ACCESS NUMBER: M07AC12462

STUDY TITLE: Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area
REPORT TITLE: Recent and Historical Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area
TASK ORDER: M07AC12462 (previously M07AC13416); Report BOEM 2012-073
SPONSORING OCS REGION: Alaska
APPLICABLE PLANNING AREA: Chukchi
FISCAL YEAR(S) OF PROJECT FUNDING: FY07–FY11
COMPLETION DATE OF REPORT: 5-March-2013
COSTS by fiscal year: CUMULATIVE PROJECT COST: FY07 ($36,370), FY08 ($127,731), FY09 ($105,036), FY10 ($70,030), FY11 ($2842); CUMULATIVE: $342,009
PROJECT MANAGER: Brenda L. Norcross
AFFILIATION of project manager: Institute of Marine Science, University of Alaska Fairbanks
ADDRESS: P.O. Box 757220, Fairbanks AK 99775
PRINCIPAL INVESTIGATOR: Brenda L. Norcross
KEY WORDS: Chukchi Sea, Arctic, Lease Sale 193, demersal fishes, historical, long term, Arctic cod, sculpin, Bering flounder, diversity, richness

BACKGROUND:
Assessment of fish resources in the eastern Chukchi Sea is particularly important not only because of the lack of current knowledge but also because of the potential for changes to the ecosystem concurrent with changing climate and anthropogenic use of the region, e.g., oil and gas exploration, fisheries, and vessel use of the area. In the northeastern Chukchi Sea, U.S. Lease Sale 193 area is now being considered for exploration for oil and gas exploration. The accurate characterization of fish presence and abundance in the northeastern Chukchi Sea requires an evaluation of previous collections from the region. Fish are the least well studied component of the Arctic vertebrate fauna. Prior to this report, the majority of information on fishes in the Chukchi Sea was limited to 10 historical surveys conducted from 1959 through 1992, many of which were not readily accessible in electronic format, and 1 cruise that fished 2 types of gear in 2004. The addition of 3 more cruises yielded a total of 15 cruise-gear combinations that collected fishes in 13 years over a 50-year time frame, 1959–2008, from which we could analyze presence/absence of fish taxa.

OBJECTIVES:
- Trawl and retain demersal fishes in the eastern Chukchi Sea in 2007 and 2008.
- Combine Chukchi demersal fish data from all available fish collections that used identical fishing gear during 2004–2008 to document recent species abundance, distribution, geographic range, species assemblages, and habitat parameters in the offshore eastern Chukchi Sea.
- Determine and compare physical characteristics of the habitats that define demersal fish communities.
- Compare recent (2004–2008) and historical (1990–1991) demersal fish communities in and near the Chukchi Sea Lease Sale 193.
- Review and correct the identification of fish specimens from historical 1959–1992 collections in the northeastern Chukchi Sea, which presently are archived in museums in the U.S., Canada, Japan, and Russia, to allow for accurate comparison with recent collections.
- Incorporate recent and historical scientific fish collection data from the eastern Chukchi Sea into an electronic database (Chukchi Demersal Fish Database provided to BOEM).
- Analyze historical distribution patterns of demersal fish communities in the eastern Chukchi Sea.

DESCRIPTION:
New collections of demersal fishes were made in the eastern Chukchi Sea during cruises in August 2007, September 2007, and July 2008 (Figure 1). Fishes were collected with the same small bottom trawl that was used during the RUSALCA-2004 cruise, i.e., a 3.05 m plumb staff beam trawl with 7 mm mesh in the body and 4 mm mesh in the codend.

A database was developed from historical offshore collections of demersal fishes in the eastern Chukchi Sea (Figure 1). This database included demersal fish presence, abundance, biomass, and associated habitat parameters. Data encompassed all offshore demersal fish collections that entered Lease Sale 193. Data contributing to this database were gathered from online electronic sources, published peer-reviewed literature, project reports (grey literature), and from specimens found in museums.

STUDY RESULTS:
New collections in 2007 and 2008 provide information about fishes currently in the Chukchi Sea and about the composition of fish communities. We collected 14,266 fishes by small bottom trawl at 60 stations in the Bering Strait and eastern Chukchi Sea during 4 recent cruises (2004–2008). Catches were predominantly (>80% by number) sculpins, pricklebacks, cods, and flatfishes. At least 51 taxa were captured, composing 14 taxonomic families. No single species dominated any of the 4 recent cruises, and the most abundant species was never Arctic cod, which it had been in during historical cruises in 1990 and 1991 that used a larger bottom trawl.

There were 15 different cruise-gear combinations that collected fishes in 13 years in a 50-year time frame, 1959–2008, from which we analyzed presence/absence of fish taxa. Fifteen demersal fish taxa made up 99% of all fish captured, and these taxa dominated the eastern Chukchi Sea over 50 years. Cumulative relative abundance, i.e., using all types of demersal collection gear, of fishes was comprised of 5 families: cods – 69%, sculpins – 20%, pricklebacks – 5%, flatfishes – 4%, and eelpouts – <1%. Catch of fishes was significantly different among decades, years and months. Catch of fishes differed with depth of capture, bottom temperature, salinity, water mass, and sediment type, but not all had an effect on each collection.

SIGNIFICANT CONCLUSIONS:
This project is a major advance in knowledge of fish abundance and assemblages in the Chukchi Sea. No single physical variable always influences the composition of demersal fish assemblages. Bottom temperature most often has an effect, though depth, salinity or water mass may at times affect composition of demersal fish assemblages. Catches of Arctic cod (*Boreogadus saida*) were not as large during 2004–2008 as during 1990–1991. This may be a true change over time, or it quite likely may be an artifact of gear. Although gear affects the number of fishes captured, the dominant fishes caught are the same in recent and historical collections: Arctic cod, shorthorn sculpin (*Myoxocephalus scorpius*), Arctic staghorn sculpin (*Gymnocanthus tricuspis*), eelpouts (*Lycodes* spp.), Bering flounder (*Hippoglossoides robustus*) and saffron cod (*Eleginus gracilis*).

Year, month, and physical parameters at location of collections are important determinants of fish abundance and assemblage compositions and should be considered when designing studies to test effects of physical factors on fish populations. Using smaller mesh nets to collect fishes in the eastern Chukchi Sea produces greater richness and diversity indices, i.e., more fish taxa are collected because small taxa are retained. There appears to have been an increase in fish diversity in recent years. Low indices of richness and evenness, which typify low stability communities, are observed in the northern region of Lease Sale 193. These low indices may, in part, be due to the few samples collected here. Fish diversity is highest at and straight north of Bering Strait, including the southwest portion of Lease Sale 193. High indices of richness and evenness in this area are indicative of high community stability. Variability in year, month and location of collections analyzed in this study confounds interpretation of effect on fish of physical environment factors, i.e., temperature, salinity, depth and water mass. Although our analyses of fishes over the 50-year time frame (1959–2008) are based on presence, not abundance, the use of various trawl nets during this time confounds interpretation of results. Caution should be exercised when interpreting all results because of small and large scale spatial and temporal variability in historical fish collections. Based on this study, we recommend that a consistent monitoring of fish and associated oceanographic variables in Lease Sale 193 be conducted with the same trawl gear, in late August every 3–5 years.

STUDY PRODUCTS:

Norcross, B. L., B. A. Holladay, and C. W. Mecklenburg. 2012. Recent and Historical Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area. Final Report to the Coastal Marine Institute, Task Order M07AC13416, OCS Study BOEM 2012-073, Fairbanks Alaska.

Norcross, B. L., and B. A. Holladay. 2010. Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area. CMI Annual Report: September 2008 – December 2009, 11 p + Figures.

Bluhm, B.A., K. Iken, S. Mincks Hardy, B. I. Sirenko, and B. A. Holladay. 2009. Community structure of epibenthic megafauna in the Chukchi Sea. Aquatic Biology Vol. 7: 269–293. *doi: 10.3354/ab00198.*

Norcross, B. L., and B. A. Holladay. 2008. Current and Historic Distribution and Ecology of Demersal Fishes in the Chukchi Sea Planning Area. CMI Annual Report: May 2007 – September 2008, 17 p + Figures.

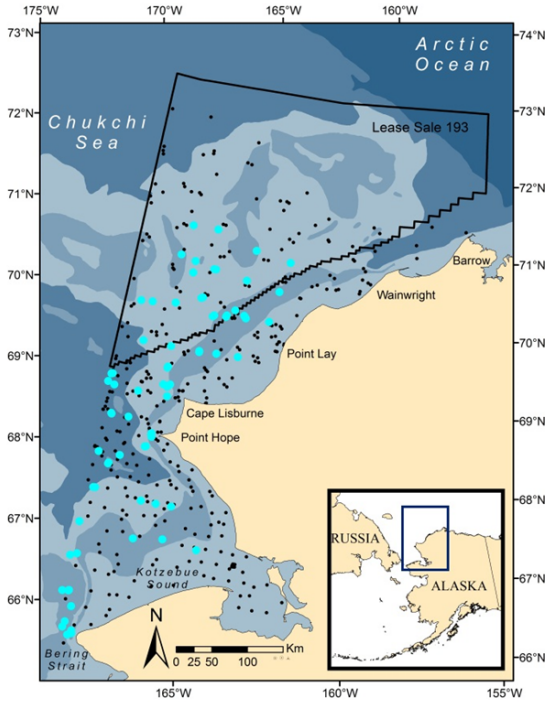

Figure 1. Chukchi Lease Sale 193, fish collection sites examined during 2007–2008 (blue dots) and fish collection sites examined during 1959–2004 (black dots). 2007–2008 collections were funded as part of the present research.