

# Inshore Acoustic Surveys in the Eastern and Central Gulf of Alaska

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## Introduction:

A series of replicate (spring/summer/fall) acoustic surveys was conducted in 10 bays on the outer coast of Southeast Alaska and the Kodiak island/Kenai Peninsula area as part of the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP).

The goals of this ongoing work are to establish seasonal patterns of habitat use by forage fishes in inshore areas, make regional comparisons, and establish habitat associations.

## Methods:

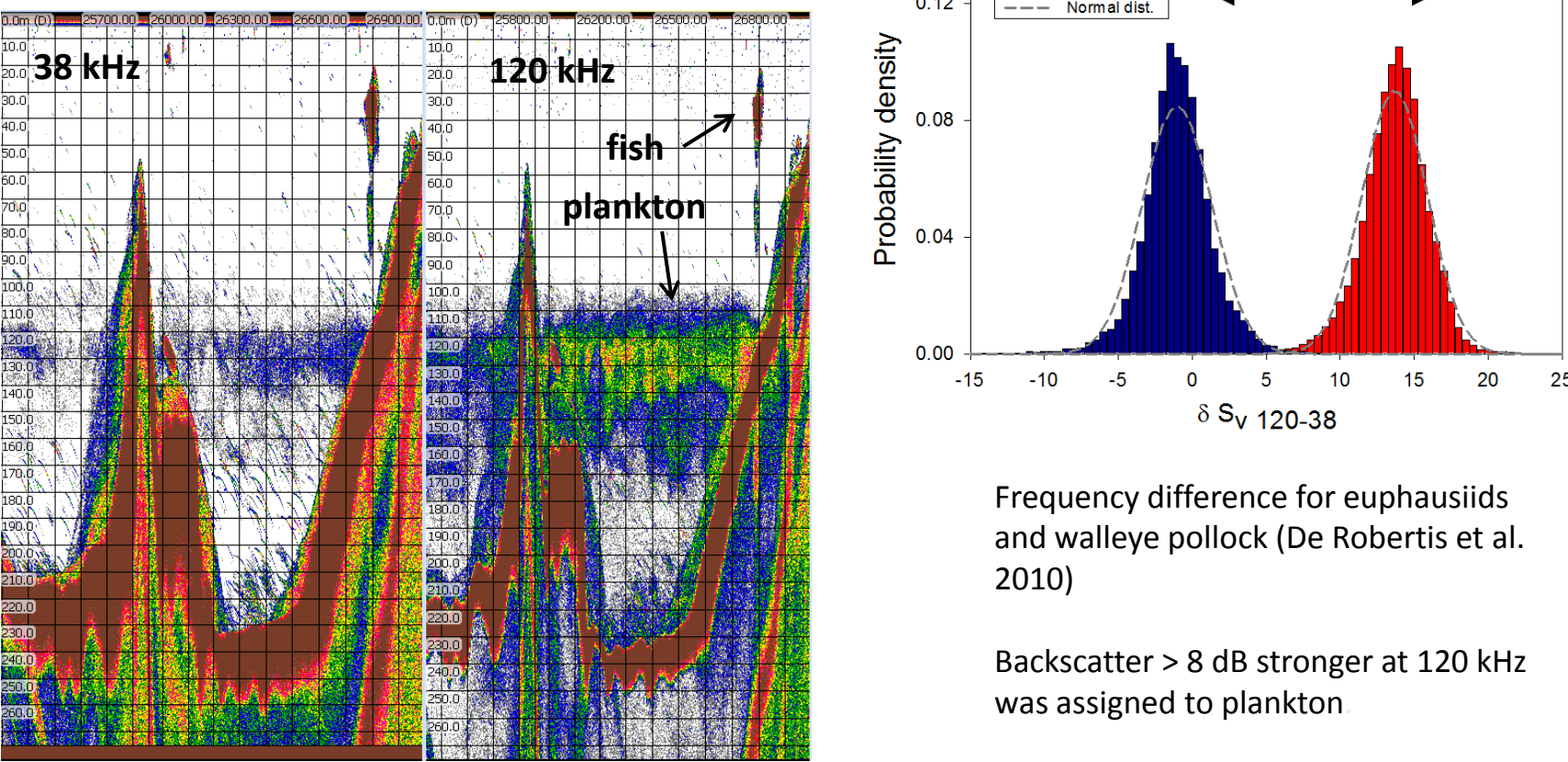
An acoustic survey was conducted in each bay using a 38/120 kHz echosounder deployed on a tow body from a 50-70' chartered vessel.

Efforts were made to identify acoustic scatters using jigs, a camera, a gillnet, and a small midwater trawl.

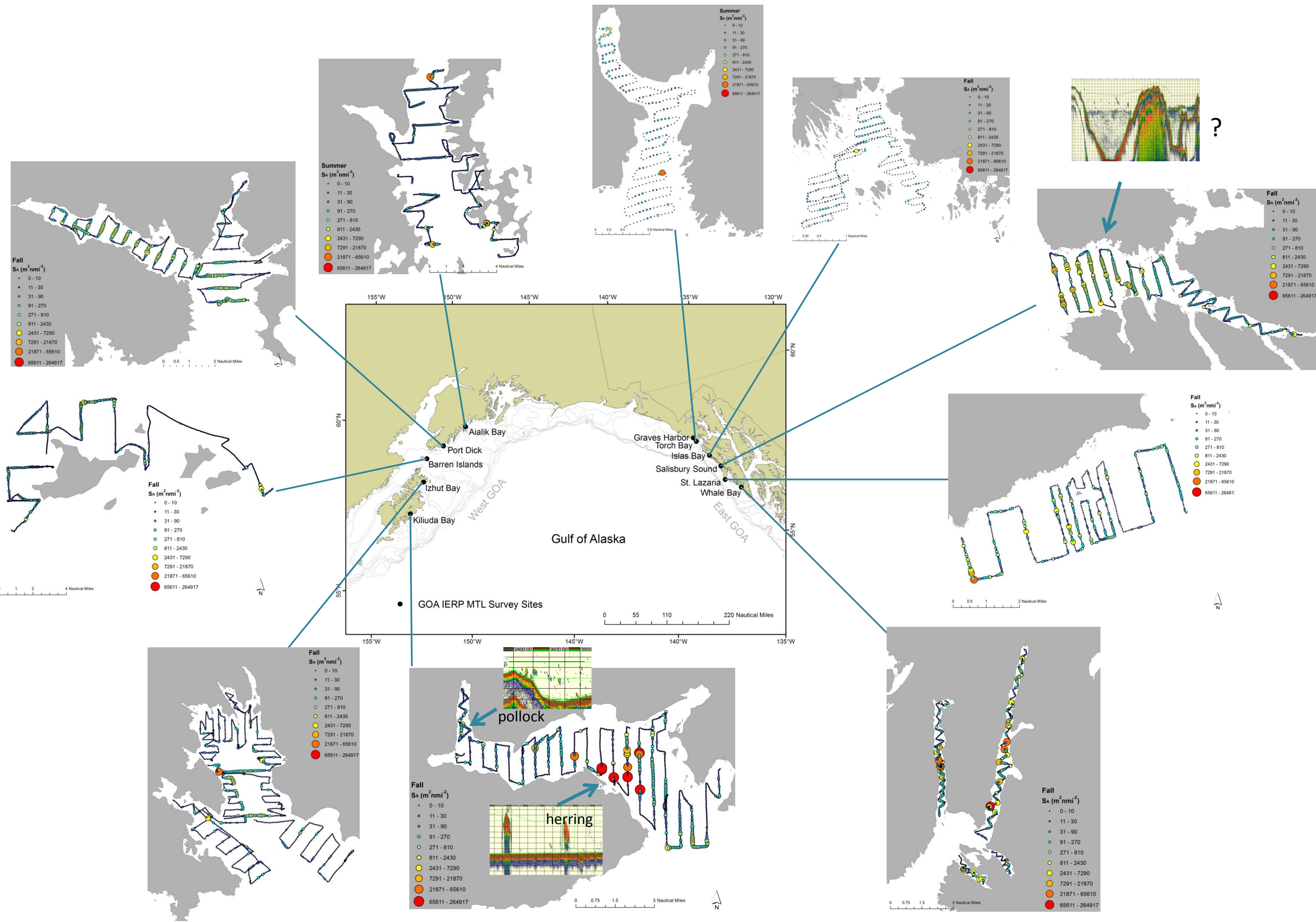
A dual-frequency technique was applied to classify backscatter as consistent with that from fish and zooplankton.

## Acoustic classification:

Backscatter from fish with swim bladders can be distinguished from zooplankton backscatter, as zooplankton exhibit much weaker backscatter at 38 kHz compared to 120 kHz.

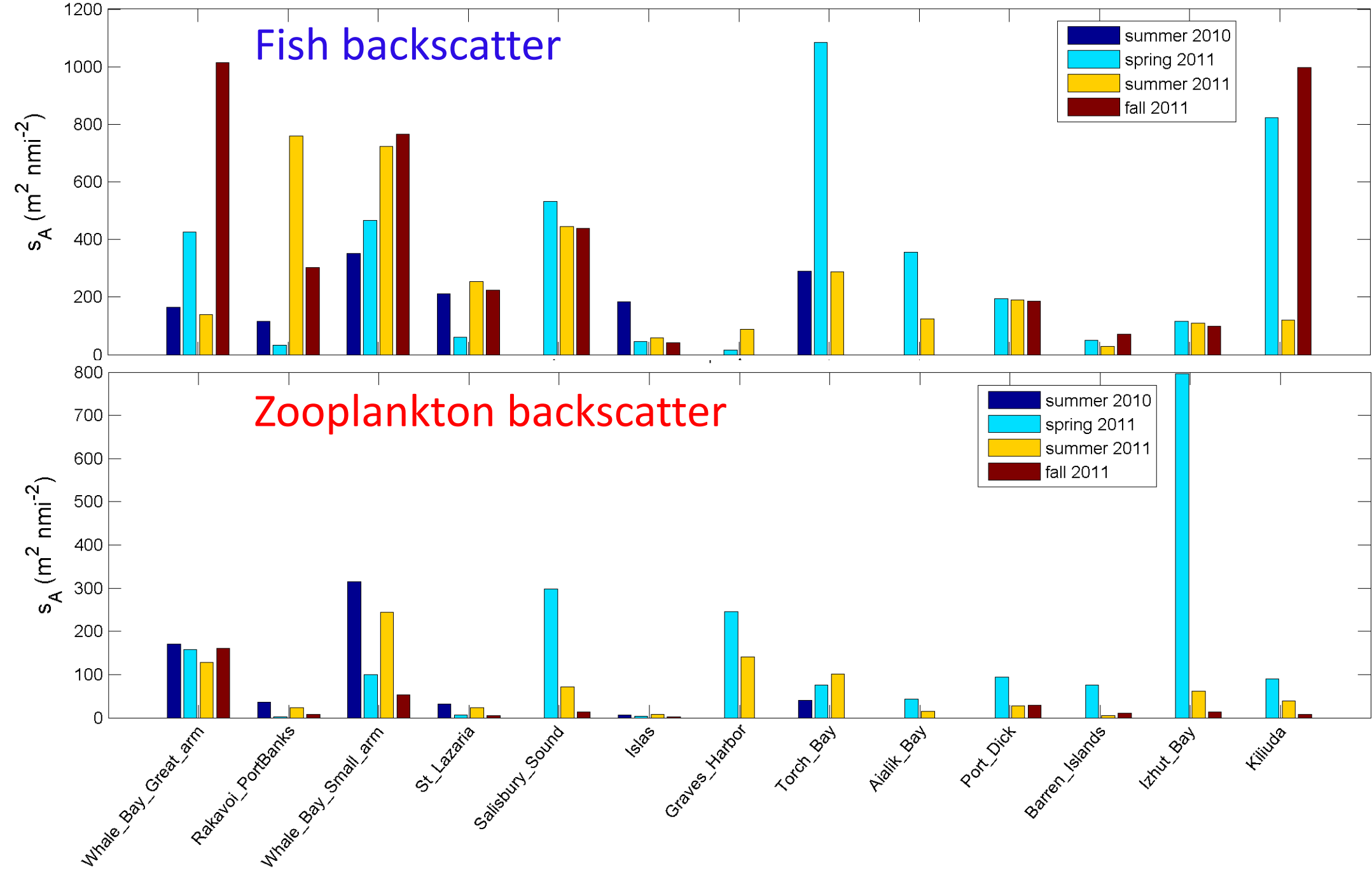


## Examples of fish backscatter



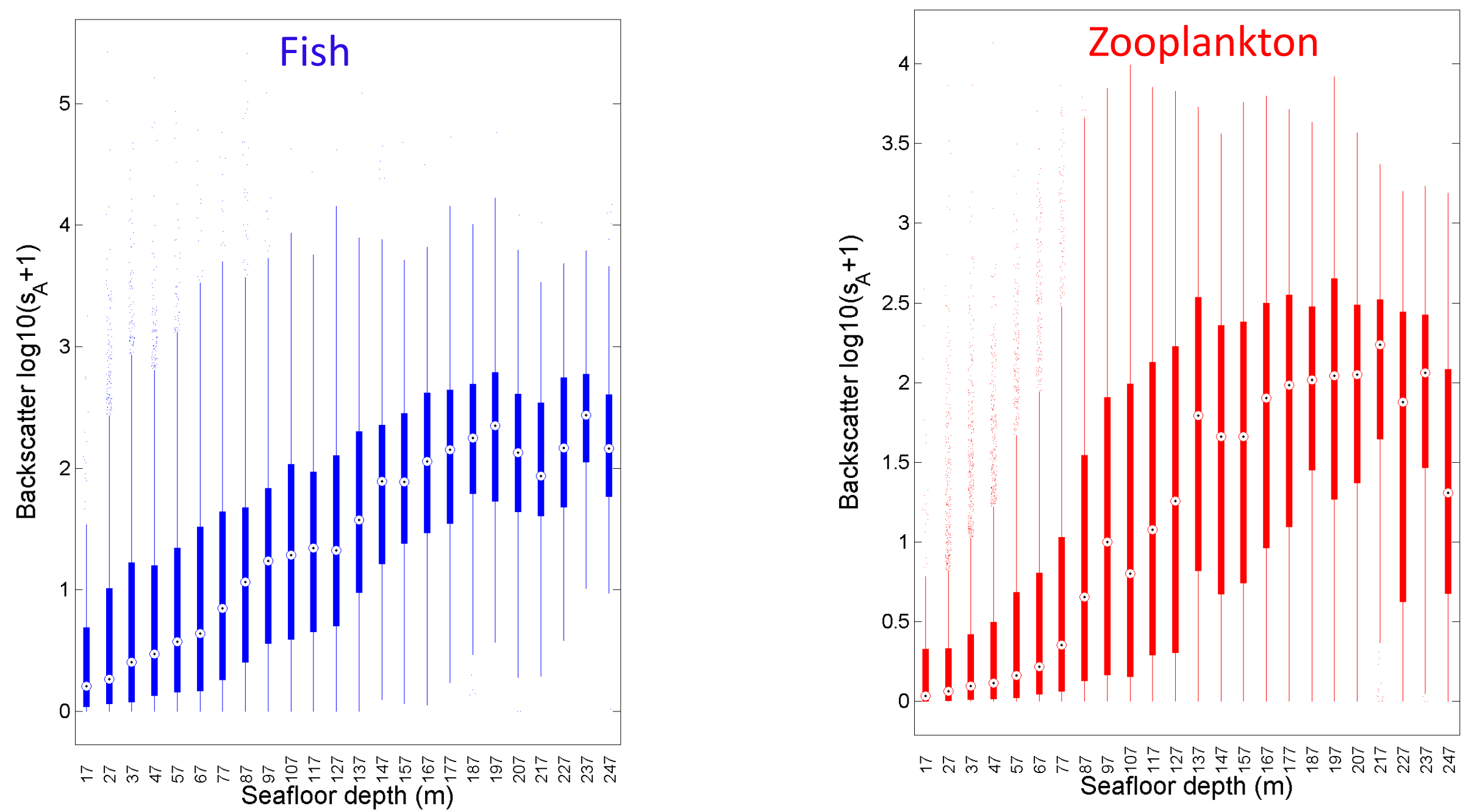
Fish backscatter varied substantially among bays, with higher observations in deeper parts of the bays. Jigging proved to be the most effective method for capturing fish, as the vessels could not tow a trawl fast enough. Aggregations of herring, pollock, and rockfish were identified, but much of the backscatter could not be identified to species.

## Backscatter varies by bay and season



Mean backscatter consistent with fish (upper panel) and zooplankton (lower panel) at each site. The sites (see map above) are displayed in increasing longitude (i.e. from EGOA to CGOA). Observations from a 2010 pilot study in the EGOA are included.

## Backscatter increases with seafloor depth



Box plots of the distribution of vertically integrated backscatter consistent with fish (left) and zooplankton (right) as a function of seafloor depth. The box plots show the median, interquartile range, and the extreme observations. Although some of the highest observations of fish backscatter were observed in relatively shallow water (dense herring schools resulted in very high values at < 100 m), median acoustic abundance of fish and zooplankton increased 30 fold (i.e. 1.5 orders of magnitude) between 20 and 200 m.

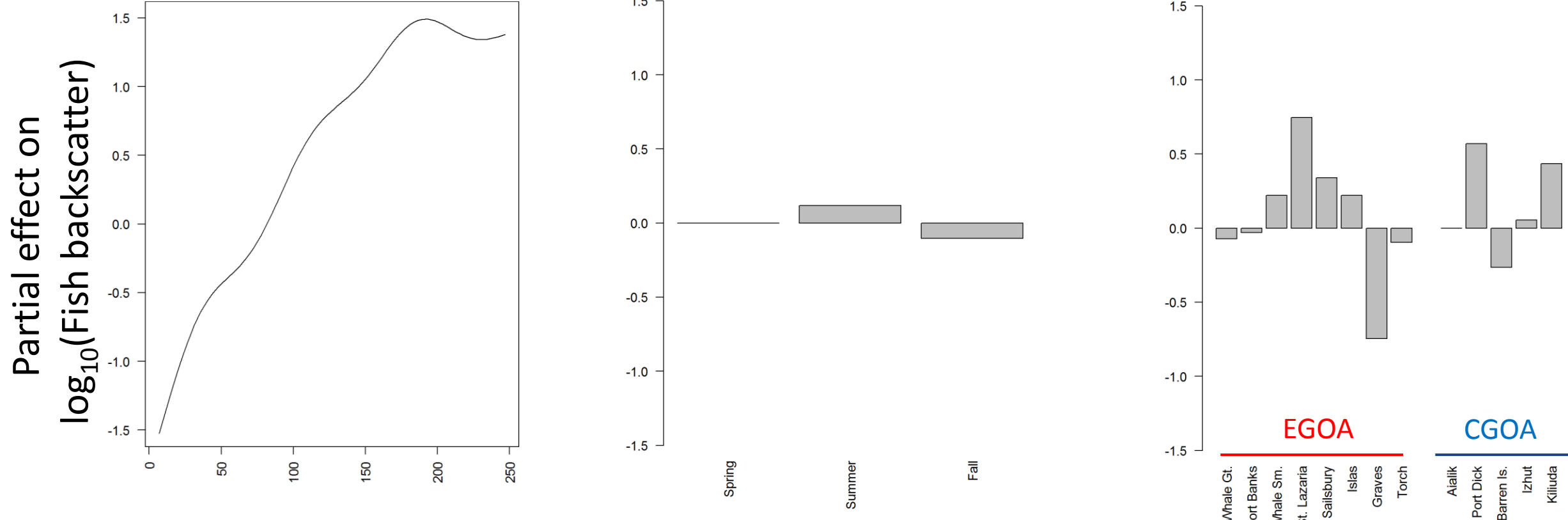
## Water depth is more predictive of fish and zooplankton backscatter than season, bay, or region

**Approach:** We fit the generalized additive model

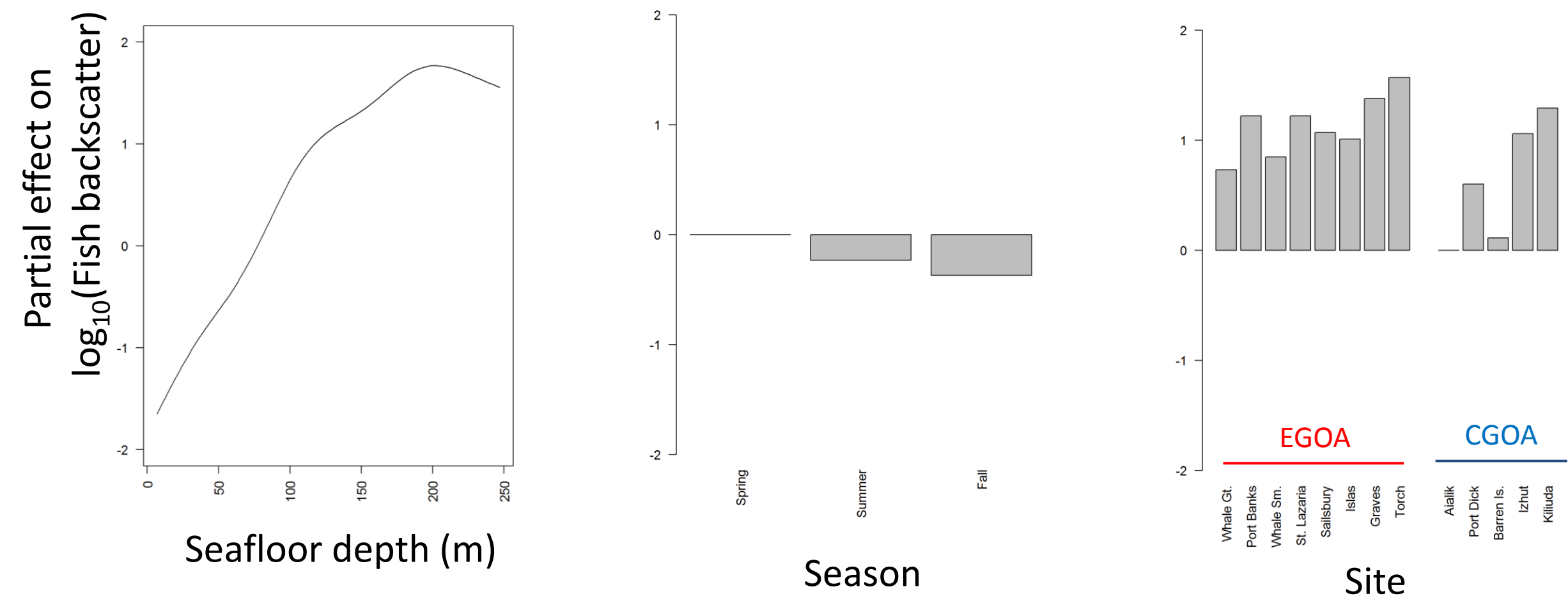
$$\log_{10}(\text{abundance}) = f(\text{depth}) + f(\text{season}) + f(\text{site}) + \text{error}$$

to the observations to explore the relative importance of depth, season, and site on acoustic abundance

## Effects on fish abundance

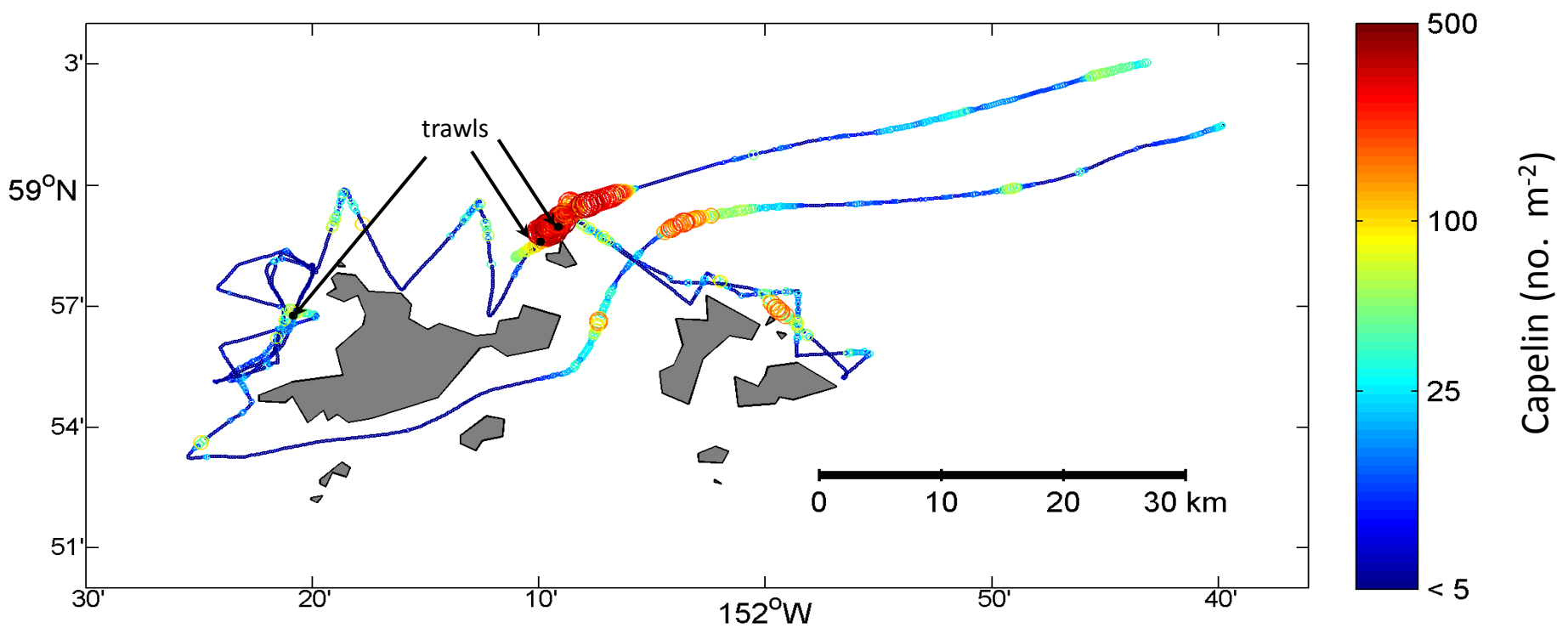


## Effects on zooplankton abundance

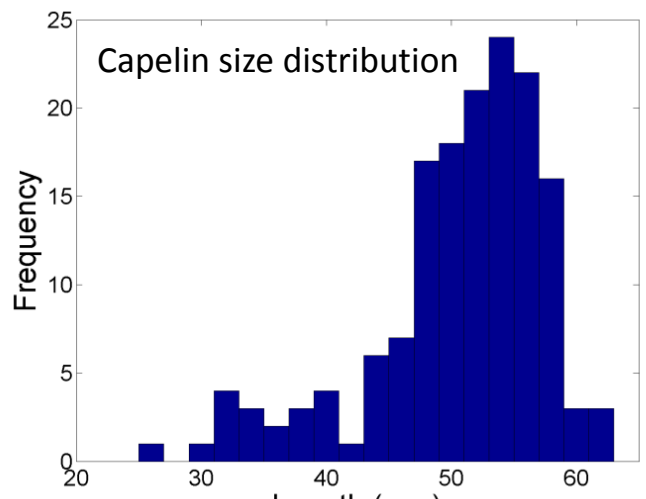


Additive effects of covariates on acoustic backscatter from fitting a preliminary generalized additive model on fish (upper panel) and zooplankton (lower panel) backscatter. Effects of seafloor depth, season, and study site are shown. The units of the y axis are the additive effect on  $\log_{10}(s_A)$  i.e., a 1 unit change represents a 10 fold change in acoustic backscatter. The increase in abundance with depth appears to have the largest effect on mean abundance.

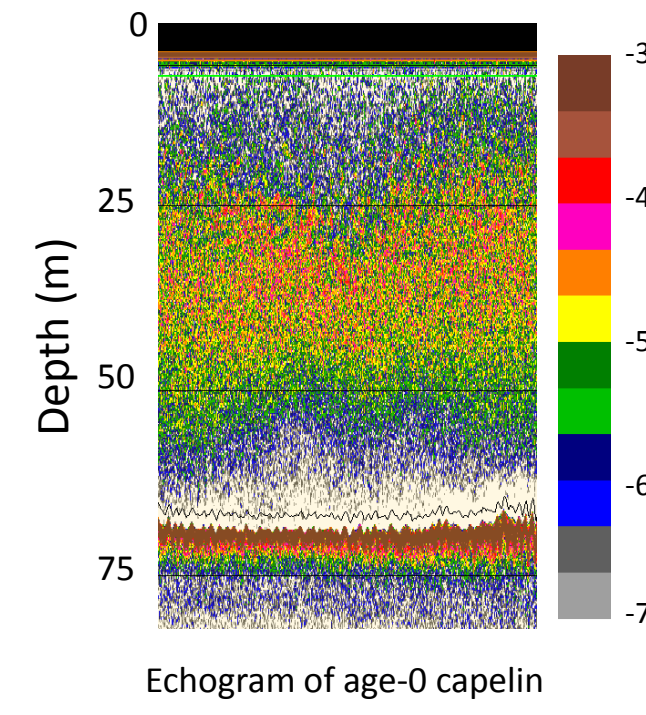
## A dense aggregation of age-0 capelin was observed in fall 2010 in the Barren Islands



An extensive aggregation of juvenile capelin was observed acoustically and sampled with trawls between Kodiak and the Kenai Peninsula (Barren Islands) during a pilot study in fall 2010.



Trawl catches were > 99% small capelin.



Although similar aggregations were not detected in subsequent surveys, this area may be an important nursery site for capelin.

## Preliminary observations:

- There is a strong gradient in fish and zooplankton abundance in inshore bays in the GOA, with higher abundance in deeper water.
- A large aggregation of juvenile capelin was observed in the Barren Islands between Kodiak and the Kenai Peninsula.
- Water depth is more predictive of fish and zooplankton backscatter than season, bay, or region (EGOA vs. CGOA).
- Zooplankton backscatter tends to be higher in the spring than later in the year.

## What's next ?

- Surveys in summer/spring/fall of 2013 with more fishing effort and camera drops to identify acoustic scatters.
- Comparison with acoustics from offshore GOAIERP cruises.
- Examination of fish abundance in relation to bottom type.

**Acknowledgements:** This work would not have been possible without the efforts of our colleagues M. Guttormsen, D. Jones, S. Furnish, C. Wilson, and K. Rand, and the crews of the fishing vessels *Seaview* and *Island C*. The work was funded by the North Pacific Research Board and the Alaska Fisheries Science Center.