

A UNITED STATES
DEPARTMENT OF
COMMERCE
PUBLICATION

NOAA Technical Report NMFS SSRF-680

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Marine Biological Laboratory
LIBRARY

NOV 12 1974

Woods Hole, Mass

Pelagic Amphipod Crustaceans from the Southeastern Bering Sea, June 1971

GERALD A. SANGER

NOAA TECHNICAL REPORTS

National Marine Fisheries Service, Special Scientific Report—Fisheries Series

The major responsibilities of the National Marine Fisheries Service (NMFS) are to monitor and assess the abundance and geographic distribution of fishery resources, to understand and predict fluctuations in the quantity and distribution of these resources, and to establish levels for optimum use of the resources. NMFS is also charged with the development and implementation of policies for managing national fishing grounds, development and enforcement of domestic fisheries regulations, surveillance of foreign fishing of United States coastal waters, and the development and enforcement of international fishery agreements and policies. NMFS also assists the fishing industry through marketing service and economic analysis programs, and mortgage insurance and vessel construction subsidies. It collects, analyzes, and publishes statistics on various phases of the industry.

The Special Scientific Report—Fisheries series was established in 1949. The series carries reports on scientific investigations that document long-term continuing programs of NMFS, or intensive scientific reports on studies of restricted scope. The reports may deal with applied fishery problems. The series is also used as a medium for the publication of bibliographies of a specialized scientific nature.

NOAA Technical Reports NMFS SSRF are available free in limited numbers to governmental agencies, both Federal and State. They are also available in exchange for other scientific and technical publications in the marine sciences. Individual copies may be obtained (unless otherwise noted) from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, D.C. 20235. Recent SSRF's are:

619. Macrozooplankton and small nekton in the coastal waters off Vancouver Island (Canada) and Washington, spring and fall of 1963. By Donald S. Day. January 1971, iii + 94 pp., 19 figs., 1 table.
620. The Trade Wind Zone Oceanography Pilot Study. Part IX. The sea-level wind field and wind stress values, July 1963 to June 1965. By Gunter R. Seckel. June 1971, iii + 66 pp., 5 figs.
621. Predation by sculpins on fall chinook salmon, *Oncorhynchus tshawytscha*, fry of hatchery origin. By Benjamin G. Patten. February 1971, iii + 14 pp., 6 figs., 9 tables.
622. Number and lengths, by season, of fishes caught with an otter trawl near Woods Hole, Massachusetts, September 1961 to December 1962. By F. E. Lux and F. E. Nichy. February 1971, iii + 15 pp., 3 figs., 19 tables.
623. Apparent abundance, distribution, and migrations of albacore, *Thunnus alalunga*, in the North Pacific longline grounds. By Brian J. Rothschild and Marian Y. Y. Yong. September 1971, v + 37 pp., 19 figs., 7 tables.
624. Influence of mechanical processing on the quality and yield of bay scallop meats. By N. B. Webb and F. B. Thomas. April 1971, iii + 11 pp., 9 figs., 3 tables.
625. Distribution of salmon and related oceanographic features in the North Pacific Ocean, spring 1958. By Robert R. French, Richard G. Bakkala, Masanae Osako, and Jun Ito. March 1971, iii + 22 pp., 19 figs., 3 tables.
626. Commercial fishery and biology of the freshwater shrimp, *Macrobrachium*, in the Lower St. Paul River, Liberia, 1952-53. By George C. Miller. February 1971, iii + 13 pp., 8 figs., 7 tables.
627. Calico scallops of the Southeastern United States, 1959-69. By Robert Cummins, Jr. June 1971, iii + 22 pp., 6 figs., 3 tables.
628. Fur Seal Investigations, 1969. By NMFS, Marine Mammal Biological Laboratory. August 1971, 82 pp., 21 figs., 44 tables, 23 appendix A tables, 10 appendix B tables.
629. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967. By Richard N. Uchida and Ray F. Sumida. March 1971, v + 25 pp., 14 figs., 21 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
630. Blue crab meat. I. Preservation by freezing, July 1971, iii + 13 pp., 5 figs., 2 tables. II. Effect of chemical treatments on acceptability. By Jurgen H. Strasser, Jean S. Lennon, and Frederick J. King. July 1971, iii + 12 pp., 1 fig., 9 tables.
631. Occurrence of thiaminase in some common aquatic animals of the United States and Canada. By R. A. Greig and R. H. Gnaedinger. July 1971, iii + 7 pp., 2 tables.
632. An annotated bibliography of attempts to rear the larvae of marine fishes in the laboratory. By Robert C. May. August 1971, iii + 24 pp., 1 appendix I table, 1 appendix II table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
633. Blueing of processed crab meat. II. Identification of some factors involved in the blue discoloration of canned crab meat (*Callinectes sapidus*). By Melvin E. Waters. May 1971, iii + 7 pp., 1 fig., 1 table.
634. Age composition, weight-length, and sex of herring, *Clupea pallasii*, used for reduction in Alaska, 1929-66. By Gerald M. Reid. July 1971, iii + 25 pp., 4 figs., 18 tables.
635. A bibliography of the blackfin tuna, *Thunnus atlanticus* (Lesson). By Grant L. Beardsley and David C. Simmons. August 1971, 10 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
636. Oil pollution on Wake Island from the tanker *R. C. Stoner*. By Reginald M. Gooding. May 1971, iii + 12 pp., 8 figs., 2 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
637. Occurrence of larval, juvenile, and mature crabs in the vicinity of Beaufort Inlet, North Carolina. By Donnie L. Dudley and Mayo H. Judy. August 1971, iii + 10 pp., 1 fig., 5 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
638. Length-weight relations of haddock from commercial landings in New England, 1931-55. By Bradford E. Brown and Richard C. Hennemuth. August 1971, v + 11 pp., 16 figs., 6 tables, 10 appendix A tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
639. A hydrographic survey of the Galveston Bay system, Texas 1963-66. By E. J. Pullen, W. L. Trent, and G. B. Adams. October 1971, v + 13 pp., 15 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
640. Annotated bibliography on the fishing industry and biology of the blue crab, *Callinectes sapidus*. By Marlin E. Tagatz and Ann Bowman Hall. August 1971, 94 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
641. Use of threadfin shad, *Dorosoma petenense*, as live bait during experimental pole-and-line fishing for skipjack tuna, *Katsuwonus pelamis*, in Hawaii. By Robert T. B. Iversen. August 1971, iii + 10 pp., 3 figs., 7 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
642. Atlantic menhaden *Brevoortia tyrannus* resource and fishery—analysis of decline. By Kenneth A. Henry. August 1971, v + 32 pp., 40 figs., 5 appendix figs., 3 tables, 2 appendix tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
643. Surface winds of the southeastern tropical Atlantic Ocean. By John M. Steigener and Merton C. Ingham. October 1971, iii + 20 pp., 17 figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
644. Inhibition of flesh browning and skin color fading in frozen fillets of yelloweye snapper (*Lutjanus cyanus*). By Harold C. Thompson, Jr., and Mary H. Thompson. February 1972, iii + 6 pp., 3 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
645. Traveling screen for removal of debris from rivers. By Daniel W. Bates, Ernest W. Murphey, and Martin G. Beam. October 1971, iii + 6 pp., 6 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
646. Dissolved nitrogen concentrations in the Columbia and Snake Rivers in 1970 and their effect on chinook salmon and steelhead trout. By Wesley J. Ebel. August 1971, iii + 7 pp., 2 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
647. Revised annotated list of parasites from sea mammals caught off the west coast of North America. By L. Margolis and M. D. Dailey. March 1972, iii + 23 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Continued on inside back cover.



U.S. DEPARTMENT OF COMMERCE

Frederick B. Dent, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Robert M. White, Administrator

NATIONAL MARINE FISHERIES SERVICE

Robert W. Schoning, Director

NOAA Technical Report NMFS SSRF-680

**Pelagic Amphipod Crustaceans from
the Southeastern Bering Sea,
June 1971**

GERALD A. SANGER



SEATTLE, WA

July 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

CONTENTS

	Page
Introduction	1
Methods	1
Results	2
Annotated species list	3
<i>Cyphocaris anonyx</i> Boeck	3
<i>Cyphocaris challengerii</i> Stebbing	3
<i>Lanceola sayana</i> Bovallius	3
<i>Scina borealis</i> (Sars)	3
<i>Scina stebbingi</i> Chevreux	3
<i>Scina rattrayi</i> Wagler	3
<i>Vibilia</i> sp. (<i>V. caeca</i> Bulycheva?)	6
<i>Paraphronima crassipes</i> Claus	6
<i>Hyperia medusarum</i> (O. F. Müller)	6
<i>Hyperoche medusarum</i> (Krøyer)	6
<i>Parathemisto pacifica</i> Stebbing	6
<i>Parathemisto libellula</i> (Lichtenstein)	7
<i>Phronima sedentaria</i> (Forskål)	7
<i>Primno macropa</i> Guerin	7
Acknowledgments	7
Literature cited	7

Figures

1. Southeastern Bering Sea, showing the extent of drift of the 10-m parachute drogue between 0700 on 8 June and 1300 on 9 June 1971. Repetitive bongo net hauls were made at the drogue throughout the period, in an attempt to sample the same parcel of water in real time
2. Estimated numbers of amphipods per 1,000 m³ of water strained, as a function of time of day
3. Relative abundance and numbers of species of amphipods per haul, as a function of time of day

Tables

1. Location and dates of plankton hauls and associated sampling data for station No. 6 of RV *George B. Kelez*, Cruise K71-3, June 1971
2. Amphipod species collected in the southeastern Bering Sea on 8-9 June 1971 (RV *George B. Kelez*, Cruise K71-3) and in July 1971 (MV *Don Edwards*, Cruise DE-4)
3. Numbers, relative abundance, and estimated numbers per 1,000 m³ of amphipods collected at station No. 6 during RV *George B. Kelez*, Cruise K71-3, June 1971

Pelagic Amphipod Crustaceans from the Southeastern Bering Sea, June 1971

GERALD A. SANGER¹

ABSTRACT

Fourteen species of pelagic amphipods were present in zooplankton samples collected from the southeastern Bering Sea in June 1971. *Parathemisto pacifica* strongly dominated relative abundance (68-96%) and was present in numbers up to an estimated 2,755/1,000 m³ of water. *Primno macropa* was the only other species present in all hauls and ranged from 4 to 27% in relative abundance. *Cyphocaris challengeri* was present in numbers up to 48/1,000 m³ during night hauls, but only one animal was taken in all daylight hauls. *Hyperia medusarum* was present in 14 (82%) of the hauls but accounted for less than 1% of the total numbers.

A presumed diurnal vertical migration was evidenced for *Primno macropa*, *Cyphocaris challengeri*, and possibly for *Scina rattrayi*, *Hyperoche medusarum*, and *Hyperia medusarum*.

The occurrence of *Scina stebbingi*, *S. rattrayi*, *Vibilia caeca* (?), *Paraphronima crassipes*, *Phronima sedentaria*, and *Primno macropa* extended their known ranges in the Bering Sea eastward, and the occurrence of *Cyphocaris ananyx* represents a new record for the Bering Sea.

INTRODUCTION

Cruise K71-3 of the RV *George B. Kelez* (Northwest Fisheries Center, National Marine Fisheries Service, Seattle, Wash.) was conducted in the southeastern Bering Sea from 21 May through 11 June 1971. One objective of the cruise was to survey the diurnal variation in kinds of zooplankton occurring in the upper layers of this biologically little-known area. To this end, a series of 18 hauls was made at a floating position-reference buoy (see below) over a 30-hr period on 8-9 June (Fig. 1).

This report lists the species of amphipod crustaceans collected and discusses aspects of their diurnal variation in numbers and occurrence during the 30-hr period. A few selected amphipods collected by the International North Pacific Halibut Commission east of the K71-3 cruise area in July 1971 are also noted and briefly discussed.

METHODS

A transponding telemetering buoy, attached to a parachute drogue at a 10-m depth, was released on 8 June to provide a reference point for monitoring various oceanographic parameters of the same parcel of water in real time. Zooplankton samples were collected with a "bongo" net array, which consisted of two 60-cm (mouth diameter) and two 20-cm frames, one each equipped with nets of 0.333-mm and

0.505-mm mesh. A 122-cm Braincon[®] V-fin depressor was used, and TSK[®] flowmeters were mounted outside the array and in the mouth of its 60-cm, 0.333-mm mesh net. Towing depths were monitored with a model 1170 Benthos[®] time-depth recorder.

Tows were oblique between the surface and a nominal maximum depth of 200 m. Tows were at speeds

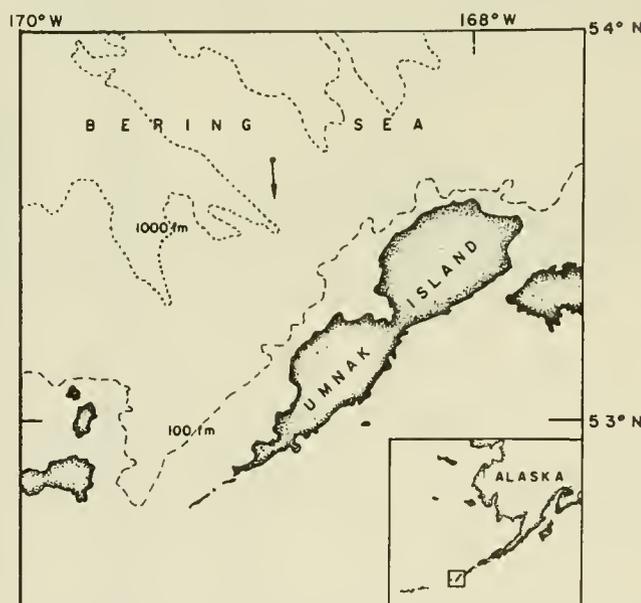


Figure 1.—Southeastern Bering Sea, showing the extent of drift of the 10-m parachute drogue between 0700 on 8 June and 1300 on 9 June 1971. Repetitive bongo net hauls were made at the drogue throughout.

¹Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112; present address: Marine Mammal Division, Northwest Fisheries Center, National Marine Fisheries Service, NOAA, Naval Support Activity, Bldg. 192, Seattle, WA 98115.

of 1.5, 3.0, and 4.5 knots, as estimated by a taffrail log, and were repeated in succession throughout the 30-hr period. Haul positions, local time, and other data for this series are listed in Table 1. Samples were preserved at sea with sodium acetate-buffered formaldehyde of about 3.7%. This report is largely restricted to the amphipods from the 60 cm, 0.333-mm mesh net.

RESULTS

Problems such as malfunctions of the flowmeter, net damage, and uncertainty of towing speeds (as measured by the taffrail log) place limitations on the data from six of the hauls (numbers 2, 8, 12, 13, 14, 18) as noted in Table 1. Also, the varying actual depths of the hauls limit the validity of direct comparisons among them. However, general trends in numbers and diurnal occurrence of some species are evident.

Table 2 lists the species identified. The higher taxa follow the classification of Bowman and Gruner (1974). Fourteen species were present in the samples, in 10 genera and 8 families. Two of these were Gammarideans and the rest of the suborder Hyperiidea.

Table 3 summarizes by haul, the numbers collected of each species, their relative abundance, estimated number per 1,000 m³ of water, and their overall relative abundance and rate of occurrence. Numbers were clearly dominated by *Parathemisto pacifica*, which formed 87.2% of all amphipods collected. *Primno*

macropa comprised 10.1% of the total and was the only species besides *Parathemisto pacifica* present in all hauls. *Cyphocaris challengerii* formed 1.6% of all amphipods taken but, except for one specimen, was present only in the night hauls. *Hyperia medusarum* was present in 14 (82%) of the hauls but accounted for less than 1% of the total numbers.

The diurnal variation in estimated numbers per 1,000 m³ of water strained is shown in Figure 2. Except for *Parathemisto pacifica*, maximum combined numbers of the other species occurred at night, just before 0100 on 9 June. Peak numbers of *P. pacifica* occurred at 1000 on 9 June, but numbers otherwise varied from haul to haul, with no diurnal trend evident. Numbers of *C. challengerii*, and to a lesser extent *Primno macropa* and *H. medusarum*, increased at night. This was presumably due to vertical migration, but daytime avoidance of the net is also a possibility.

Figure 3 depicts the diurnal variations in relative abundance and total number of species per haul. The relative abundance was strongly dominated by *Parathemisto pacifica* throughout the study period, although it fell to 68% during the two hauls between midnight and 0100. At that time maximum relative abundance of *Primno macropa* (27.4%) and *C. challengerii* (13.5%) were observed. The maximum number of species per haul (8) occurred at 0200.

The drogue travelled about 6 miles during the sampling (Fig. 1), and surface conditions suggest that it

Table 1.—Location and dates of plankton hauls¹ and associated sampling data for station no. 6 of RV *George B. Kelez*, Cruise K71-3, June 1971.

Date	Haul no.	Position		Local time	Max. depth (m)	Water volume filtered (m ³)	
		Lat. N.	Long. W.				
8 June:	1	53°40'	168°53'	0705-0736	163	544.6	
	2	53°40'	168°53'	0842-0917	200	² (792.2)	
	3	53°40'	168°53'	1013-1049	178	948.2	
	4	53°40'	168°53'	1131-1202	162	632.5	
	5	53°36'	168°52'	1319-1359	180	435.3	
	6	53°36'	168°52'	1444-1522	168	1,463.5	
	7	53°36'	168°52'	1628-1658	165	485.7	
	8	53°36'	168°52'	1844-1928	200	³ (918.0)	
	9	53°36'	168°52'	2003-2039	225	631.5	
	10	53°35'	168°52'	2108-2140	215	493.8	
	11	53°35'	168°52'	2216-2255	205	868.4	
	9 June:	12	53°35'	168°52'	2325-0002	201	⁴ (853.1)
13		53°35'	168°52'	0038-0109	185	³ (333.5)	
14		53°35'	168°52'	0141-0221	212	⁴ (933.8)	
15		----- No sample; net badly torn -----					
16		53°34'	168°52'	0948-1020	200	408.3	
17		53°34'	168°52'	1050-1130	176	580.9	
18		53°34'	168°52'	1236-1312	181	⁴ (990.2)	

¹Zooplankton collected with 60 cm bongo net of 0.333-mm mesh.

²Value estimated; towing time uncertain.

³Value estimated; based on ship's speed.

⁴Net damaged during tow.

tracked approximately the same parcel of water. The surface salinity ranged from 33.11 to 33.15‰ and the surface temperature ranged from 4.1 to 4.5°C, as measured by a constantly recording salinothermograph.

ANNOTATED SPECIES LIST

Below are notes on each species, including total numbers collected, lengths when available, relative abundance, and taxonomic notes. Where pertinent, remarks on diurnal variation in numbers or occurrence are made, as well as comments on the species' occurrences in relation to previously known depth and geographic distributions.

Abbreviations used are: P = pereopod; S = segment; A = antennae.

Cyphocaris anonyx Boeck

One specimen in one haul. Length: 3.4 mm.

Guryanova (1962) stated that *Cyphocaris anonyx* "... inhabits a depth of no less than 500 m," and Birstein and Vinogradov (1958) consider it a species of the "upper deep-water subzone," although they did take it in one haul of 0-600 m. The occurrence of the present specimen in a 0-212 m haul is thus somewhat unusual.

The present specimen is a first record for the Bering Sea and represents a northward range extension from lat. 43°N in the North Pacific (Guryanova, 1962).

Cyphocaris challengerii Stebbing

One hundred and six (106) specimens in seven hauls. Length: up to 16.7 mm.

This species is the most common epipelagic gammaridean amphipod in the subarctic Pacific (Bowman and McCain, 1967). Its occurrence was limited to hauls between about 2015 on 8 June and 0200 on 9 June, suggesting a diurnal vertical migration. Bowman and McCain reported that it was caught mainly at night off Oregon and California, and attributed this to a diurnal vertical migration. Maximum numbers of our specimens occurred at night, when they comprised 13% of the total catch during haul 12 and when an estimated concentration of 48/1,000 m³ was encountered during haul 13.

Birstein and Vinogradov (1955) reported the species from the western Bering Sea near the Commander Islands at about lat. 58°N, and Thorsteinson (1941) reported it from about lat. 57°30'N in the Gulf of Alaska.

Lanceola sayana Bovallius

One specimen in one haul. Length: 9.7 mm; female.

Vinogradov (1957) noted that this species is usually taken at depths over 1,000 m, although it frequently occurs in surface catches at night. Bulycheva (1955)

Table 2.—Amphipod species collected in the southeastern Bering Sea on 8-9 June 1971 (RV *George B. Kelez*, Cruise K71-3) and in July 1971 (MV *Don Edwards*, Cruise DE-4).

Suborder Gammaridea

Lysianassidae

Cyphocaris anonyx Boeck, 1871

Cyphocaris challengerii Stebbing, 1888

Suborder Hyperiidea

Tribe Physosomata

Lanceolidae

Lanceola sayana Bovallius, 1885

Scinidae

Scina borealis (G. Sars, 1882)

Scina stebbingi Chevreux, 1919

Scina rattrayi Wagler, 1926

Tribe Physocephalata

Vibilliidae

Vibilia caeca Bulycheva, 1955 (?)

Paraphronimidae

Paraphronima crassipes Claus, 1879

Hyperiididae

Parathemisto pacifica Stebbing, 1888

Parathemisto libellula (Lichenstein, in Mandt, 1822)

Hyperoche medusarum (Krøyer, 1838)

Hyperia medusarum (Müller, 1776)

Anchylomeridae

Primno macropa Guerin, 1863

Phronimidae

Phronima sedentaria (Forskäl, 1775)

reported the species from the western Bering Sea, but stated that it was absent from the western North Pacific Ocean off the Kurile Islands. Thorsteinson (1941) did not report it in catches from the eastern North Pacific Ocean.

The telson of this specimen is relatively short, but it fits Vinogradov's (1957) description of *L. sayana* in other respects.

Scina borealis (Sars)

Four specimens in three hauls. Length: 1.6-7.5 mm.

The species is reported as common in the Arctic (Vinogradov, 1957) and off California (Hurley, 1956). Thorsteinson (1941) reported it from the Gulf of Alaska and coastal British Columbia, Canada.

Scina stebbingi Chevreux

Three specimens in one haul. Lengths: 1.6, 4.5, and 4.8 mm; latter two males.

Vinogradov (1957) reported only one specimen, but stated "It is known only from the southwestern Bering Sea to latitude 58°08'N."

Scina rattrayi Wagler

Two specimens in two hauls. Length: 4.4 and 5.9 mm; males. Another male from a 0.505-mm net sample.

Table 3.—Numbers, relative abundance, and estimated numbers per 1,000 m³ of amphipods collected at station No. 6 during RV *George B. Kelez*, Cruise K71-3, June 1971.—Continued.

Species	Parameter	Haul number ^a																	Total col-lected	Rela-tive abun-dance ^b (%)	Occurrence rate ^c No. %
		1	(2)	3	4	5	6	7	(8)	9	10	11	(12)	(13)	(14)	16	17	(18)			
<i>Parathemisto pacifica</i>	Numbers ^d	319	328	200	119	167	344	309	195	244	362	238	202	459	483	1,125	399	196			
	Relative abundance (%)	94.9	90.1	88.1	90.8	85.2	90.8	93.6	87.8	81.3	90.3	67.8	68.5	85.8	75.1	95.7	94.1	89.9			
	No./1,000 m ³	585.7	414.0	209.9	188.2	383.7	235.0	636.2	212.4	386.4	733.0	274.1	236.8	1,376.2	517.3	2,755.1	686.9	197.9			
<i>Hyperoche medusarum</i>	Numbers							1				1									
	Relative abundance (%)							0.3				0.3									
<i>Hyperia medusarum</i>	Numbers	1	5	5	2	1	2	7	2	7	3	1	9	7	1	1	2				
	Relative abundance (%)	0.3	1.4	2.2	1.0	0.3	0.9	2.0	0.8	0.3	1.7	1.1	<0.1	0.2	0.6	0.6	0.6	0.6			
	No./1,000 m ³	1.8	6.3	5.3	4.6	0.7	2.2	7.9	3.4	1.2	27.0	7.5	2.4	1.7	2.0						
<i>Primo macropa</i>	Numbers	16	31	21	12	27	34	19	21	45	34	96	53	50	115	48	22	17			
	Relative abundance (%)	4.8	8.5	9.2	9.2	13.8	9.0	5.8	9.4	15.0	8.5	27.4	18.0	9.3	17.9	4.1	5.2	7.8			
	No./1,000 m ³	29.4	39.1	22.1	19.0	62.0	23.2	39.1	22.9	71.2	68.8	110.6	62.1	149.9	123.2	117.5	37.9	17.2			
<i>Phronima sedentaria</i>	Number																	1			
	Relative abundance (%)																	0.4			
Total	Numbers	336	364	227	131	196	379	330	222	300	401	351	295	535	643	1,175	424	217			
	Relative abundance (%) ^e	5.1	5.6	3.5	2.0	3.0	5.8	5.0	3.4	4.6	6.1	5.4	4.5	8.2	9.8	18.0	6.5	3.3			
	No./1,000 m ³	616.9	459.4	239.4	207.1	450.3	259.0	679.4	241.8	475.0	812.0	404.2	345.8	1,604.1	688.6	2,877.6	729.9	220.2			

^a Quantitative data from hauls in parentheses are questionable; see Table 1 footnotes.

^b Overall relative abundance (%).

^c Occurrence rate; frequency of occurrence in the 17 hauls.

^d Plus "preimmature" in hauls follows: 7=10; 9=208; 10=40; 11=256; 12=31; 13=91; 14=41; 16=15; 17=1; 18=26.

^e Relative abundance of No./1,000 m³ for haul, of total for all hauls.

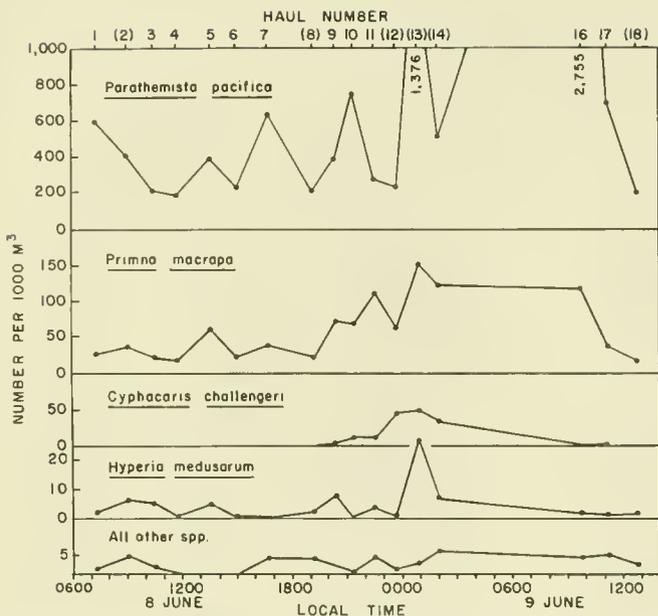


Figure 2.—Estimated numbers of amphipods per 1,000 m³ of water strained, as a function of time of day.

Vinogradov (1957) reported this species from the southwestern Bering Sea.

Vibilia sp. (*V. caeca* Bulycheva ?)

Six specimens in four hauls. Length: 3.6-5.5 mm.

The identification of these specimens is in question, because of the confused taxonomic status of *V. caeca*; the original description (Bulycheva, 1955) is sketchy at best. The only other reference to *V. caeca* (Vinogradov, 1956) differs somewhat from the original description. Also, the distinctions between *V. caeca* and *V. australis* var. *pelagica*, which like *caeca* is eyeless, need to be clarified.

Paraphronima crassipes Claus

Two specimens in two hauls, plus one other from the 0.505-mm mesh net in a third haul (no. 13). Lengths: 6.7, 7.1, 8.1 mm.

Vinogradov (1956) reported the species from lat. 59°00'N in the western Bering Sea.

Hyperia medusarum (O. F. Müller)

Forty-seven specimens in 14 hauls, plus three others from the 0.505-mm mesh net or International Pacific Halibut Commission samples. Length: up to 23.8 mm.

Bowman (1973) described two forms of this species, *hystrix*-form and *medusarum*-form, based in part on the spine armature of P 1 and P 2; *medusarum*-form has more and relatively longer spines on S 6 than *hystrix*-form. Bowman implies that *medusarum*-form may be associated with coastal scyphomedusae and *hystrix*-form with offshore ones.

Of the 47 specimens taken in the diurnal study, 30

can be positively identified as *Hyperia medusarum*, *hystrix*-form. One, a 9.2-mm female, seems intermediate between the two forms. The remaining 16 specimens are too small (≤ 3.9 mm) to be positively ascribed to either form, but they are presumably *hystrix*-form. Two specimens, both taken by the Halibut Commission in shallow water (≤ 15 fm), were identified as *medusarum*-form.

Occurrences and numbers were scattered among the hauls, although they seemed most prevalent at night (Fig. 2, Table 3).

This species is the most common *Hyperia* in the eastern North Pacific Ocean (Bowman, 1973).

Hyperoche medusarum (Krøyer)

Three specimens in three hauls. Length: 4.8-5.5 mm.

The species has been recorded from the Arctic Ocean (Shoemaker, 1920; Tencati, 1970); in the subarctic Pacific from off the Kurile Islands and in the Okhotsk Sea (Bulycheva, 1955); off southern British Columbia; and in the Gulf of Alaska (Thorsteinson, 1941; misnamed as *H. leutkeni* according to Bowman, 1953).

Parathemisto pacifica Stebbing

Five thousand six hundred and eighty-nine (5,689) specimens in 17 hauls. Length: up to 8.3 mm.

The morphologically similar *Parathemisto japonica* was recently reported from the southeastern Bering Sea (Fukuchi, 1970), although it usually ranges several hundred miles to the west and southwest of here (Bowman, 1960). All of the females examined in the

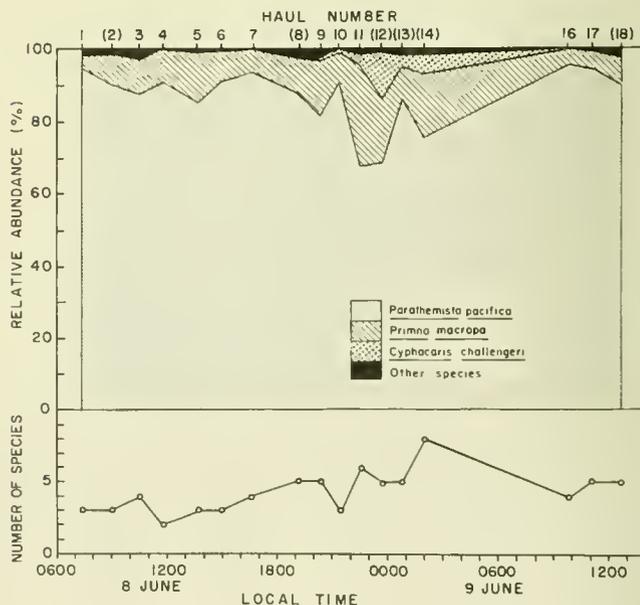


Figure 3.—Relative abundance and numbers of species of amphipods per haul, as a function of time of day.

present samples had subsimilar A 1 and A 2, while in *P. japonica* A 2 is considerably longer than A 1. Also, the relatively short lengths of the present specimens, many of which bore eggs or young, rules out their being *japonica* (Bowman, 1960).

The relative abundance of *P. pacifica* decreased markedly at night (Fig. 3), but it was always the most abundant species. The numbers per 1,000 m³ seemed to show no diurnal variation (Fig. 2), suggesting a lack of diurnal vertical migration. Bowman (1960) found no evidence for a diurnal vertical migration off Oregon and California.

Many of the females examined had eggs or brood young. Also, many samples contained loose eggs and young that were likely separated from females while being caught in the net or during subsequent handling and examination. This factor introduces a possible error into the numbers of animals. An attempt to overcome this was made by counting separately loose eggs and what appeared to be brood young. Whenever young appeared small enough, or undeveloped enough, they were considered to be "preimmatures." An "immature" is taken to be a free-swimming, non-brooding young, less than 3 mm in length. The numbers of animals or eggs thus designated are indicated as footnotes in Table 3, and are not included in the numbers collected, nor do they figure in estimated number per 1,000 m³. There was no diurnal variation in size range or sex ratio. Overall, the females outnumbered the males by a ratio of 1.2:1, although this difference is insignificant at the 5% level (heterogeneity χ^2 test).

Bowman (1960) showed that *P. pacifica* is widely distributed in the subarctic Pacific and that it is the most abundant epipelagic amphipod off Oregon and California. He further stated, "It is apparent that *P. pacifica*, like *Sagitta elegans* and *Eukrohnia hamata*, is by virtue of its temperature requirements an inhabitant of the subarctic water, and like these chaetognaths can serve as a biological indicator of this cold water of low salinity. However . . . the euphausiid, *Euphausia pacifica* . . . has a distribution more nearly like that of *P. pacifica* than does *S. elegans*."

Although no *P. japonica* were taken in the present hauls, this species has recently been taken in the same general area (Fukuchi, 1970). Since its population center lies far to the southwest, the southeastern Bering Sea should be considered to be in the fringes of its range. Its occurrence there is probably dependent on intrusion of water from the western Bering Sea, and *P. japonica* should probably be considered to be an indicator species for western subarctic water in the eastern Bering Sea.

Parathemisto libellula (Lichtenstein)

One specimen in one haul (International Pacific Halibut Commission). Length: 21.3 mm, female.

This specimen was taken in a shallow tow over shelf

waters. Bowman (1960) reported the species as widespread throughout the Bering Sea.

Phronima sedentaria (Forskäl)

One specimen in one haul, plus another in a 0.505-mm mesh sample. Length: 16.5 and 17.7 mm, both males.

Thorsteinson (1941) recorded the species from the Gulf of Alaska but gave no details on actual locations. Fukuchi (1970) recorded the species from lat. 41°55'N off Hokkaido, Japan, and Vinogradov (1956) reported the species from the western Bering Sea at lat. 55°N.

Primno macropa Guerin

Six hundred and sixty-one (661) specimens in 17 hauls. Length: up to 16.0 mm for females and 10.5 mm for males.

This species is common in the North Pacific Ocean from southern California (Brusca, 1967) northward to the Gulf of Alaska (Thorsteinson, 1941), off the Kurile Islands (Bulycheva, 1955), and in the western Bering Sea (Vinogradov, 1956).

The increase during the night hauls in numbers per 1,000 m³ and relative abundance (as high as 27% at haul 11) strongly suggest a diurnal vertical migration of this species.

ACKNOWLEDGMENTS

Thomas E. Bowman, Division of Crustacea, National Museum of Natural History, Washington, D.C., kindly verified my identifications of the amphipods, and offered useful advice on amphipod taxonomy and ecology. Jerry Larrance and Donald Day gave useful comments on the manuscript. Stephen R. Threlkeld and Arthur Cvar, respectively, measured and sexed the *Parathemisto pacifica* specimens and helped analyze the resulting data. The patient, careful work of the Northwest Fisheries Center's Sorting Center staff was invaluable in this study; in particular I thank Janet Condon, Larry Landrie, and Beverly Vinter.

LITERATURE CITED

- BIRSTEIN, YA.A., and M. E. VINOGRADOV.
1955. Pelagicheskie gammaridy (Amphipoda-Gammaridea) Kurilo-Kamchatskoi vpadiny [Pelagic gammarids (Amphipoda-Gammaridea) of the Kurile-Kamchatka Trench]. Tr. Inst. Okeanol., Akad. Nauk SSSR 12:210-287.
1958. Pelagicheskie gammaridy (Amphipoda, Gammaridea) severo-zapadnoi chasti Tikhogo okeana [Pelagic gammarids (Amphipoda, Gammaridea) of the northwest Pacific Ocean]. Tr. Inst. Okeanol., Akad. Nauk SSSR 27:219-257. (Transl. 1959, Fish. Res. Board Can., Transl. Ser. 253.)
BOWMAN, T. E.
1953. The systematics and distribution of pelagic amphipods of the families Vibicillidae, Paraphronimidae, Hyperiididae, Dairellidae, and Phrosinidae from the northeastern Pacific. Ph.D. Thesis, Univ. Calif., Los Angeles, 430 p.

1960. The pelagic amphipod genus *Parathemisto* (Hyperideae: Hyperiididae) in the North Pacific and adjacent Arctic Ocean. Proc. U.S. Natl. Mus. 112:343-392.
1973. Pelagic amphipods of the Genus *Hyperia* and closely related Genera (Hyperideae: Hyperiididae). Smithson. Contrib. Zool. 136, 76 p.
- BOWMAN, T. E., and H. E. GRUNER.
1974. The families and genera of Hyperideae (Crustacea: Amphipoda). Smithson. Contrib., Zool. 146, 64 p.
- BOWMAN, T. E., and J. C. McCAIN.
1967. Variation and distribution of the pelagic amphipod *Cyphocaris challengerii* in the northeast Pacific (Gammaridea: Lysianassidae). Proc. U.S. Natl. Mus. 122:1-14.
- BRUSCA, G. J.
1967. The ecology of pelagic Amphipoda, I. Species accounts, vertical zonation and migration of Amphipoda from the waters off southern California. Pac. Sci. 21:382-393.
- BULYCHEVA, A. I.
1955. Giperiidy (Amphipoda-Hyperideae) severo-zapadnoi chasti Tikhogo okeana [Hyperiid (Amphipoda-Hyperideae) of the northwestern Pacific Ocean]. Dokl. Akad. Nauk SSSR 102:1047-1050.
- FUKUCHI, M.
1970. Studies on Euphausiacea and Amphipoda collected by high-speed sampling from the northern North Pacific and Bering Sea ("Oshoro Maru" on Cruise 32, June-August 1969). Graduation Thesis, Plankton Lab., Fac. Fish., Hokkaido Univ., Hakodate, Hokkaido, Japan, 23 p. + plates and tables.
- GURYANOVA, E. F.
1962. Bokoplavy severnoi chasti Tikhogo okeana (Amphipoda-Gammaridea). Chast 1. [Scud shrimps (Amphipoda-Gammaridea) of the northern part of the Pacific Ocean. Part 1.] Akad. Nauk SSSR, Zool. Inst., Opredeliteli po Faune SSSR 74, 441 p. (Transl., For. Lang. Div., Dep. Sec. State, Canada.)
- HURLEY, D. E.
1956. Bathypelagic and other Hyperiididae from Californian waters. Allan Hancock Found. Publ., Occas. Pap. 18, 25 p.
- SHOEMAKER, C. R.
1920. The amphipods of the Canadian Arctic Expedition, 1913-18. Rep. Can. Arctic Exp., Vol. 7 - Crustacea, Pt. E: Amphipods, 30 p.
- TENCATI, J. R.
1970. Amphipods of the central Arctic. In Y. M. Leung and H. A. Kobayashi (editors), Taxonomic guides to Arctic zooplankton, p. 1-37. Univ. South. Calif., Dep. Biol. Sci., Rep. 2.
- THORSTEINSON, E. D.
1941. New or noteworthy amphipods from the North Pacific coast. Univ. Wash., Publ. Oceanogr. 4:53-94.
- VINOGRADOV, M. E.
1956. Giperiidy (Amphipoda-Hyperideae) zapadnykh raionov Beringova morya [Hyperiid (Amphipoda-Hyperideae) of the western Bering Sea]. Zool. Zh. 35:194-218.
1957. Giperiidy (Amphipoda-Hyperideae) severo-zapadnoi chasti Tikhogo okeana. 1. Triba Hyperideae physosomata [Hyperiid (Amphipoda-Hyperideae) from the northwest section of the Pacific Ocean. 1. Tribe Hyperideae Physosomata.] Tr. Inst. Okeanol., Akad. Nauk SSSR 20:186-227. (Translated by Foerster, 1959, Fish. Res. Board Can., Transl. Ser. 245, 37 p.)

- 648 Weight loss of pond-raised channel catfish (*Ictalurus punctatus*) during holding in processing plant vats. By Donald C. Greenland and Robert L. Gill. December 1971, iii + 7 pp., 3 figs., 2 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 649 Distribution of forage of skipjack tuna (*Euthynnus pelamis*) in the eastern tropical Pacific. By Maurice Blackburn and Michael Laurs. January 1972, iii + 16 pp., 7 figs., 3 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 650 Effects of some antioxidants and EDTA on the development of rancidity in Spanish mackerel (*Scomberomorus maculatus*) during frozen storage. By Robert N. Farragut. February 1972, iv + 12 pp., 6 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 651 The effect of pre-mortem stress, holding temperatures, and freezing on the biochemistry and quality of skipjack tuna. By Ladell Crawford. April 1972, iii + 23 pp., 3 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 652 The use of electricity in conjunction with a 12.5-meter (Headrope) Gulf of Mexico shrimp trawl in Lake Michigan. By James E. Ellis. March 1972, iv + 10 pp., 11 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 654 An electric detector system for recovering internally tagged menhaden, genus *Brevoortia*. By R. O. Parker, Jr. February 1972, iii + 7 pp., 3 figs., 1 appendix table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 655 Immobilization of fingerling salmon and trout by decompression. By Doyle F. Sutherland. March 1972, iii + 7 pp., 3 figs., 2 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 656 The calico scallop, *Argopecten gibbus*. By Donald M. Allen and T. J. Costello. May 1972, iii + 19 pp., 9 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 657 Making fish protein concentrates by enzymatic hydrolysis. A status report on research and some processes and products studied by NMFS. By Malcolm B. Hale. November 1972, v + 32 pp., 15 figs., 17 tables, 1 appendix table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 658 List of fishes of Alaska and adjacent waters with a guide to some of their literature. By Jay C. Quast and Elizabeth L. Hall. July 1972, iv + 47 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 659 The Southeast Fisheries Center bionumeric code. Part I. Fishes. By Harvey R. Billis, Jr., Richard B. Roe, and Judith C. Gatlin. July 1972, xi + 95 pp., 2 figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 660 A freshwater fish electro-motivator (FFEM)-its characteristics and operation. By James E. Ellis and Charles C. Hoopes. November 1972, iii + 11 pp., 9 figs.
- 661 A review of the literature on the development of skipjack tuna fisheries in the central and western Pacific Ocean. By Frank J. Hester and Tamio Otsu. January 1973, iii + 13 pp., 1 fig. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 662 Seasonal distribution of tunas and billfishes in the Atlantic. By John P. Wise and Charles W. Davis. January 1973, iv + 24 pp., 13 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 663 Fish larvae collected from the northeastern Pacific Ocean and Puget Sound during April and May 1967. By Kenneth D. Waldron. December 1972, iii + 16 pp., 2 figs., 1 table, 4 appendix tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 664 Tagging and tag-recovery experiments with Atlantic menhaden, *Brevoortia tyrannus*. By Richard L. Kroger and Robert L. Dryfoos. December 1972, iv + 11 pp., 4 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 665 Larval fish survey of Humboldt Bay, California. By Maxwell B. Eldridge and Charles F. Bryan. December 1972, iii + 8 pp., 8 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 666 Distribution and relative abundance of fishes in Newport River, North Carolina. By William R. Turner and George N. Johnson. September 1973, iv + 23 pp., 1 fig., 13 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 667 An analysis of the commercial lobster (*Homarus americanus*) fishery along the coast of Maine, August 1966 through December 1970. By James C. Thomas. June 1973, v + 57 pp., 18 figs., 11 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 668 An annotated bibliography of the cunner, *Tautoglabrus adspersus* (Walbaum). By Fredric M. Serchuk and David W. Frame. May 1973, ii + 43 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 669 Subpoint prediction for direct readout meteorological satellites. By L. E. Eber. August 1973, iii + 7 pp., 2 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 670 Unharvested fishes in the U.S. commercial fishery of western Lake Erie in 1969. By Harry D. Van Meter. July 1973, iii + 11 pp., 6 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 671 Coastal upwelling indices, west coast of North America, 1946-71. By Andrew Bakun. June 1973, iv + 103 pp., 6 figs., 3 tables, 45 appendix figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 672 Seasonal occurrence of young Gulf menhaden and other fishes in a northwestern Florida estuary. By Marlin E. Tagatz and E. Peter H. Wilkins. August 1973, iii + 14 pp., 1 fig., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- 673 Abundance and distribution of inshore benthic fauna off southwestern Long Island, N.Y. By Frank W. Steimle, Jr. and Richard B. Stone. December 1973, iii + 50 pp., 2 figs., 5 appendix tables.
- 674 Lake Erie bottom trawl explorations, 1962-66. By Edgar W. Bowman. January 1974, iv + 21 pp., 9 figs., 1 table, 7 appendix tables.



UNITED STATES

DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL MARINE FISHERIES SERVICE

SCIENTIFIC PUBLICATIONS STAFF

ROOM 450

1107 N E 45TH ST

SEATTLE, WA 98105

OFFICIAL BUSINESS

FOURTH CLASS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210



Marine Biological Laboratory S
Library - Periodicals
Woods Hole, Ma 02543