

## **Project Title: AFSC Longline Survey and Sablefish Logbook Program**

### **Alaska Fisheries Science Center**

#### **Principal Investigators:**

Chris Lunsford, Pat Malecha, Cara Rodgveller, AFSC, Auke Bay Laboratories, Juneau, AK

#### **Industry Co-Principal Investigators:**

*Petersburg Vessel Owners Association (PVOA):* A diverse group of over 100 commercial fishermen and businesses based in Alaska. Members provide millions of meals to the public annually by participating in a variety of fisheries statewide with our foremost interest being the commercial longline fisheries managed by the North Pacific Fishery Management Council.

*Alaska Longline Fishermen's Association (ALFA):* A non-profit association of independent commercial longline vessel owners and crewmembers who are committed to continuing the sustainable harvest of sablefish, halibut, and groundfish, while supporting healthy marine ecosystems and strong coastal communities through resource stewardship and participation in federal, state, and local forums.

*Fishing Vessel Owners Association (FVOA):* A trade association of longline vessel operators formed in 1914. Its mission is to promote safety at sea, ensure competitive pricing, and promote habitat-friendly gear with minimum bycatch.

*Southeast Alaska Fishermen's Alliance (SEAFa):* A multi-gear, non-profit fishing organization representing our 275+ members involved in the salmon, crab, shrimp and longline fisheries of Southeast Alaska and Gulf of Alaska.

*Deep Sea Fishermen's Union of the Pacific:* An independent union and the oldest organization of crewmen and skippers in the North Pacific. The Union has a distinguished, positive and progressive history as well as an unbroken series of accomplishments on behalf of working fishermen.

**Background and Justification:** The sablefish fishery in Alaska is a \$130 million dollar NOAA spotlight catch share fishery. It is managed through an Individual Fishing Quota (IFQ) system, which has led to increased involvement by industry stakeholders in sablefish management. In order to produce an annual stock assessment for sablefish in Alaska, the National Marine Fisheries Service (NMFS) depends on two important projects cooperatively executed by the Alaska Fisheries Science Center (AFSC), the International Pacific Halibut Commission (IPHC), and longline industry stakeholders. These projects are the annual domestic longline survey and the sablefish logbook program. The longline survey determines; 1) the relative abundance and size composition of commercially important groundfish species, 2) migration patterns of sablefish and other groundfish, and 3) sablefish age compositions from otolith collections. The sablefish logbook program provides the majority of fishery data used in the sablefish stock assessment. A large segment of the sablefish fishery is not required to carry observers; therefore the sablefish logbook program fills a vast data gap and provides fishery data throughout the year.

*Longline Survey:* Since 1978, the AFSC has conducted an annual longline survey in Alaska waters. The survey samples groundfish habitat throughout the upper continental slope and select gullies of the Gulf of Alaska, as well as the eastern Bering Sea (in odd years) and the Aleutian Islands (in even years). The survey includes habitats and depths not well sampled by trawl surveys and provides data about many important groundfish species. Information collected during this survey is critical to conducting stock assessments of major groundfish species in Alaska including, sablefish, Greenland turbot, and roughey rockfish. A novel aspect of the longline survey is that the charter vessel retains most of the catch after the scientific data are recorded. The proceeds from the sale of the catch are retained by the survey vessel in exchange for no-cost charter time granted to the AFSC to perform the survey. This cost-recovery arrangement is therefore beneficial to the government and to the fishing vessel since it pays for vessel operations, estimated at approximately \$1 million, and provides additional working opportunities for potential vessels. Requisite agency costs not included in vessel operations, such as staff overtime, travel, and supplies, are requested in this proposal.

*Sablefish Logbook Program:* Sablefish logbooks make up the majority of fishery catch data in the stock assessment. Since 1997, AFSC scientists, in cooperation with Alaska's longline industry, have been conducting a sablefish logbook program that documents sablefish fishery catch rates. In the mid-1990's there was strong industry support to use fishery data in the sablefish stock assessment to supplement data collected by surveys and fishery observers. Since 2000, the North Pacific Fishery Management Council (NPFMC) has endorsed the use of sablefish logbook fishery data as an index of abundance in the stock assessment model and directs stock assessment authors to use fishery catch rates for determining the apportionment of catch by management area.

Observer coverage in the sablefish fishery is 100% for vessels over 125 ft, only 30% for vessels between 60 and 125 feet, and there is no observer requirement for vessels under 60 ft. However, the majority of vessels that participate in the sablefish fishery are less than 60ft. Therefore, much of the sablefish fishery is unobserved. The logbook program provides essential fishery data by requiring logs for all vessels over 60 ft and requests voluntary logs for unobserved vessels less than 60 ft.

Unfortunately, NMFS does not have a dockside program to collect logbooks and verify data. To facilitate collection of logbooks, AFSC scientists have partnered with the IPHC since 2004 for logbook collection and data entry. The IPHC has a long-standing dockside logbook collection program and has developed a positive relationship with the fleet. Using the existing program rather than administering a program of their own, NMFS realizes a great cost savings, gains the trust of fishermen through the use of an established dockside sampling program, and ensures high data quality. Without dockside collection, logbooks would be submitted directly to NMFS Enforcement. Through past experience, we have learned that they are difficult to interpret because of data omissions or misinterpretations which could be clarified by dock-side interviews. In 2004 the AFSC began partnering with the IPHC for logbook collections. Since then, there has been a large increase in volunteer logbook submissions due to the IPHC's positive reputation with the fleet. Now about 69% of all logbooks are voluntarily submitted by vessels under 60 ft. Additionally, dockside samplers are there to answer questions and concerns that the industry may have about the use of their data. AFSC staff annually train IPHC dock samplers how to answer

many of these questions, which helps to promote acceptance of the science behind the stock assessment. Logbook data are now much more extensive than observer data in almost every geographic management area in Alaska (~4 times the amount of data).

### **Methodology:**

*Longline Survey:* In 2013, the eastern Bering Sea and the Gulf of Alaska will be sampled by the AFSC longline survey. Survey operations will be conducted using a chartered U.S. longline fishing vessel. The charter will begin on May 25 and end on August 28. A total of 86 stations will be sampled. The charter period is divided into seven legs approximately two weeks in duration. Two NMFS scientists will participate during each leg as well as two fishery observers, provided by the vessel. At the conclusion of the survey, data will be available to stock assessment authors and to the general public via online databases.

*Sablefish Logbook Program:* We propose to continue contracting with the IPHC to collect sablefish logbooks at all major ports in Alaska during the entire IFQ season, which coincides with the Pacific halibut season (~March 1-Nov. 18). In addition to collection, IPHC samplers will continue to monitor data quality with dock-side interviews, promote sablefish management through direct interactions with the fishermen, enter the edited data into a database, and change the database as needed to adapt to new data needs. The IPHC requires that they enter the data to protect confidentiality of fishery records they handle. Data will be used in the sablefish stock assessment as an index of abundance and for apportionment of the quota to different geographic areas.

### **Linkage to MSRA priority areas:**

*Longline Survey:* The longline survey annually charters a longline fishing vessel to conduct the survey. The charter is awarded on a competitive basis and because a fishery vessel is directly involved with the survey, it establishes a connection and trust for the science supporting groundfish stock assessments by the fleet. The primary objective of the survey is to provide critical information for stock assessments. Additionally, the longline survey has a long history of collaboration on conservation projects including deep sea coral identification, sea bird avoidance, and whale/fishery interactions. This work directly relates to the MSRA priority of “collecting data to improve, supplement, or enhance stock assessments, including the use of fishing vessels or acoustic or other marine technology (Section 318(c)(i))” and MSRA Section 408 (a)(4) which requires the agency “to conduct research, including cooperative research with fishing industry participants, on deep sea corals and related species, and on survey methods.”

*Sablefish Logbook Program:* The sablefish logbook program is a cooperative partnership between the sablefish fishing industry, the IPHC, and the AFSC. The collection and use of fishery data in the stock assessment has been requested by industry and increases the acceptance of the science by stakeholders. The co-principal investigators of this project represent a large proportion of vessel owners and sablefish fishermen in Alaska. These groups have and will continue to promote the logbook program within their organizations and to the NPFMC by encouraging their members to submit logbooks to dockside samplers, and interact closely with the principal investigators to ensure a successful cooperative relationship. They also support the longline survey by encouraging their members to work closely with the survey vessel and avoid interactions with survey operations. The data collected is used directly in the Alaska sablefish

stock assessment and since 2000, the NPFMC has directed stock assessment authors to use fishery data for apportionment of catch by management area. This work directly relates to the MSRA priority of “collecting data to improve, supplement, or enhance stock assessments, including the use of fishing vessels or acoustic or other marine technology (Section 318(c)(i)).”

**National Applicability/Implementation that cuts across multiple regions:** The sablefish fishery is one of NOAA’s spotlight catch share fisheries. The longline survey and the sablefish logbook program represent two critical data sources for the sablefish stock assessment and management of a prominent catch share fishery. These two projects contribute to the sustainability and successful management of the sablefish fishery in Alaska, and ultimately achieve the goals of the NOAA catch share policy. Implementing a foundation for successful management of a catch share fishery is applicable to all regions and can be useful on an agency-wide level. The novel implementation of a cost-recovery charter by the longline survey is an exemplary demonstration of cooperative research that benefits both the government and industry and serves as a model for all regions. Furthermore, utilization of the existing IPHC logbook port sampling program provides a unique opportunity to collect high quality fishery data at low cost, which is a challenge for many fisheries across all regions.

**Outreach and education:** Communicating the science behind management decisions is important for cooperative research to succeed. In 2010 AFSC scientists began providing longline survey results to the general public via an online database residing on the AFSC website: ([http://www.afsc.noaa.gov/abl/mesa/mesa\\_sfs\\_lsd.htm](http://www.afsc.noaa.gov/abl/mesa/mesa_sfs_lsd.htm)). In 2011, AFSC scientists provided detailed database functions to stock assessment authors through an online database managed by the Pacific States Marine Fisheries Commission. These two online data sources provide up-to-date information on all longline survey catch data. In 2009, AFSC assessment staff began meeting annually with sablefish industry association members to discuss the longline survey, the sablefish logbook program, and the sablefish stock assessment. In 2012, AFSC scientists met with industry representatives in Seattle, Sitka, Petersburg, Ketchikan, and Juneau to discuss stock status, ongoing research, and to answer questions. There continues to be strong industry support for these meetings from the co-investigators of this project. Objectives of this effort are to meet annually with multiple associations in both Alaska and Washington.

**Qualifications of Investigators:** Principal investigators for the longline survey are Chris Lunsford and Pat Malecha. Cara Rodgveller is the principal investigator for the sablefish logbook program. All three principal investigators are NOAA employees at the AFSC, Auke Bay Laboratories, Juneau, AK. Please see attached CVs.

**Detailed Budget:**

**Personnel:**

NMFS Staff overtime for longline survey participation: \$47,000

**Fringe Benefits:**

None

**Travel:**

NMFS staff travel for survey participation: \$29,000

NMFS staff travel for participation in regional Industry outreach meetings: \$ 4,000

NMFS staff travel for logbook sampler training: \$ 2,000

**Equipment:**

Survey sampling equipment	\$10,000
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**Supplies:**

Supplies to support tagging, survey operations, sample collection, and survey transportation/shipping.	\$25,000
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**Contractual:**

Contract with IPHC to collect, edit, keypunch logbooks.	\$73,000
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*Justification: The IPHC has an existing port sampling program to collect logbooks. Utilizing this existing program represents a great cost savings.*

Contract to maintain longline survey database and at sea data collection.	\$20,000
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*Justification: ABL has no database programmers on staff. In order to provide survey data to stock assessment authors and the public, database maintenance is required.*

Contract to build 400 skates of longline gear to specifications of survey. Gear is provided by the Government through the longline survey vessel contract.	\$16,500
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*Justification: Longline gear must be built to exact specifications to ensure consistency of the survey time series. An experienced independent contractor is required to build this gear as no Government resources are available for this.*

**Other:**

None

<b>Total Direct Charges:</b>	<b>\$226,500</b>
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**Indirect Charges:**

None

<b>Totals:</b>	<b>\$226,500</b>
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**Leveraged Sources of Funding:**

- 1) Vessel charter costs for a 95 day charter to conduct a longline survey in the Gulf of Alaska and Bering Sea. Charter costs are offset by proceeds of selling the catch (approx. \$950,000).
- 2) Salaries for 2.55 Full Time Equivalent (FTE) permanent NMFS employees and 0.25 FTE term NMFS employees to administer longline survey contract, oversee survey operations, and staff survey operations (\$365,100).
- 3) Salary for 0.20 FTE permanent employee to administer and oversee sablefish logbook program (\$32,600).
- 4) Industry partner costs associated with printing and distributing logbooks to association members (\$7,500).

# CURRICULUM VITAE

## Cara Rodgveller

### Contact

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Alaska Fisheries Science Center, Auke Bay Laboratories  
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Juneau, Alaska 99801  
Tel. (907) 789-6052, e-mail: cara.rodgveller@noaa.gov

### Education

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M.S., Fishery Management, University of Alaska Fairbanks, Juneau School of Fisheries and Ocean Sciences, 2004.  
B.S., Wildlife and Fisheries Science, University of Arizona, 2001.

### Work History

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2006-present: Fishery Research Biologist, National Marine Fisheries Service, Auke Bay Lab., Juneau, AK  
2004-2006: Fishery Biologist Contractor, National Marine Fisheries Service, Auke Bay Lab., Juneau, AK  
2001-2004: Graduate Research Assistant, University of Alaska, Fairbanks

### Relevant experience

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- 2005-present: worked with logbook collection contractor to obtain quality data
- 2006-present: analyzed sablefish logbook and observer fishery data and coauthored the sablefish stock assessment
- 2009-present: cooperatively developed database and primary data steward of the AFSC Alaska groundfish longline survey database
- 2004-present: participated on fishery research surveys since 2004

### Publications

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Coauthor of the Alaska sablefish stock assessment 2006-present

Coauthor of the Alaska shark and grenadier stock assessments 2008-present

D. M. Clausen, and **C. J. Rodgveller**. In prep. Deep-water longline experimental survey for giant grenadier and sablefish in the western Gulf of Alaska. NOAA Tech. Memo.

Stachura, M. M, C. R. Lunsford, **C. J. Rodgveller**, and J. Heifetz. 2012. Estimation of discard mortality of sablefish (*Anoplopoma fimbria*) in Alaska longline fisheries. Fishery Bulletin 110:271-279.

**Rodgveller, C. J.,** C. R. Lunsford, J. T. Fujioka. 2012. Effects of maternal age and size on embryonic energy reserves, development timing, and fecundity in quillback rockfish (*Sebastes maliger*). Fishery Bulletin 110:35-45.

**Rodgveller, C. J.,** M. F. Sigler, D. H. Hanselman, and D. H. Ito. 2011. Sampling efficiency of longlines for shortraker and rougheye rockfish using observations from a manned submersible. Marine and Coastal Fisheries 3(1):1-9.

**Rodgveller, C. J.,** D. M. Clausen, J. Nagler, and C. Hutchinson. 2010. Reproductive characteristics and mortality of female giant grenadiers in the Northern Pacific Ocean. Marine and Coastal Fisheries 2(1):73-82.

**Rodgveller, C. J.,** C. R. Lunsford, J. H. Fujioka. 2008. Evidence of longline survey hook competition in Alaska. Fishery Bulletin 106:364-374.

Sewell, F., and **C. J. Rodgveller.** 2007. Changes in body composition and fatty acid profile during quillback rockfish (*Sebastes Maliger*) embryogenesis. Fishery Bulletin 107:207-220.

**Rodgveller, C. J.,** J. H. Moss, and A. M. Feldmann. 2007 The influence of sampling location, timing, and hatching origin on the prediction of energy density on juvenile pink salmon. NOAA Tech. Memo. NMFS-AFSC-170. 27 p.

**Rodgveller, C. J.,** W. W. Smoker, A. K. Gray, J. E. Joyce, and A. J. Gharrett. 2005. Effects of inbreeding and family origin on variation of size of Chinook salmon *Oncorhynchus tshawytscha* fry. Alaska Fishery Research Bulletin 11(2):73-81.

## CURRICULUM VITAE

# Patrick William Malecha

### PERSONAL

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Address: Alaska Fisheries Science Center, Auke Bay Laboratories  
National Marine Fisheries Service (NMFS)  
National Oceanic and Atmospheric Administration (NOAA)  
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Juneau, AK 99801

### EDUCATIONAL BACKGROUND

M.S. University of Alaska Fairbanks, Fisheries, 2002

B.S. University of Minnesota, Fisheries and Wildlife, 1993

North Dakota State University, Fisheries and Wildlife, 1989

### PROFESSIONAL EXPERIENCE

Research Fishery Biologist - NMFS, Auke Bay Laboratory, January 2001-present

Research Analyst III - Commercial Fisheries Entry Commission, December 1999-January 2001

Contract Biologist - NMFS, Auke Bay Laboratory, June 1999- November 1999

Research Fishery Biologist - NMFS, Auke Bay Laboratory, August 1998-September 1998

Research Fellow - University of Alaska Fairbanks, July 1997-June 1999

Resident Caretaker - University of Alaska Fairbanks, Kowee Creek Hatchery, Aug. 1996-June 1998

Graduate Research Assistant - University of Alaska Fairbanks, August 1995-June 1996

Research Intern - Marine Bioservices, June 1993-August 1993

Research Intern - Minnesota Aquafarms, June 1991-August 1991

### PUBLICATIONS

Malecha, P. W. and R. P. Stone. 2009. Response of the sea whip *Halipteris willemoesi* to simulated trawl disturbance and its vulnerability to subsequent predation. *Mar. Ecol. Prog. Ser.* 388:197-206.

Geiger, H. J., I. Wang, P. Malecha, K. Hebert, W. W. Smoker, and A. J. Gharrett. 2007. What causes variability in pink salmon family size? *Trans. Am. Fish. Soc.* 136:1688-1698.

Malecha, P. W., D. H. Hanselman, and J. Heifetz. 2007. Growth and mortality of rockfishes (Scorpaenidae) from Alaska waters. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-172, 61 p.

Malecha, P. W., R. P. Stone, and J. Heifetz. 2005. Living substrate in Alaska: distribution, abundance, and species associations. Pages 289-299 in P. W. Barnes and J. P. Thomas,

editors. Benthic habitats and the effects of Fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

Heifetz, J., B. L. Wing, R. P. Stone, P. W. Malecha, and D. L. Courtney. 2005. Corals of the Aleutian Islands. Fisheries Oceanography 14 (Supplement 1), 131-138.

Stone, R. P., M. M. Masuda, and P.W. Malecha. 2005. Effects of bottom trawling on soft-sediment epibenthic communities in the Gulf of Alaska. Pages 461-475 in P. W. Barnes and J. P. Thomas, editors. Benthic habitats and the effects of Fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

Malecha, P. W. and R. P. Stone. 2003. Benthic currents at three nearshore sites near Point Lena and Auke Bay, Alaska. Alaska Fisheries Science Center, Auke Bay Laboratory, National Marine Fisheries Service. AFSC Processed Report 2003-06, 39p.

Malecha, P. W. 2002. Survival and development of pink salmon (*Oncorhynchus gorbuscha*) embryos and fry as related to egg size and quantitative genetic variation. M.S. Thesis. University of Alaska Fairbanks.

Malecha, P. W. and K. Iverson. 2000. The Pacific cod fishery in Cook Inlet state waters. Commercial Fisheries Entry Commission, Juneau, Alaska, 99801. CFEC Briefing Report 00-4C, 43 p.

Malecha, P. W. 2000. Kodiak food and bait herring fishery. Commercial Fisheries Entry Commission, Juneau, Alaska, 99801. CFEC Briefing Report 00-2C, 29 p.

Malecha, P. W., A. Tingley, and K. Iverson. 2000. Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits, 1975 to 1999. Commercial Fisheries Entry Commission, Juneau, Alaska, 99801. CFEC Report 00-3N.

Thrower, F. P., J. E. Joyce, A. G. Celewycz, and P. W. Malecha. 2008. The potential importance of reservoirs in the Western United States for the recovery of endangered populations of anadromous steelhead. American Fisheries Society, Symposium 62:309-324.

Stone, R. P and P. W. Malecha. In preparation. Growth and recruitment of the shallow-water Alaskan gorgonian *Calcigorgia spiculifera*.

## **PRESENTATIONS**

Juvenile quillback rockfish habitat utilization. 15<sup>th</sup> Western Groundfish Conference. Santa Cruz, CA. 2008.

Sea whip (Order Pennatulacea) resiliency to simulated trawl disturbance. 2<sup>nd</sup> International Symposium on Deep-Sea Corals. Erlangen, Germany. 2003.

Living substrate in Alaska: distribution, abundance, and species associations. American Fisheries Society Symposium on Benthic habitats and the effects of Fishing. Tampa, FL. 2002.

**HONORS**

Stevan R. Phelps Award, American Fisheries Society, 2008

NOAA Administrator's Award, 2004

Rasmuson Fellowship, Rasmuson Fisheries Research Center, 1997

Phi Eta Sigma National Honor Society, 1989

## CURRICULUM VITAE

### Chris R. Lunsford

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#### Education:

M.S. University of Alaska Fairbanks, Fisheries Science, 1999  
B.S. Oregon State University, Marine Fisheries Science, 1993

#### Professional Experience:

Research Fishery Biologist – NMFS, Auke Bay Laboratories, June 1997 – present  
Graduate Research Assistant – University of Alaska Fairbanks, August 1994 – May 1997  
Fisheries Biologist – Alaska Department Fish and Game, January 1994 – August 1994  
Research Technician – Oregon State University, October 1992 – December 1993

**Present Position:** Fishery Research Biologist, National Marine Fisheries Service. Stock assessment work on sablefish and rockfish. Assessment author for age-structured model of dusky rockfish. Project coordinator for sablefish longline survey. Field support for surveys and research projects.

**Relevant Experience:** Stock assessment author for sablefish and dusky rockfish in Alaska since 1998. Member of North Pacific Fishery Management Council Plan Team since 2010. Project coordinator of longline survey since 2001. Participated in over 35 research cruises in Alaska since 1997.

#### Publications:

- Rodgveller, C. J., C. R. Lunsford, J. T. Fujioka. 2012. Effects of maternal age and size on embryonic energy reserves, development timing, and fecundity in quillback rockfish (*Sebastes maliger*). *Fishery Bulletin* 110:35-45.
- Strachura, M.M., C.R. Lunsford, C.J. Rodgveller, and J. Heifetz. 2012. Estimation of discard mortality of sablefish (*Anoplopoma fimbria*) in Alaska longline fisheries. *Fishery Bulletin* 110: 271-279.
- Lunsford, C. R., S. K. Shotwell, P.J. Hulson, and D. H. Hanselman. 2011. Assessment of dusky rockfish stocks in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 1009-1104. North Pacific Fishery Management Council, 605 W. 4th. Avenue, Suite 306, Anchorage, AK 99501.

- Hanselman, D. H., C. R. Lunsford, and C. J. Rodgveller. 2011. Assessment of the sablefish stock in Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 477-582. North Pacific Fishery Management Council, 605 W. 4th. Avenue, Suite 306, Anchorage, AK 99501.
- Rodgveller, C. J., C. R. Lunsford, and J. T. Fujioka. 2008. Evidence of hook competition in longline surveys. *Fish. Bull., U.S.* 106:364-374.
- Sigler, M. F., C. R. Lunsford, J. M. Straley, and J. B. Liddle. 2008. Sperm whale depredation of sablefish longline gear in the northeast Pacific Ocean. *Mar. Mammal Sci.* 24(1):16-27.
- Fujioka, J. T., C. R. Lunsford, J. Heifetz, and D. M. Clausen. 2007. Stratification by echosounder signal to improve trawl survey precision for Pacific ocean perch, p. 473-492. In J. Heifetz, J. DiCosimo, A. J. Gharrett, M. S. Love, V. M. O'Connell, and R. D. Stanley (editors), *Biology, Assessment, and Management of North Pacific Rockfishes*. University of Alaska Sea Grant Program Report No. AK-SG-07-01, University of Alaska, Fairbanks.
- Lunsford, C. R., L. Haldorson, J. T. Fujioka, and T. J. Quinn II. 2001. Distribution patterns and survey design considerations of Pacific ocean perch (*Sebastes alutus*) in the Gulf of Alaska. *Spatial Processes and Management of Marine Populations*, Alaska Sea Grant College Program. Lowell Wakefield Fisheries Symposium. Anchorage, AK., AK-SG-01-02.
- Sigler, M. F., and C. R. Lunsford. 2001. Effects of individual quotas on catching efficiency and spawning potential in the Alaska sablefish fishery. *Can. J. Fish. Aquat. Sci.* 58:1300-1312.