

1999 Annual Progress Report to CIFAR

Ecosystem analysis and modeling of eastern and western Bering Sea living marine resources

Richard J. Marasco and Patricia A. Livingston
Alaska Fisheries Science Center
7600 Sand Point Way NE.
Seattle, WA 98115 USA

Vladimir I. Radchenko,
Pacific Research Institute of Fisheries and Oceanography (TINRO)
4 Shevchenko Alley
Vladivostok
Russia 690600

Objectives

The Alaska Fisheries Science Center (AFSC) and the Russian Pacific Institute of Fisheries and Ocean Research (TINRO) have each been conducting ecosystem studies in their respective sides of the Bering Sea. It is evident from the published Russian literature and data listings provided to the National Marine Fisheries Service that Russian researchers have data on the abundances and trophic links of marine ecosystem components in the western Bering Sea. Similarly, scientists on the eastern side of the Pacific have been updating energy flow models of the eastern Bering Sea shelf. Unfortunately, there have never been any joint integrative studies looking at the ecosystem production of the Bering Sea as a whole. TINRO scientists have shown that there may be alternating production states of the western Bering Sea, characterized by very different amounts of pollock production. Walleye pollock is a key species in the Bering Sea ecosystem that may be the main upper trophic level species to benefit from the enhanced production of the Bering Sea green belt. The goal of this project is to elucidate ecosystem production and pathways in the eastern and western Bering Sea shelf and slope regions through the development and comparison of mass-balance models of these areas.

Methods

A mass-balance model of the eastern Bering Sea has already been developed for the 1980s period. This project focuses on 1) development of a similar model for the western Bering Sea by Russian researchers and 2) comparison of the two models in a US-Russian workshop.

The first step in development of a mass-balance model of the 1980s western Bering Sea shelf is to evaluate and retrieve data on the western Bering Sea ecosystem. The main

data to be retrieved are those of phytoplankton, zooplankton, benthos, and fish stomach contents that reside in publications, files, and archives of former Soviet Union agencies. Some of these data from paper media are being compiled into computer databases. The second step is to use these data in the estimation of biomass, diet composition, daily ration, and production of western Bering Sea ecosystem components for the 1980's and then using ECOPATH software to evaluate mass-balance in the system.

Finally, the eastern and western Bering Sea models will be compared with respect to amounts and rates of energy transfer between ecosystem components Bering Sea. By using the same model, we can put our estimates in comparable terms and provide a forum for discussing our respective parameter estimates and methods and sources of information for obtaining the estimates.

Main Results

A plankton database on the western Bering Sea was completed, which contains the results of five research cruises conducted from 1987-1991 where species composition and biomass of small (<1.5mm), medium (1.5-3.5mm), and large (>3.5 mm) plankton were determined. Databases on other ecosystem components are now being prepared and are partly completed.

Complex expeditions in the western and central Bering Sea, data of which are available in the planktonic database

No.	R/v names:	Survey terms:	Survey area, km ² x 10 ³ :	Station number, hauls in 0-200 m layer
2	Gnevny	6.08-22.10.1987	708.0	231
4	Professor Soldatov	23.5-11.7.1989	896.5	174
5	Mlechny Put	9.4-26.6.1990	896.5	163
6	Professor Soldatov	30.9-18.11.1990	896.5	133
7	Professor Kaganovsky	22.6-5.7.1991	378.3	38

Remark: Total number of records (lines) is equal to total station numbers: 739

The lower trophic level ecosystem components are also now well defined with respect to parameter estimation and descriptions for inclusion in the western Bering Sea ECOPATH model. Detailed descriptions of the phytoplankton, bacterioplankton, microzooplankton, and large zooplankton components have been completed. Below is a table summarizing the main ECOPATH parameters for these lower trophic level groups.

ECOPATH parameters describing the 1980s western Bering Sea ecosystem

Functional group	Biomass (t/km ²)	P/B (year ⁻¹)	Q/B (year ⁻¹)	Catch (t/ km ²)
Phytoplankton	11	139	0	0
Bacteria	3,3	180	0	0

Microzooplankton	1,4	170	1,8	0
Large zooplankton,	217,4	7,62	26,2	0
inc. euryphagous	130,4	10,3	33,1	0
inc. predatory	87,0	3,6	15,8	0

A list of literature sources for parameterizing the western Bering Sea ECOPATH model is also being compiled. This list presently consists of almost 200 references in both Russian and English with references still being added. TINRO scientists are now systematically compiling the results of research cruises on fishes and commercially important invertebrates. These data are stored in the TINRO center archives as survey reports, the results of which were previously not summarized in a consistent manner. As in the eastern Bering Sea, data on most whales and small benthos have not been collected frequently in recent years. However, there are published reports and data from brief observation periods that can be relied on to provide initial parameter estimates for the model.

We anticipate completion of initial parameterization of the western Bering Sea mass-balance model by this fall. A workshop for comparing the eastern and western Bering Sea ECOPATH models is presently scheduled to be held on October 8-9, 1999 just prior to the PICES annual meeting in Vladivostok, Russia. Final balancing of the western Bering Sea model will be done at the workshop and ecosystem characteristics of the two systems will be explored and compared. The results of the workshop will be compiled into a final report.