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Summary: Genetic mixed stock analysis of sockeye salmon in northern Chatham commercial fisheries, 2012-2014

During the 2012-2014 fishing seasons, a study was conducted by ADF&G to provide stock-specific estimates of the stock composition of sockeye salmon caught in commercial purse seine fisheries in northern Chatham Strait. Samples were collected from sockeye salmon harvested in statistical areas 112-14/114-27 and 112-16, and genetic mixed stock analysis was used to estimate annual contributions of 9 broad-scale, genetically identifiable reporting groups. For this analysis "stocks" are defined as the following reporting groups: 1) *Chilkoot*, 2) *Chilkat*, 3) *Chatham Large*, 4) *Chatham Small*, 5) *Speel*, 6) *Northern Southeast Alaska*, 7) *Taku Lakes*, 8) *Taku/Stikine Mainstem*, and 9) *Other*). In addition, contributions of *Kanalku*, *Hasselborg*, and *Pavlof* were assessed independently as fine-scale reporting groups in 2013. This document summarizes the findings from the study, which are published in ADF&G's Fishery Data Series[1].

Description of genetic mixed stock analysis

Genetic mixed stock analysis is a method that uses genetic characteristics of populations (allele frequencies) and genotypes of individuals sampled from the harvest to estimate proportional stock compositions of the fishery harvest.

Methods and Results

Samples were collected from statistical areas 112-14/114-27 and 112-16 purse seine fisheries during the 2012-2014 seasons (Table 1; Figure 1). Sample sizes were set to 300-400 per stratum. Due to poor pink salmon returns, purse seine openings were very limited in 2012 and 2014, while a stronger pink salmon return in 2013 allowed for more openings in both time and area. Not all harvest was sampled in all years; unsampled strata represented 18% (2012), 27% (2013), and 12% (2014) of the total sockeye salmon harvests in districts 112 and 114 (Table 2).

Laboratory analysis was conducted at the ADF&G Gene Conservation Laboratory in Anchorage using well-established protocols. Reporting groups were selected based on 1) sociological and management needs, 2) the number of fish expected from the reporting group within a mixture, with a 5% minimum contribution, and 3) genetic distinction. Based on these factors, the 9 broad-scale reporting groups described above were selected (Figure 2). The *Chatham Small* broad-scale reporting group included baseline populations from Kanalku Lake, Hasselborg Lake, and Pavlof Lake. When the allocation to this reporting group exceeded 5% in a mixture, it was possible to estimate the contribution of the fine-scale reporting groups including each of these 3 populations. In tests, other reporting groups met the critical level of 90% correct allocation, with the *Kanalku* reporting group performing the best with at least 99% correct allocation over all tests.

Table 1.–Fishery type and location of sockeye salmon mixed fishery samples from 2012–2014 including statistical area, project sample goal, and total number of samples collected.

[1] Gilk-Baumer, S. E., S. D. Rogers Olive, D. K. Harris, S. C. Heinl, E. K. C. Fox, and W. D. Templin. 2015. Genetic mixed stock analysis of sockeye salmon harvests in selected northern Chatham Strait commercial fisheries, Southeast Alaska, 2012-2014. Alaska Department of Fish and Game, Fishery Data Series No. 15-03, Anchorage. http://www.adfg.alaska.gov/FedAidPDFs/FDS15-03.pdf

Fishery	Location	Statistical Area	Sample Goal	Number Collected 2012	2013	2014
Purse Seine	Hawk Inlet	112-16	2,400	376[a]	1,815[b]	347[a]
Purse Seine	Augusta/Whitestone	112-14/114-27	3,000	1,180/None	2,358[c]	636/None
Total			5,400	1,556	4,173	983

[a] Samples taken were from the test fishery; no common property fishery took place.

[b] Samples taken were from both the test fishery and common property fisheries.

[c] Samples were from Districts 112-14 and 114-27 combined; it was not possible to sample these separately.

Table 2.–Harvest of sockeye salmon in northern Chatham Strait purse seine fisheries, 2012-2014. Fishery areas include statistical areas 112-14 traditional fisheries; 112-16 test fishery only; 112-16 traditional fishery; traditional fisheries in District 112 on the Chichagof, Baranof, and Admiralty shorelines; 112-22 Hidden Falls terminal hatchery harvest; 114-27 traditional; and traditional fisheries in all other areas in District 114 combined. Harvest indicated as "included in MSA" were sampled and thus are represented in genetic mixed stock analyses.

	2012		2013		2014	
Fishery Area	Total Harvest	Included in MSA	Total Harvest	Included in MSA	Total Harvest	Included in MSA
112-14	5,977	5,977	5,083	5,083	3,604	3,604
112-16 Test	1,826	1,826	1,905	1,390	2,051	2,051
112-16	0	0	23,480	23,480	0	0
112-Chichagof	0	0	7,839	0	0	0
112-Baranof	0	0	2,114	0	0	0
112-Admiralty	2	0	944	0	0	0
112-22 Hidden Falls	1,740	0	4,302	0	501	0
114-27	0	0	10,967	10,909	0	0
114-Other	0	0	459	0	284	0

In 2012 and 2014, purse seine fisheries were limited due to low numbers of returning pink salmon. In 2012 estimates, the sockeye salmon harvest in statistical area 112-16 was combined into one stratum, and the harvest in statistical area 112-14 was combined into 3 strata. In 2014 estimates, the harvest in statistical area 112-16 was combined into 2 strata, and the harvest in statistical area 112-14 was combined into 3 strata. Proportions of less than 5% were observed for the *Chatham Small* reporting group, so results are reported for broad-scale reporting groups only (Figures 3, 4). When estimated proportions were applied to harvest, the *Taku/Stikine Mainstem* reporting group contributed the greatest number of sockeye salmon to the statistical area 112-16 fishery in 2012, and the *Chilkat* reporting group contributed the greatest number to the 112-16 fishery in 2014 (Figure 3). The *Speel* reporting group contributed the greatest number of sockeye salmon to the statistical area 112-14 fishery in both 2012 and 2014 (Figure 4).

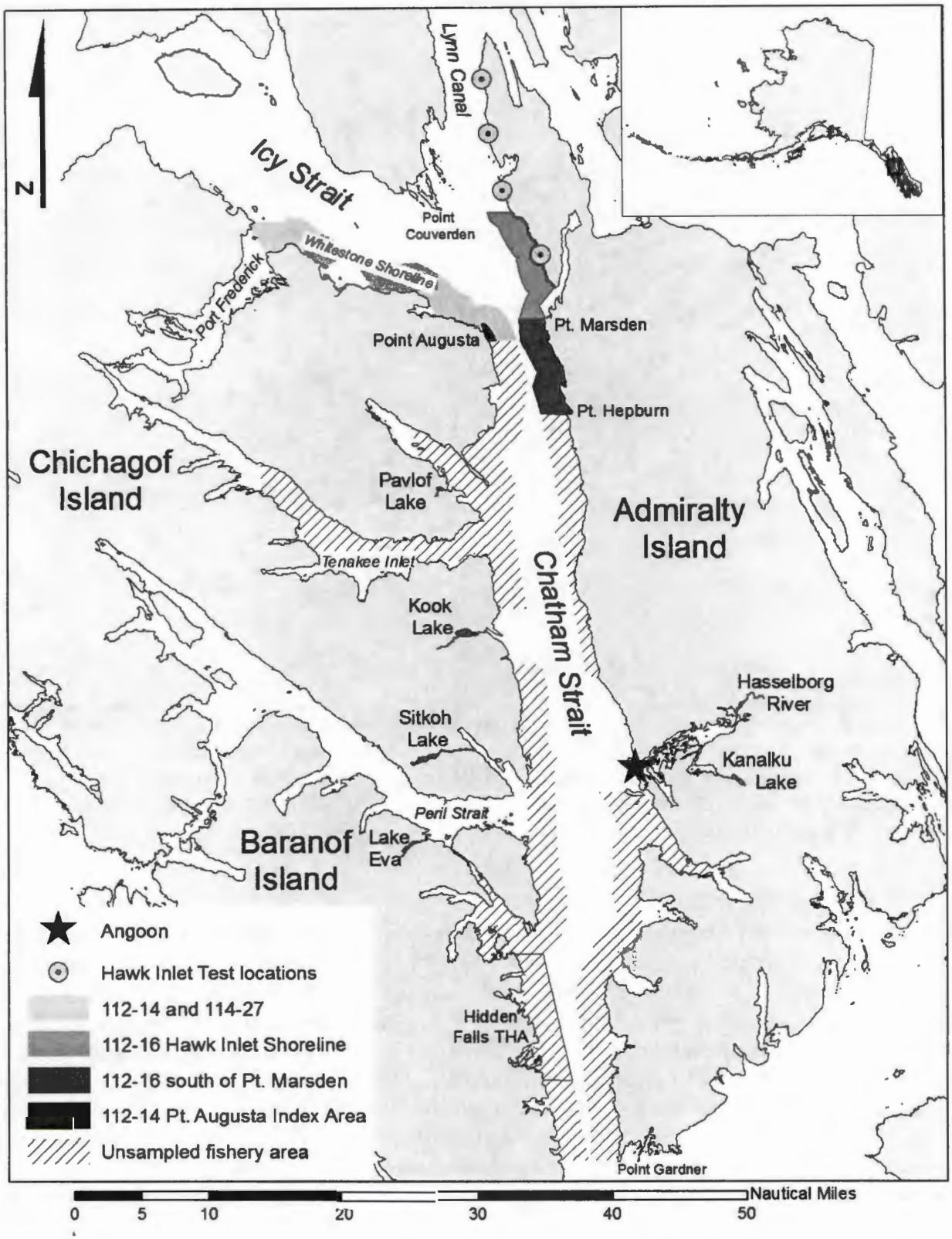


Figure 1.–Map showing the districts 112 and 114 purse seine fishery locations in northern Southeast Alaska.

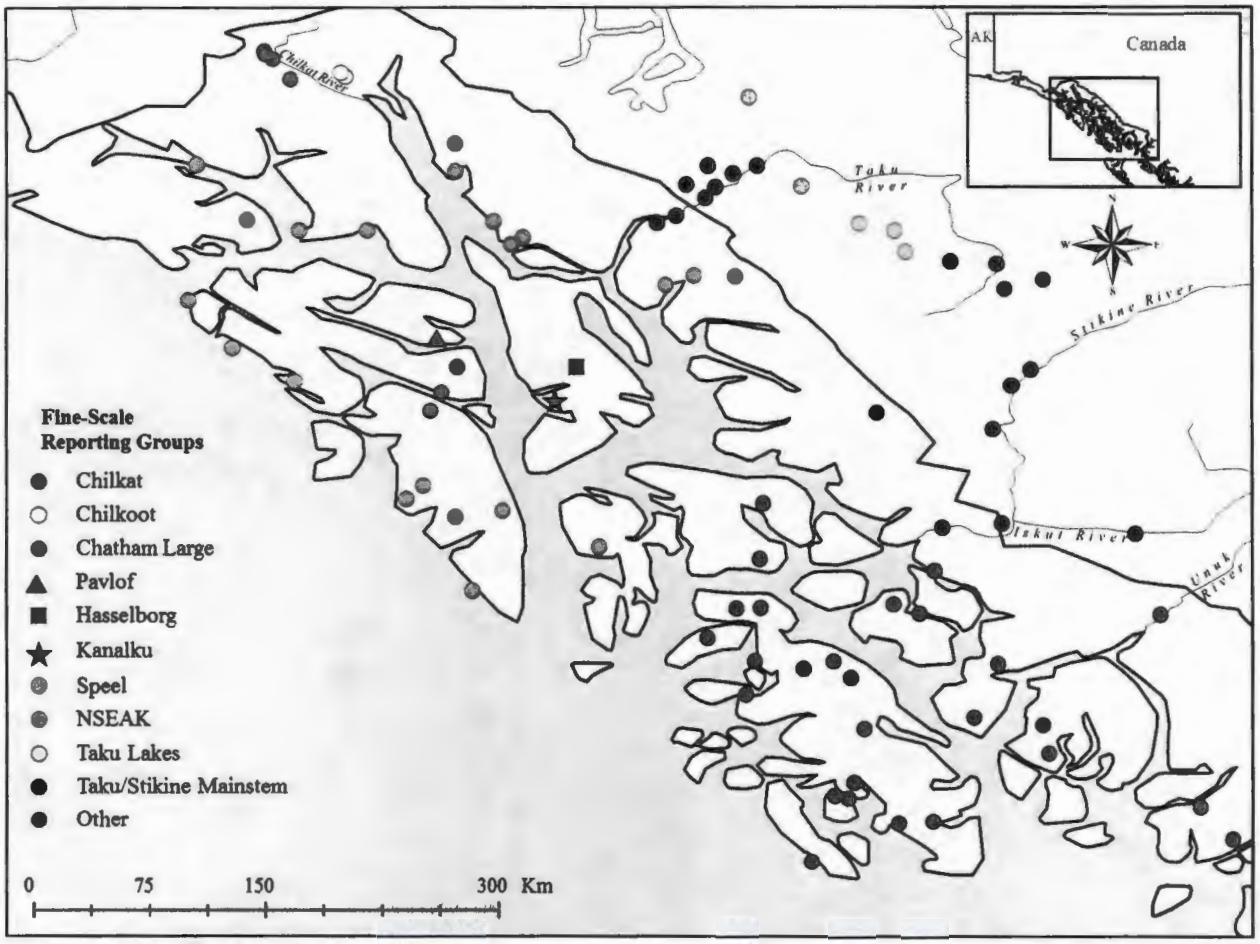


Figure 2.–The location and fine-scale reporting group affiliation of populations of sockeye salmon included in the Chatham Strait fishery analysis. The *Chatham Small* broad-scale reporting group is represented in purple, with each individual fine-scale group represented as a unique shape. Additional populations in the *Other* reporting group are not shown, and range as far north as Prince William Sound and south to the state of Washington.

Stronger pink salmon returns in 2013 allowed for more purse seine openings. In 2013 estimates, the sockeye salmon harvest in statistical area 112-16 was combined into 5 strata, and the harvest in statistical areas 112-14/114-27 were combined into 8 strata (Figures 3, 4). Because the *Chatham Small* reporting group contributed at least 5% to the mixtures in both areas, it was possible to estimate allocations to fine-scale reporting groups (Figures 5, 6). All strata for each reporting group within 2013 were combined and weighted by their respective harvests, resulting in full-season estimates. When estimated proportions were applied to the 2013 harvest, the *Chilkat* reporting group contributed the greatest number of sockeye salmon to the statistical area 112-16 fishery (Figure 3), and the *Speel* reporting group contributed the greatest number of sockeye salmon to the 112-14/114-27 fisheries (Figure 4). Within the fine-scale reporting groups, the largest contributor of the *Chatham Small* stocks was *Hasselborg* (2,115 fish in the 112-16 fishery and 1,626 fish in the 112-14/114-27 fishery; Figures 5, 6). The estimated contribution of *Kanalku* fish to both fisheries was 125 fish in the 112-16 fishery and 111 fish in the 112-14/114-27 fisheries.

a)

b)

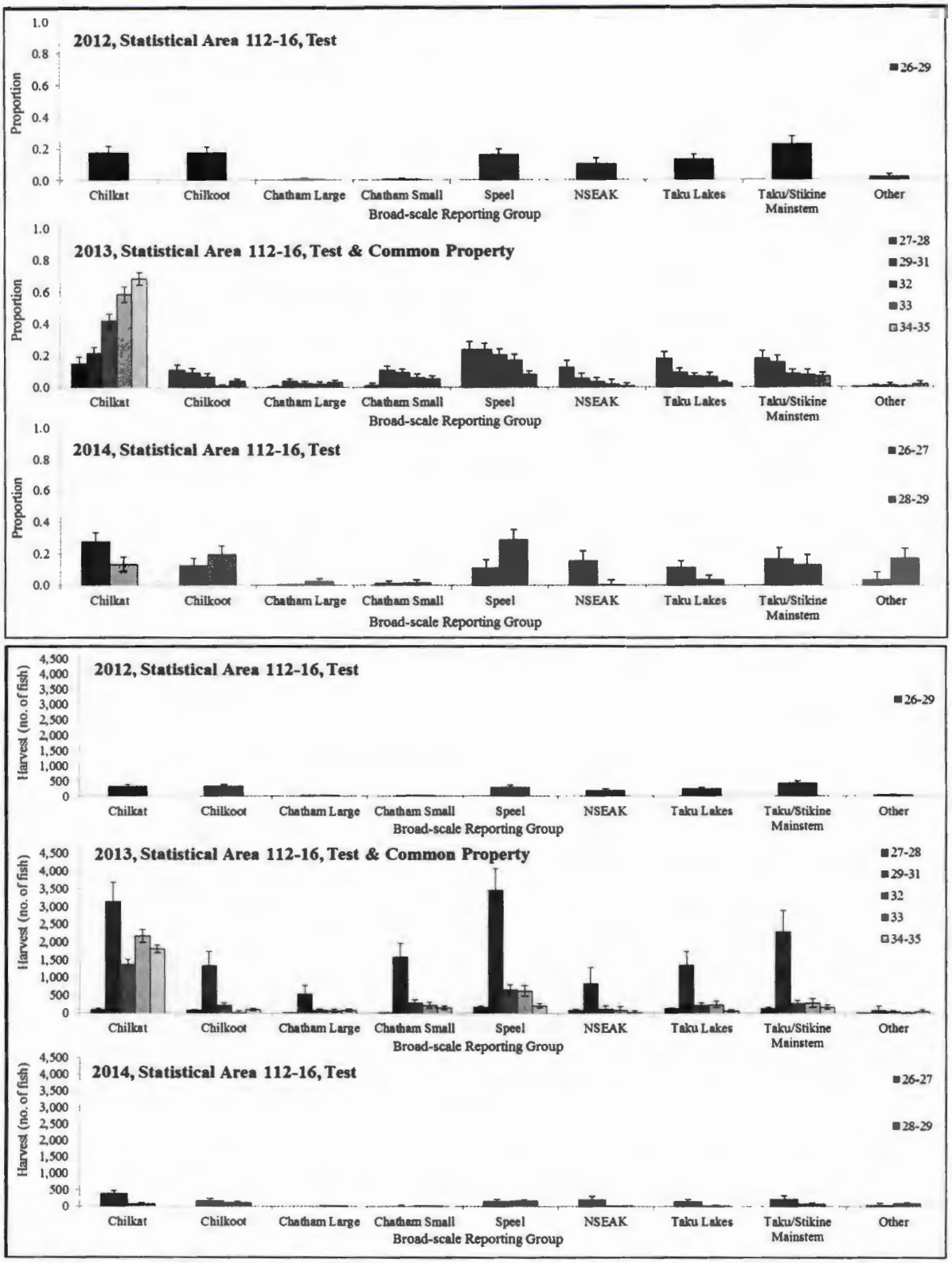


Figure 3.–Proportional stock composition estimates (a) and stock composition estimates applied to harvest (b) of sockeye salmon harvested in statistical area 112-16 test and common property commercial purse seine fisheries, by statistical week (noted in legends) for 2012-2014. Error bars represent 90% credibility intervals.

a)

b)

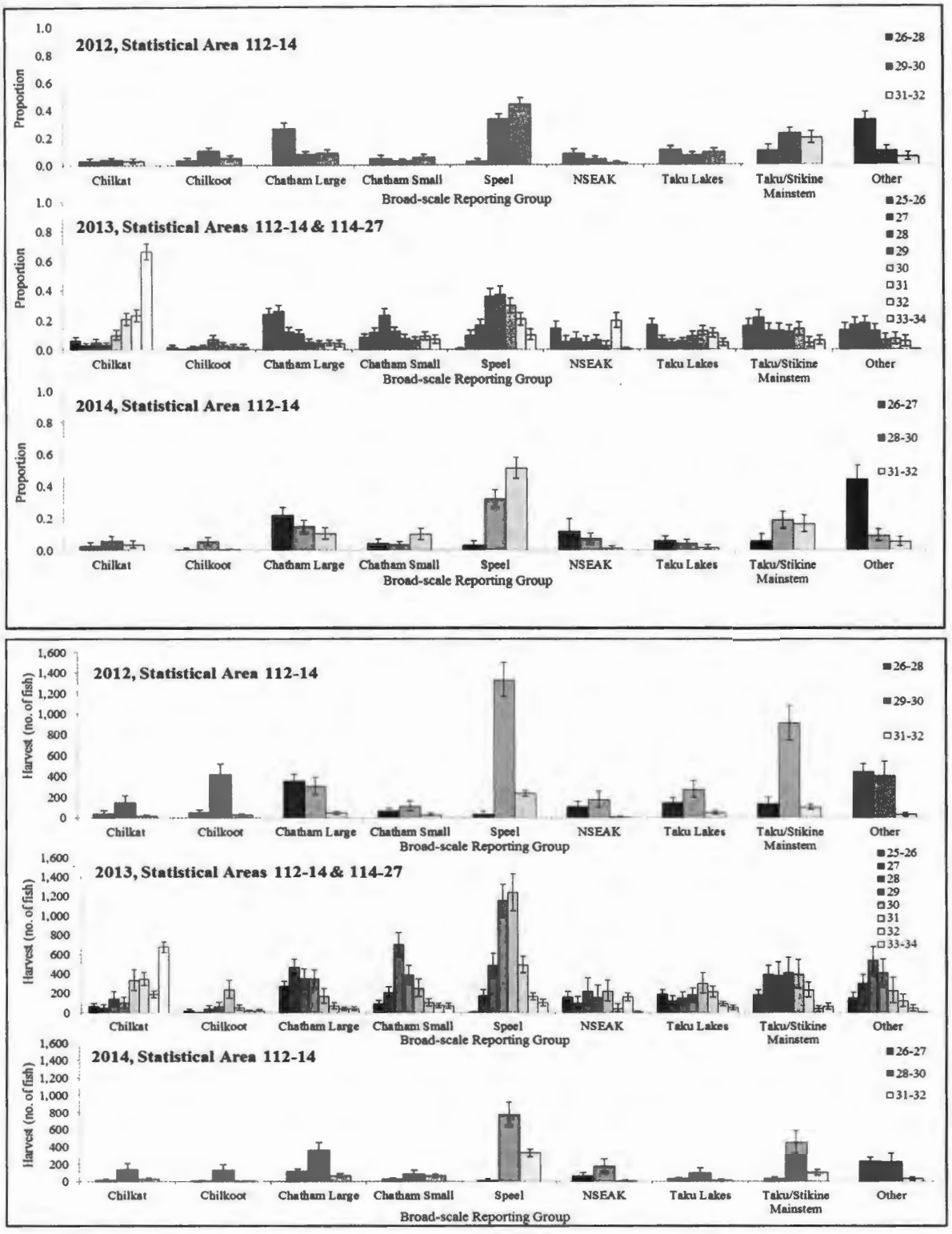
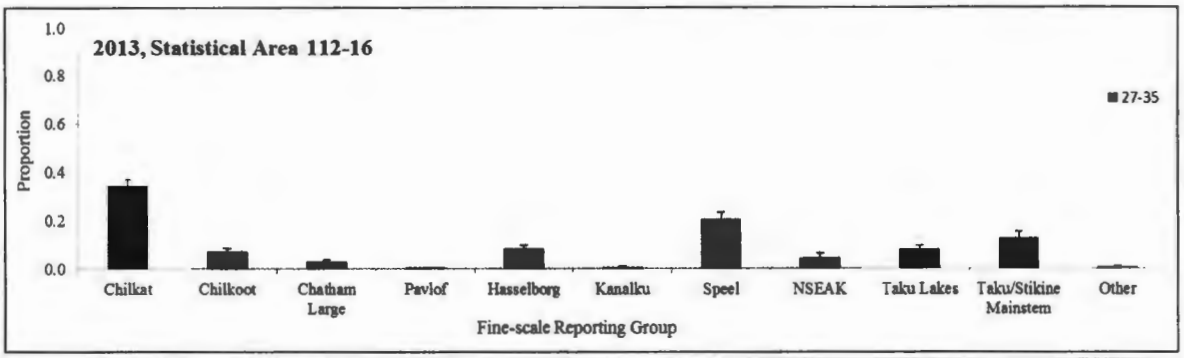


Figure 4.–Proportional stock composition estimates (a) and stock composition estimates applied to harvest (b) of sockeye salmon harvested in statistical area 112-14, and combined 112-14 and 114-27 commercial purse seine fisheries, by statistical week (noted in legends) for 2012–2014. Error bars represent 90% credibility intervals

a)



b)

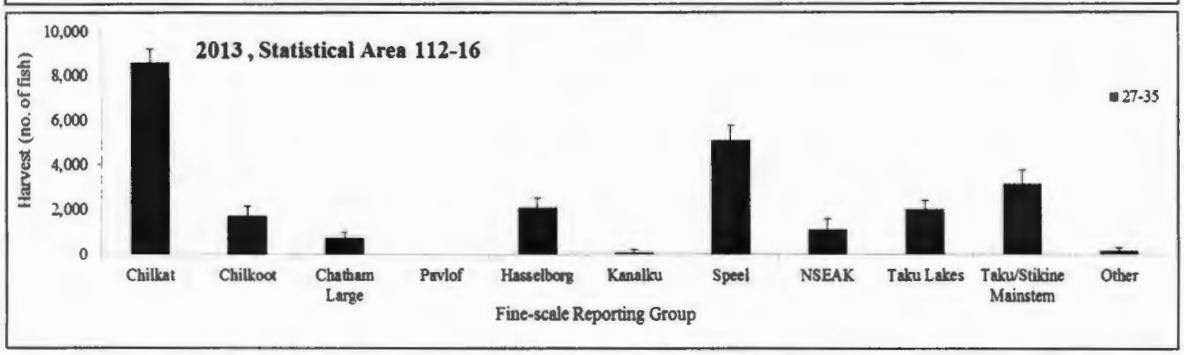
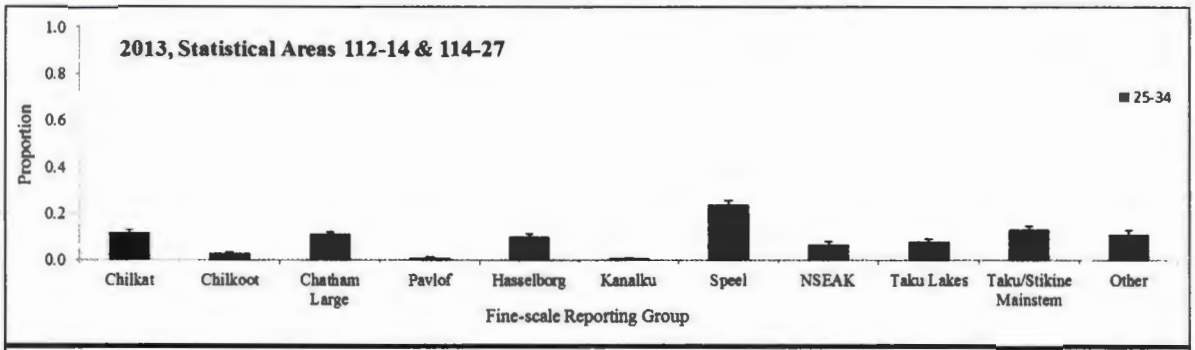


Figure 5.–Proportional stock composition estimates (a) and stock composition estimates applied to harvest (b) of sockeye salmon from fine-scale reporting groups in statistical area 112-16 test and common property commercial purse seine fisheries for the 2013 season (all statistical weeks combined). Error bars represent 90% credibility intervals.

a)



b)

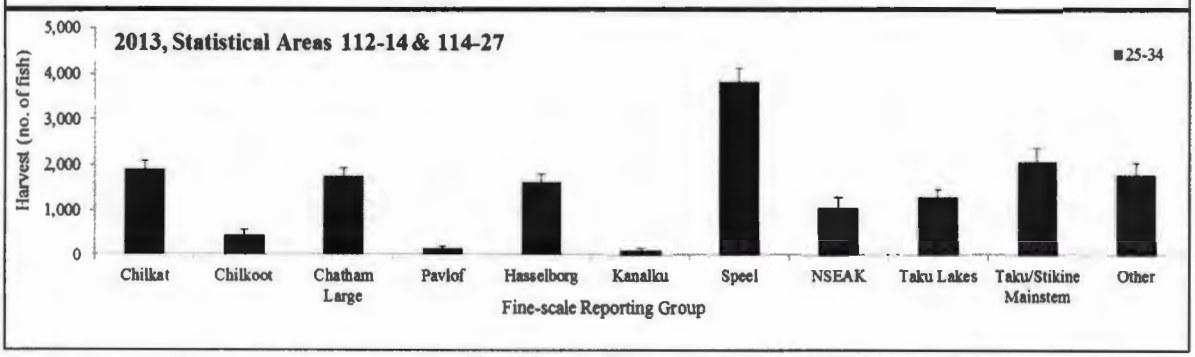


Figure 6.–Proportional stock composition estimates (b) and stock composition estimates applied to harvest (b) of sockeye salmon from fine-scale reporting groups in statistical areas 112-14 and 114-27 commercial purse seine fisheries for the 2013 season (all statistical weeks combined). Error bars represent 90% credibility intervals.

Conclusions

- There is interannual variability in stock compositions of the harvest due to changes in relative abundance of stocks, prosecution of fisheries, and migratory behavior due to environmental conditions.
- The high abundance of pink salmon in 2013 led to increases in both time and area available for fisheries, resulting in different stock compositions compared to 2012 and 2014.
- There were higher proportions of the *Chatham Small* reporting group in both the 112-16 and 112-14/114-27 fisheries in 2013 than observed in 2012 and 2014 (Figures 4–7). A fine-scale analysis of the 2013 fisheries was only possible because 1) the *Chatham Small* reporting group was present at greater than 5% of the total season harvest, 2) large sample sizes were available throughout the season, and 3) the 3 populations are highly identifiable in the baseline.
- Within the *Chatham Small* group, *Hasselborg* was the greatest contributor in both the 112-14/114-27 and 112-16 fisheries in 2013, whereas *Kanalku* and *Pavlof* contributed <1% to those fisheries (Figures 8–9). The Hasselborg sockeye salmon run may be larger than previously believed.
- The proportions of *Kanalku* sockeye salmon present in the fisheries were very small compared to other stock groups (Figures 8–9), which is not surprising given the relatively small escapements to this system (total escapement ranged from 1,938 to 2,289 fish over the 3 years of this study).
- Precision and accuracy considerations:
  - Not all of the harvest was sampled in all years (Table 2, Figure 1). However, the size, timing, and location of these harvests suggest the *Chatham Small* reporting group would be present in low proportions in some of those unsampled fisheries.
    - 112-22 Hidden Falls: harvests occurred almost entirely within the terminal harvest area in fisheries targeting enhanced chum salmon; location is also on Baranof Island south of northern Chatham stocks.
    - 112-Baranof, 112-Chichagof, 112-Admiralty: harvests occurred on the western side of Chatham Strait (Baranof, Chichagof shorelines) and/or south of the sockeye salmon systems important to the community of Angoon (Baranof and southern Admiralty shorelines).
    - 114-Other: harvests are either small or the timing is late compared to the expected run timing of northern Chatham systems.
  - Although the baseline contains samples from all major contributing stocks and most minor stocks, it is likely that some very small stocks are not represented in the baseline. This could lead to some misallocation of fish, although this effect is likely small given the overall representation of stocks in the baseline.
  - The accuracy of the statistical method is influenced by biases in the allocation of contributions to populations in the baseline, and the precision of the estimates is driven by a combination of sample size and genetic distinction among reporting groups. Fortunately, reporting groups are highly identifiable and biases for each group were characterized by proof tests. In addition, the precision of estimates was summarized in the results with 90% credibility intervals and standard deviations.
- Additional years of sampling and analysis, particularly during odd-year, high-abundance pink salmon runs, and from fisheries along the western side of Chatham Strait, would increase confidence in application of these results.