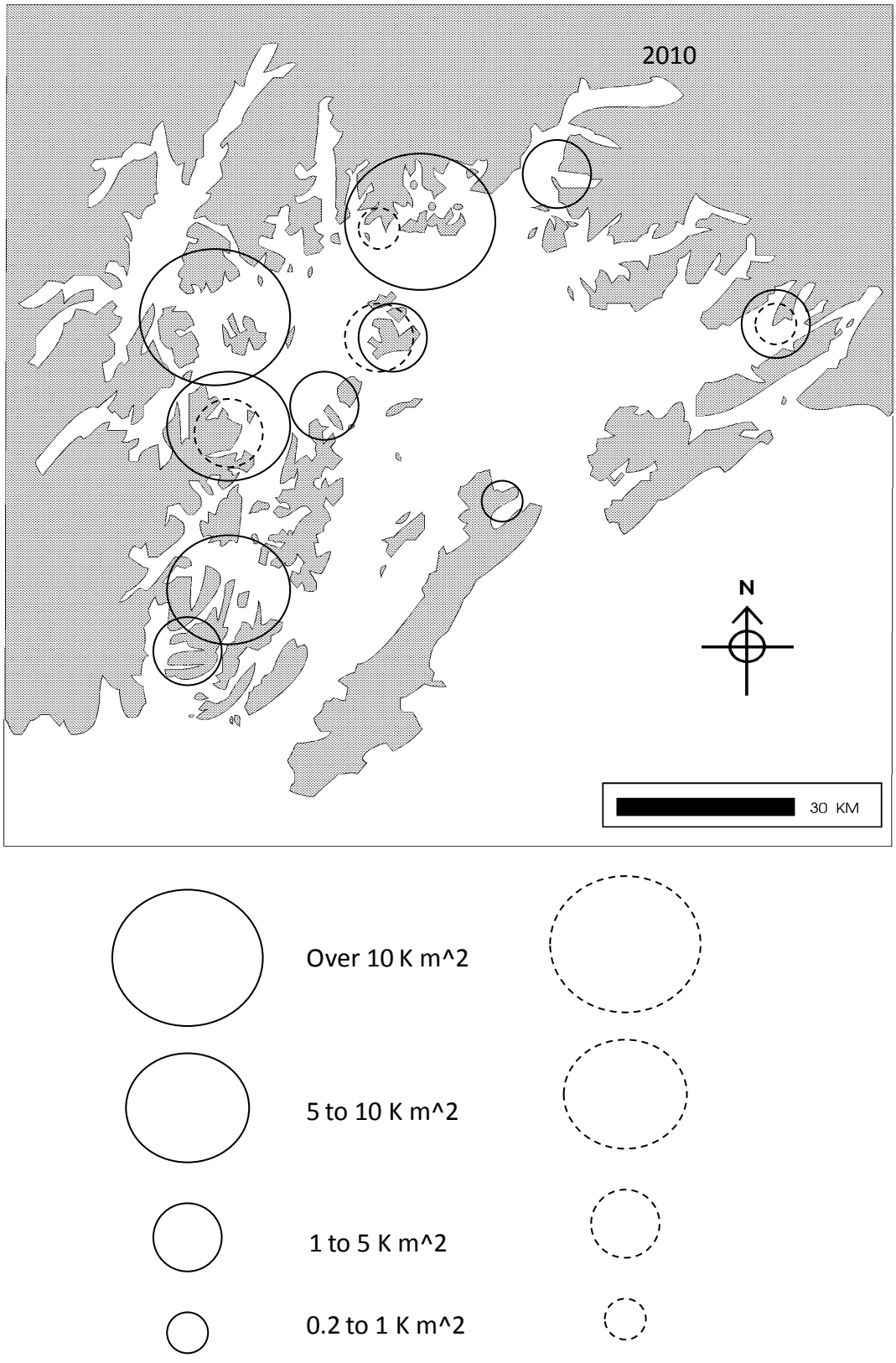
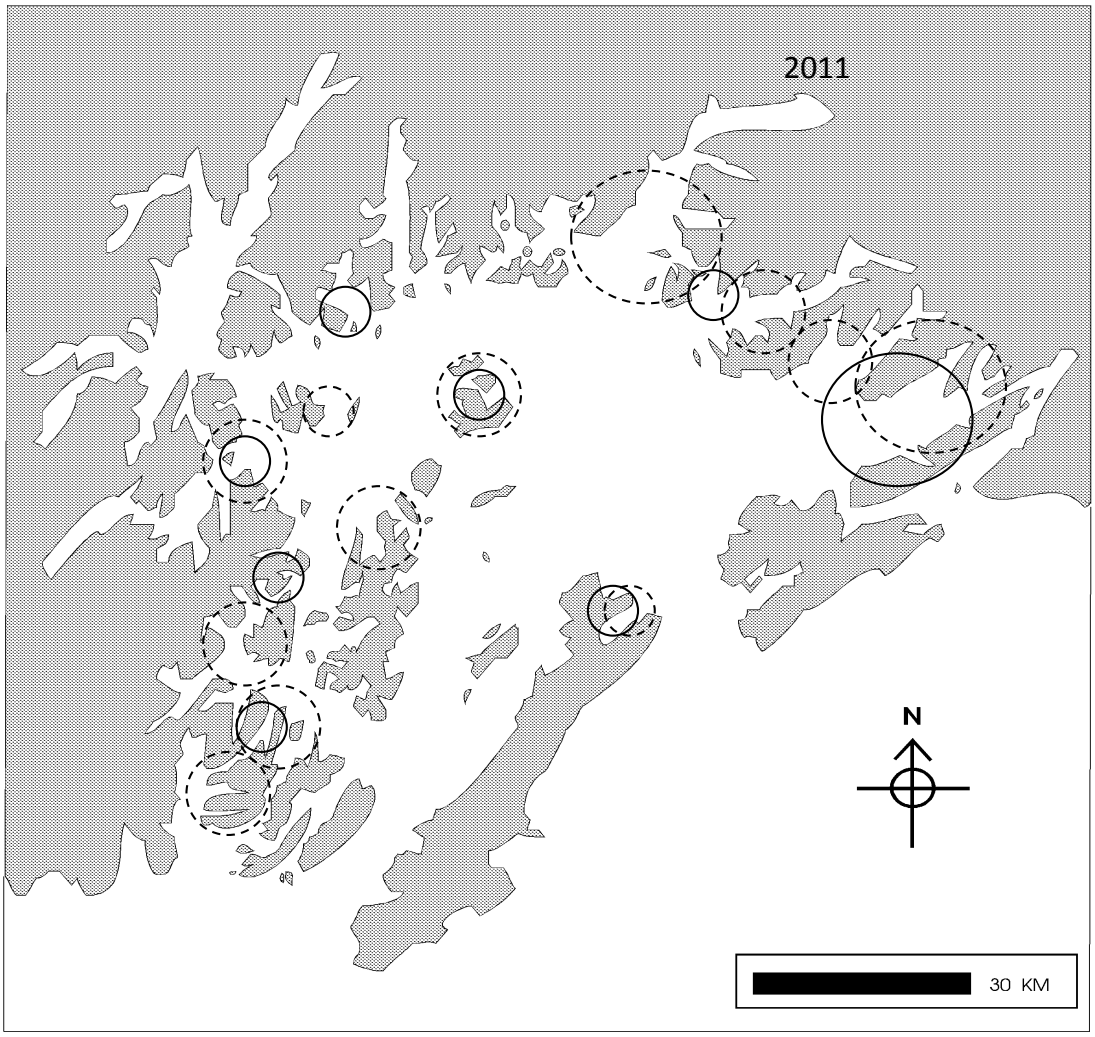
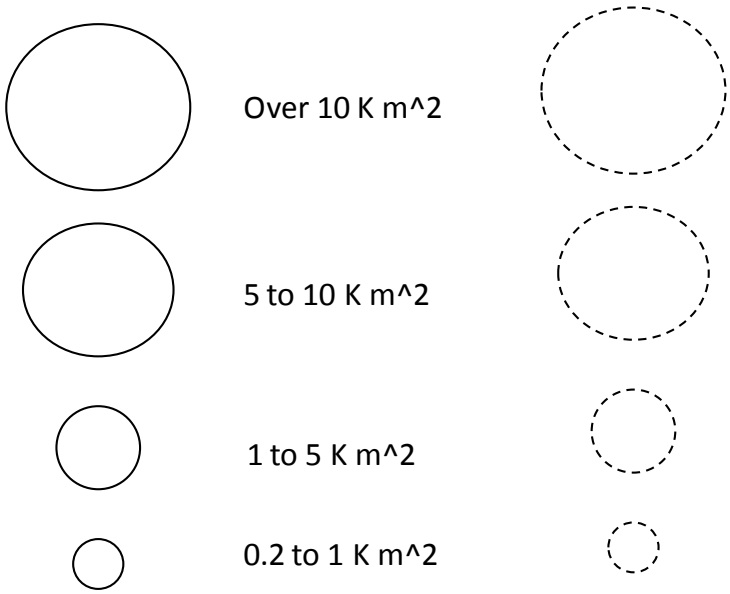


Figure 2. Generalized distribution and abundance of age 1 (solid circles) and age 0 (dashed circles) observed from aerial surveys in 2011. Circles are sized by total school surface area observed in the region.





Prince William Sound Aerial Surveys Page #:

Date: Surveyor: Pilot:

Start Time(AST): End Time: Tide Stage Start: Tide Stage End:

Cloud Cover: Ceiling: Survey Conditions: Water Visibility:

General Survey Region:

Type (Broadscale, Validation/Camera, Coordinated-Acoustic, etc.):

Obs No	asttime	species	no/ count	shape	tick1	tick2	bird beh1	bird beh2	feature	altitude	validation/ photo	notes