EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL

GEM
Gulf Ecosystem Monitoring

NPRB

Seasonal distribution of Euphausiids on a transect from the Gulf of Alaska to the Bering Sea

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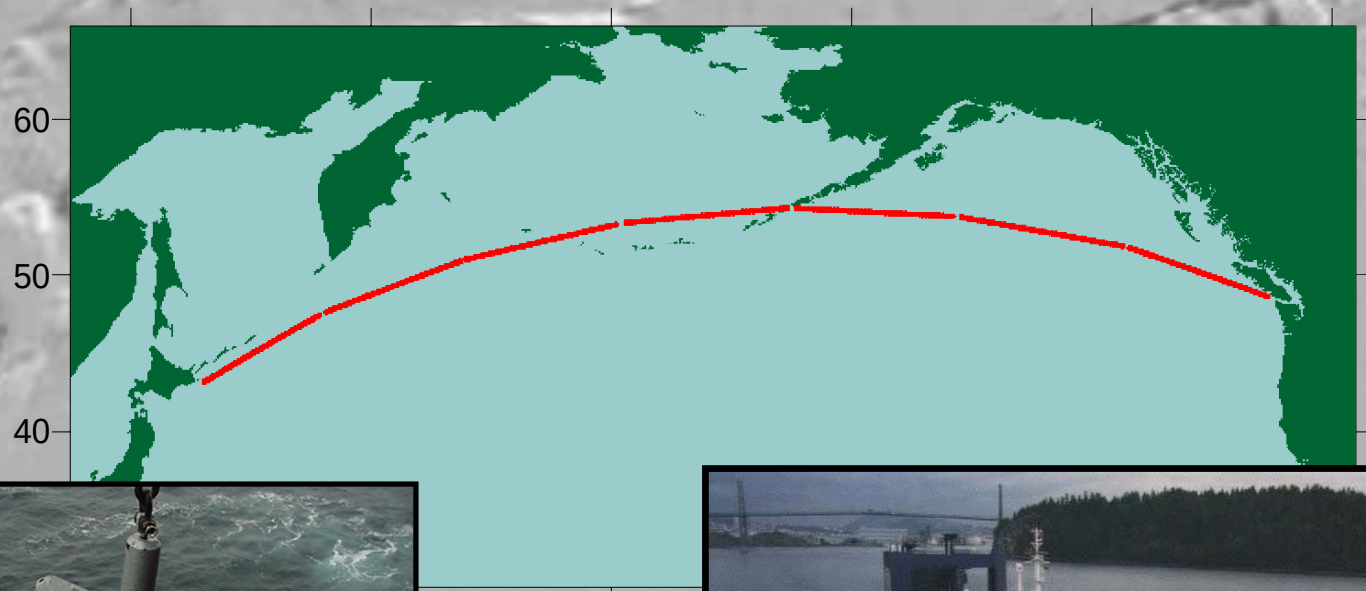
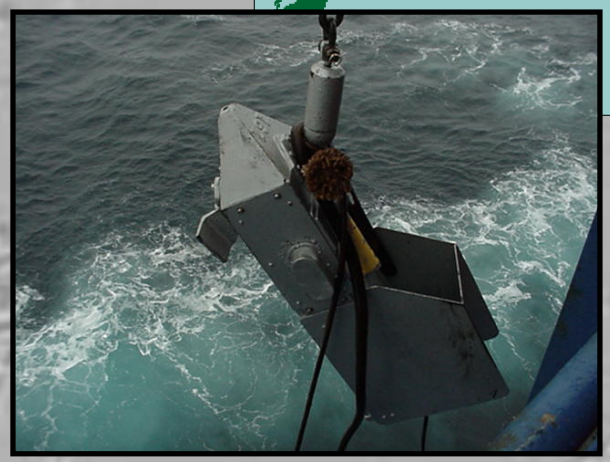
CONTINUOUS PLANKTON RECORDER SURVEY
SAHFOS

Sampling was carried out with a Continuous Plankton Recorder towed behind a cargo ship



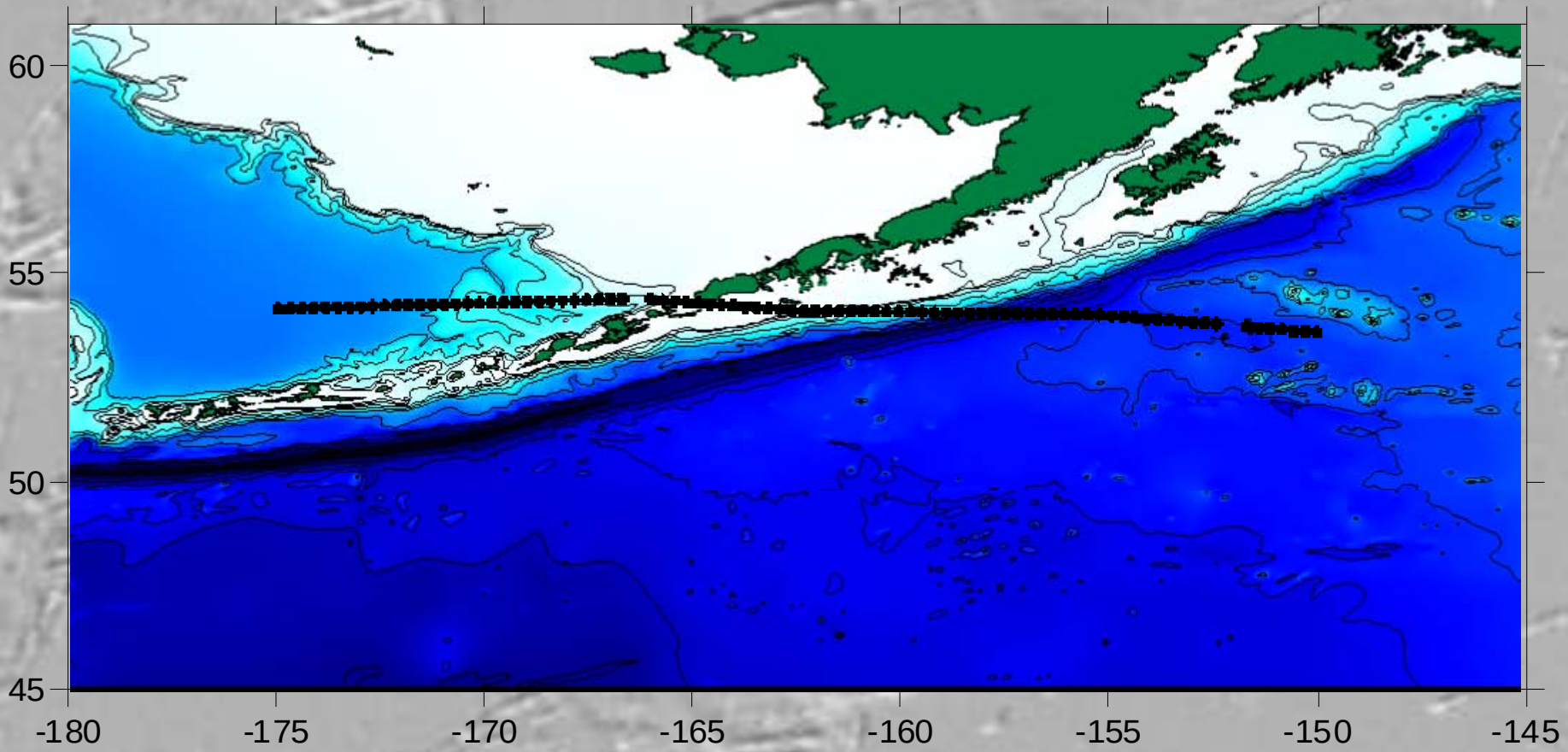


Samples are 18 km, usually every 4th is processed

The transect is normally sampled 3 times per year – April, June and October. In 2002 it was also sampled in December giving a complete seasonal cycle.

Before samples were processed we noticed that even in winter, euphausiids seemed to be common around the Aleutian Islands and so decided to investigate more closely……..

We focussed on the section from the Gulf of Alaska to the Bering Sea, processing ALL samples for euphausiid species



Data analysis issues

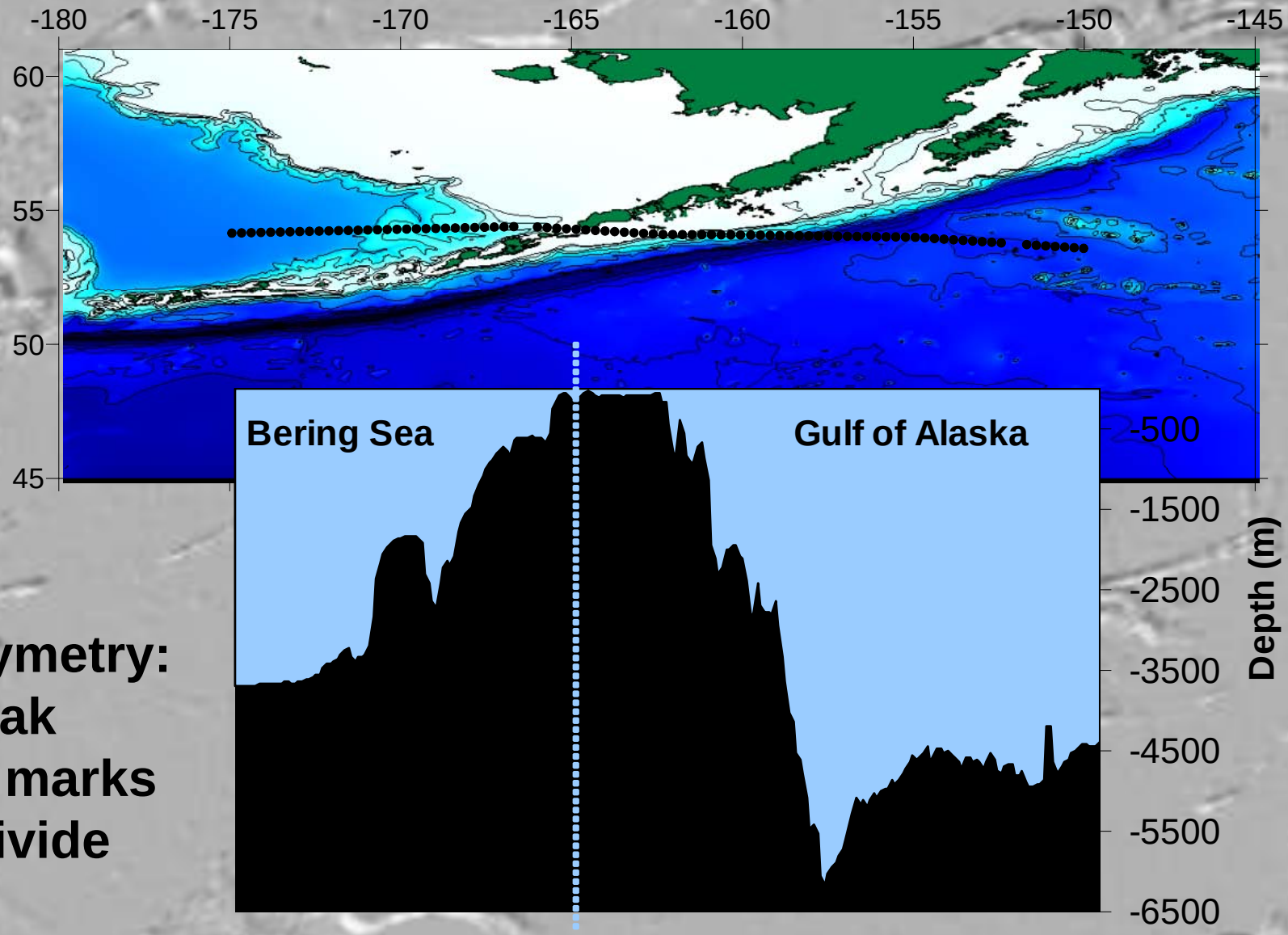
The CPR samples at about 5-7 m, euphausiids vertically migrate so night samples generally have higher abundance

Aperture of CPR (1.2x1.2cm) may favour capture of smaller species over others

Commercial ships have their own schedule – can't control where/when they go

Abundance changes seasonally (life history), spatially (shelf to ocean) and daily (night and day) so several confounding factors.

Fortunately, all 4 transects (June, Oct, Dec 02, Apr 03) had very similar locations, through Unimak Pass.



Bathymetry: Unimak Pass marks the divide

Species Distributions

6 species were recorded:

Most abundant

Least abundant

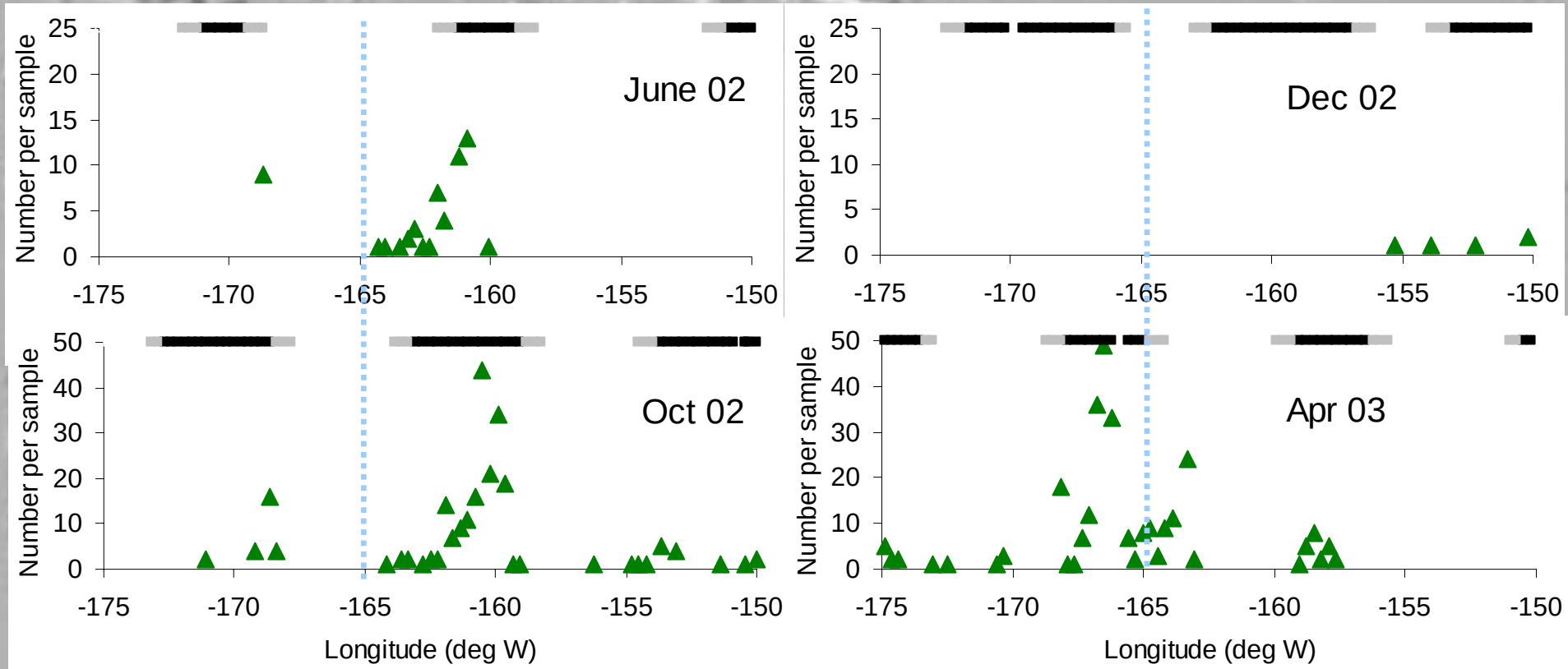
Thysanoessa inermis
T. longipes
T. inspinata
T. spinifera
Euphausia pacifica
T. rachii (just 1 individual)

2 examples:

Thysanoessa inermis

Widespread in spring
Biased towards GoA side rest of year, particularly the shelf

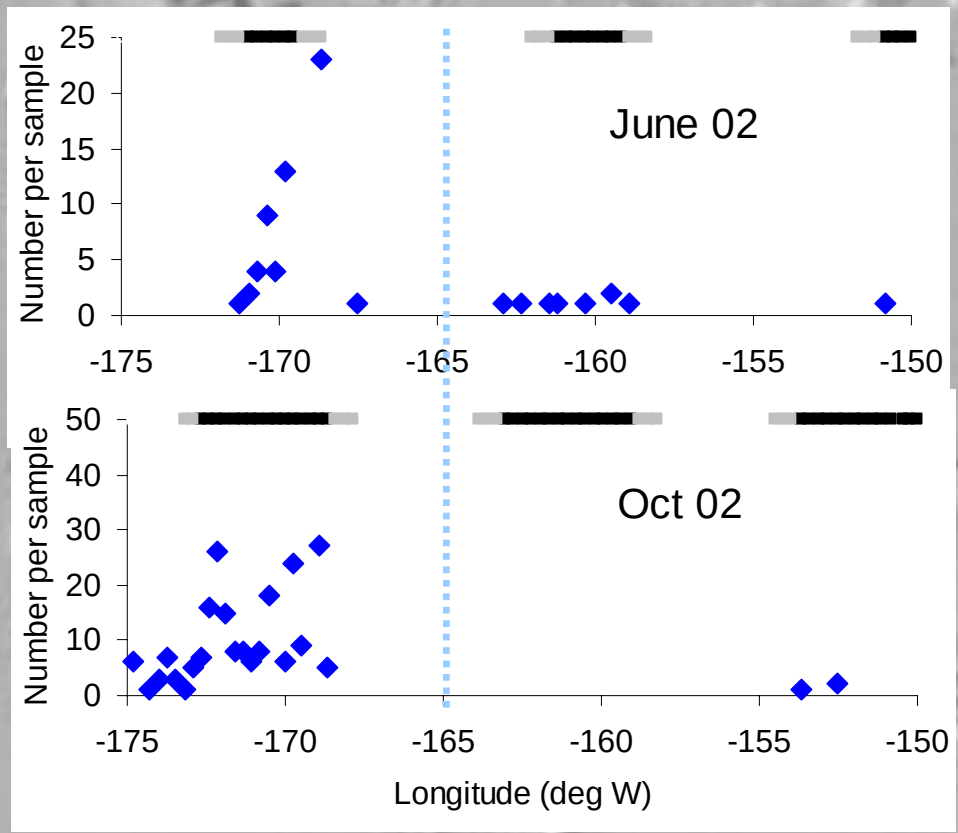
Black = night, grey = twilight (sunset/rise +/- 1 hr), white = day

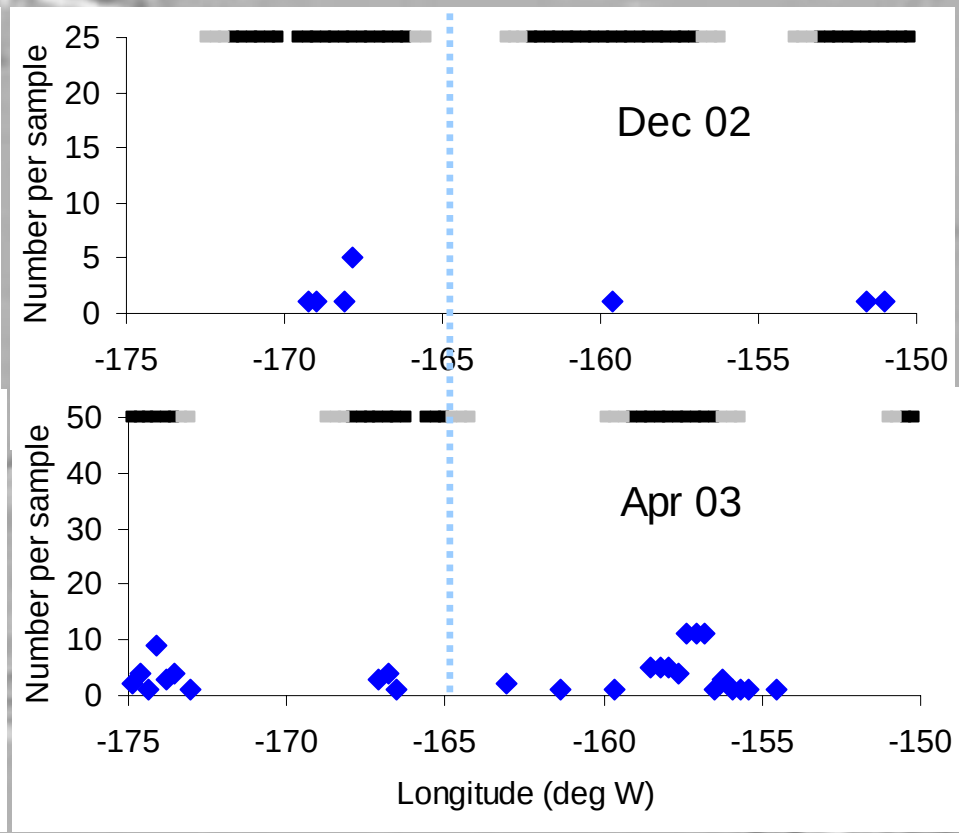


Thysanoessa longipes

Rare/low numbers on shelf
Biased towards Bering Sea

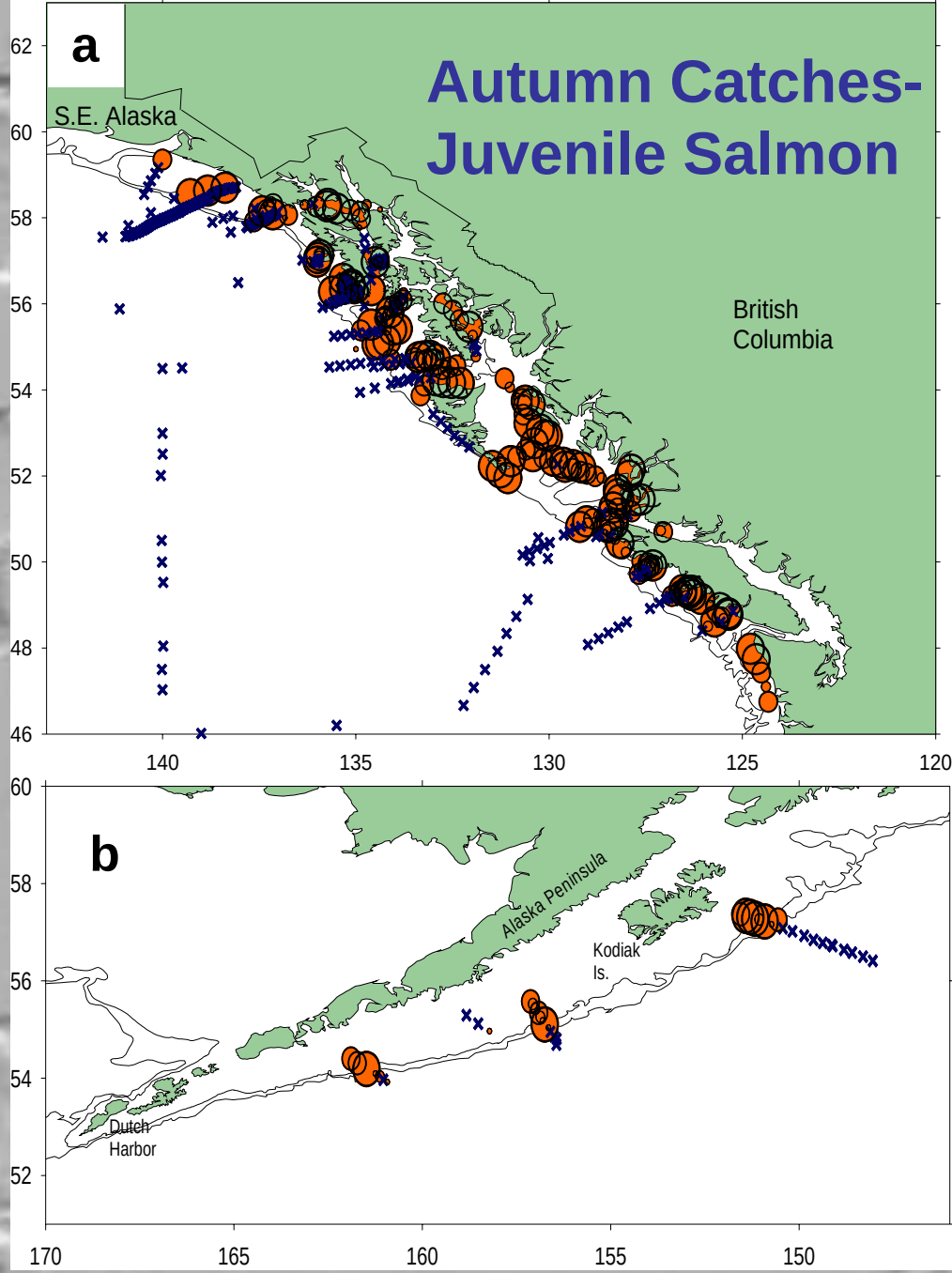
Black = night, grey = twilight (sunset/rise +/- 1 hr), white = day





Juvenile Salmon Movements

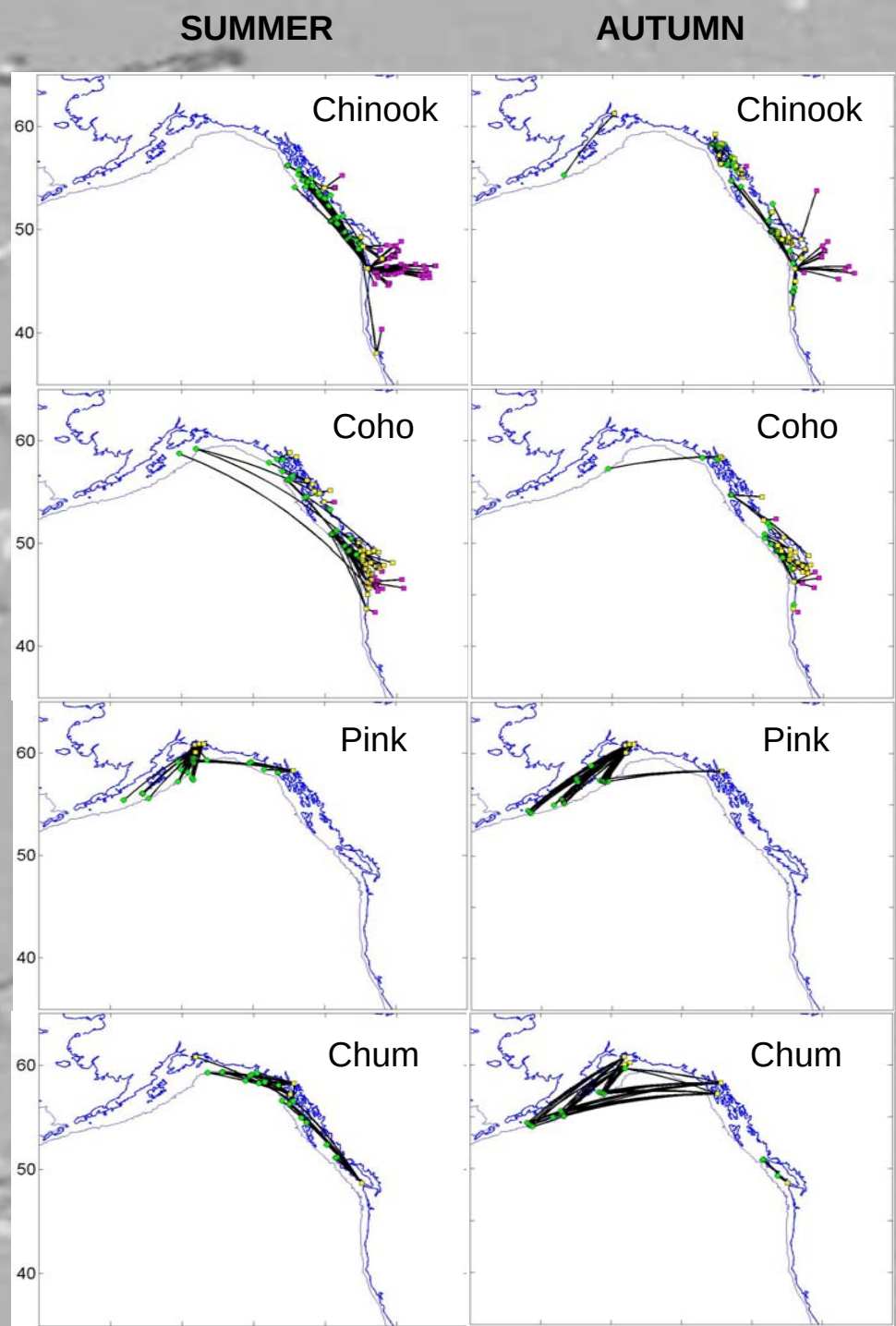
- Sampling shows that most juvenile salmon stay on the shelf while migrating rapidly towards the Aleutians over the summer & fall
- Do the vast majority of salmon choose this migration route in order to feed on the rich winter plankton populations in the Aleutians?



Juvenile Salmon Movements

Our hypothesis:

Juvenile salmon migrate along the shelf until late fall/winter when they reach the Aleutians. We believe this migration evolved to take advantage of the differential abundance of euphausiids, a key prey.

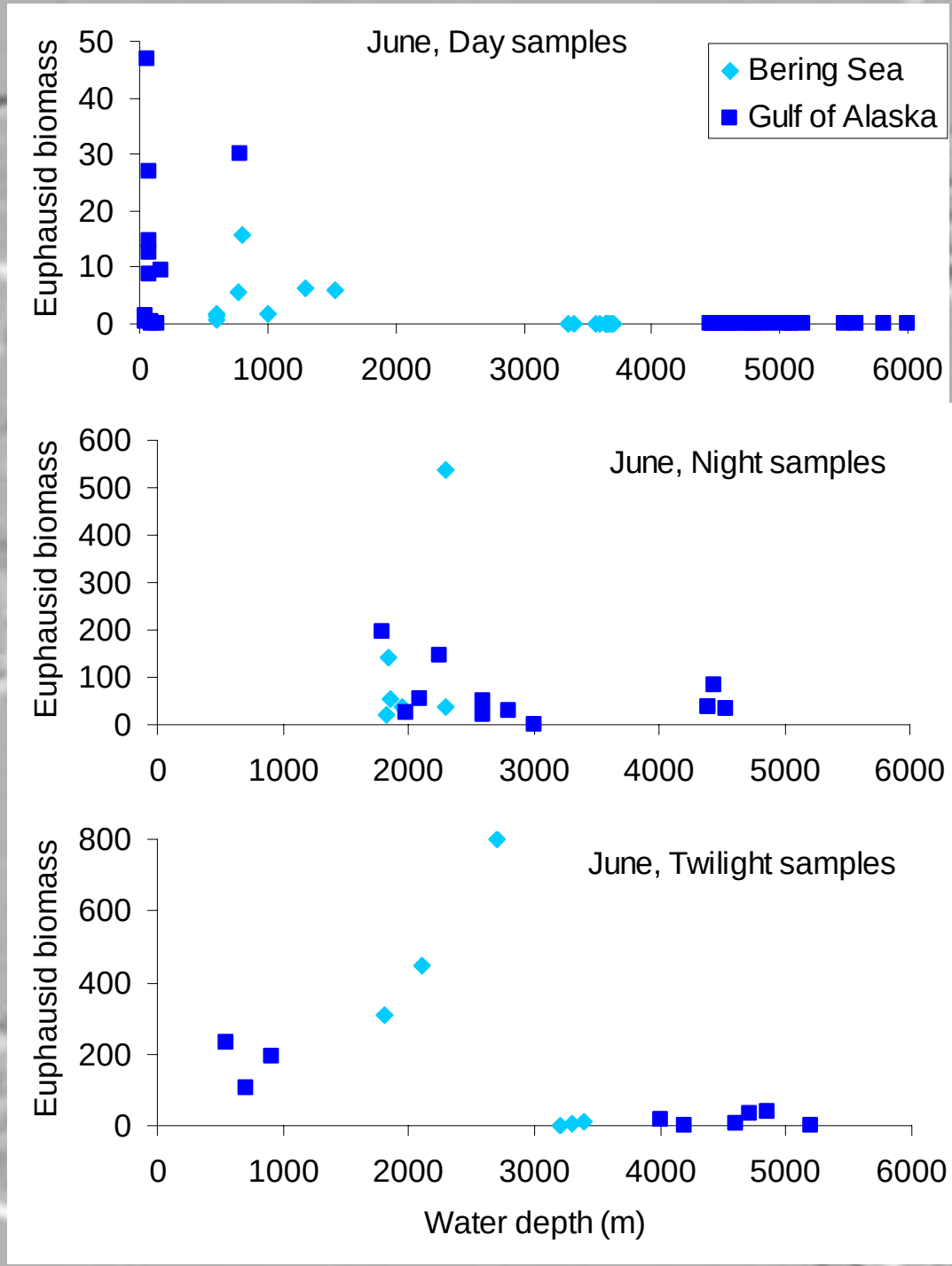


We would expect to find a negative relationship between euphausiid biomass and water depth on our transect i.e highest biomass on the shelf, in all seasons (based on our initial observations).

In spring/summer (April & June) this was true

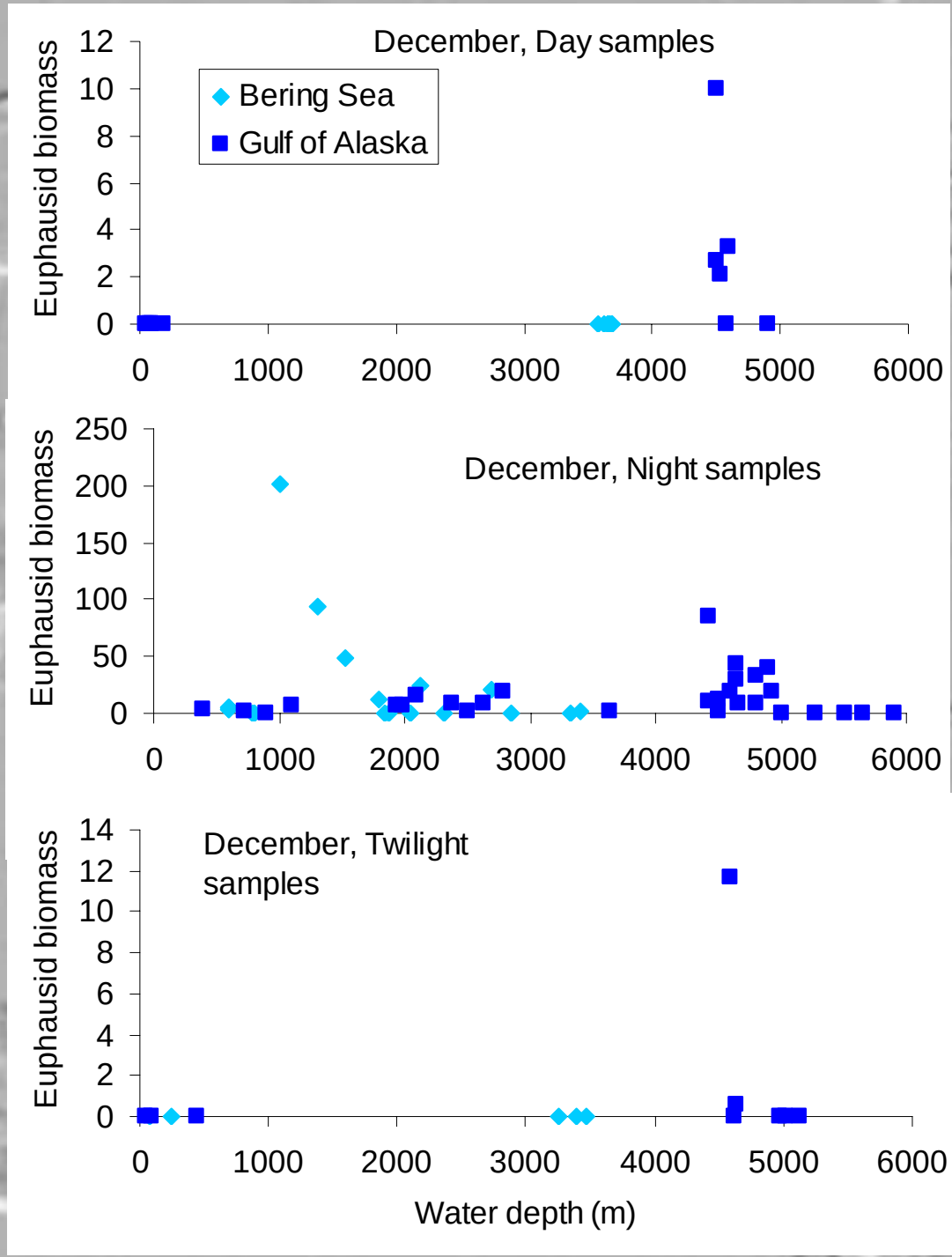
Of the 12 month/time of day combinations in all but 2 cases biomass was negatively correlated with depth

(Note, Unimak pass marks the divide between BS and GoA)

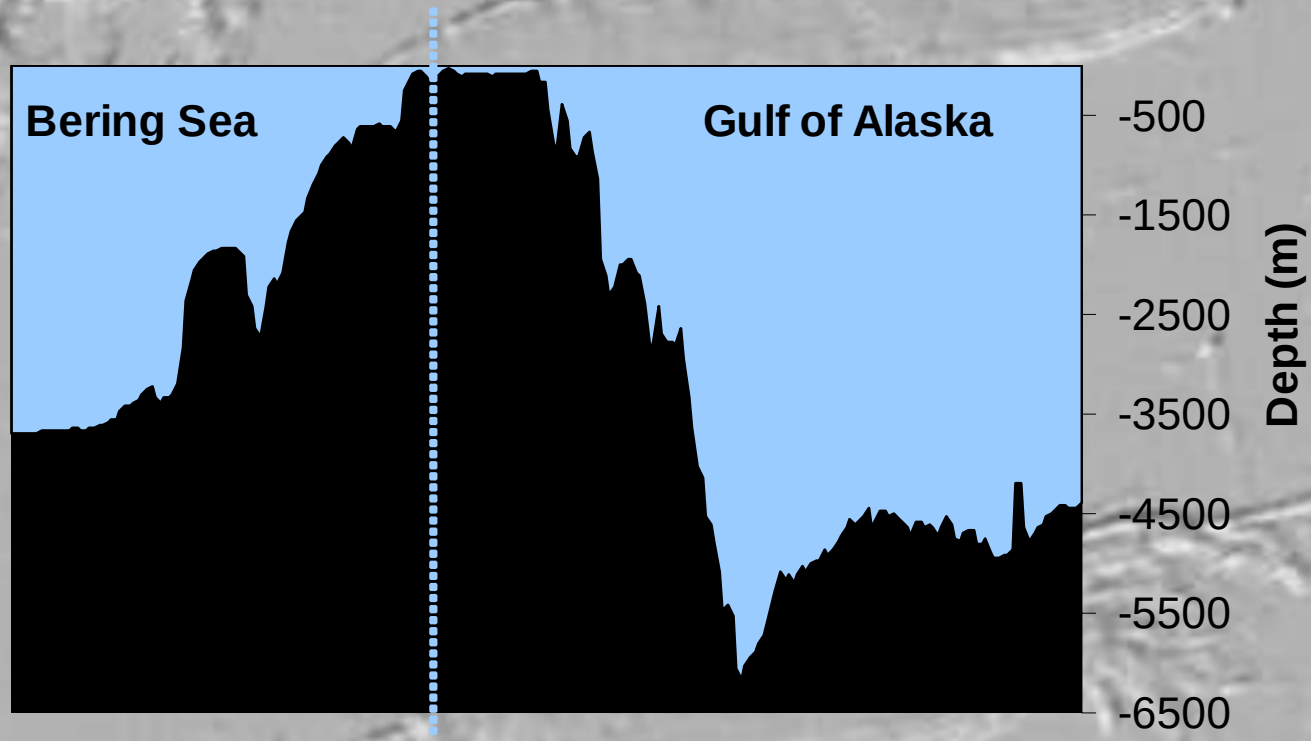


But in fall/winter (Oct/Dec sampling) this was only true in the Bering Sea

Of the 6 month/time of day combinations for GoA, in all cases, biomass was positively correlated with depth



If we consider the bathymetry again we see that the deepest waters of the GoA are over the Aleutian trench, just east of the shelf:



Anticyclonic eddies spin off the Alaskan Stream and propagate eastwards into the GoA. They are a mechanism for shelf/slope exchange in this region (Okkonen et al., 2003) as seen in this satellite chlorophyll image:

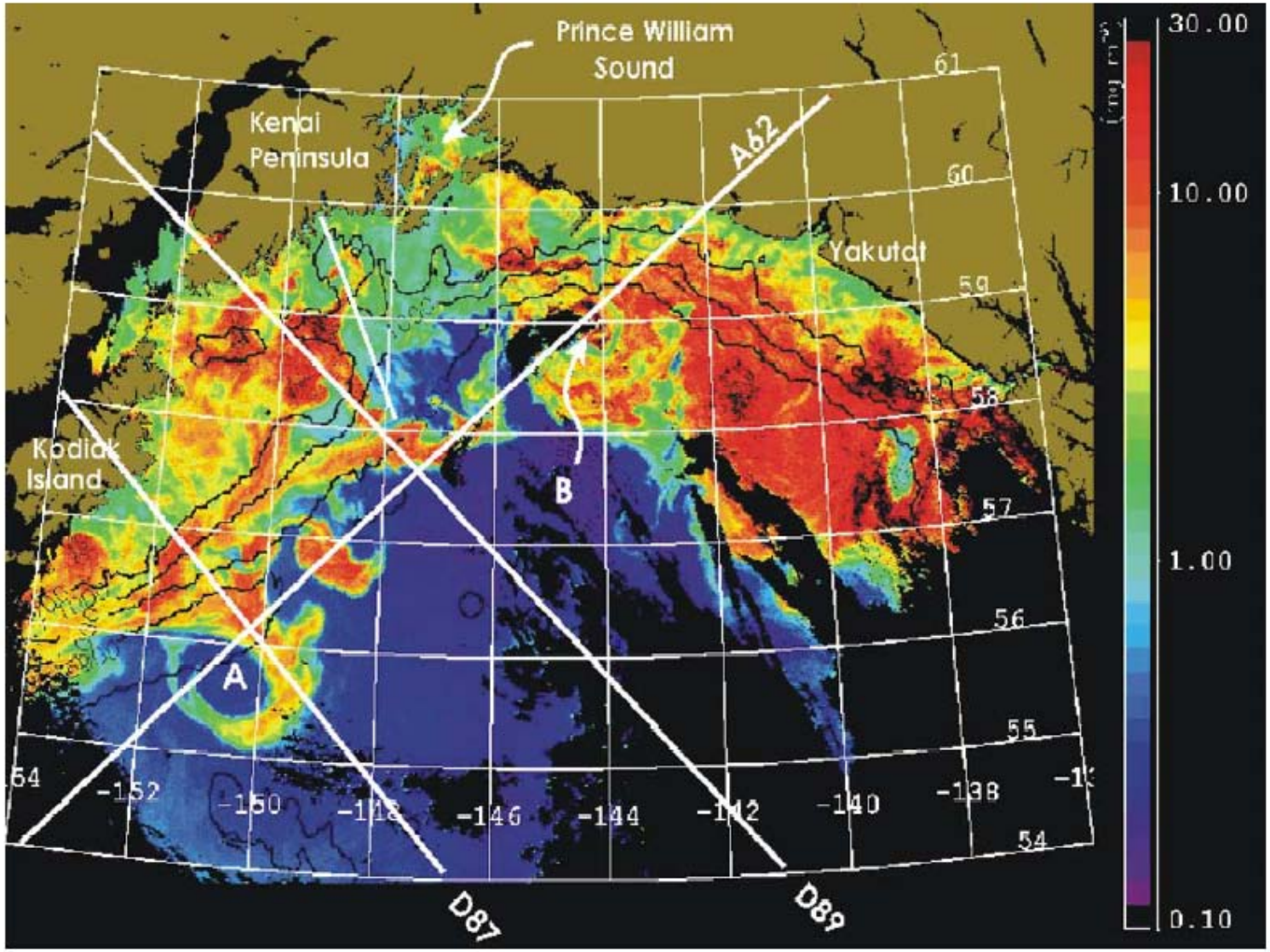


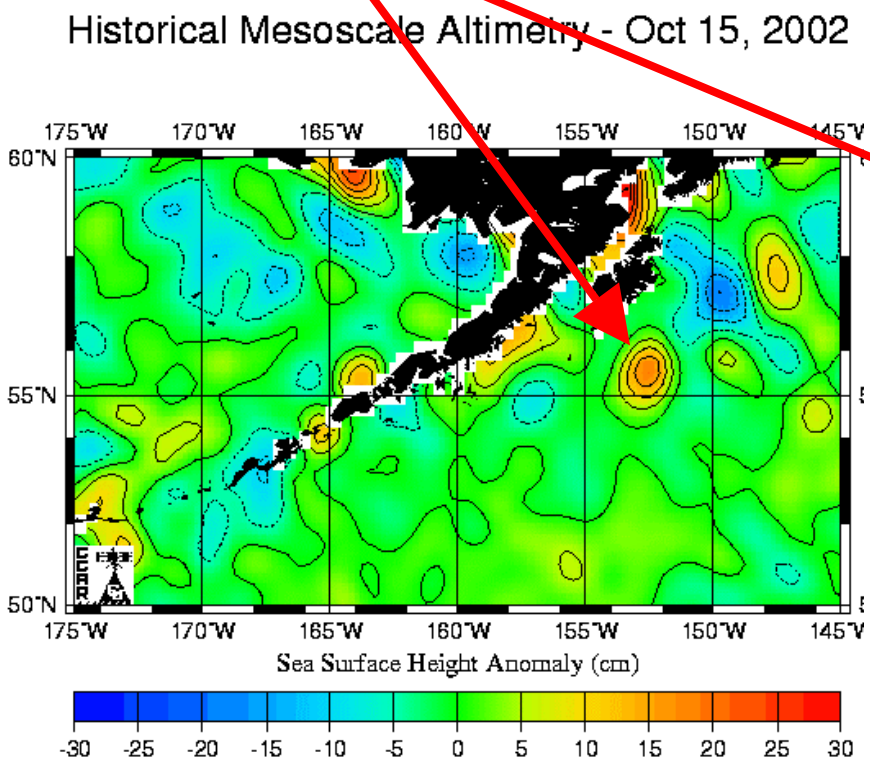
Figure 1. SeaWiFS false-color image of chlorophyll pigment concentration in the Gulf of Alaska on 10 May 2000. Cloud cover is black. TOPEX altimeter ground tracks A62, D87, and D89 are shown. The Seward hydrographic line runs from the Kenai Peninsula south-southeast to near the 3000-m isobath. The 200-m, 1000-m, 3000-m, and 5000-m isobaths are contoured in black.

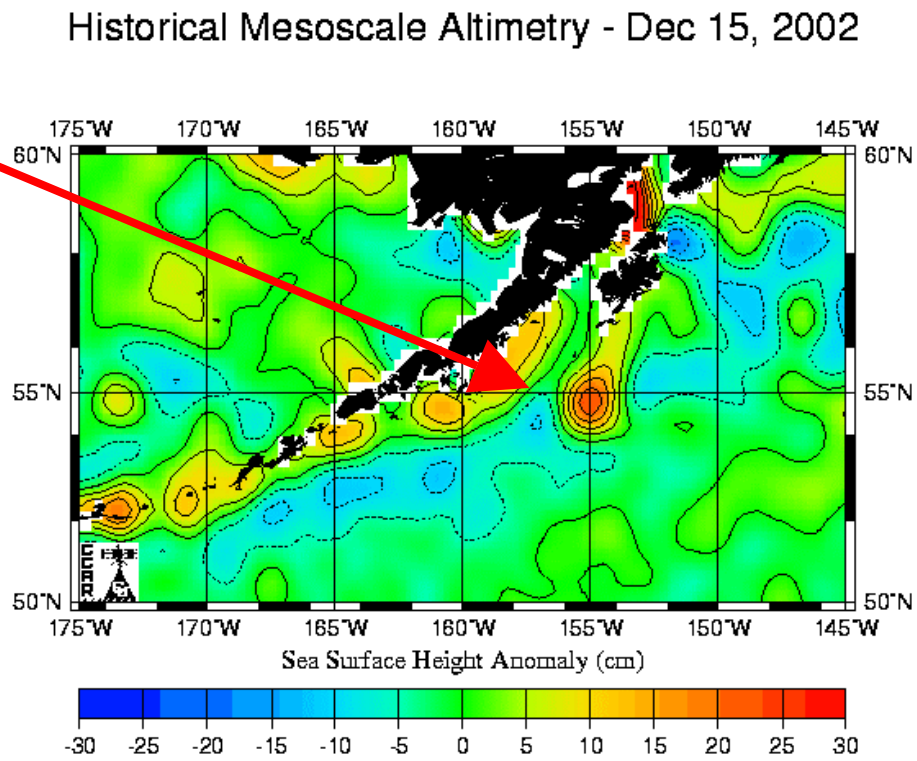
Anticyclonic eddies spin off the Alaskan Stream and propagate eastwards into the GoA. They are a mechanism for shelf/slope exchange in this region (Okkonen et al., 2003) as seen in this chlorophyll image:

The euphausiids could also be transported offshore, or could be taking advantage of the higher productivity water in the eddies

These eddies typically form in fall/winter.

Altimetry images from our sampling times show eddies:





Conclusions

Although the CPR isn't an ideal sampler of euphausiids, some information on species distributions and abundance can be gained from this time series (not many other programs sample regularly offshore in this region)

Our original observation that euphausiid biomass was high at the Aleutians, even in winter was not entirely supported. In spring and summer the shelf supports the highest biomass (and is presumably why so many birds and mammals feed here)…..

Conclusions continued

…….But, in fall and winter highest abundances are off the shelf, in the deep waters over the Aleutian trench.

Eddy activity is probably responsible (directly or indirectly is unknown)

Is it a coincidence that juvenile salmon seems to show the same distribution at this time of year?