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CRUISE REPORT
M/V *QUILLBACK* CRUISE Q-1-97-GB

PHYSICAL CHARACTERISTICS OF DUNGENESS CRAB AND HALIBUT HABITATS IN GLACIER BAY, ALASKA

October 15 through October 30, 1997
Glacier Bay, Alaska

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Cruise Objectives

In Glacier Bay National Park, Alaska there are ongoing studies of Dungeness Crab (*Cancer magister*) and Pacific Halibut (*Hippoglosus stenolepis*). Scientists of the United States Geological Survey (USGS) are attempting to ascertain life history, distribution, and abundance, and to determine the effects of commercial fishing in the park (Carlson et al., 1998). Statistical sampling studies suggest that seafloor characteristics and bathymetry affect the distribution, abundance and behavior of benthic species. Examples include the distribution of Dungeness crab which varies from 78 to 2012 crabs/ha in nearshore areas to depths of 18 m (O'Clair et al., 1995), and changes in halibut foraging behavior according to bottom type (Chilton et al., 1995).

This report discusses geophysical data collected in six areas within the park in 1998. The geophysical surveying done in this and previous studies will be combined with existing population and sonic-tracking data sets as well as future sediment sampling, scuba, submersible, and bottom video camera observations to better understand Dungeness crab and Pacific halibut habitat relationships.

Glacier Bay Park

Glacier Bay National Park is a 3.3 million-acre park and preserve that extends from Icy Strait and Cross Sound in the south to the Canadian border in the northwest (Figure 1). In the last 200 years, the large glacier that filled Glacier Bay during late Neoglacial time (commonly referred to as the Little Ice Age, Goldthwait, 1963), has retreated, exposing about 100 km of a spectacular fjord system that has developed over possibly the past 100,000 years (Goldthwait, 1987). As the glacier has retreated, the newly exposed benthic habitat has undergone rapid physical and biological changes making it an ideal site to study glaciology, fjord sedimentation, and species succession (Milner and Woods, 1990; Engstrom, 1995).

Commercial fishing is one of the major sources of income in the adjacent communities. There is also an economically important recreational fishery in the area. But, significant questions have been raised in Congress as to whether fishing should be allowed in Glacier Bay Park. Mapping of the benthic habitat will result in improved management of the fisheries resources in the area,

Klein 2000 Sidescan Surveying System

A Klein 2000 sidescan system was used for geophysical surveying. The unit features 8 channels of processed data, 7 subsurface from the towfish (5 sonar and 2 instrumentation) and 1 surface (external analog input). Two sonar channels each were devoted to 100 KHz and 500 KHz sidescan data and a fifth sonar channel was used for 4KHz subbottom profiling.

Navigation Systems

The 1997 Glacier Bay survey was navigated with a Leica Differential Global Positioning System (DGPS) which provided a position with accuracy of 1-5 m in DGPS mode. At times during the cruise, differential signal was interrupted. In non-differential mode, the receiver provided a position with 30-50 m accuracy. A KVH Industries Inc. azimuth digital gyro-compass provided ship headings with 0.5 degree accuracy. Navigation data were recorded using Yo-Nav version 1.19 (Gann, 1992).

Data Acquisition and Processing

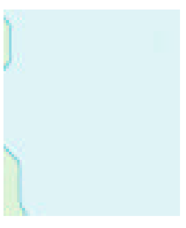
We used the M/V *QUILLBACK*, owned by the United States Minerals Management Service and operated by the National Park Service, for our geophysical surveying. Side-scan-sonar imaging (side-scan) and seismic reflection profiling (profiling) began on October 15 after two days of mobilization and ended October 30 with one day of demobilization. A Triton Elics Isis brand side-scan data recording system was used on the cruise, that simultaneously records 5 channels of data; port and starboard 100 KHz side-scan data, port and starboard 500 KHz side-scan data, and profiler data. Side-scan data shown in this report are 100 KHz data. Typically, 2048 samples were recorded per channel over a swath width of 200-400 m yielding a resolution of 0.1 - 0.5 m of seafloor area for the side-scan data. The resolution of the profiler data is 1-3 m of sub-bottom depth (with penetration of tens of meters in soft sediment and a few meters in harder sediment).

The sidescan-sonar data were processed following the methodology of Danforth et al. (1991, 1997), through use of USGS software packages Xsonar and Showimage. The slant-range, destripe, and beam pattern-processing routines, executed within Xsonar and Showimage, correct geometric and radiometric distortions inherent in the sonar data. The slant-range algorithm removes the water column artifact from the sonograph and corrects slant-range distance to true ground distance; the destripe routine corrects fluctuations in adjacent ping values within the sonar record; the beam pattern routine corrects variations in beam intensity with range. The processed data files were mosaiced to form a composite image using PCI Remote Sensing Software. A linear stretch was applied to the final mosaics to enhance the contrast between low and high backscatter areas. The final mosaics were exported from PCI in TIFF format. The TIFF images were imported into an arc/info database (Geiselman et al., 1997) that contained coastline, geology, and bathymetry coverages.

Figure 1 (125 KBytes)

Sidescan Sonar Mosaic Imagery

The 1997 sidescan images are displayed here. Interpretive efforts are ongoing for each of these areas.



Drake Island (5183 KBytes)

Drake Island (182 KBytes)

Hutchins Bay (6716 KBytes)

Hutchins Bay (244 KBytes)

Strawberry Island (3733 KBytes)

Strawberry Island (222 KBytes)

Bug Bay (8744 KBytes)

Bug Bay (223 KBytes)

Secret Bay (5786 KBytes)

Secret Bay (317 KBytes)

Bartlett Cove (5223 KBytes)

Bartlett Cove (248 KBytes)

Analysis of Side Scan Imagery (An Example)

In a future report, we will characterize the benthic habitat using a combination of the side-scan data, the profiling data, onshore geologic mapping by Brew et al. (1978), and previous marine geology work (e.g. Carlson et al., 1977; Cai et al., 1997). Final interpretations will be in the form of georeferenced habitat polygons which will be combined with the existing Geographic Information System (GIS) database (Geiselman et al., 1997). Our interpretation of the geophysical data will be based on the experience garnered in studying similar acoustic data from Glacier Bay and the Gulf of Alaska (e.g. Carlson et al., 1992, Carlson et al., 1980). We are using a variety of techniques (scuba, delta submersible, rebreathers, drop camera) to visually confirm our interpretation of the geophysical data. We plan to test the predictive value of the interpretation by conducting fish population studies in the areas where the geophysical data interpretations exist.

In this report we present an analysis of the sidescan image collected to the west of Strawberry Island (see above). Based on geologic mapping on Strawberry Island, we know that the surficial sediments are Quaternary age (Brew et al., 1978). Possible interpretations of the sidescan image include layered or structurally deformed bedrock, lateral moraines, or sediments grooved by the passage of large icebergs. A bedrock seafloor habitat will support a much different benthos than that supported by other adjacent bottom types including lateral moraines, or sediments grooved by the passage of large icebergs. Examination of the sub-seafloor seismic data (150 Kbytes) shows a prominent sub-seafloor reflection which rules out exposed bedrock as a possible interpretation, except at two locations where the reflector may intersect the sea floor at distances of 7 m and 68 m. Samples of the rock are needed to define what geologic units underlie the onshore sediment. Sampling, planned next year, with closed-circuit diving equipment (i.e. rebreathers) may provide bedrock samples from the area.

The criss-crossing pattern of grooves seen in the sidescan image east of Strawberry Island rules out lateral moraines as an interpretation of the seafloor habitat. Our preferred interpretation of the data is that the seafloor is composed of coarse sediment grooved by the passage of large icebergs. The earliest period when large icebergs would have calved up stream of this area is when the glacier terminus was in the Strawberry Island area between 1794 and 1845 (American Geographical Society, 1966). Sediment grooving could have occurred in more recent times as icebergs calving further up stream passed Strawberry Island on their way south. Using the habitat characterization scheme of Greene et al. (1995), this habitat would be described as Intermediate shelf, grooved gravel and boulder, flat bottom, with probable winnowing by tidal and riparian currents.

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http://walrus.wr.usgs.gov/docs/projects/glacierbay/opnfil98.html
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