Progress Report for January 2002

Analysis of hydrographic data collected by the Pollock Conservation Cooperative in the Bering Sea

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Objectives:

We analyzed records of salinity and temperature collected on Pollock fishing boats in the Southeast Bering Sea during the fishing seasons of 2000 and 2001. We hoped to use statistical analysis techniques to elucidate correlations of the water mass structure with catch and by catch data. The salinity and temperature data are collected from Conductivity-Temperature-Depth (CTD) recorders attached to fishing nets during normal fishing operations. We are in the process of evaluating the utility of using water mass characteristics to identify regions of high catch and by catch.

Background:

In 2001, the catch quotas for Bering Sea Pollock are 1.4 million metric tons, which will account for three-quarters of the Bering Sea ground fish catch in U.S. waters. Pollock is harvested exclusively with trawl nets from vessels that process at sea and by catcher boats that deliver to mother ship vessels and to shore-based processors. Pollock products include surimi, fillets roe and fishmeal.

Alaskan Pollock, *Theragra chalcogramma*, weigh 1/2 to 2 pounds and average 12 to 20 inches in length. These Pollock are members of the cod family and are commonly referred to as Walleye Pollock. Alaskan Walleye Pollock represent the world's most abundant food fish and is second only to Peruvian anchovy in global landings since 1993.

Introduction:

Over the course of the A/B seasons of 2000 and 2001 (January 20 - June 10) and the C/D season of 2000 (June 10 - November 1), twenty-two fishing vessels operated in the Pollock fishery of the Bering Sea within U.S. waters(**Figure 1**).

The fishery exclusively took place in waters less than 500 meters deep on the continental shelves of the southeastern Bering. These vessels collected data pertaining to the total weight of Pollock, Squid and Herring brought aboard during each net haul, the numbers of Chinook and other types of salmon, the estimated fishing depth, fishing location, and start and start times for the trawls. Three fishing vessels out of the twenty-two outfitted their trawl nets with conductivity, temperature and depth recorders (CTDs) designed to

withstand the abuse of trawl work. The locations of the vessels outfitted with CTD recorders are shown in **Figure 2**.

Eight regions have been defined to represent the fishing activity of the Bering Sea, while this number of regions is arbitrarily chosen; the boundaries of each region are closely related to the bathymetric structures present.

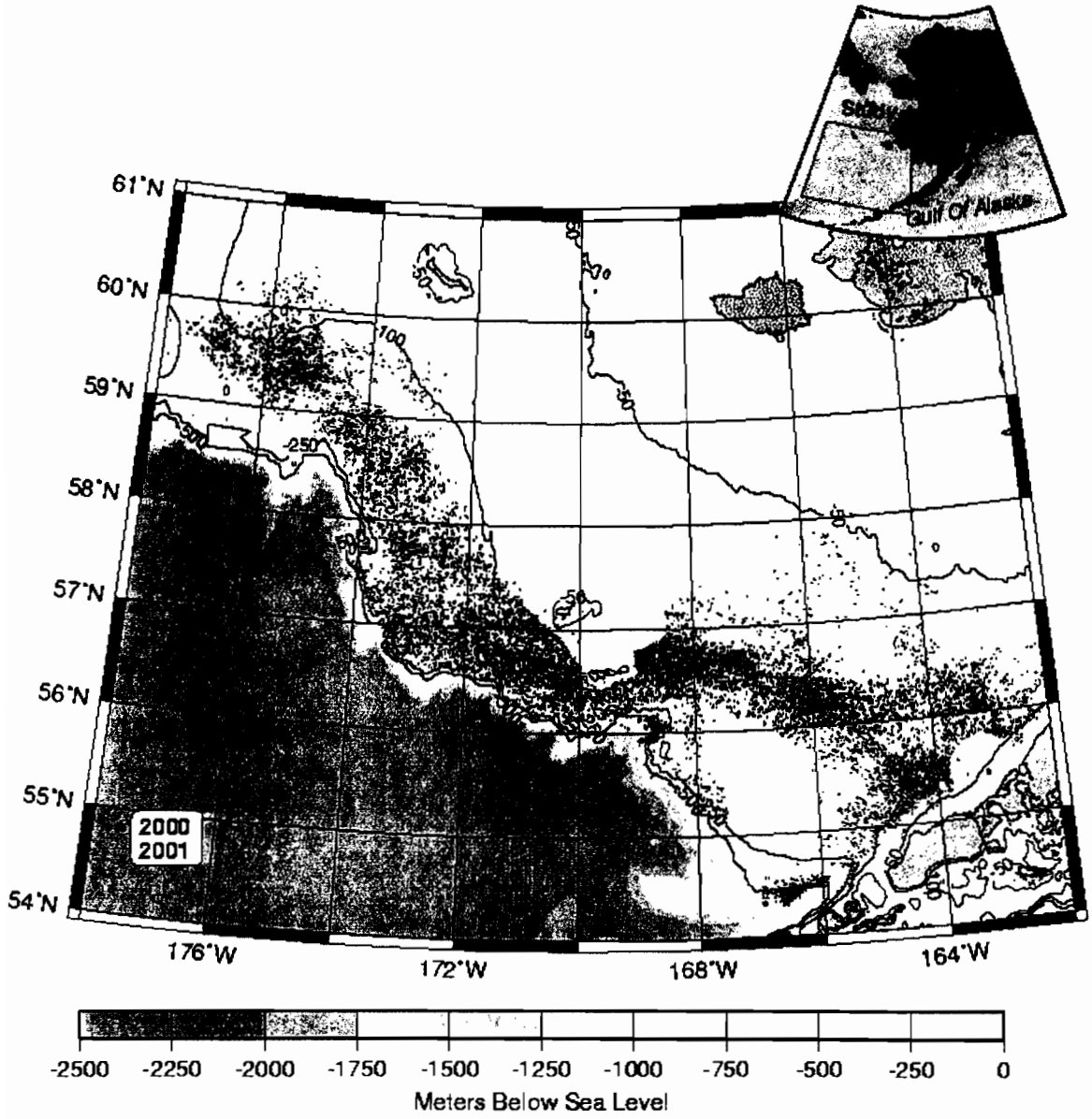

Figure 1: Locations of Fishing vessels operating in the Bering Sea. Blue dots indicate locations for the spring and fall 2000 fishery and red dots indicate locations for the spring 2001 fishery.

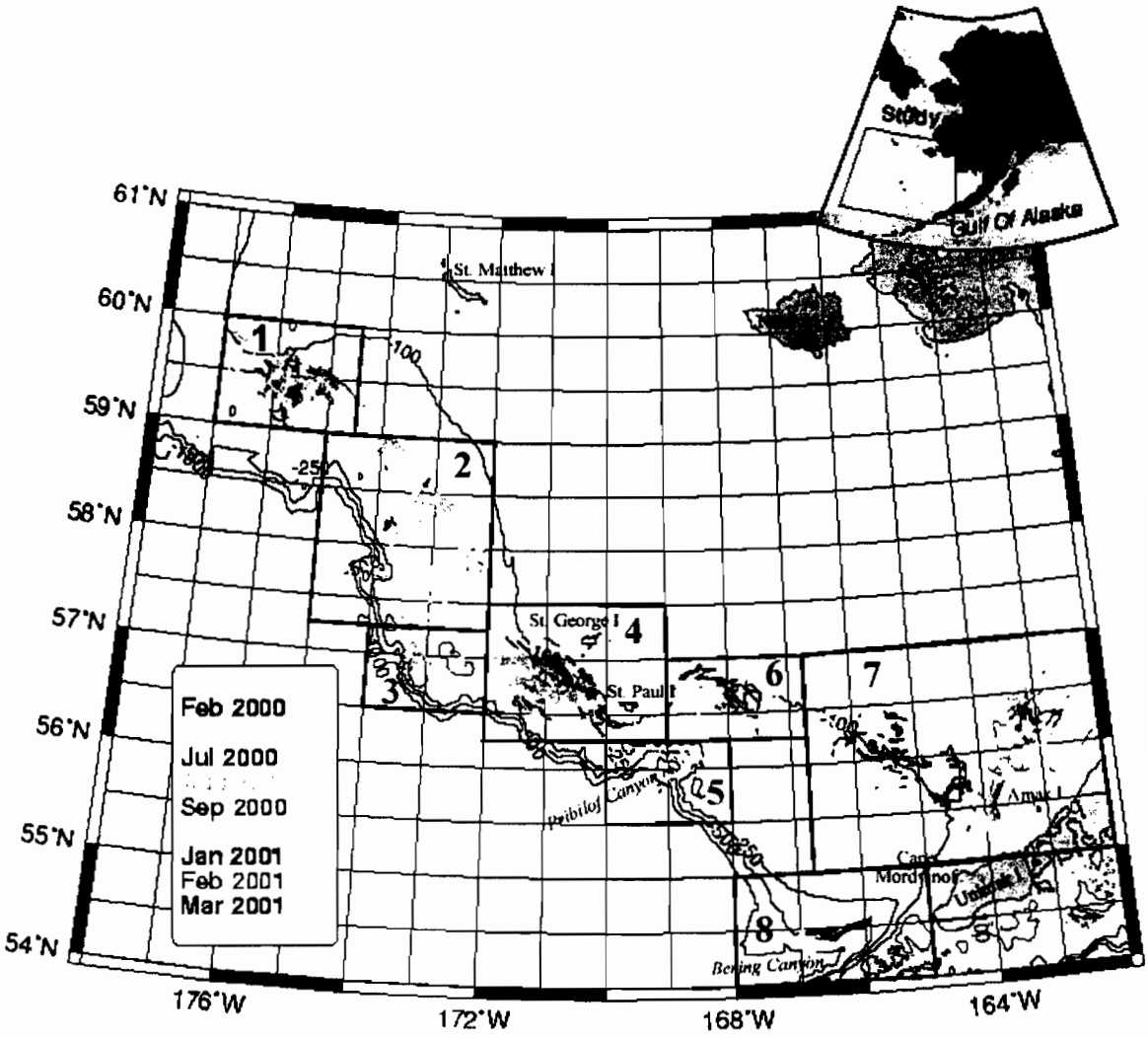

Figure 2: Locations of the fishing vessels outfitted with CTD recorders operating in the 2000 and 2001 Pollock fishery. Trawl net activity is broken down by month and region, each month is given a specific color and regions are delineated by the thick black lines and corresponding labels numbered 1-8.

Data Analysis and Methods:

Analysis of this data set was challenging because of: the sheer volume of data, 138,603 realizations of temperature, pressure, conductivity with location and 16,915 realizations of catch information, the large spatial extent of coverage, and the fact that hydrographic measurements were not collected in conjunction with all fishing activities. Because of these difficulties, an appropriate spatial and temporal binning technique was essential in addressing hydrographic regimes within which catch information would be applicable.

The hydrographic information was broken up into individual casts. Once a trawl is placed into the water, a cast would consist of lowering the trawl to the desired fishing depth (downcast), towing the trawl for some time period (tow), and raising the trawl back to the surface (upcast). The total time that the trawl is in the water is then considered the trawl duration. An initial criterion for our analysis of the hydrographic data set is that trawl

duration must be longer than 20 minutes. This length albeit is rather arbitrary, but it nonetheless adequately eliminates trawls that were not deployed in a proper fashion or do not consist of a downcast, tow and upcast. The mean latitude and longitude for each cast is then calculated and considered to be the center of each cast. This analysis technique yielded 709 complete hydrographic casts.

The catch information was then aligned with the hydrographic data by doing a spatial and temporal search. The criteria for the spatial search consist of sorting the 50 catch locations which were in closest proximity to a cast and then throwing out all catch records that were greater than 10 km away from the cast center. The catch records located within 10 km from the center of the cast are then further screened so that the time of collection between the hydrographic cast and catch information does not exceed 6 hours. This temporal period was chosen to eliminate biasing the data set by including the effects of tidal mixing and front formation due to the strong influence that these physical conditions may have, e.g. aggregations of phytoplankton are typically found along tidal mixing fronts. This data screening technique yielded 28 hydrographic casts with no corresponding catch information, a maximum of 19 catch records associated with a single hydrographic cast and a mean of 5.2 catch records per hydrographic cast. One point that should no go without mention is that of the original 16,915 realizations of catch information, only 3,687 were found to be associated with hydrographic information. Of these 3,687 catch records; only 1,753 were unique, the others were found to be associated with multiple hydrographic records.

The bar chart in **figure 3** shows the temporal and spatial distribution of monthly mean temperatures and salinities for trawls outfitted with CTD recorders.

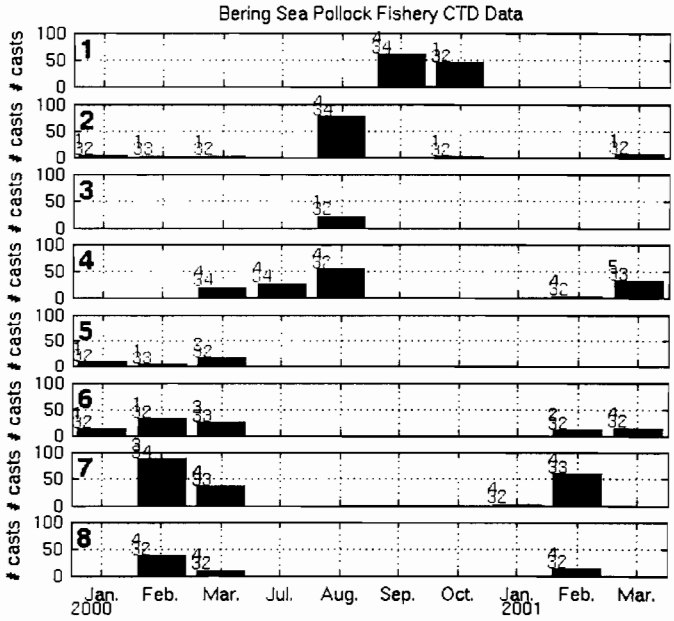

Figure 3: Bar chart showing the number of trawls outfitted with CTDs that were collected during each month. The blue and red numbers above each bar indicate the mean respective temperature and salinity.

Typical diagnostics, in this case for the Bering Canyon (region 8) are shown in **figure 4.**

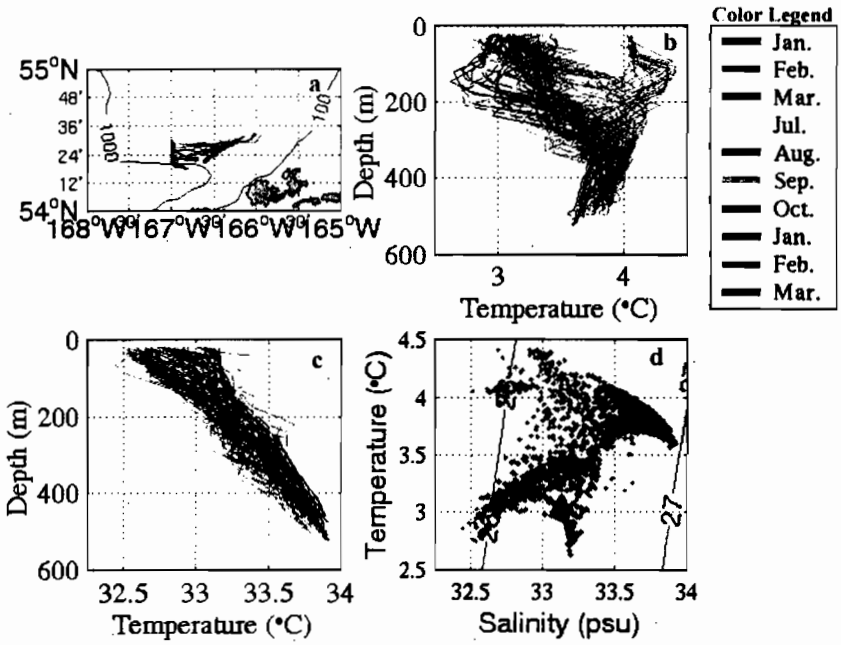

Figure 4: Hydrography for region 8 (Bering Canyon) showing a plan view with topographic contours for the region (a), vertical casts of temperature (solid lines are downcasts and dashed lines are upcasts) (b), vertical casts of salinity (c) and a temperature – salinity diagram with contours of sigma-t overlain (d).

In 2000, the bycatch was negligible and therefore little can be said about the relationship between bycatch and water mass structure. However, the increased bycatch in the 2001 A/B season is associated with a large increase (2 degrees °C) in temperature.

- Hard to tell if picking up salmon on way up or down rather than while fishing.

Conclusion – preliminary

warmer temps indicator of regions of higher bycatch and higher salinity

- Pribilof Canyon & Bering Canyon highest bycatch & lowest pollock catch.

- Don't need salinity data only depth & temp. on all ships Surface salinity & temp observed vessels.

- Wants real-time data reporting (Richard already reporting catch & (bycatch?) in real time.