North Pacific Research Board
Gulf Project Semiannual Progress Report: Middle Trophic Level (MTL) Component

1. PROJECT INFORMATION

GOA IERP Project Number:	G82
Title:	Middle Trophic Level: Temporal and spatial axes of variability in the structure of Gulf of Alaska forage fish communities
Overall project duration	October 1, 2010 to January 31, 2015
Overall project funding	$1,858,400
Report period	December 1, 2011 to March 31, 2012
Report submission date	June 14, 2012
Lead Author of Report*	Olav A. Ormseth

Principal Investigator(s), Co-Principal Investigators and Recipient Organization(s):

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2. PROJECT OVERVIEW

a. Briefly (4-5 sentences) describe the core purpose of your project, and the underlying need for this research.

Forage fish link primary and secondary producers to upper trophic level (UTL) predators. The forage fish community includes small, fast-growing species such as capelin and sand lance, as well as juvenile stages of groundfishes (e.g. walleye pollock and Pacific cod). The MTL seeks to understand the ecosystem role of forage fishes as well as their predators, prey, and competitors by studying how forage fish communities and the GOA ecosystem varies over time (seasonally and annually) and through space (variation within regions and between regions). Sampling is being conducted in spring, summer, and fall of two years (2011 and 2013). The study area includes two main regions (eastern, comprising the outer coast of southeast Alaska, and western, comprising the east side of Kodiak Island and the southern coast of the Kenai Peninsula). Nearshore surveys are focusing on 5-6 sampling sites within each main region; offshore acoustic surveys throughout each region are being conducted aboard the UTL vessel; and diet and energetics studies are addressing relationships among species and the flow of energy among trophic levels. Oceanographic studies are being conducted aboard the nearshore surveys in collaboration with the LTL component. The MTL project is also contributing to the all-component retrospective analysis effort.

b. State the specific GOAIERP hypothesis or hypotheses that your project is addressing.

The MTL component is addressing all three of the overarching GOA IERP hypotheses:

1) The primary determinant of year-class strength for marine groundfishes in the GOA is early life survival. This is regulated in space and time by climate-driven variability in a biophysical gauntlet comprising offshore and nearshore habitat quality, larval and juvenile transport, and settlement into suitable demersal habitat.

2) The physical and biological mechanisms that determine annual survival of juvenile groundfishes and forage fishes differ in the eastern and western GOA regions.

3) Interactions among species (including predation and competition) are influenced by the abundance and distribution of individual species and by their habitat requirements, which vary with life stage and season.

c. List the specific objective(s) of your research project.

1) Provide a synoptic view of nearshore/offshore distribution and abundance (past and present) to gain a comprehensive understanding of how GOA forage communities are structured, how this structure changes in response to the environment, and the effects of this variability on prey availability for upper trophic level species.

2) Analyze habitat associations to determine how habitat needs influence the spatial overlap among species and resulting predation and competition.

3) Use analysis of stomach contents, stable isotopes, and fatty acids to infer diets and elucidate relationships among forage community members, lower trophic level prey, and upper trophic level predators.

4) Use proximate analysis to assess nutritional condition of community members and relate condition to spatial and diet overlaps among species.

3. PROGRESS SUMMARY

a. Provide a table showing the timeline and milestones for the current reporting period only.

	2011	*2012*		
	D	J	F	M
organization & analysis of inshore fish catch data	x	x	x	x
organization & analysis of inshore acoustics data	x	x	x	x
organization & analysis of offshore acoustics data	x	x	x	x
prep work for diet/energetics samples analysis			x	x
analysis of oceanography samples		x	x	x
collection of historical data	x	x	x	x

b. Describe report period progress.

Objectives 1 & 2

Research activities: nearshore surveys, offshore acoustics surveys, retrospective analysis

Progress:

- A relational database has been created to contain all of the fish catch, oceanography, and related data from the MTL fieldwork.
- All data has been checked for errors, and missing information (eg geographical position) has been filled in.
- Analysis of 2011 inshore fish catch data is underway.
- All inshore nutrient samples and most inshore chlorophyll samples have been analyzed.
- We have developed a plan for analyzing plankton samples and collecting ichthyoplankton data from the same samples. Samples have been shipped to UAF and will be analyzed during summer 2012.
- Acoustic data from inshore and offshore cruises is being processed and analyzed.
- We have developed collaboration with Beth Matta and Tom Helser at the AFSC to study otolith microchemistry in YOY Pacific cod. This will enhance our understanding of this species' distribution. The otoliths have been removed from our samples and are currently being prepared for analysis.
- Saffron cod samples obtained from the 2011 fieldwork are being used by AJ Gharrett to expand an ongoing study of saffron cod population structure.
- We are working with various members of the PWS long-term monitoring project to coordinate and standardize (to a certain extent) sampling efforts
- Along with investigators from other components, we are currently collecting and organizing historical data for the retrospective analyses. Greater detail is available in the separate progress report submitted by the retrospective component.

Objective 3

Research activities: analysis of stomach contents and tissues

Progress:

- Analysis of fatty acids has begun at Dalhousie University. Currently, samples from Kiliuda Bay in the summer are being processed. Subsequent analyses will depend on the outcome of this first batch of samples (eg among-sample variability will affect our final sample size and sampling design).
- Analysis of stable isotopes and of stomach contents is scheduled to begin during summer of 2012.
- We have developed collaboration with Mayumi Arimitsu (USGS Juneau) to combine efforts in looking at spatial patterns of stable isotopes in bays.

Objective 4

Research activities: proximate analysis of fish tissues

Progress:

- A sampling plan has been developed in conjunction with the UTL component. We are still working out some of the final details (eg the number of samples to analyze for

proximate composition vs. bomb calorimetry). The analyses are scheduled to begin in the summer of 2012.

c. Describe preliminary results.

Following are some preliminary results from the 2011 field research (figures are at the end of the report):

1) *Seasonal changes in species composition*: At all inshore sites, species composition changed with season (Figure 1). Preliminary analyses suggest that the composition changed more dramatically between spring and summer than between summer and fall.

2) *Spatial patterns of focal species (using rockfish as an example)*: We looked at patterns in the catches of unidentified rockfish YOY in the inshore and offshore fieldwork (Figure 2). The results suggest that the pattern was similar between inshore and offshore in the summer (ie much greater abundance in the eastern region), but different in the fall (ie the inshore abundance was more evenly split between the eastern and western regions, while the offshore abundance remained greater in the east).

3) *Length compositions*: Analysis of the length compositions for YOY rockfish (Figure 3) and herring (Figure 4) suggest the presence of multiple cohorts within a year in the GOA, and that the timing of these cohorts may vary between the eastern and western regions.

d. Describe integration activity.

Retrospective analysis: We are an integral part of the retrospective team that has formed to coordinate the analyses.

General: Overall, and specifically in preparation for the March 2012 PI meeting, we have pursued integration with other GOAIERP components on many fronts. Fish catch data were combined with UTL and LT data to show connectivity; we are working on combining the MTL, UTL, and LTL oceanography data; and we are working with the modelers to define spatial boundaries and determine the best way to integrate MTL data in the models.

Energetics: Our energetics work is directly integrated with the UTL bioenergetics work. In addition, many of our samples will be used to determine the quality of prey available to seabirds, providing a further link to UTL work.

Diet: Our diet work is being carried out in cooperation with UTL diet work and the needs of the modelers. We expect that this level of integration will only grow as the project proceeds.

e. Describe any concerns you may have about your project's progress.

We do not have any concerns about our progress. The retrospective work has been slowed somewhat due to Kim Rand (the researcher with primary responsibility for that aspect of the project) being out of the office on maternity leave, but we do not have any concerns about completing the retrospective work.

f. Poster and oral presentations at scientific conferences or seminars

- **Jamal Moss**, Sarah Hinckley, Russell Hopcroft, **Olav Ormseth**. The Gulf of Alaska Project: an Integrated Ecosystem Research Program. Alaska Marine Science Symposium, Anchorage AK, January 2012
- **Miriam Doyle**, Ann Matarese, **Olav Ormseth**, Jamal Moss, **John Horne**, **Alex DeRobertis**, Dave McGowan, **Buck Stockhausen**. Fish distribution & Abundance, GOAIERP PI meeting, Juneau, March 2012
- **Olav Ormseth,** Comparative studies in the GOAIERP, GOAIERP PI meeting, Juneau, March 2012
- Alex DeRobertis & Olav Ormseth, MTL Inshore Acoustics, poster, GOAIERP PI meeting, Juneau, March 2012
- Olav Ormseth & Kim Rand, MTL Oceanography, poster, GOAIERP PI meeting, Juneau, March 2012
- Kim Rand & Olav Ormseth, MTL purse seine catches – 2011, poster, GOAIERP PI meeting, Juneau, March 2012

g. Education and outreach

We have not conducted any formal outreach activities during this reporting period. However, our efforts at collaboration with researchers outside the GOAIERP have led to a greater awareness of and interest in the project. For example, our collaboration on stable isotope patterns with the USGS has raised the visibility of the GOAIERP within that agency.

4. PROGRESS STATUS

With the exception of the retrospective work, the MTL study has proceeded as originally expected. Analyses are proceeding on all fronts and it will be some time before we have enough data generated (e.g. from fatty acid or energy content analyses) to make any preliminary conclusions. We are simultaneously preparing for the 2013 field season. We have developed some valuable collaboration that will expand the utility and scope of the GOAIERP.

5. FUTURE WORKPLAN and DATA DELIVERY

Workplan

Note: We have included workplan dates that only include the next reporting period.

What	*Who*	*Start and end dates*
nearshore fish data analysis	Ormseth	4/1/12-11/30/12
nearshore acoustic data processing and analysis	DeRobertis	4/1/12-11/30/12
Stable isotope and fatty acid analysis	Budge/Wang	4/1/12-11/30/12
Energetics analysis	Vollenweider/Heinz	7/1/12-11/30/12
Analysis of plankton samples	Ormseth (Hopcroft/LTL)	7/1/12-11/30/12
offshore acoustic data processing and analysis	Horne/ McGowan/Barbee/Nomura	4/1/12-11/30/12
retrospective data collection and analysis	Ormseth	4/1/12-11/30/12

Data delivery.

GOAIERP Data Delivery Table		
Data type for delivery	Delivery Month & Year	Person sending data, with email address
Nearshore survey fish catch data	6/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore acoustics integrated backscatter	9/12	Alex DeRobertis (Alex.DeRobertis@noaa.gov)
Offshore acoustics integrated backscatter	9/12	John Horne (jhorne@u.washington.edu)
Nearshore CTD data	9/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore zooplankton data	12/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore chlorophyll data	6/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore nutrients data	6/12	Olav Ormseth (olav.ormseth@noaa.gov)

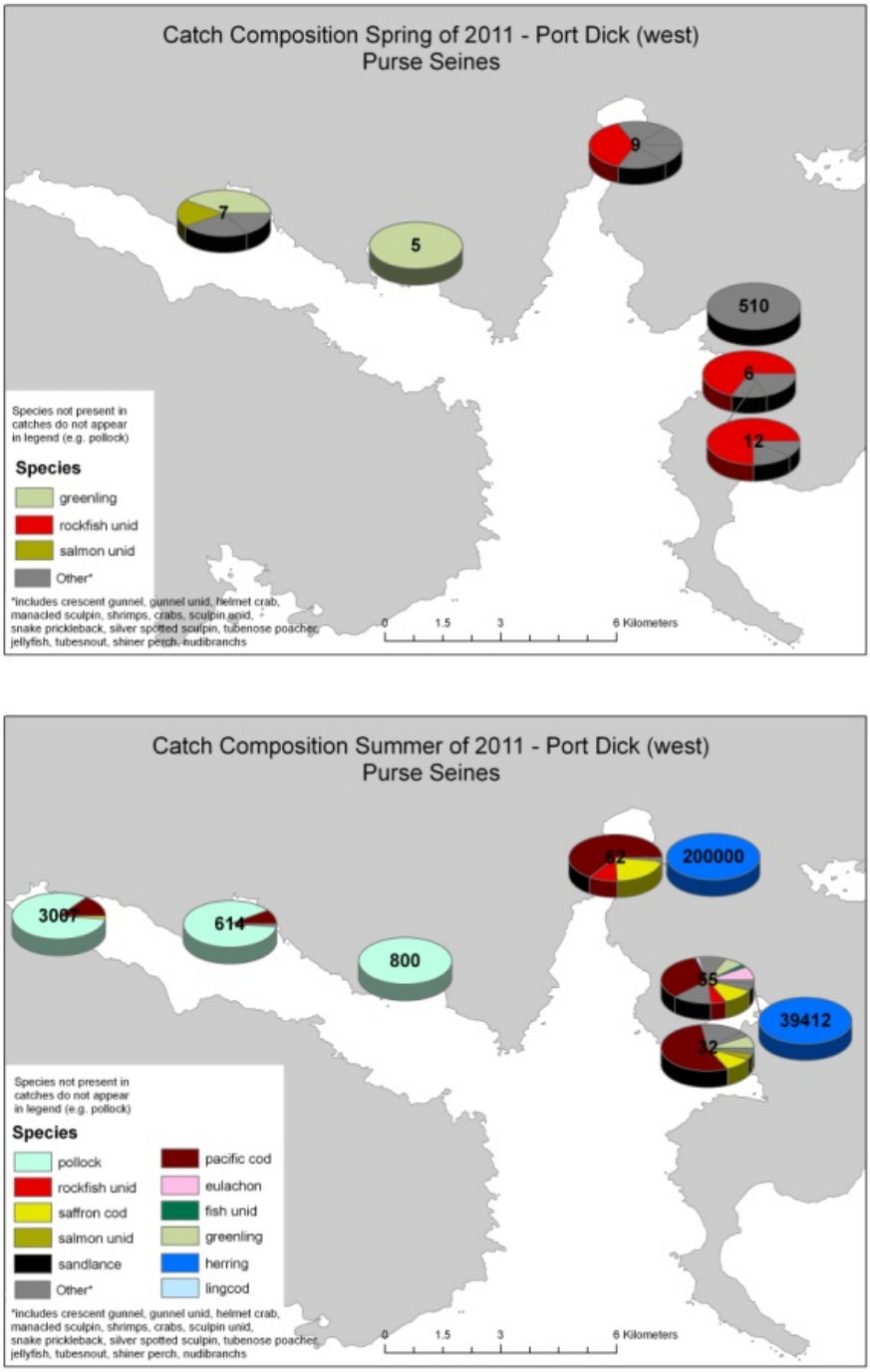

Figure 1. Species composition of purse seine catches in Port Dick, western GOA region. Top panel: spring, bottom panel: summer.

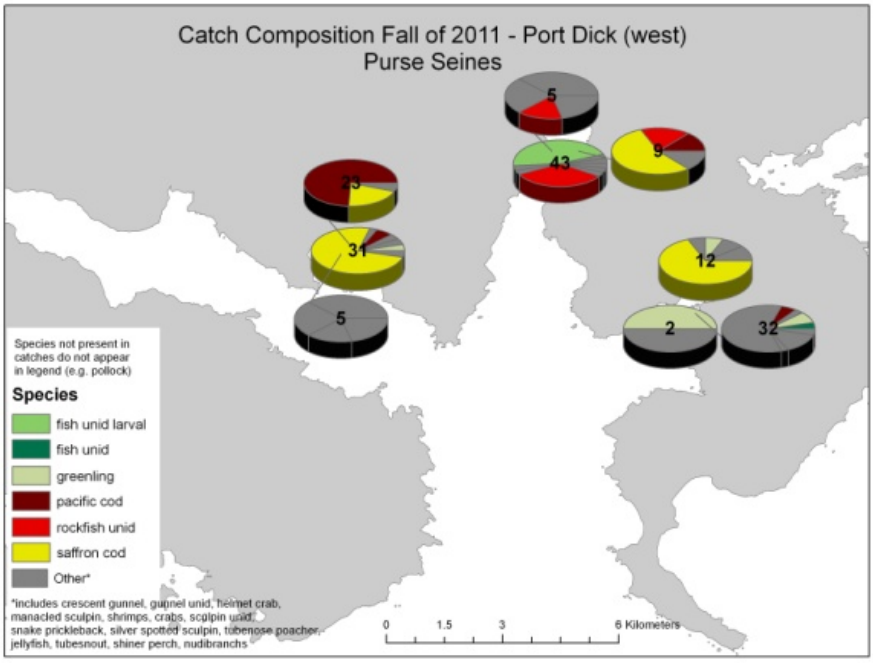

Figure 1 (cont.). Species composition of purse seine catches in Port Dick, western GOA region. Panel shows fall results.

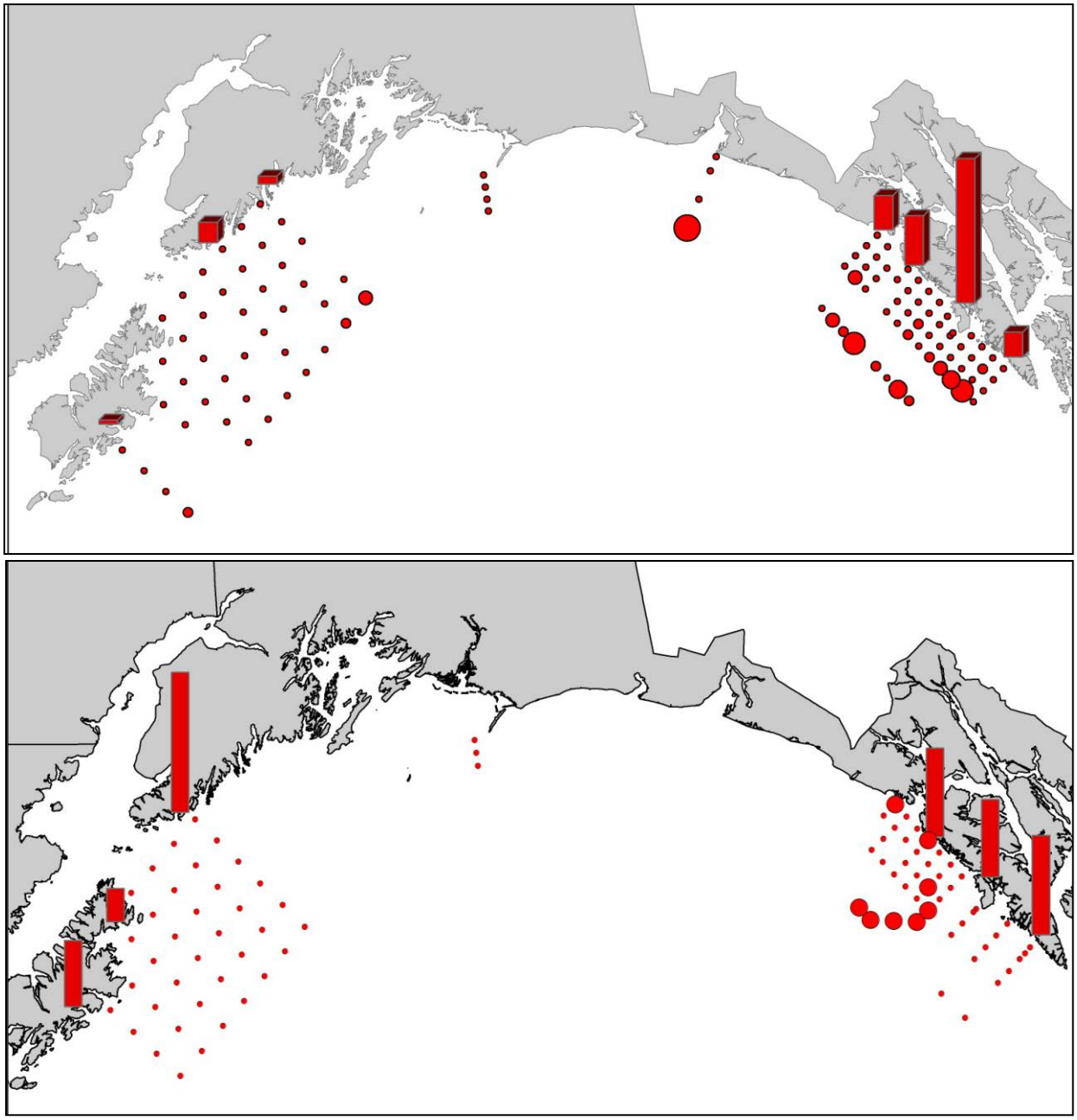

Figure 2. Patterns of abundance of YOY rockfish in inshore catches (red columns) and offshore catches (red circles). Height of column and size of circle indicate relative abundance within in each zone. Top panel: summer, bottom panel: fall.

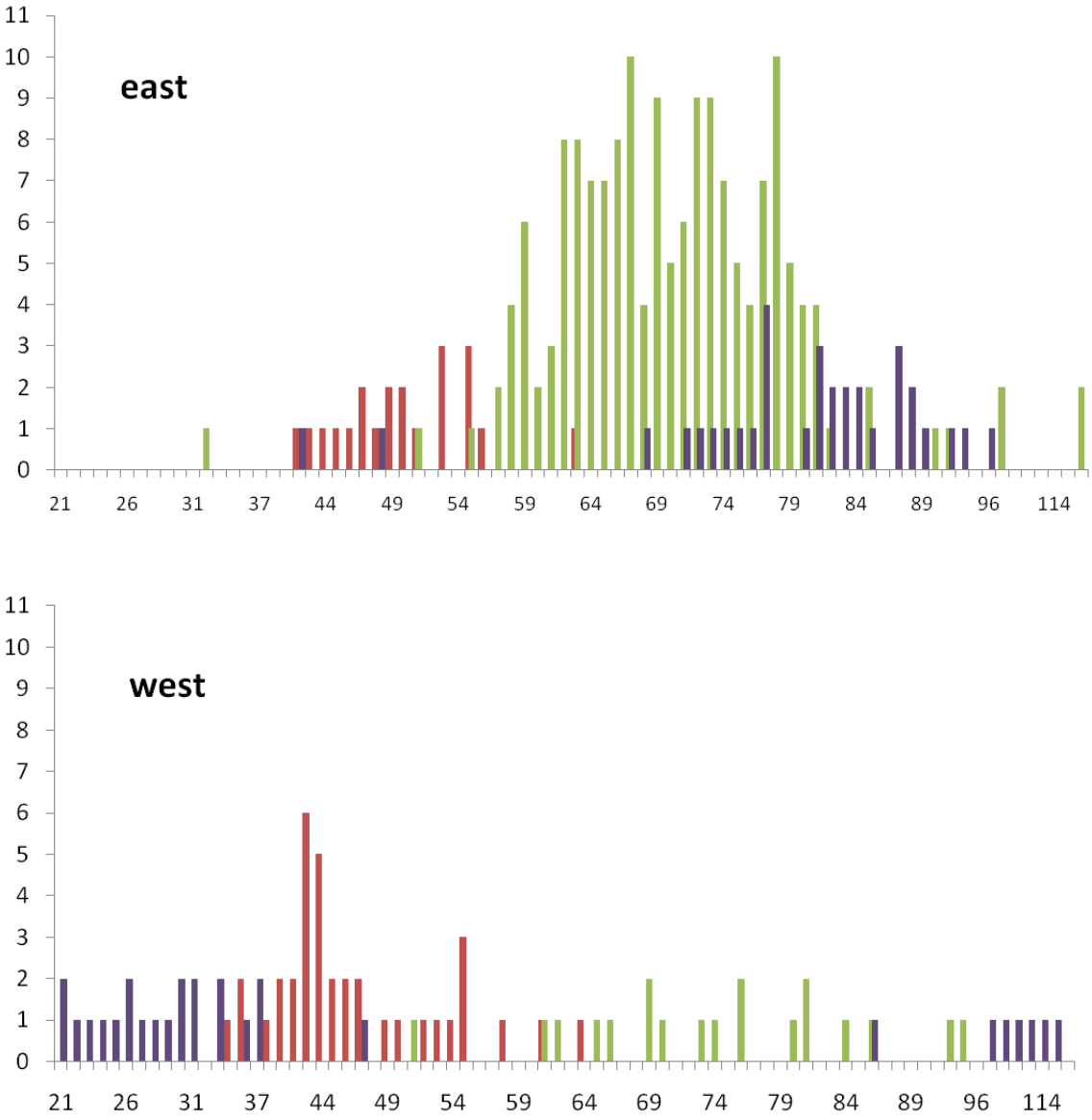

Figure 3. Length composition of YOY rockfish captured in spring (red), summer (green), and fall (purple). Top panel: eastern region, bottom panel: western region.

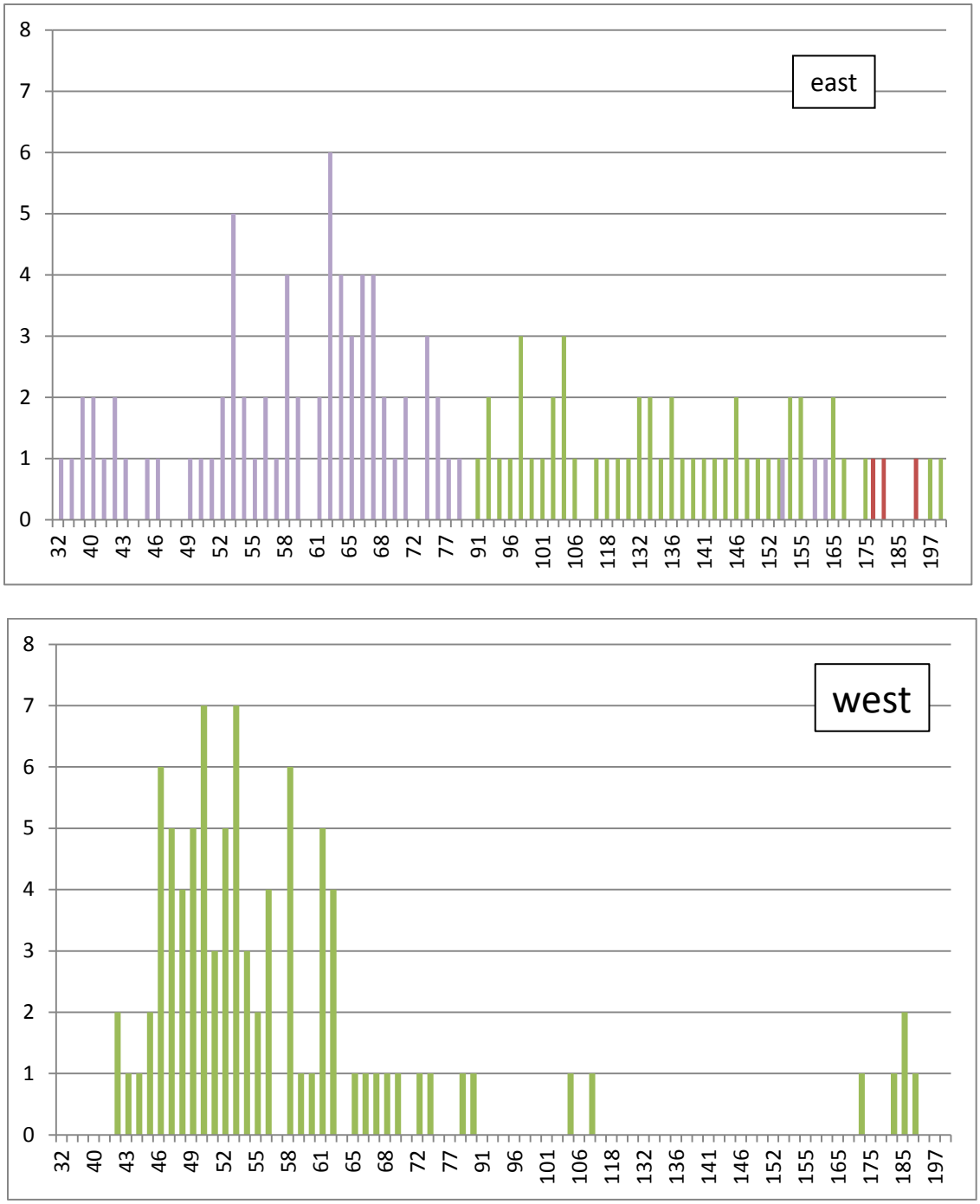

Figure 4. Length composition of Pacific herring captured in spring (red), summer (green), and fall (purple). Top panel: eastern region, bottom panel: western region.