Southeast Alaska Coastal Monitoring of Epipelagic Fish and Marine Ecosystem Conditions Associated with Salmon: Continuation of a Long-term Data Series in a Changing Climate

Final Report
Dec. 23, 2020

Pacific Salmon Commission
Northern Fund Project NF-2019-I-14
(NOAA Portion)

PERIOD COVERED: April 1, 2019 to June 30, 2021
PERIOD FUNDED: April 1, 2019 to June 30, 2021
TOTAL PSC FUNDS AWARDED: $48,091
PSC FUNDS RECEIVED: $43,281.90

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Background

Since 1997 researchers from the NOAA Alaska Fisheries Science Center Auke Bay Laboratories' Southeast Coastal Monitoring (SECM) project have sampled juvenile salmon and associated biophysical parameters in the marine waters of the northern region of Southeast Alaska (SEAK) (Figure 1). Because juvenile salmon experience highly variable marine mortality during their early spring residence, fish are sampled later in the season along SECM stations strategically positioned across a primary seaward migration corridor leading into the Gulf of Alaska. This research was originally supported by the NOAA Ship *John N. Cobb,* which was decommissioned in 2008; subsequent research years have been supported by chartered commercial trawl vessels and in 2019 by the Alaska Department of Fish and Game RV Medeia. The SECM time series provides information on salmon pre-recruit year-class strength and associated biophysical data and is used to develop forecast models of adult pink salmon harvest and an index of Chinook salmon abundance. In addition, the continuous SECM time series has provided a baseline window of biophysical metrics to view the potential impact of climate change on salmon production in marine ecosystems.

The Northern Fund (NF) has provided support to the SECM project to continue biophysical sampling in order to improve salmon forecast modeling and better understand factors in marine ecosystems that influence year class strength. The project type identified was: "Improved information for resource management, including stock assessment; data acquisition & scientific understanding of limiting factors," and covered the period from April 1, 2019 to June 30, 2021. Specifically, the project addresses the persistent problems of developing reliable forecast methodologies for pink salmon and Chinook salmon fisheries, and improving knowledge of factors that limit ocean survival.

Complete 2019 SECM information supplemental to this NF Project Final Report is covered in the following 6 attached documents:

1. Memorandum of Understanding between NOAA & the Pacific Salmon Commission. NF-2019-I-14 AKC-234.

2. Murphy, J.M., A. Piston, E.A. Fergusson, and A.K. Gray. 2019. Southeast Alaska coastal monitoring survey plan for 2019. NPAFC Doc. 1846. 5 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, and Alaska Department of Fish and Game (Available at https://npafc.org).

3. Murphy, J.M., A. Piston, J.H. Moss, E.A. Fergusson, S. Heinl, W. Strasburger, and A.K. Gray. In Review. Southeast Alaska coastal monitoring cruise report, 2019. NPAFC Doc. xxxx. 24 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, and Alaska Department of Fish and Game (will be available in spring 2021 at http://www.npafc.org).

4. Fergusson, E., J. Murphy, and A. Gray. 2019. Southeast Alaska Coastal Monitoring Survey: salmon trophic ecology and bioenergetics, 2019. NPAFC Doc. XXXX. 41 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, Ted Stevens Marine Research Institute (will be available in spring 2021 at http://www.npafc.org).

5. 2020 NOAA Fisheries–Alaska Department of Fish and Game Southeast Alaska Pink Salmon Harvest Forecast. News releases web site: http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1126221367.pdf.

6. Management Analyst and Reporting System (MARS) Summary

Objectives

The SECM project objectives for NF-2019-I-14 were to: 1) conduct May-August ocean surveys in the marine waters of the northern region of SEAK; 2) provide regional stock assessment metrics for pink and Chinook salmon; and 3) contribute ecosystem monitoring reports to better understand mechanisms related to salmon production. The work completed to meet these objectives is summarized below; documents produced from the project to date are also cited where appropriate.

Objective 1. Monthly ocean surveys in the northern region of SEAK:
a. Sample biophysical environmental metrics (May-August 2019);
b. Sample epipelagic fish including salmon (June-August 2019);

Objective 1 was fully accomplished by sampling inshore and strait habitats in the northern region of SEAK in 2019 (Figure 1). A research plan was developed for the 2019 SECM survey and reported in North Pacific Anadromous Fish Commission (NPAFC) document that is attached to this final report (Murphy et al. 2019). In 2019, the R/V Sashin was used to complete oceanographic sampling in early June and the Alaska Department of Fish and Game RV Medeia was used to complete oceanographic and fish sampling in late June, July, and August. Draft NPAFC documents of the biophysical data collections from 2019 (Fergusson et al., 2020 and Murphy et al., 2020) are attached to this final report. A total of 182 biophysical sample collections were made in 2019 (Table 1, Murphy et al. 2019). Previous documents include syntheses of interannual catch and biophysical trends that allow comparison of the 2019 sampling year with baseline patterns of marine conditions in the time series (i.e., Orsi et al. 2012, Sturdevant et al. 2012, Fergusson et al. 2013, Orsi and Fergusson 2014).

Objective 2. Regional salmon stock assessments:
a) Explore new modeling approaches and ecosystem metrics to improve forecast precision.

b) Develop a forecast model for SEAK pink salmon harvest in 2020.
c) Develop a forecast model for SEAK transboundary river Chinook salmon abundance index.

Objective 2 was fully accomplished for both pink salmon and Chinook salmon assessments. The pre-season harvest forecast model for pink salmon was evaluated for the actual 2019 SEAK harvest, and the preseason forecast model for pink salmon was developed for 2020 using the SECM time series of peak June-July catch-per-unit-effort (CPUE) of juvenile pink salmon and associated biophysical data collected from 1997-2019. The pre-season pink salmon forecast model is attached as an ADFG NEWS release. This was the second season NOAA and ADFG collaborated to produce a joint NOAA/Alaska Department of Fish and Game Pink salmon salmon forecasts. Pink salmon forecasts have been generally accurate over the past decade (Figure 2, Wertheimer et al. 2014, 2016). An oral presentation of the 2020 pre-season pink salmon harvest forecast was delivered at the Southeast Alaska Purse Seine Task Force Meeting in Sitka, Alaska in December of 2019.

Chinook salmon stock assessment information was available from the SECM trawl catches and reported in a draft NPAFC Document (Murphy et al. 2020) and attached to this final report. In 2019, caudal fin clips from all Chinook salmon were also preserved in alcohol and provided to the ADF&G for future genetic work and to better describe the origin of pre-recruit fish in adjacent commercial troll fisheries.

Objective 3. Ecosystem monitoring reports:
a. Contribute to the annual NOAA Ecosystem Considerations Report;
b. Produce North Pacific Anadromous Fish Commission Documents;

NOAA Ecosystem Considerations Reports were completed:

1. Emily Fergusson. Long-term zooplankton and temperature trends in Icy Strait, Southeast Alaska. In Ecosystem Considerations 2019: Status of the Gulf of Alaska Marine Ecosystem. Eds Zador, S. and E. Yasumiishi. Technical report, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99301.

2. Charles D. Waters, Jordan T. Watson, James M. Murphy, Andrew Gray, Emily Fergusson 2019. Trends in Salmon Abundance from the Southeast Coastal Monitoring (SECM) Survey . In Ecosystem Considerations 2019: Status of the Gulf of Alaska Marine Ecosystem. Eds Zador, S. and E. Yasumiishi. Technical report, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99301.

3. Emily Fergusson, Jim Murphy, and Andrew Gray 2019. Juvenile Salmon Size and Condition Trends in Icy Strait, Southeast Alaska. In Ecosystem Considerations 2019: Status of the Gulf of Alaska Marine Ecosystem. Eds Zador, S. and E. Yasumiishi. Technical report, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99301.

NPAFC Documents were completed:

1. Murphy, J.M., A. Piston, E.A. Fergusson, and A.K. Gray. 2019. Southeast Alaska coastal monitoring survey plan for 2019. NPAFC Doc. 1846. 5 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, and Alaska Department of Fish and Game (Available at https://npafc.org).

2. Murphy, J.M., A. Piston, J.H. Moss, E.A. Fergusson, S. Heinl, W. Strasburger, and A.K. Gray. In Review. Southeast Alaska coastal monitoring cruise report, 2019. NPAFC Doc. xxxx. 24 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, and Alaska Department of Fish and Game (will be available in spring 2021 at http://www.npafc.org).

3. Fergusson, E., J. Murphy, and A. Gray. 2019. Southeast Alaska Coastal Monitoring Survey: salmon trophic ecology and bioenergetics, 2019. NPAFC Doc. XXXX. 41 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, Ted Stevens Marine Research Institute (will be available in spring 2021 at http://www.npafc.org).

Scientific Accomplishments

Maintaining the long-term SECM project on juvenile salmon metrics and associated marine biophysical conditions in SEAK has contributed substantially to our understanding of processes affecting salmon production. The SECM forecast has been cited as a pragmatic example of ocean research applied to fisheries management (Turner and Haidvogel 2009). The consistency of the research has fostered communications and cooperation with regional ADF&G offices, other NOAA Fisheries Centers, regional aquaculture associations, commercial fishing constituents, academia, and international salmon fisheries organizations such as NPAFC. The SECM staff have presented numerous oral and poster reports at scientific meetings and to stakeholder groups and have published numerous scientific publications and reports.

Budget Summary

The budget summary is provided by Table 2 budget sheet and attached MARS report. The COVID Pandemic hindered travel to most meetings after March 2020, therefore 7k in travel will be returned to the Northern Fund. The pandemic also hindered repair, maintenance, and supply replenishment post survey 2020. We will be finishing these tasks in the spring of 2021. We will not be asking for the 10% holdback.

References

Fergusson, E. A., M. V. Sturdevant, and J. A. Orsi. 2013. Trophic relationships among juvenile salmon during a 16-year time series of climate variability in Southeast Alaska. N. Pac. Anadr. Fish Comm. Tech. Rep. 9.

Orsi, J. A. and E. A. Fergusson. 2014. Annual survey of juvenile salmon, ecologically-related species, and biophysical factors in the marine waters of southeastern Alaska, May–August 2013. (NPAFC Doc.). Auke Bay Lab., Alaska Fish. Sci. Cent., Natl. Mar. Fish., NOAA, NMFS, 17109 Point Lena Loop Road, Juneau, 99801, USA. 85 pp. (Available at http://www.npafc.org).

Sturdevant, M. V., J. A. Orsi, and E. A. Fergusson. 2012. Diets and Trophic Linkages of Epipelagic Fish Predators in Coastal Southeast Alaska during a Period of Warm and Cold Climate Years, 1997–2011, Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science, 4:1, 526-545

Turner, E. and D. B. Haidvogel. 2009. Taking ocean research results to applications: examples and lessons from US GLOBEC. Oceanography 22(4): 233-241.

Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2014. Forecasting pink salmon harvest in southeast Alaska from juvenile salmon abundance and associated biophysical parameters: 2013 returns and 2014 forecast. NPAFC Doc. 1555. 24 pp. Auke Bay Lab., Alaska Fisheries Science Center, NOAA, NMFS. (Available at http://www.npafc.org)

Wertheimer, A. C., J. A. Orsi, and E. A. Fergusson. 2016. Forecasting pink salmon harvest in southeast Alaska from juvenile salmon abundance and associated biophysical parameters: 2014 returns and 2015 forecast. NPAFC Doc. 1618. 26 pp. National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratories, Ted Stevens Marine Research Institute (Available at http://www.npafc.org).

FIGURES

Figure 1. SECM stations sampled during 2019.

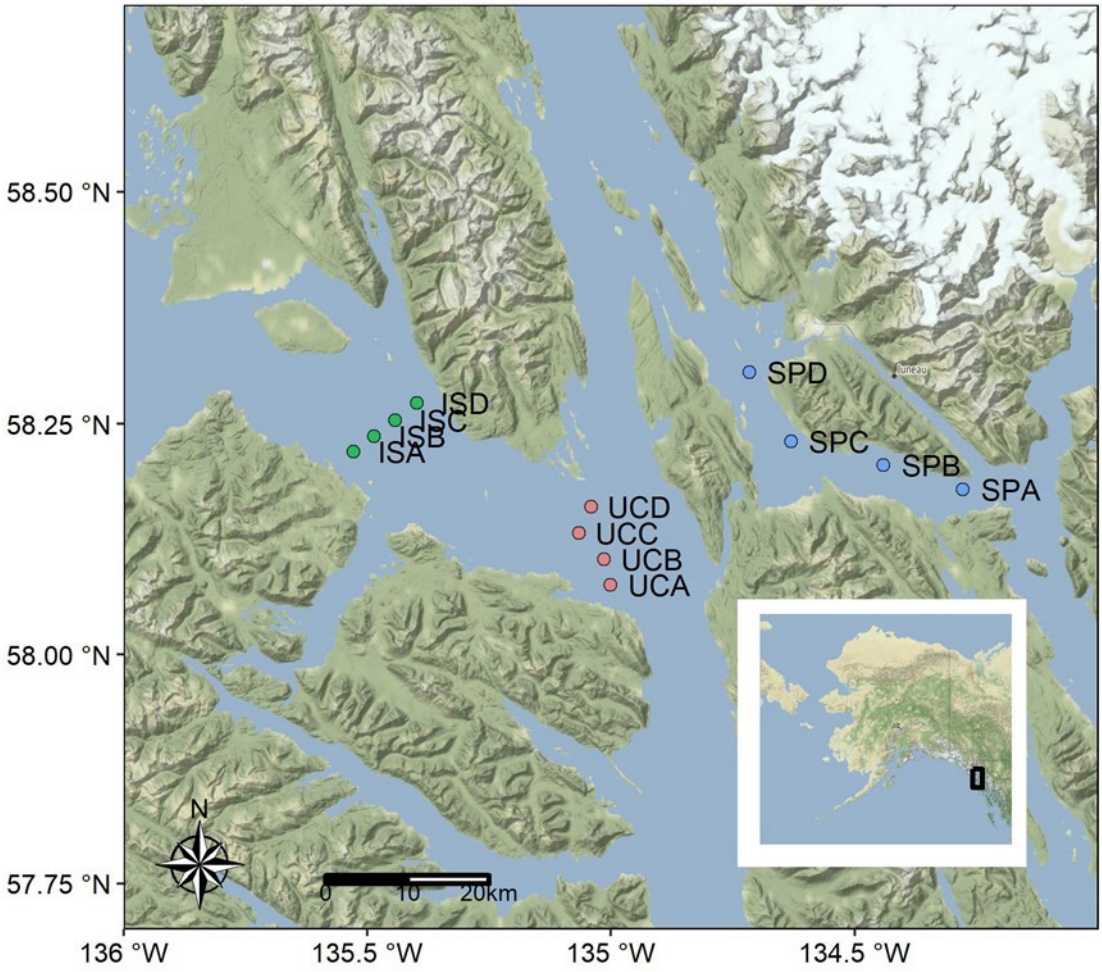
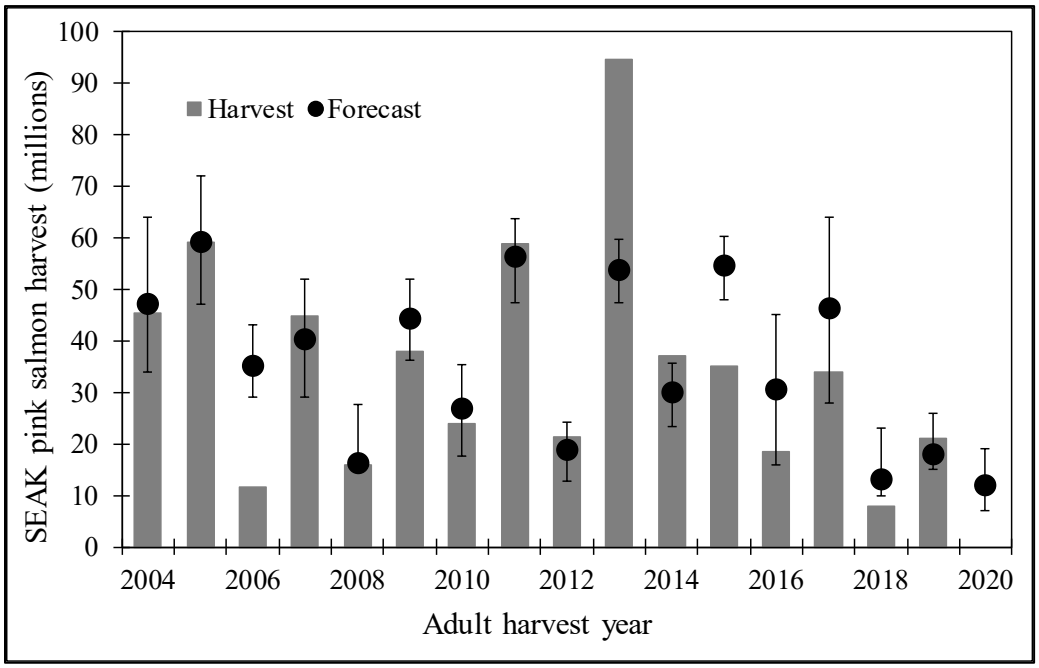


Figure 2. Annual harvests of pink salmon in SEAK compared to the actual preseason harvest forecasts, 2004–2020. The error bars represent the 80% confidence intervals of the forecasts.



TABLES

Table 1. Number and types of sampling gear deployed during the Southeast Alaska Coastal Monitoring Survey, 2019.

Dates (days)	Vessel	Habitat	Stations	Data Collection Type			
				Rope trawl[1]	CTD[2]	Bongo[3]	Chlorophyll[4]
06/01 (1)	R/V *Sashin*	Strait	8	0	8	4	8
06/19-06/23 (5)	R/V *Medeia*	Inshore	4	8	4	2	4
		Strait	8	16	8	4	8
07/26-07/30 (5)	R/V *Medeia*	Inshore	4	8	4	2	4
		Strait	8	16	8	4	8
08/20-08/24 (5)	R/V *Medeia*	Inshore	4	8	4	2	4
		Strait	8	16	8	4	8
		Total	44	72	44	22	44

[1] 20-min hauls (Strait habitat) 60-min hauls (Inshore habitat) with Nordic 264 surface trawl.

[2] To 200m or within 20m of the bottom.

[3] 60-cm frame, 505- & 333-µm mesh, oblique tows down to & up from 200m or within 20m of bottom.

[4] chlorophyll are from surface seawater samples.

Table 2. Project NF-2019-I-11 budget expenditures by line item, including amount projected, amount spent (including projected spending through Juneau 30, 2021), the amount and percent variance, and a short explanation for variances greater than 10% of the projected spending.

Line item	Projected	Spent	Variance	% Variance	Comments
Subcontractors & consultants					
Technician support, laboratory	$11,024	$11,224	**($200)**	2%	A NOAA internal contracting fee of 0.3k code 77-00 was accessed to our tech support contract.
Otolith/water sample processing	$6,000	$6,000	$0	0%	
Total subcontractor & consultants	**$17,024**	**$17,224**	**($200)**	**1%**	
Site/project costs					
Travel	$9,000	$2,000	**$7,000**	-78%	Due to COVID, 7K in travel will be returned to Northern Fund
Cruise and laboratory supplies	$8,752	$7,400	**$1,352**	-15%	The rest of these funds will be spent to resupply survey supplies used in 2019
Work & safety gear	$1,315	$1,000	**$315**	-24%	The rest of these funds will be spent to resupply survey supplies used in 2019
CTD calibration, trawl repairs and shipping	$7,000	$100	**$6900**	-99%	Due to COVID, CTD Calibration and trawl repair will be completed spring 2021
Oceanographic Winch annual maintenance	$5,000	$0	**$5000**	-100%	Due to COVID, annual winch repair and maintenance will be completed spring 2021
Total site/project costs	**$31,067**	**$10,500**	**$20,567**	**-66%**	
Total project costs	**$48,091**	**$27,724**	**$20,367**	**-42%**	