



**Alaska
Fisheries Science
Center**

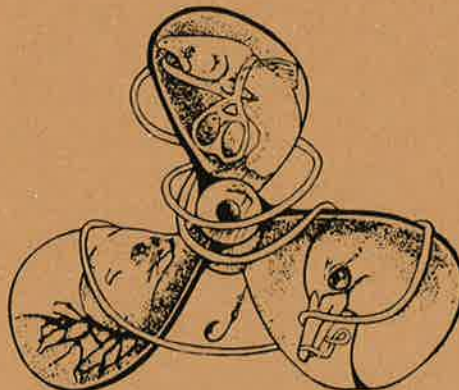
National Marine
Fisheries Service

U.S. DEPARTMENT OF COMMERCE

AFSC PROCESSED REPORT 91-12

Description and Status of Tasks in the
National Oceanic and Atmospheric
Administration's Marine Entanglement
Research Program
For Fiscal Years 1985 - 1991

April 1991



This report does not constitute a publication and is for information only. All data herein are to be considered provisional.

ERRATA NOTICE

This document is being made available in .PDF format for the convenience of users; however, the accuracy and correctness of the document can only be certified as was presented in the original hard copy format.

Inaccuracies in the OCR scanning process may influence text searches of the .PDF file. Light or faded ink in the original document may also affect the quality of the scanned document.

DESCRIPTION AND STATUS OF TASKS IN THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S
MARINE ENTANGLEMENT RESEARCH PROGRAM
FOR FISCAL YEARS 1985 - 1991

by

James M. Herkelrath

James M. Coe

Alan R. Bunn

Alaska Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way N.E.
BIN C15700
Seattle, WA 98115

April 1991

PREFACE

The purpose of this document is to catalog the tasks undertaken by the National Marine Fisheries Service (NMFS) Marine Entanglement Research Program (MERP) since its inception in Fiscal Year 1985. The scope of work, status, costs, and products for each task are presented.

Publications listed herein may be requested from the listed author, laboratories, or institutions conducting the study. Most reports are also available from the MERP Office at the Alaska Fisheries Science Center, NMFS, National Oceanic and Atmospheric Administration (NOAA), 7600 Sand Point Way N.E., BIN C15700, Seattle, WA 98115-0070.

A comprehensive bibliography on the subject of marine debris was compiled by M. Bradley Hansen with support from the MERP. This bibliography is available from the MERP manager.

NOAA Technical Memorandum NMFS F/NWR-23 lists a variety of marine debris information resources including available publications, brochures, posters, video, slide shows, etc. The publication is entitled "Dealing with Annex V - Reference Guide for Ports," and is available from the MERP manager.

Current information about the impacts of marine debris and regional environmental education issues can be obtained from NOAA's Marine Debris Information Offices which are operated under contract by the Center for Marine Conservation. The Marine Debris Information Offices are:

Pacific Marine Debris Office
312 Sutter St., Suite 606
San Francisco, CA 94108
(415) 391-6204

Atlantic and Gulf of Mexico
Marine Debris Office
1725 DeSales St. N.W.
Suite 500
Washington, D.C. 20036
(202) 429-5609

ACKNOWLEDGEMENT

The cover artwork was designed by Ms. Kathi Zecca of the Alaska Fisheries Science Center, Graphics Department. Special acknowledgement is given to Mrs. Taka Kogita of the Alaska Fisheries Science Center Director's office. Mrs. Kogita assisted in the typing and editing of this report.

CONTENTS

	Page
Introduction	1
Fiscal Year 1985 Activities	4
Fiscal Year 1986 Activities	19
Fiscal Year 1987 Activities	32
Fiscal Year 1988 Activities	47
Fiscal Year 1989 Activities	64
Fiscal Year 1990 Activities	80
Fiscal Year 1991 Activities	93
Bibliography	102

DESCRIPTION AND STATUS OF TASKS IN THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S
MARINE ENTANGLEMENT RESEARCH PROGRAM FOR
FISCAL YEARS 1985 - 1991

INTRODUCTION

In response to public concern over the impacts of marine debris on wildlife, Congress appropriated \$1,000,000 in Fiscal Year 1985; \$750,000 in 1986, 1987 and 1988; \$706,000 in 1989 and 1990; and \$703,800 in 1991 for the National Oceanic and Atmospheric Administration's (NOAA) Marine Entanglement Research Program (MERP). The program is divided into three major areas of activity; Education, Mitigation, and Impacts Research and Monitoring. Initially, impacts research and monitoring accounted for nearly one half of the funds, while a little less than one quarter of the funds were spent on each of the remaining two activities. As more facts were uncovered from research activities a larger portion of Program funds were directed to mitigation and education activities, which currently account for 68% of the MERP budget. Roughly 11% of the funds are spent on project management.

The impacts research and monitoring tasks are designed to increase our understanding of the origin, amount, distribution, fate, and effects of plastics and other synthetic debris in marine environment, as well as how these materials may be removed. A number of research tasks have been undertaken over the last five years in the following general categories: (1) the role of entanglement in the population dynamics of pinnipeds; (2) the sources and dynamics of litter on Alaskan beaches; (3) the rate of net discard from foreign vessels operating in the U.S. EEZ; (4) the hazard dynamics of derelict monofilament gillnets; (5) incidental take rates in high seas driftnet fisheries; (6) prevalence and physiological impacts of plastic ingestion by cetaceans, sea turtles and birds; (7) methods development for assessing density and distribution of marine debris; (8) impacts of floating plastic debris on pelagic ecosystems; and (9) entanglement rates of endangered Hawaiian monk seals and sea turtles.

The education and public awareness component was originally designed to increase the knowledge of both industrial and commercial contributors about the impacts and control of marine debris. The educational tasks for the fiscal years 1985-1987 included: (1) education program development and implementation for the Gulf of Mexico, Atlantic, and North Pacific regions; (2) beach clean-ups and reports; (3) developing standard methods for assessment of debris in the marine environment; and (4) evaluations of education program effectiveness. The 1988, 1989, and 1990 education components focused on disseminating information to public and recreational contributors of marine debris nationwide as mandated in Public Law 100-220, "The

Marine Plastic Pollution Research and Control Act of 1987." In April 1989, The Second International Conference on Marine Debris was held in Honolulu, Hawaii. The conference included technical sessions to review the current international state of knowledge on the marine debris issue and working groups which made recommendations for research, mitigation and education actions.

Mitigation projects are directed towards reducing the amount of non-degradable material that is disposed of directly or indirectly into the sea. These tasks have included: (1) synthesis of available information on existing refuse handling technologies applicable to ships; (2) research on degradable materials; (3) studies of port reception facilities for marine debris; (4) survey of disposal methods; (5) study of marine photodegradation processes; (6) evaluations of plastic recycling systems; (7) assessment of shipboard incineration hazards; (8) development of guidelines for the implementation of international regulations to control vessel sources of marine debris and (9) National beach clean-up database support. In addition to these activities, the MERP has initiated efforts to coordinate research activities on the impacts of persistent wastes on marine and coastal environments and on commerce.

The MERP participated in the Pacific Rim Fishermen's Conference on Marine Debris held in Kailua - Kona, Hawaii, during October 1987. This was an international fishing industry conference which established guidelines for fishing vessel management of marine debris. (Conference proceedings are available from the MERP.) NOAA is also actively working with the appropriate international organizations (IMO, IOC, UNEP, CCAMLR) and federal agencies (EPA, USCG, USFWS, NPS, USN) on many aspects of the plastics pollution issue.

The following sections provide a description of the tasks comprising the MERP for each fiscal year since its inception, including a note on the status of each as of March 1, 1991, and a summary table showing the distribution of funds.

The MERP accepts marine debris research suggestions at any time. All such suggestions are considered for inclusion in the coming year's program during the annual MERP Ad Hoc Advisory Committee review.

To facilitate the overall reduction of the impacts of persistent wastes in the marine and coastal environments and on commerce, the Marine Entanglement Research Program is constituted to accomplish the following:

1. Design and implement education programs to inform industry and the public about the problems caused by persistent marine debris and the range of available solutions.

2. Identify, monitor, and evaluate adverse impacts of persistent marine debris upon the marine environment and living marine resources.
3. Minimize the amounts of marine debris entering the oceans by developing procedures, equipment, and programs, and where necessary, recommending regulations to prevent the loss or disposal of persistent debris into the marine and coastal environments.

FINAL FUNDING PLAN FOR FY 1985 ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
a.	Education program development and implementation	\$144.0K
b.	West Coast/New England coast beach clean-up, September 21, 1985	6.1K
c.	Hawaii Workshop on the Fate and Impacts of Marine Debris	50.0K
2.	MITIGATION	
a.	Development of methodology to reduce the disposal of ship generated refuse into the marine environment	66.0K (FY85) 18.0K (FY86)
b.	Research on the use of degradable materials	49.0K
c.	Development of regulatory approaches to the problems of marine debris	0.0K
3.	IMPACTS RESEARCH AND MONITORING	
a.	Northern fur seal entanglement research	106.0K
b.	Northern sea lion entanglement research	85.0K
c.	Establishment of a reference collection and development of expertise to identify marine debris	48.0K
d.	Accumulation and disappearance rates of marine litter on beaches in Alaska	35.0K
e.	Compilation and analysis of U.S. fishery observer data on marine debris in the foreign and joint venture groundfish fishery	23.0K
f.	Survey of high seas squid gillnet fishery	100.0K

g.	Identification of sources of fishing debris affecting endangered marine animals in the Northwestern Hawaiian Islands.	13.0K
h.	Dynamic of derelict gillnet gear in the North Pacific	27.0K
i.	Impact of ingested debris on sea turtles	27.0K (FY85) 10.0K (FY86)
j.	Impact of ingested plastics on sea birds	30.0K
k.	Method for surveying at sea distribution and abundance of marine debris	20.0K
l.	Expansion of information collected by stranding programs	8.0K
m.	Evaluation of aerial techniques for assessing debris density	8.0K
4.	MANAGEMENT	
a.	Program management	\$54.1K

FISCAL YEAR 1985 ACTIVITIES TO ADDRESS PROBLEMS ASSOCIATED
WITH DEBRIS IN THE MARINE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

a. Education program development and implementation, \$144.0K

With primary reference to the North Pacific basin, the objectives of this project were to identify the most significant groups of non-degradable debris generators, develop the means for educating them, and carry out the described education program. Primary tasks included: identifying the debris items causing the most serious problems and upon which attention should be focused (e.g., discarded net fragments, packing bands, plastic pellets, etc.); identifying the most significant U.S. and foreign debris generators (e.g., specific fishing industries, shipping industry, military, etc.); identifying key manufacturers of raw materials and finished products that are important contributors to marine debris problems; developing persuasive arguments for convincing debris generators to minimize debris and manufacturers to modify the composition and/or design of materials to lessen impacts upon the marine environment; developing effective means of conveying these persuasive arguments so as to engender in debris generators a real understanding of the nature and extent of the problem; and then carrying out an intensive education program making use of the information and methods developed in the activities described above.

Status: A contract to provide these education services was awarded to Natural Resources Consultants (NRC) of Seattle, Washington. The educational contract with NRC lasted until March 1987. As a result of the successes of NRC, the FY86 Marine Debris Education Program was revised to target the North Pacific region. Educational products completed during the contract period included:

1. Three technical papers (published in Fisheries, Marine Pollution Bulletin, International Council on the Exploration of the Sea).
2. Seminar/slide show (approx. 50 presentations including audiences in Japan, Taiwan, South Korea, and the Soviet Union).
3. Numerous articles/editorials in trade journals, etc.
4. "Stow Your Trash" posters.

Response from the commercial fishing industry has been outstanding. Progress to a lesser degree has been made in the plastics and maritime industries.

b. West Coast/New England coast beach clean-up, September 21, 1985, \$6.1K.

At the Workshop on the Fate and Impact of Marine Debris (held November 27-29, 1984), actions taken in 1984 by the State of Oregon to increase public awareness of the problem were discussed at length. On October 13 of that year, approximately 2,100 volunteers collected more than 26 tons of plastic debris from Oregon beaches. In so doing, they also gathered certain useful information, previously non-existent, on the incidence and volume of debris along the coast. Of perhaps even greater long-term significance was the fact that the exercise generated considerable public interest in and recognition of the scope and magnitude of the problem. A similar clean-up day was conducted for the entire West Coast and the New England Coast on September 21, 1985. Project support was for a report on the materials collected and the activities necessary to organize and evaluate the project. As in the case of Oregon, it was anticipated that while the project would have transitory benefit in terms of beach clean-up, even greater long-term benefits would be realized as a result of the greatly heightened public awareness of the problem.

Status: The National Volunteer Beach Clean-up Days were held in September and October of 1985. Eleven coastal states participated in the clean-up and provided varying levels of data on their organization and findings. The final report from the National Coordinator has been widely distributed and may be requested from the MERP manager, reference:

Neilson, J. 1986. Final Report - Get the Drift and Bag It. NWAFC Processed Rep. 86-11, 23 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Hawaii Workshop on the Fate and Impacts of Marine Debris, \$50.0K

The evidence that fisheries debris could potentially be responsible for the decline of the northern fur seal population since the 1960's pointed to the need for a better understanding of the fate and impacts of debris in the oceans. The state of knowledge on this issue had yet to be assembled and evaluated. The consequences of debris for marine life, the sources of marine debris and the range of appropriate strategies for its control, if necessary, were very poorly understood.

Status: In November of 1984 NOAA, the Marine Mammal Commission, the U.S. Fish and Wildlife Service and the four Fisheries Management Commissions in the Pacific sponsored the International Workshop on the Fate and Impact of Marine Debris. The workshop concluded that persistent debris was an emerging environmental pollutant that warranted further investigation and that education programs to alert people to the consequences of contributing to the problem were necessary and timely. The Workshop proceedings are referenced as follows:

Shomura, R.S., and H.O. Yoshida. 1985. Proceedings of Workshop on the Fate and Impact of Marine Debris, 26-29 November 1984, Honolulu, HI. U.S. Department of Commerce, NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

2. MITIGATION

These projects are directed toward reducing the amount of non-degradable material that is disposed of at sea. While the beach clean-up program described under "Education and Public Awareness" might also be included under "Mitigation," it is listed in the former section because its beneficial effects upon increased public awareness and education are probably of greater long-term benefit than the clean-up itself.

a. Development of methodology to reduce the disposal of ship generated refuse into the marine environment, \$66.0K (FY85) \$18.0K (FY86)

Participants in the Workshop on the Fate and Impact of Marine Debris recommended that, however possible, the fishing industry, the shipping/transportation fleet, and all research and military vessels be encouraged to reduce the amount of refuse thrown overboard. The purpose of this project was to provide for the synthesis of existing information on compaction and incineration methods for at-sea disposal of refuse, to identify new compaction or incineration systems, and to evaluate the economic feasibility of recycling programs for non-degradable refuse. Without such initiatives, the current disposal rate (in 1985) of over 6 million tons per year would continue unchecked.

Status: In September 1985, a contract was awarded to KVB Inc. of Irvine, CA to synthesize available information on existing refuse handling technology applicable to shipboard circumstances. This included a survey of past and present refuse handling technology, and the technical capabilities

and characteristics of each system. The product of this task was to identify (for vessel operators), the most appropriate existing waste management system(s) for each type of vessel and its expected waste production. Obvious gaps in technology and reasonable approaches to addressing these gaps would be discussed. The draft final report of this work was received in February 1987, and returned to the authors for a major rewrite and editing. The absence of an acceptable final report and a difference of opinion regarding cost overruns delayed task completion. A final report is available from the MERP manager, reference:

Parker, N.R., S.C. Hunter, and R.J. Young. 1987. Development of Methodology to Reduce the Disposal of Non-Degradable Material into the Marine Environment. Report to the NMFS Marine Entanglement Research Program, Contract 85-ABC-00203, 50 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Research on the use of degradable materials, \$49.0K

The purpose of this study was to start research on the nature and characteristics of synthetic materials involved in the fabrication of fishing gear, packaging materials, and commonly used supplies with a view to exploring the potential for building degradability into a number of materials and components used.

Status: The funding for this task was carried-over into Fiscal 1986 and the contract was awarded in March 1986, to the Research Triangle Institute of Research Triangle Park, NC. The task results identified the range of polymers and mechanisms for degradation (if any) for each commonly used type of fishing gear. Photodegradation technology is well developed for the polymers typically used in packaging, however, biodegradation technology is in its infancy. The final report for this task is available from the MERP manager, referenced as:

Andrady, A.L. 1987. Research on the Use of Degradable Fishing Gear and Packaging Materials. NWAFC Processed Rep. 87-03, 49 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Development of regulatory approaches to the problems of marine debris, \$0K

At the Workshop on the Fate and Impact of Marine Debris, Michael J. Bean of the Environmental Defense Fund reported on a wide range of existing legal authorities that might be used

to address marine debris problems. The purpose of this study was to further develop the most promising options outlined in that report and such others as may appear feasible. Whereas, the potential use of existing laws, treaties, and programs for minimizing the deposition of harmful debris into the ocean was explored in the first report, it was anticipated that the product of this second review would be a series of detailed specific actions to be pursued under existing authority, and that the report would also include, where appropriate, specific recommendations for changes in the text of international conventions, domestic statutes, or regulations.

Status: This task has evolved into a loosely cooperative, unfunded activity involving legal staff, administrators and biologists from a number of government agencies and private foundations. This network is supplying information, research, legal opinions, draft language, position papers, terms of reference, etc. for national, international, state and local initiatives to manage the input of debris into the marine environment.

3. IMPACTS RESEARCH AND MONITORING

These activities are designed to increase our understanding of the origin, amount, distribution, fate, and effects of debris in the marine environment as well as our knowledge of the means for its control.

a. Northern fur seal entanglement research, \$106.0K

Participants at the Workshop on Fate and Impact of Marine Debris concluded that: (1) northern fur seals may suffer more serious impacts as a result of entanglement in marine debris than any other species; (2) trawl net fragments and plastic packing bands appear to be the primary problem; (3) the only available data on fur seal entanglement are from the sub-adult male harvest; and, (4) no data are available for other age and sex classes. This effort would provide information on the survival rate of entangled males and females, the entanglement rate in large and small net fragments at sea, and the effects of entanglement on the feeding cycle of lactating females. Because the northern fur seal ranges over the entire North Pacific, the species should provide a biological assay as to the amount of certain types of marine debris that are discarded in the North Pacific.

Status: The research activities on northern fur seal entanglement for the 1985 field season on the Pribilof Islands was conducted between June and November 1985. Experiments were initiated and data were collected on the rates of entanglement of juvenile males, adult and juvenile

females, the impact of entanglement on nursing females and their pups, and the behavior of newly weaned pups exposed to net fragments. The report of these research activities and their results have been published in a NOAA Technical Memorandum available from the Alaska Fisheries Science Center (AFSC) NOAA Fisheries National Marine Mammal Laboratory (NMML), reference:

Kozloff, P. and H. Kajimura (editors). 1988. Fur Seal Investigations, 1985. NOAA Tech. Memo. NMFS F/NWC-146, 189 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Northern sea lion entanglement research, \$85.0K

A recent survey had indicated that the sea lion population in the eastern Aleutians was declining at a rate comparable to that observed in the northern fur seal population. This study was to provide information on the rate of entanglement for all age and sex classes of the northern sea lion population, and would concentrate on entanglement effects on the survival of sea lion young of the year. It was reasoned that if this research provided evidence that entanglement in marine debris is causing or contributing to the observed decline, such knowledge may provide valuable information on causative factors in both the northern fur seal and Steller sea lion population declines.

Status: This survey of the incidence of entanglement of northern sea lions was completed in July 1985. During the survey, 17 rookeries and 15 haul-out sites were visited on 28 islands in the Aleutian chain and 15,957 adults and 14,160 pups were counted. A total of 13 entangled sea lions were noted and the researchers concluded that this entanglement rate could not be sufficient to cause the recent declines in the northern sea lion population. The report is available through the authors at the AFSC NMML, reference:

Loughlin, T.R., et al. 1986. Assessment of Net Entanglement on Northern Sea Lions in the Aleutian Islands, 25 June - 15 July 1985. NWAFC Processed Rep. 86-02, 50 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Establishment of a reference collection and development of expertise to identify marine debris, \$48.0K

There is a need to be able to identify derelict fishing gear and other debris. Physical characteristics such as the type of knot, the material, the hanging construction, etc., can provide information as to the source of derelict gear.

Source identification is critical to the development of mitigating measures, and this effort would provide for (1) a gear specialist to become familiar with the fishing gear that is used in various foreign and domestic fisheries, and (2) the establishment of an identification center, complete with a full reference collection where different types of debris could be sent for identification.

Status: The reference collection is in place at the Alaska Fisheries Science Center in Seattle, Washington. Techniques have been developed to identify various polymer types used in fishing gear manufacture and a wide range of fishing gears have been typed for future reference comparisons. The Center staff is accepting materials for identification and may be contacted for information on procedures for delivery of specimens at:

Marine Debris Reference Center
Building #32
7600 Sand Point Way, N.E.
Seattle, WA 98115
ATTN: Mr. Dave King

d. Accumulation and disappearance rates of marine litter on beaches in Alaska, \$35.0K

Marine litter, including derelict net fragments, accumulates on beaches where it can be inventoried. A recent study in Alaska had indicated that the amount of accumulated debris can be correlated with the number of vessels that fish in the U.S. economic zone. The objective of this study was to establish a monitoring system for evaluating the effectiveness of various management actions designed to reduce the amount of debris discarded at sea. In the first phase of the study, an experiment is conducted to determine how sensitive beach surveys are to the sampling intensity and variability in the rate of debris accumulation. If this work demonstrates that beach surveys of marine litter are efficient for detecting changes in the accumulation rates of debris, long term monitoring programs are then initiated.

Status: The field surveys for this task were carried out between May and November 1985. Beach types in four categories were surveyed for debris at locations from Amchitka Island in the Eastern Aleutian chain eastward to Southeast Alaska around Juneau. The final review and editing of this work was completed in August 1987. A final report is available from the MERP manager, reference:

Merrell, T.R. and S.W. Johnson. 1987. Surveys of Plastic Litter on Alaskan Beaches, 1985. NOAA Tech. Memo. NMFS F/NWC-116, 21 p. Alaska Fish. Sci. Cent.,

Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E.,
Seattle, WA 98115-0070.

e. Compilation and analysis of U.S. fishery observer data on marine debris in the foreign and joint venture groundfish fishery, \$23.0K

There is now available a collection of several hundred data reports providing information on debris observed during foreign fishing operations in the eastern Bering Sea. There are also recorded observations on the loss of gear as it occurred during operations. These data, which have been collected since the fall of 1982, had yet to be tabulated and evaluated. The objective of this study was to compile and evaluate information contained in the 1983 and 1984 fishery observer logbooks to determine: (1) if observer logbook data should be summarized and analyzed for the years in which partial data were collected (1976-1982); (2) if observer logbook data should be routinely summarized and analyzed now and in the future; and (3) if some modification in logbook format is appropriate.

Status: The data collection and analysis for this task was completed in March of 1986. The final report has been published as a NOAA Technical Memorandum and is available from the authors at AFSC, reference:

Berger, J.D. and C. Armistead. 1987. Discarded Net Material in Alaskan Waters, 1982-84. NOAA Tech. Mem. NMFS F/NWC-110, 66 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

f. Survey of high seas squid gillnet fishery, \$100.0K

A large squid fishery has been developed since 1978 outside the U.S. fishery conservation zone in the central north Pacific. The fishery may be the source of much of the derelict gillnet found in Alaskan waters. Unfortunately, virtually nothing is known about the fishery and recent attempts to put observers on vessels in the fishery have been difficult. Therefore, it is appropriate and necessary to determine the feasibility of monitoring this fishery by direct observations from small charter boats. The information collected by observers on this initial charter boat survey would provide very rough estimates of loss rates, entanglement of non-target species in actively fishing and lost gear, and the fate of lost gear, and more importantly, provide the background information necessary to develop a large-scale survey of such statistical significance that it could be expected to shed definitive light on those points. Without this research, the contribution of the fishery to the

marine debris problem will remain unknown and our ability to develop mitigation measures is impaired.

Status: The field work for this task was conducted through a cooperative agreement with the U.S. Coast Guard using the Cutter Storis in the North Pacific for 36 days. Fifteen high seas gillnet vessels were contacted with the help of Coast Guard surveillance flights from Kodiak, Alaska. The scientific party observed 5 deployments and 11 retrievals of commercial squid driftnets. Although 29 seabirds were observed entangled, no marine mammals or salmon were observed to be taken. Debris surveys covered over 2300 track miles finding 3.4 discarded or lost gillnet fragments per 1000 track miles. The report is available through NMFS, AFSC, Auke Bay, Alaska Laboratory, reference:

Ignell, S., J. Bailey and J. Joyce. 1986. Observations on High-Seas Squid Gill-Net Fisheries, North Pacific Ocean, 1985. NOAA Tech. Mem. NMFS F/NWC-105., 52 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

g. Identification of sources of fishing debris affecting endangered marine animals in the northwestern Hawaiian Island, \$13.0K

Endangered and threatened species of wildlife such as the Hawaiian monk seal and the green sea turtle of the Hawaiian Archipelago are being subjected to increased mortality risks due to discarded and lost material from gillnet, trawl, and other fisheries. Under this project, (a) samples of beach debris from the northwestern Hawaiian Islands would be cataloged and identified as to the possible source fishery and location, and (b) estimates of the current rate of accumulation would be made. Without this work, the type of debris responsible for entangling endangered and threatened species in the Hawaiian area would remain essentially unidentified and unmitigated.

Status: The collection of marine debris from the haul-out and rookery sites of the endangered Hawaiian monk seal was sorted and identified to fishery of origin during the winter of 1985-86. These results show that the principle fishing gear found to entangle monk seals is trawl webbing fragments of North Pacific origin. Further information concerning this research is reported in FY86 MERP task 3c.

This line of investigation is continuing as a long term effort to protect the Hawaiian Monk Seal.

h. Dynamics of derelict gillnet gear in the North Pacific, \$27.0K

The increasing volumes of non-degradable debris in the world's oceans, especially the increase in lost and discarded fishing gear, is now a matter of broad concern. It is not known how long derelict gillnets continue to fish, and this study was designed to develop information on the ghost fishing profile of derelict gillnets in the North Pacific. The project entails intentionally setting gillnets adrift and then tracking them to determine changes in the physical characteristics of the gear during the early, mid, and late stages of dereliction. If this project were not done, we would remain essentially ignorant of the ghost fishing potential of gear lost from any drift gillnet fishery in the North Pacific.

Status: Established as a long term investigation using free ship time from other complimentary research activities, this task was completed in November 1987. For further details, refer to task 3h of FY 1986.

i. Impact of ingested debris on sea turtles, \$27K (FY85) \$10.0K (FY86)

The growing volume of persistent ocean debris in recent years has been accompanied by increased reports of sea turtle ingestion of plastic bags, sheets, and pellets as well as entanglement in tar, rope, and fragments of fishing net. It is thought that turtles ingest plastic bags and sheets because they are similar in appearance to their principal food item, jellyfish. At the time of this study, there was no information on the effects of ingesting plastic on the longevity and reproductive potential of turtles. Under this project, experiments on captive animals were done to determine the relationships between type and quantity of debris ingested and subsequent direct mortality, general physical condition, feeding behavior, and, as possible, hydrocarbon uptake.

Status: The contract to carry out this research was awarded in December of 1985 to the University of Miami, that already had a stock of captive turtles. The feeding experiments concluded that sea turtles can actively seek out and consume plastic sheeting. Except for a possible minor change in glucose metabolism, the effects appeared to be innocuous at the levels of ingestion allowed. A final report on this study is available from the MERP manager. reference:

Lutz, P., 1987. Effect of Ingestion of Non-biodegradable Debris in Sea Turtles. Report to the Marine Entanglement Research Project, Contract FSN-5-0178, 50 p. Alaska

Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

j. Impact of ingested plastics on sea birds, \$30.0K

Observers have recorded ingestion of plastics in 50 species of marine birds. Species which feed primarily by surface-seizing or pursuit diving have the highest occurrences of ingesting marine debris. Although plastic ingestion has been observed in many species of marine birds and this trend is thought to be increasing, there is uncertainty as to whether plastic ingestion has detrimental effects on the health of individual birds or on their reproductive success. The purpose of this study was to evaluate impacts of plastic ingestion on one or more species of seabirds with respect to direct mortality, general physical condition, and, as possible, hydrocarbon uptake.

Status: This task was not initiated in FY85 due to the poor quality of proposals received in response to the solicitation for bids. NOAA authorized the carry-over of these funds into FY86. The status of seabird ingestion research is reported in task 3g of FY86 and task 31 of FY87 activities.

k. Method for surveying at sea distribution and abundance of marine debris, \$20.0K

The purpose of this study was to test the utility of carrying out surveys in the Bering Sea and Gulf of Alaska to determine the abundance and distribution of marine debris at or near the surface. Different survey methodologies were to be developed for quantitatively estimating debris density in total and by type. Whatever biases may exist with differing methods would be described as will the comparative cost of each. The study evaluates the relative merits of platforms of opportunity in addition to using dedicated vessels. Previous field experiments were evaluated as necessary to identify sources of bias in data collection methodologies.

Status: The Center for Quantitative Studies at the University of Washington carried out this investigation between August 1985, and April of 1986. Their findings suggest that platforms of opportunity and augmentation of existing research vessel activities are the only cost effective ways of acquiring data on the density, types and trends in oceanic debris. Copies of the final report of this task are available from the MERP manager, reference:

Ribic, C.A. and L.J. Bledsoe. 1986. Design of Surveys for the Density of Surface Marine Debris in the North Pacific. NWAFC Processed Rep. 86-12, 69 p. Alaska Fish.

Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

1. Expansion of information collected by stranding programs, \$8.0K

Information and samples of value investigating entanglement and debris ingestion can be collected from marine mammals, birds, and turtles found dead on the beach. Under this project, the NMFS would intensify its educational efforts with stranding networks, particularly in Alaska, in order to encourage the collection and processing of more information on the impact of marine debris on marine mammals and other species.

Status: The staff at the Division of Marine Mammals at the Smithsonian Institution was contracted to prepare a handbook describing procedures for gathering information from stranded marine mammals on human impacts, including entanglement in and ingestion of marine debris. Copies of the handbook are available from the authors at the Marine Mammal Program at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560, reference:

Hare, M.P. and J.G. Mead. 1987. Handbook for Determination of Adverse Human-Marine Mammal Interactions from Necropsies. NWAFC Processed Rep. 87-06, 35 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

m. Evaluation of aerial techniques for assessing debris density, \$8.0K

The ability to measure the amount and types of marine debris present in ocean or coastal areas from aircraft would permit rapid estimation of changes in input as well as impacts of these materials. Since a number of marine animal populations are assessed by aerial survey, it may be a simple matter to incorporate debris data recording into the field procedures.

Status: Scientists aboard flights performing coastal marine mammal and turtle surveys in the Gulf of Mexico kept data on marine debris sightings in September and October of 1985. The investigators concluded in a brief report to the MERP manager that it was feasible to gather data on distribution of large debris items from low-flying aircraft over calm seas.

4. PROGRAM MANAGEMENT, \$54.1K

Funding for this task supports the office of the MERP manager. The manager carries out the annual program plan for MERP as well as represents NMFS/NOAA on the marine debris issue in many public and government fora.

Status: During this year (in addition to the activities already reported) additional accomplishments were made relating to the management structure of the MERP. These activities included the establishment of the MERP planning mechanism and the formation of the Ad Hoc Committee on Entanglement. These activities were accomplished in only six months of effort.

FINAL FUNDING PLAN FOR FY 1986 ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
	Marine debris education (continued)	\$112.0K
2.	MITIGATION	
	Funds from the FY86 Entanglement Program budget were used to complete the disposal technology assessment task started in FY85	18.1K
	a. Disposal methods development	97.0K
	b. Fur seal rookery clean-up	5.0K
	c. Photodegradation processes in the marine environment	24.0K
3.	IMPACTS RESEARCH AND MONITORING	
	NOTE: FY85 sea turtle ingestion research contract was augmented with \$10.0K from the FY86 program funds.	
	a. Alaskan beach debris survey methodology (continued)	35.0K
	b. Survey of high seas squid driftnet fisheries	95.0K
	c. Hawaiian Island endangered species monitoring (continued)	15.0K
	d. Fur seal responses to large pieces of derelict fishing gear	35.0K
	e. Entanglement rates of female northern fur seals (continued)	25.0K
	f. Northern fur seal and sea lion pup entanglement assessment	35.0K
	g. Study of the extent and effect of plastic ingestion by Hawaiian seabirds	20.0K
	h. Studies of the dynamics of gillnet gear (continued)	15.0K
	i. Benthic impact of marine debris	19.8K
	j. Cetacean ingestion	23.0K

k. Infrared spectrophotometric analysis of
derelict fishing net material on Alaskan
beaches

37.0K

4. **MANAGEMENT**

a. Program management

\$73.7K

FISCAL YEAR 1986 ACTIVITIES TO ADDRESS PROBLEMS ASSOCIATED
WITH DEBRIS IN THE MARINE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

Marine debris education (continued), \$112.0K

The FY85 task by this title was to plan and carry out a program designed to raise the awareness of industrial contributors to the marine debris problem such that they would voluntarily reduce their output of debris. The task as envisioned in FY86 was a continuation of the more successful facets of this project in the North Pacific area as well as initiation of similar activities on the East and Gulf Coasts. The development of plans for the East and Gulf Coast projects would be made considerably easier and cheaper by the experience gained from the North Pacific efforts. This task included the development of video and radio public service messages which could continue to be run at intervals to maintain public awareness. Attempts to coordinate and report the results of voluntary public beach clean-up efforts would also be included in the task.

Status: Awards were made in September 1986, to two separate contractors - our previous contractor for the North Pacific and a separate contract awarded to the Center for Environmental Education (now the Center for Marine Conservation [CMC]) to handle the East and Gulf Coasts. An educational scoping meeting and briefing was held in Seattle in December 1986, with representatives of each contracting agency present. Draft program plans were formulated. Revised plans were subsequently approved, and marine debris education program activities began through both contractors. Production plans were made to produce a video of our existing slide show. Trade journal advertisements and brochures indicating the severity of the problem were synthesized. An assessment of the North Pacific Education Plan was finalized and the findings and recommendations incorporated into a revised plan. Organization of a Pacific Rim Commercial Fishermen's Forum on Marine Debris was formulated. Participants from Canada, Japan, Taiwan, South Korea, China, and the U.S. were in attendance. The proceedings from this forum are referenced in FY 1987 MERP task summary 3m.

A publication entitled "Plastics in the Ocean: More Than A Litter Problem," was prepared by CMC in February 1987. It is available for a nominal fee from Center for Marine Conservation, 1725 DeSales St. N.W., Suite 500, Washington, D.C. 20036.

2. MITIGATION

NOTE: \$18.1K from the FY86 Entanglement Program budget was used to complete the disposal technology assessment task started in FY85.

a. Disposal methods development, \$97.0K

The assessment of existing technologies applied to the problem of marine debris disposal and management was undertaken in the FY85 Program. This task is the logical extension of that effort and was intended to specialize as necessary and put into practice the techniques identified as having practical merit in reducing the amount of debris released into the marine environment each year. If the most promising method of this reduction is clearly identified in the final report, the hardware may be built and proven. These results would then be widely publicized through the education contractor to the MERP. If the most promising method(s) involves return to land disposal and/or recycling, these systems will be put into practice on a small scale and widely publicized through the education contract.

Status: The development of a prototype port-based refuse reception and disposal system was accomplished under this task. A cooperative agreement between NOAA/NMFS and the Port of Newport, Oregon, was established to support this development as a feasibility study for all the port cities in the U.S. This task provided important information on vessel-generated refuse management that is mandated for port entities in MARPOL Annex V, which the U.S. became signatory to in 1987. The study began in January 1987, and was completed in March 1988. Several posters, brochures, newspaper articles and a video have been released on the program, resulting in a high level of acceptance and utilization. The final report was produced as NWAFC Processed Report 88-13. Information from the final report was expanded into a NOAA Technical Memorandum. Both publications are available from the MERP manager, reference:

Recht, F. 1988. Report on a Port-Based Project to Reduce Marine Debris. NWAFC Processed Rep. 88-13, 75 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Recht, F. 1988. Dealing with Annex V - Reference Guide for Ports. NOAA Tech. Memo. NMFS F/NWR-23, 132 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Fur seal rookery clean-up, \$5.0K

A cooperative task between U.S. and Japanese fur seal research teams would systematically clear selected St. Paul Island haul-out beaches and uplands of all marine debris. These beaches would be cleared of all debris again at the end of the breeding season. This would be done to reduce the incidence of entanglement at these sites and would be coordinated with the research assessing the contribution of debris/entanglement to the current decline in the fur seal population.

Status: Funding was provided to the U.S. fur seal research team to support this task. Arrangements with the Japanese fur seal researchers enhanced activity during July and October 1986. Debris was identified, measured, weighed, sampled and cleared from the rookeries whenever possible. A summary report is available from Dr. Charles Fowler of the AFSC, NMML. Work has been completed and an informal report issued.

**c. Photodegradation processes in the marine environment
\$24.0K**

Wider use of plastic materials in society has led to various hazards for living marine resources. Entrapment in plastic materials such as six-pack holders, packing bands, wrapping materials, trawl web and other netting, and ingestion of plastic particles and materials is known to kill birds, seals, sea turtles, sea lions, and fish. Experimental demonstrations of controlled photodegradation on relevant plastic debris under actual marine environmental conditions will allow an evaluation of the suitability of disposal or degradability-based solutions to the more hazardous debris sources. This task would develop methodology and conduct experiments designed to measure the physical properties and consequences of controlled photodegradation formulations of common plastic compounds in the marine environment. These experiments would be conducted in both a land based and marine environment for analogy. A list would be compiled detailing the activities, and plastic compounds to which the system of photodegradation might be applied to reduce the hazard of plastic debris to marine life.

Status: The contract was awarded in October 1986 to Research Triangle Institute of Research Triangle Park, N.C. The task commenced January 1987, and was completed in March 1988. In general, the plastic/rubber materials were found to deteriorate much slower in sea water than on land during the one-year exposure tests. The final report is available from the MERP manager, reference:

Andrady, A. 1988. Experimental Demonstration of Controlled Photodegradation of Relevant Plastic Compositions under Marine Environment Conditions. NWAFC Processed Report 88-19, 68 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

3. IMPACTS RESEARCH AND MONITORING

NOTE: FY85 sea turtle ingestion research contract was augmented with \$10.0K from the FY86 program funds.

a. Alaskan beach debris survey methodology (continued), \$35.0K

Since it is intuitively more cost effective to measure changes in the abundance and types of marine debris by surveying beaches than by using vessels on the high seas, the development and proving of a scientifically based methodology for doing so is desirable. This effort began in FY85 and continued throughout FY86 as the precision of the methods needed to be validated and the statistical relationship between assessments of accumulation and loss were developed. Infrared spectrometric methods for determining the longevity of various types of debris was assessed during FY86 and scheduled for continuation into FY87. The ability to age debris will enable a broader understanding of the "life history" of the various types of marine debris thus improving the ability to assess changes in the debris accumulation and provide a better focus on mitigation measures directed toward the most persistent and hazardous types.

Status: There are two activities under this task, the Alaska beach survey to index debris changes and the spectrophotometric characterization of plastic debris. Both tasks were funded and carried out at the NOAA AFSC, Auke Bay Laboratory in Alaska. Reports of results of the beach survey activities are available from the author in Auke Bay, reference:

Johnson, S. and T. Merrell. 1988. Entanglement Debris on Alaskan Beaches, 1986. NOAA Tech. Memo. NMFS F/NWC-126, 26 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

The spectrophotometric studies were continued into FY 1987, and the report of the results of this research was delayed, due to commitments resulting from the Exxon Valdez oil spill. Preliminary results from this study were reported

during the Second International Conference on Marine Debris. A final report is expected to be released during fall 1990.

b. Survey of high seas squid driftnet fisheries, \$95.0K

The purpose of this task was to design and execute a program to estimate the rates of gear loss and the rates of entanglement of non-target species in the high seas squid driftnet fisheries. The project was designed to make estimates of the annual incidental and accidental take of target and non-target species in these fisheries. The fishing patterns and techniques would be elucidated and the feasibility of locating and marking derelict gear would be determined. One or more vessels would be chartered to carry experienced observers into the North Pacific for approximately 100 days between May and September 1986, to make the observations necessary to estimate rates of gear loss and catch rates at a predetermined level of precision. The data would be used to estimate the impacts of these fisheries on marine mammals, seabirds, sea turtles and fish stocks and fisheries of interest to the U.S.

Status: The high seas squid fishery assessment work described in this task for FY86 was dependent on the cooperation of the governments and fishing companies in Japan, Korea, and Taiwan for the placement of biologists in the fishery. This cooperation was not forthcoming for the 1986 fishing season although the Japanese hosted one U.S. biologist on a squid fishing vessel after intense, last minute negotiations. Both Taiwanese and Korean research vessels were carrying U.S. biologists in the general squid fishing area of the North Pacific to study the oceanography of salmon and squid distributions. Marine mammal and debris sighting data as well as experimental fishing data from these cruises will be of some value in assessing the impacts of these fisheries. Negotiations are continuing in an effort to gather data from these fisheries.

Some associated reports resulting from this study are available from the AKC, Auke Bay Laboratory in Auke Bay, Alaska, reference:

Ignell, S. and M. Dahlberg. 1986. Results of 1986 Cooperative Research on the Distribution of Marine Debris in the North Pacific Ocean. Unpubl. manusc., 17 p. (Document submitted to the International North Pacific Fisheries Commission, Anchorage, Alaska, November 1986.) Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

Day, R., D. Clausen, and S. Ignell. 1986.
Distribution and Density of Plastic Particulates in the
North Pacific Ocean in 1986. Unpubl. manscr., 17 p.
(Document submitted to the International North Pacific
Fisheries Commission, Anchorage, Alaska, November
1986.) Alaska Fish. Sci. Cent., Auke Bay Lab., Natl.
Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK
99821. (Also referenced in FY87 MERP task 3k.)

**c. Hawaiian island endangered species monitoring
(continued), \$15.0K**

As was done in 1985, beaches and nearshore reefs in the Northwest Hawaiian Islands (Kure Atoll, Pearl and Hermes Reefs, Lisianski Island, Laysan Island and French Frigate Shoals) were regularly monitored during 1986 for presence of entangled seals and turtles. Personnel noted the presence and accumulation of nets and lines, and such flotsam was measured, sampled, cataloged, and burned. Nets found on reefs within the lagoon at Kure Atoll, Pearl and Hermes Reef, and French Frigate Shoals were checked for entangled animals. This work was "piggy-backed" with other tasks for existing personnel already on these Islands. Work was accomplished by the NMFS Hawaii Laboratory.

Status: As described above, this task supports the continuing evaluation of the role of debris in the recovery of the Hawaiian monk seal. Haul-out and rookery sites were cleaned of hazardous debris that washed ashore and entangled animals were rescued wherever and whenever possible. A report of activities under this task is available from the authors or the MERP manager, reference:

Henderson, J.R., S.L. Austin, and M.B. Pillos. 1987.
Summary of Webbing and Net Fragments Found on
Northwestern Hawaiian Islands Beaches, 1982-1986. SWFC
Admin. Rep. H-87-11, 15 p. Southwest Fish. Cent.,
Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole
St., Honolulu, HI 96822-2396.

d. Fur seal responses to large pieces of derelict fishing gear, \$35.0K

This task attempted to determine the behavioral responses of fur seals to pieces of derelict fishing gear large enough to prevent feeding or significant locomotion if entanglement occurs. The answer to this question would help to sharpen our understanding of the causes of the recent declines in the northern fur seal population. The experiment was designed in two phases, one to look at behavior in relation to drifting derelict fishing gear and the other in relation

to anchored pieces of fishing gear. The experimental design would be devised and reviewed during the 1986 field season.

Status: Logistics, equipment and personnel were put in place in the Pribilof Islands for this task, however, last minute contention over the Marine Mammal Protection Act (MMPA) research permit between the NMFS, the Marine Mammal Commission (MMC), and certain constituent groups prevented the experiment from being carried out.

e. Entanglement rates of female northern fur seals (continued), \$25.0K

During July through September 1985, the NMML had conducted surveys of entangled female fur seals on three separate rookeries on St. Paul Island. These surveys were expected to assess the rates of entanglement, disentanglement, and intraseasonal entanglement of lactating females. A single survey of all rookeries and hauling grounds conducted in September of 1985 assessed the entanglement rates of young adult and juvenile females. This task would repeat these surveys in the 1986 breeding season on St. Paul Island to qualify the 1985 findings and begin the series necessary for trend detection. Further, during 1985 a number of adult females were experimentally entangled to assess the impact of entanglement on foraging energetics and survival. The cumulative results of this experiment show that these animals are capable of disentangling themselves. For 1986, this task would support the continued monitoring of the experimentally entangled females to assess their survival and disentanglement rates.

Status: Logistics and methodology were put in place in the Pribilof Islands for this task, however, last minute contention over the MMPA research permit between the NMFS, the MMC, and certain constituent groups prevented the experiment from being carried out.

f. Northern fur seal and sea lion pup entanglement assessment, \$35.0K

This task was designed to assess the role of entanglement of pups with regard to the recent declines of the northern fur seal and sea lion populations. To test the assumption that the young of the year fur seals and sea lions are naive and curious enough to become entangled in derelict fishing gear and packing materials (bands) in large numbers immediately after leaving the rookeries, a land based survey of beaches near the rookeries for entangled pups would be conducted. To test this hypothesis for northern sea lion pups, strategic beaches along the Alaska Peninsula and in the Fox Islands in the Eastern Aleutians would be surveyed during

November of 1985. For northern fur seals, the surveys would be carried out on beaches of the Aleutian Islands adjacent to the major passes exiting the eastern Bering Sea such as Akutan and Unimak Islands and Samalga Pass.

Status: This task was completed in November 1985, and the results were reported in NWAFC Processed Report 86-02 by Loughlin et al. as previously referenced in FY85 MERP task 3b.

g. Study of the extent and effect of plastic ingestion by Hawaiian seabirds, \$20.0K

Because the U.S. Fish and Wildlife Service conducts extensive research and monitoring activities on the seabird populations of the central Pacific, it has been determined that for a small amount of additional funding, the present program can be augmented to assess the rate and impact of debris ingestion on a number of species. This task would determine the rate of occurrence of plastic particles in three orders of Hawaiian seabirds; Procellariiformes, Pelicaniformes, and Charadriiformes. The level of PCB's in the body fat of species in these three orders would be determined and the effects of this ingestion on survival, growth and reproduction would be assessed.

Status: Using funds carried over from FY85 (\$30K) combined with FY86 funds, the NMFS entered into a cooperative agreement with the National Wildlife Health Laboratory of the U.S. Fish and Wildlife Service to do experiments to determine the impacts of plastic ingestion on Laysan albatross and to collect data on the prevalence of ingested plastic in a diverse group of Hawaiian seabirds. Work was completed in 1989 encompassing four Laysan albatross breeding seasons (January to May 1986, and 1987, 1988, and 1989). Results from this research provided no evidence that ingested plastic caused mortality to albatross chicks, or that ingested plastics interacted synergistically with other causes of mortality. A report on this research is available from the authors or from the MERP manager, and is referenced in FY89 MERP task 3f.

h. Studies of the dynamics of gillnet gear (continued), \$15.0K

Begun in FY85 at the NMFS Hawaii Laboratory, this task was designed to develop a model for the life history of gillnet debris in the Pacific. The model would be used to test assumptions concerning the longevity and rate of change of the hazard level of ghost gillnet gear. The continuation of this activity into FY86 was principally to take advantage of vessel time available on the NOAA Ship Townsend Cromwell,

which could be used to extend the experimental observations over many months, thus strengthening the assumptions employed in the model.

Status: Funding for this research task was used to purchase fishing gear to be set adrift, satellite linked buoys and computer time. The task was continued into 1987 with one of the nets completing a long term drift. For further information regarding this task, refer to FY87 MERP task 3c.

i. Benthic impact of marine debris, \$19.8K

The U.S. government and its ocean and pollution agencies tolerated the disposal of a wide range of non-degradable materials into the ocean from ships and from shore-based plants until enactment of the MARPOL Annex V agreement, December 31, 1988. We know that certain of the polymer plastics are negatively buoyant and as such are deposited on the sea floor whenever they are released or lost at sea. These compounds are susceptible to degradation primarily by heat and light, neither of which are in abundance at the bottom of the sea. It is known that some types of synthetic materials are ingested by marine organisms to their detriment. Other synthetic materials, especially fishing gear, are known to entangle and cause the deaths of a wide variety of marine animals. Unfortunately, there is little data available on which to base an evaluation of the biological and commercial consequences of this physical pollution. This task was to conduct a mini-symposium to develop a conceptual assessment of the biological impacts caused by the present and future deposit of persistent, negatively buoyant waste materials into the ocean, providing rationale for conclusions and fully specifying the most probable scenarios for continental shelf and deep ocean ecosystems impacts.

Status: A contract was awarded to the University of Washington Fisheries Research Institute to organize and carry out a mini-symposium on the impacts of debris in the benthic environment. After conferring with a number of experts in the field, it was established that a symposium on the subject seemed inappropriate due to a lack of information pertaining to benthic marine debris. An informed advisory group was established to develop conceptual models. A final report was written, and is available from the author at the University of Washington or from the MERP manager, reference:

Sibley, T. H., R. M. Strickland. 1989. Potential Effects of Marine Debris on Benthic Communities. Report to the NMFS Marine Entanglement Research Program, Contract 40-ABNF6-2619, 37 p. Alaska Fish.

Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA
98115-0070.

j. Cetacean ingestion, \$23.0K

The Proceedings of the Hawaii Workshop on the Fate and Impacts of Marine Debris contains thorough reviews of the impacts of ingestion of debris by seabirds and sea turtles. This information has been invaluable in the designing of specific program tasks within the MERP. There has been no review of this nature for cetaceans although discussion with researchers reveal that data exists on the stomach contents of many cetacean species. This task would produce an extensive review of the available data on the incidence of debris ingestion by cetaceans and the mechanisms and extent of its impacts.

Status: A contract was awarded to William Walker, Natural History Museum of Los Angeles County (Mammalogy Section) in September 1986. A literature search and institutional survey was conducted to compile data on Odontocete cetaceans and their incidences of marine debris ingestion. A final report on this task was submitted to the MERP manager. This information was presented at the Second International Conference on Marine Debris in April 1989. Additional cetacean ingestion information was added to the report in 1990, and the final report is referenced in FY90 MERP task 3g.

k. Infrared spectrophotometric analysis of derelict fishing net material on Alaskan beaches, \$37.0K

Chemical characterization may provide information on the type, origin, and relative age of derelict fishing net materials found on Alaskan beaches. The chemical structure and composition of fishing nets depends not only on the polymer type, but also on the kind and relative amounts of plasticizers used, and on the details of net fabrication. For nets constructed of a particular polymer type, subtle differences in chemical structure may therefore exist among nets produced by different manufacturers, by the same manufacturer but at different times, and among otherwise identical nets exposed to the elements for different durations. The intent is to evaluate fourier transform infrared spectrophotometry (FTIR) as a means of detecting these subtle differences among nets collected from Alaskan beaches.

Status: The FY86 efforts in this investigation found that FTIR could be used to distinguish aging characteristics of webbing samples from Alaskan beaches. All of these samples were trawl webbing and all were made of polyethylene.

Further investigation of FTIR and the identification and aging of marine plastic debris was conducted in FY87. Results from this FTIR research are reported in FY87 MERP task 3i.

4. PROGRAM MANAGEMENT, \$73.7K

The responsible obligation of funds to accomplish the FY86 Program tasks (15 of them) requires the full time attention of the Program Manager. With the products of the FY85 program tasks coming in for review, acceptance, and dissemination concurrent with the RFP and research plan process for the FY86 program, it is apparent that a full-time program manager is justified. These funds support program management and provide for the effective administration of program tasks.

Status: A priority level billet was established for a NOAA Corps Officer as an Assistant Program Manager, beginning in 1987. This assistance is realized for the life of the program at no direct cost. Planning for FY87 activities, fiscal management and agency budget cycle responsibilities are covered under this task as well. Contracts management, inter and intra-agency research coordination and public contract for the program were accomplished under this task. In short, concept of the Entanglement/Debris Program became reality through this task.

In addition to the above success, the MERP manager accomplished the following:

1. Prepared an information paper and policy development assessment for CCAMLR which was used as the basis for the 1986 U.S. recommendations to the Commission on incidental mortality and entanglement in the Convention Area.
2. Drafted NOAA/NMFS testimony for House Coast Guard and Navigation Subcommittee hearings on plastic pollution in the oceans. This testimony was delivered with virtually no modifications.
3. Prepared background information papers for NOAA General Counsel, United States Coast Guard, and State Department use during International Maritime Organization (IMO) Marine Environmental Protection Committee (MEPC) meetings in July.
4. In cooperation with the U.S. Marine Mammal Commission and NOAA General Council, co-authored the U.S. position paper on the implementation of MARPOL Annex V, for presentation at the bi-annual meeting of the MEPC in February 1987.

FINAL FUNDING PLAN FOR FY 1987 ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
a.	Pacific debris education program (continued)	40.0K
b.	NW Atlantic debris education program (continued)	40.0K
c.	Gulf of Mexico debris education program (continued)	40.0K
d.	North Pacific education program evaluation	19.6K
e.	Marine debris teaching unit development for Project WILD	12.7K
f.	Development of a manual on procedures for monitoring plastic debris on beaches and at sea	2.0K
2.	MITIGATION	
a.	Plastics research steering group meeting	2.0K
b.	Evaluation of plastic recycling systems	48.0K
c.	Vessel refuse reception problems in Alaskan ports	25.0K
3.	IMPACTS RESEARCH AND MONITORING	
a.	High seas squid fishery impacts	150.0K
b.	Hawaiian monk seal entanglement protection and evaluation (continued)	10.0K
c.	Dynamics of gillnet gear (continued)	15.0K
d.	Alaska beach litter index (continued)	30.0K
e.	Sampling survey of impacts of marine and coastal debris and entanglement on sea turtles	12.0K
f.	Northern fur seal entanglement studies	
	(1) Workshop to guide entanglement research on northern fur seals	20.0K

(2)	Modeling and analysis of effects of entanglement on northern fur seals	25.0K
g.	Channel Islands pinniped entanglement index	5.0K
h.	Analyses of sea turtle stomachs collected from strandings on the Atlantic coast	20.0K
i.	Composition and weathering of derelict trawl web collected from Alaskan beaches: Analyses by FTIR (continued)	21.0K
j.	Marine debris in upwelling and frontal zones the Gulf of Mexico	31.0K
k.	Assessment of floating plastic particulates	21.0K
l.	Hawaiian seabird plastic ingestion impacts study - continuance of letter of agreement with USFWS National Wildlife Health Laboratory	18.7K
m.	Support for Pacific Rim Fishermens Conference on Marine Debris	5.0K
4.	PROGRAM MANAGEMENT	80.0K

FISCAL YEAR 1987 ACTIVITIES TO ADDRESS PROBLEMS
ASSOCIATED WITH DEBRIS IN THE MARINE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

Marine debris education - continued.

The Marine Debris Educational programs of FY86 were continued in FY87 in the form of three separate tasks with the following objectives:

a. Pacific debris education program (continued), \$40.0K

Taking into consideration the FY85 and FY86 program results and the FY87 program evaluation report, a contractor would be selected to continue and expand the education program previously established for the Pacific.

Status: A contract was awarded to Natural Resources Consultants of Seattle, Washington, to continue the North Pacific Education program. Public education about persistent marine debris was continued and expanded to all contributors in the fishing industry. An international conference was held to further educate fishermen about the hazards associated with plastics discarded into the ocean. For additional information on this conference, refer to FY87 MERP task 3m.

b. NW Atlantic debris education program (continued), \$40.0K

During 1987, an increased effort would be made to enlighten the primary industrial contributors and others identified during the initial FY86 program for this region.

c. Gulf of Mexico debris education program (continued), \$40.0K

A similar effort would be made to further enlighten the primary industrial contributors from the Gulf Coast.

Status: A contract was awarded to Kearney/Centaur of Washington, D.C., to continue and expand the education program in both the North Atlantic and along the Gulf of Mexico. The contractor expanded the education program to include the offshore oil and gas industry and manufacturers and distributors of monofilament fishing line. A comprehensive booklet was prepared as an educational tool to inform the general public about the problem of persistent marine debris. The booklet is available from the Center for Marine Conservation of Washington, D.C., reference:

A Citizens Guide to Plastics in the Ocean: More than a Litter Problem. 1987. 131 p. Center for Marine Conservation, 1725 DeSales St., N.W., Suite 500, Washington, D.C. 20036.

d. North Pacific education program evaluation, \$19.6K

A marine debris educational program was developed in late 1985 and implemented in 1986 for the North Pacific area. For 1987 the MERP intended to continue the more successful facets of this project in the North Pacific and further utilize the experience, contacts, and developments of the previous educational program's accomplishments. In order to effectuate this goal, an independent assessment of the past educational program impacts would be conducted to produce cost-effective recommendations for present and future educational efforts.

Status: After lengthy delays necessitated by survey, questionnaire review and formal authorization from the Office of Management and Budget, the surveys of various commercial fishing and shipping interests are near completion. The contract was increased from \$15.0K to \$19.6K to meet expenses relating to the cost of the survey. A final report on this project is expected soon.

e. Marine debris teaching unit development for Project WILD, \$12.7K (Revised)

Project WILD is a program created in 1980 by a coalition between the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council. Its purpose is to develop balanced instructional materials for use by teachers in elementary and secondary schools to teach the principals of wildlife biology and management. The U.S. Fish and Wildlife Service entered into a cooperative agreement with the sponsors of Project WILD to develop a comprehensive set of instructional materials for aquatic wildlife issues. These materials include a series on plastic pollution and its implications for living marine resources.

Status: A cooperative agreement was finalized between the Western Regional Environmental Education Council and the NMFS/MERP to design and produce instructional support materials on marine debris as supplements for the curriculum sections of the Project WILD Aquatic Educational program. A draft final report on this task was received by the MERP manager in October 1989. Subsequent discussions between the National Wildlife Federation and the Project WILD coordinator resulted in the Aquatic Education Kits being produced and distributed through the Project WILD office in Boulder,

Colorado. These teacher education kits are available at \$5.00 each. Reference:

Project Wild. 1990. Get The Drift: Cleaning Up Plastic Pollution for People and Wildlife. 38 p. Project WILD, P.O. Box 18060, Boulder, CO 80308-8060.

f. Development of a manual on procedures for monitoring plastic debris on beaches and at sea, \$2.0K

During 1985 and 1986, numerous efforts had been undertaken to apply and assess various techniques for monitoring plastic debris at sea and on beaches. In order to encourage and provide guidance to both domestic and international officials, scientists, and organizations in a position to collect relevant data, there existed a need to develop a procedural manual. The manual would outline a standard set of procedures for collecting and recording data that is comparable with existing data sets and responsive to information needs for management purposes.

Status: A draft manual for monitoring plastic/manmade debris on beaches and at sea was developed within the MERP office. Subsequent discussions at the Second International Conference on Marine Debris indicated the draft manual would require substantial revision. Funds have been allocated under the MERP program for FY90 to develop a national manual for monitoring plastic/manmade debris on beaches and at sea. This manual will include sections on survey assessment on the amount of marine debris (suitable for volunteer beach clean-up programs); scientific survey sampling; at-sea sampling methodology; and sampling for small particles of marine debris at sea using a neuston net.

It is the intention that this manual be written in a manner acceptable to the Intergovernmental Oceanographic Commission, Marine Pollution Research and Monitoring Unit, for acceptance as an international manual under MARPOL Annex V. For further information, refer to FY90 MERP task 2d.

2. MITIGATION

a. Plastic research steering group meeting, \$2.0K

Effective strategies for supporting marine debris research involve a number of complex decisions based on the level of resources that government, industry and public organizations are willing and able to commit to the perceived need and potential resources for mitigating the marine debris problem. To identify effective research and development projects,

representatives from involved agencies and industries needed to be surveyed.

Status: A diverse group of experts from the industrial, governmental and environmental communities were brought together in Seattle during December 1986, by the MERP to evaluate strategies for future research and development to mitigate the impacts of non-degradable debris in the oceans. Due to the mutually acclaimed success of the meeting, a second "Roundtable" meeting was sponsored by the Society of Plastics Industries in Washington, D.C., in June 1987. A third meeting was sponsored by the Port Authority of New York and New Jersey and was held in New York in March 1988. A fourth meeting was held in Baltimore, in May 1989, and was sponsored by the EPA. The Center for Marine Conservation sponsored the Fifth Roundtable meeting in Washington, D.C. in November 1989 and the U.S. Coast Guard will sponsor the Sixth meeting in Miami sometime in 1991. Information from these meetings has been used by the MERP to guide the development of debris mitigation and education tasks since FY88.

b. Evaluation of plastic recycling systems, \$48.0K

Recycling is often mentioned as a suitable means for changing the flow patterns of waste plastics. This task's objective was to evaluate the practicality of recycling systems in reducing the flow of plastic refuse into the aquatic environment and to identify factors critical to the systems' success or failure for the polymers used in the manufacturing of items hazardous to wildlife.

Status: The contract was awarded in July 1987, to Cal Recovery Systems, Inc. of Richmond, California. Work on this task was completed during 1987, and a final report is available from the MERP manager, reference:

Cal Recovery Systems, Inc. 1988. Evaluation of Plastic Recycling Systems. NWAFC Processed Rep. 88-16, 90 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA. 98115-0070.

c. Vessel refuse reception problems in Alaskan ports, \$25.0K

In response to public concern about littered beaches and the increasing records of damage to species that are managed and protected under U.S. law, the U.S. has ratified Optional Annex V of the Convention for the Prevention of Pollution from Ships (MARPOL). Annex V is entitled "Regulations for the Prevention of Pollution by Garbage from Ships" and prohibits, with certain exceptions, the disposal of all garbage, particularly synthetics, from ships. The objective of this task was to evaluate the adequacy of the waste

management systems in selected remote Alaskan seaports which were expected to receive the increased volume of landed refuse as a result of MARPOL Annex V.

Status: Under cooperative agreement between the NMFS and the Alaska Department of Environmental Conservation, the Alaskan ports of Kodiak and Unalaska were selected for the study which relied on methods and data developed during the Port of Newport cooperative project.

A final report has been published and is available from the MERP manager, reference:

Pacific Associates. 1988. The Effects of MARPOL, Annex V, on the Ports of Kodiak and Unalaska. NWAFC Processed Rep. 88-26, 64 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

3. IMPACTS RESEARCH AND MONITORING

a. High seas squid fishery impacts, \$150.0K

Large-scale driftnet fisheries for squid and other species in the North Pacific Ocean were initiated by Japan, Republic of Korea (ROK), and Taiwan in the late 1970's. The size of the squid fleets, the fishing characteristics of driftnets and, the likelihood that they entrap marine mammals and seabirds and intercept North American salmon is causing concern in the United States. The concern is well-founded, because most high seas squid fisheries are unregulated by any international fisheries convention or management regime. As a result, there is no monitoring program to gain data to estimate the interception or entrapment of various species. There is, therefore, a serious need for the following:

- (1) Evidence on the extent of entanglement of marine mammals and seabirds in squid driftnets.
- (2) Information on the amount of net discarded or lost by these fisheries.
- (3) Estimates on the catch of target and non-target species.

Status: During 1987, the program supported bilateral negotiations with Japan, Korea and Taiwan in which the United States requested the establishment of an observer program in the squid driftnet fisheries of each nation. These negotiations were unsuccessful.

United States scientists were invited aboard five foreign research vessels operating in squid fishing areas of the North Pacific. Also, the United States sent the R/V Miller Freeman into the fishery area to assess the distribution and density of marine mammals and seabirds. These vessels collected information on abundance and distribution of species, the oceanography of the area, the bycatch of species in research gillnets and the amounts and distribution of marine debris. The cruises were as follows:

<u>Nation</u>	<u>Vessel</u>	<u>Time Period</u>
Japan	Shoyo Maru	June-August
Japan	Hokuho Maru	November
Taiwan	Hai Kung	Aug-Sept.
ROK	Pusan 851	July-August
Canada	W. E. Ricker	May-July
U.S.	Miller Freeman	October

Reports from these cruises are available from the manager of the MERP.

During this year, funds were provided to the Joint Institutes for Marine and Atmospheric Research at the University of Hawaii to support an international meeting of scientists on driftnet issues in 1988. A loosely knit group of NMFS research program leaders with interest in the driftnet fisheries was formed and identified and the "Squid Advisory Committee". The interests of the committee cover marine mammals, salmonids, tunas and biological oceanography of the North Pacific Ocean.

b. Hawaiian monk seal entanglement protection and evaluation (continued), \$10.0K

Net fragments, line, and other flotsam accumulate on the beaches and offshore reefs of the Northwestern Hawaiian Islands (NWHI). Hawaiian monk seals, an endangered species, are known to become entangled in these materials and occasionally die. Recording, removal, and destruction of hazardous materials began here in FY85 during a task entitled "Identification of Sources of Fishing Debris Affecting Endangered Marine Animals in the Northwestern Hawaiian Islands." The work continued as a piggyback study on monk seal field research at very low cost.

Status: As in prior years, this task provided funds for the removal of hazardous debris that washes ashore at haul-out and rookery sites and causes monk seal entanglement. Data gathered during this task was combined with data from previous years, and presented in a report to the North

Pacific Rim Fishermen's Conference on Marine Debris,
reference:

Henderson, J. R. 1988. Marine Debris in Hawaii. In D.L. Alverson and J. June (editors). Proceedings of the North Pacific Rim Fishermen's Conference on Marine Debris, October 13-16, 1987, Kailua-Kona, HI p. 189-206. National Resources Consultants, 4055 21st Ave. West, Seattle, WA 98199.

c. Dynamics of gillnet gear (continued), \$15.0K

The "Dynamics of gillnet gear" task is a continuation of a study established in FY85 and continued through FY86 to recover drifting gillnets of known age and history. In addition to estimates of ghost-fishing, the recovered nets would provide ancillary information on changes in buoyancy, deterioration of netting, growth of fouling organisms, association of fish around floating debris, etc. This information will augment our understanding of the fate and hazard dynamics of derelict driftnets.

Status: Driftnets released in August 1986 with satellite tracking systems were recovered by June 1987. A final report was published in November of 1987. Copies are available from the NOAA Fisheries Hawaii Laboratory or from the MERP manager, reference:

Gerrodette, T., B.K. Choy, and L.M. Hiruki. 1987. An Experimental Study of Derelict Gillnets in the Central Pacific Ocean. SWFC Admin. Report H-87-18, 12 p. Southwest Fish. Sci. Center, Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

d. Alaska beach litter index (continued), \$30.0K

Plastic litter and commercial fishing gear lost or discarded at sea entangles marine mammals, sea birds, and fish; disables vessels; and degrades the scenic quality of wilderness beaches. Since most plastic litter eventually washes ashore, it can be inventoried by cost-effective beach surveys. These data constitute the beginning of an index of debris in the North Pacific and will be used to track changes in apparent rates of input.

Status: In 1987 the Auke Bay Laboratory (ABL) intended to continue past surveys that have established "baseline" observations on quantities and types of litter found on many Alaskan beaches. These surveys were accomplished and many trawl web samples were collected from fourier transform infrared spectrophotometric (FTIR) analysis by another

entanglement/debris task at ABL. Findings from this task were presented during the Second International Conference on Marine Debris, and are referenced in FY88 MERP task 3g.

e. Sampling survey of impacts of marine and coastal debris and entanglement on sea turtles, \$12.0K

Accidental mortality of endangered and threatened species of sea turtles continue to occur throughout their range in oceanic-coastal systems of the Southeastern United States and Western North Atlantic. There exists a need to investigate the degree and frequency of impacts of marine and coastal entanglement and debris in relation to stranded sea turtles of all species and all sizes in the upper Texas and Southwest Louisiana coasts.

Status: Funds were transferred to the NOAA Fisheries SEFC-Galveston Laboratory to systematically patrol, sample, and document stranding observations and events and describe the problem as it relates to the fate of sea turtles. This task was continued into FY 1988. For further details, refer to task 3j in the FY 1988 task summary.

f. Northern fur seal entanglement studies, \$45.0K

(1) Workshop to guide entanglement research on northern fur seals, \$20.0K

One hypothesis for the recent decline in abundance of northern fur seals is increased mortality at sea from entanglement in marine debris. Numerous studies on land and various analyses have been completed in recent years to assess the magnitude of mortality at sea and an assessment of the age and sex of animals dying at sea from marine debris. The principal reasons for not conducting the research at sea are high costs and the difficulty in designing research experiments that would provide the needed information. Some experts have suggested that certain pilot studies be conducted which may provide the needed information while other experts believe that such studies are not practical. Since there are numerous and conflicting opinions by recognized experts on the type and amount of research needed to address the problem of entanglement, the NMML would host a workshop to guide future research to assess entanglement of northern fur seals.

Status: A workshop to review and evaluate NMML fur seal entanglement research (including on land and at sea programs), was held January 6-8, 1988, in Seattle, Washington. Although recommendations from that workshop have been considered within the MERP, no report on the workshop has been finished.

(2) Modeling and analysis of effects of entanglement on northern fur seals, \$25.0K

Studies conducted on data collected through 1984, along with preliminary analysis of data collected in 1985-86, suggest that mortality caused by entanglement in trawl net fragments in the pelagic environment may be a principal factor in recent declining trends in the northern fur seal population. However, a complete synthesis, especially a modeling study including the more recent data, has not been completed. In particular, there is a need to re-examine mortality estimates from entanglement in large net fragments based on data involving composition of debris observed on land and at sea, both on seals and as debris alone. In view of quantity of data collected in recent years, it was important that a comprehensive quantitative synthesis be conducted involving a re-analysis of the historic data in combination with the results of the most recent studies, surveys, and experiments. The objectives of the task were:

To estimate the degree to which entanglement is contributing to mortality among northern fur seals, to better estimate the portion of entanglement related mortality caused by large net fragments.

To identify more clearly the specific data needed to better refine estimated mortality caused by entanglement.

To look for alternative means of deriving estimated mortality due to entanglement, and to enter raw data needed for such analysis into an ADP format.

Status: Work on this subtask continued through FY 1988 and is reported in task 3b of the FY 1988 task activity summary.

g. Channel Island pinniped entanglement index, \$5.0K

Data has been systematically collected on the prevalence of entangled California sea lions, harbor seals, and northern elephant seals in the California Channel Islands since late 1983. This series, if it can be continued, has the potential of developing into one of the few useful indicators of entanglement problem status.

Status: Work on this task was performed by the Hubbs Marine Research Center of San Diego, California. Related work on this task was continued in FY 1988. For further information, refer to task 3f of the FY 1988 MERP task summary.

h. Analyses of sea turtle stomachs collected from strandings on the Atlantic coast, \$20.0K

The consequences of entanglement, incidental catch, and ingestion of debris by sea turtles is severe, as known from limited sample studies. Although many of the stranded sea turtle mortalities can be attributed to entanglement and incidental catch in fishing gear or deliberate mutilation and killing by humans, some strandings result from ingestion of plastic debris. Researchers in the Southern New England region of the Atlantic have conducted necropsies and collected gut contents of approximately 600 stranded turtles. These samples are in storage and represent a significant source of information on the ingestion of foreign materials by sea turtles.

Status: Funds were transferred to the NMFS Northeast Region (NER) to commence this task. The NER contracted with Dr. Shoop of the University of Rhode Island to determine the levels and types of plastic debris in loggerhead and leatherback turtle stomachs and to develop baseline information on frequency of plastic ingestion, materials ingested, and apparent damage. The research efforts/necropsies are complete. A final report has been submitted, and is available from the MERP manager, reference:

Shoop, R.C. and C.A. Ruckdeschel. 1989. Analyses of Sea Turtle Gut Contents for Nonfood Components. Report to the NMFS Marine Entanglement Program, Contract 52-EANF-7-00067, 16 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

i. Composition and weathering of derelict trawl web collected from Alaskan beaches: Analyses by FTIR (continued), \$21.0K

Previous work in this area indicates that trawl web and other persistent plastics become brittle and loose strength over time due to weathering effects, oxidation, and ultraviolet exposure. Results of the 1986 FTIR analyses of derelict trawl fragments collected in Alaska indicated that all of the trawl web material was made of polyethylene, and that FTIR may be used to quantitatively determine weathering effects.

Status: FY87 work is complete. Samples of trawl web collected from fishing vessels of the region were analyzed as well as raw polyethylene pellets and web fragments found by beach surveys and observers at sea. A preliminary report on findings and accomplishments has been drafted but the revised final report has been delayed due to changing work priorities resulting from the Exxon Valdez oil spill.

j. Marine debris in upwelling and frontal zones in the Gulf of Mexico, \$31.0K

A variety of sealife has been found to associate closely with flotsam and other debris near oceanographic frontal zones. Both adult and larval fishes, including species of economic importance, and other marine life have been observed in aggregations along these zones. Little work has been done on the possible affects of marine debris on the aggregations of marine life in oceanographic frontal zones. This task was designed to initiate debris impact studies as a part of an ongoing program directed towards understanding the many factors that influence population strength of the marine species associated with these frontal zones.

Status: Scientific cruises aboard the NOAA Ship OREGON II have been conducted in the Gulf of Mexico. Work was conducted to augment certain NMFS field activities to maximize sample and data collections, thus utilizing some existing data and oceanic models. Cruise reports are available for the FY87 work. The study was continued in FY88 and the work described in FY88 task 31.

k. Assessment of floating plastic particulates, \$21.0K

Neuston samples from various ocean regions have contained plastic fragments and resin pellets. This phenomena has been reported since the early 1970's, primarily as an oddity from ichthyoplankton research activities. A study of the literature reveals a steady increase in the number of particles per unit area depending on how closely the researcher looks at the collected sample. The implication is that substantial amounts of plastic "micro-particles" floating on the ocean surface have yet to be documented. There exists a need to document the density, type, and range of size of plastic debris particles at the ocean surface in a specific, preferably remote region or regions.

Status: Neustonic samples collected on a cooperative, U.S./Korea research cruise were analyzed by NMFS scientists. A report was prepared for presentation to the International North Pacific Fisheries Commission and is available from the Institute of Marine Science, 200 O'Neill Building, University of Alaska, Fairbanks, Alaska 99775, reference:

Day, R.H., D.M. Clausen and S.E. Ignell. 1986. Distribution and Density of Plastic Particulates in the North Pacific Ocean in 1986. (Document submitted to the International North Pacific Fisheries Commission, Anchorage, Alaska, November 1986.) 17 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

**l. Hawaiian seabird plastic ingestion impacts study -
continuance of letter of agreement with USFWS National
Wildlife Health Laboratory, \$18.7K**

Initiated in FY85, this task continues through FY87 (Note FY85 and FY86 Status report updates). The FY87 plan extended the project biotechnician's appointment and provides for the conduct of a statistically adequate survey of the mortality caused by plastic and other problems affecting the tropical seabirds at Midway Island. A diagnostician position to conduct postmortem examinations on the island was also funded.

Status: FY87 field work was completed. Findings indicate that 16 of 18 species of seabirds studied had ingested plastic. A final report was prepared and is available from the author or the MERP manager, reference:

Sileo, L. 1987. The Prevalence and Effect of Plastic Ingestion in Hawaiian Seabirds from October 1986 to January 1987. Progress Report for NWHC Work Unit 20. 15 p. Natl. Wildlife Health Res. Cent., U.S. Fish and Wildlife Serv., 6006 Schroder Rd., Madison, WI 53711.

**m. Support for the Pacific Rim Fisheries Conference on
marine debris, \$5.0K**

Fishing industry associations in the United States, Canada, Japan, the Republic of Korea, and the Republic of China initiated this conference. The MERP provided funds to assist in the production of the proceedings.

Status: The Conference was held October 13-16, 1987, in Kailua-Kona, Hawaii, and included sessions on law, technology, industry policy and government programs. The workshop was a success with final sponsorship from commercial fishing industry groups and associations from Canada, Republic of China, Japan, Republic of Korea, and the United States. Proceedings of the meeting were published, and copies are available from the MERP manager, reference:

Alverson, D.L. and J.A. June (editors). 1988. Proceedings of the North Pacific Rim Fishermen's Conference on Marine Debris. 460 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

4. PROGRAM MANAGEMENT

Program management, \$80.0K

Successful planning and execution of each year's Marine Entanglement Research Program tasks has been the primary responsibility of the designated Program Manager. The activities that have proven relevant to the effective direction of the program are the discovery, receipt, interpretation and distribution of information related to fisheries research, plastics technology, industrial and public education, national and international trade and treaty developments, public policy issues, myriad constituent concerns, Federal administrative systems and domestic law. Communication, negotiation and compromise have been the most useful tools in managing the program, both internally and externally. The overall goal of existing management for the program is to promote the realization of long term solutions to the proliferation of non-degradable refuse in the oceans, thereby controlling a significant cause of unnecessary destruction of living marine resources.

Status: Program Management gained the concurrence of the Marine Mammal Commission on a plan to effectively utilize the FY87 appropriation of \$750K to address the goals of the Program. A NOAA Corps Officer's billet was granted to the Program and filled by LCDR Alan Bunn who acted as the assistant program manager at no cost to the Program. Program management has played an increasing role in the development of agency policy on the marine debris problem. Briefings have been given at the Administration policy level and advice provided to the national and international organizations regarding marine debris research, education, and control. The MERP also provided advice to the U.S. Coast Guard and the International Maritime Organization regarding the implementation of MARPOL Annex V.

In addition to the activities described above, MERP management provided administrative support to a Saltonstall-Kennedy (S-K) grant to study the feasibility of marking fishing gear as a method of mitigating the problem of derelict fishing gear in the environment. This work continued through 1989, and is reported in FY89 MERP task 4a.

FINAL FUNDING PLAN FOR FY 1988 ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS:	
a.	Marine Debris Education Programs (continued)	
	(1) Marine debris information office - Pacific coast. By contract	\$30.0K
	(2) Marine debris information office - Atlantic coast. By contract	\$30.0K
b.	Shipping industry marine debris education (part 1)	\$13.2K
c.	Second International Conference on marine debris	\$42.9K
2.	MITIGATION	
a.	Degradable plastic technology research and development	\$60.0K
b.	Unalaska port waste management planning	\$50.0K
c.	Guidelines for waste burning aboard ships	\$20.0K
3.	IMPACTS RESEARCH AND MONITORING	
a.	High seas squid investigations program-framework plan	\$120.0K
b.	Synthesis of information on northern fur seal entanglement (continued)	\$25.0K
c.	Juvenile male fur seal survivorship and entanglement in marine debris (continued)	\$20.0K
d.	Entangled and unentangled juvenile male fur seal behavior patterns	\$10.0K
e.	Removal of debris hazardous to monk seals from Northwestern Hawaiian Islands (continued)	\$10.0K

f.	Channel Islands pinniped entanglement monitoring (continued)	\$5.0K
g.	Entanglement debris on Alaskan beaches (continued)	\$25.0K
h.	Effects of marine pollution on juvenile, pelagic sea turtles	\$35.0K
i.	National seashore debris survey program	\$40.0K
j.	Debris, entanglement, strandings, and causes of death in sea turtles in the Gulf Of Mexico (continued)	\$20.0K
k.	Hawaii sea turtle stranding network enhancement	\$10.0K
l.	Associations of marine debris with upwelling and frontal zones (continued)	\$25.0K

4. MANAGEMENT

a.	Program management (continued)	\$85.5K
----	--------------------------------	---------

FISCAL YEAR 1988 ACTIVITIES TO ADDRESS PROBLEMS
ASSOCIATED WITH DEBRIS IN THE MARINE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

**a. Marine debris education program (continued), \$60.0K
[Tasks (1) and (2)]**

Due to funding shortfalls and evolving marine debris education requirements (given the growing national interest in the subject), the MERP established the Marine Debris Information Offices (MDIO). These offices would be national "clearing houses" to efficiently disseminate information about the persistent marine debris problem to the public at large using educational materials developed through government and private industry funding.

Status: Two MDIO's were established during late 1988 through a contract with the Center for Marine Conservation (CMC), using \$60.0K of FY 1988 funding. One office was opened in Washington, D.C. to meet the marine debris information requirements relating to the Atlantic and Gulf of Mexico coasts. Another office was opened in San Francisco, CA to meet marine debris information needs in the Western States.

The report of the first year of operation of NOAA's marine debris information offices is available from CMC or the MERP manager and is referenced in FY89 MERP task 1a.

**b. Shipping industry marine debris education plan (Part I),
\$13.2K**

Prior inability to engage ship operators in region marine debris education activities indicated that an effective marine debris education program for foreign and domestic shipping and cruise ship industries was needed. Such a program would result in their awareness of and increased compliance with MARPOL Annex V and the Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA). The task was divided into two parts, with the plan development being part I and the implementation of that plan in part II. Part I was expected to be completed during FY 1988, and should a workable plan be developed, funding for part II would be made available in FY 1989.

Status: A contract was awarded to A.T. Kearney, Inc. of Alexandria, Virginia. In consultation with representatives from government and shipping industry factions, the contractor submitted a shipping industry marine debris education plan in February of 1989. Reference:

Kearney/Centaur and the Center for Marine Conservation. 1989. Shipping Industry Marine Debris Education Plan. Report to the NMFS Marine Entanglement Research Program Contract 52ABNF800132, 79 p. Kearney/Centaur Division of A.T. Kearney, Inc., 225 Reinekers Lane, Suite 300, Alexandria, VA. 22314.

For further information about the shipping industry marine debris education plan, refer to task 1c of the FY 1989 MERP task summary.

c. Second International Conference on Marine Debris, \$42.9K

The first International Conference on persistent marine debris in the oceans was held in Hawaii in November 1984. This Workshop on the Fate and Impact on Marine Debris laid the foundation of information and recommendations that has driven government, industry and private programs to solve this problem. In conjunction with the entry into force of MARPOL Annex V, a second conference was planned, to review the status of science, technology and administration relevant to the marine debris problem. The conference would upgrade the information base and provide long-term insights and recommendations for continuing progress in managing the impacts of man's debris on ocean resources.

Status: FY 1988 funds were increased from \$30.0K to \$42.9K and used for conference preparation, including the hiring of a conference chairman, the renting of office space, and for the reservation of an appropriate conference venue. Funds were also used for the purchase of supplies and for printing costs for the conference announcement. For further information about the conference, refer to task 1d of the FY 1989 MERP task summary.

2. MITIGATION

a. Degradable plastic technology research and development (\$50.0K from MERP, \$10.0K from NOAA)

Certain plastic materials that find their way into the marine environment damage marine life, ships and the quality of our beaches (aesthetic damage). The range of strategies to counteract this damage includes plastic recycling, incineration and heat recovery from plastic wastes, landfills and utilization of alternate, less durable materials. The objective of this task was to conduct a detailed technical, economic and strategic evaluation of the feasibility and practicality of controlled-lifetime plastics as a partial solution to the problems caused by plastic debris in the ocean and on the shore. Attention would be focused on the impact of "degradable" plastics, which after

a reasonable service lifetime would embrittle and disintegrate into ever smaller particles.

Status: NOAA/NMFS entered into a cooperative agreement with elements of the U.S. Navy in order to amend an existing Navy contract with the Research Triangle Institute of North Carolina. The focus of the work was to develop a list of the damaging marine plastic debris items reported in literature, and classify each item according to its specific polymer and processing technology employed in its manufacture. Then, develop a list of known controlled lifetime polymers, and identify possible items found in marine debris which might be manufactured using a controlled lifetime polymer. Having identified the applications where the substitution of controlled-lifetime plastics may be feasible, identify possible problems and solutions in converting the applicable plastic items to manufacture using controlled-lifetime polymers.

Work on this task was completed in 1988, and the findings were reported in a final report to the MERP manager and as part of a final report of the Interagency Task Force on Persistent Marine Debris, references:

Dunford, R.W., A.L. Andrady and L.J. Norwood. 1989. The Economic Impacts of Required Rapidly Degradable Plastics in Selected Products: A Preliminary Analysis. Report to the NMFS Marine Entanglement Research Program, Contract RTI/4074/00-01F, 24 p. Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709-2194.

Dunford, R.W., A.L. Andrady and L.J. Norwood. 1988. Assessment of Degradable Technologies. Chapter Six of the Report of the Interagency Task Force on Persistent Marine Debris, 170 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Unalaska port waste management planning, \$50.0K

Unalaska Island is adjacent to the richest fishing grounds in the United States, if not the world. The Dutch Harbor/Unalaska port areas are becoming increasingly important as staging areas for domestic fishermen and, with the rapid deployment of shoreside and nearshore fish processing capacity, for the processing and cargo vessels of many nations. The fishing industry operating within this region generates a large quantity of net and plastic debris, which impact the large number of marine mammal and bird populations. In anticipation of the ratification of MARPOL Annex V, an international effort should be mounted to develop the capabilities of Unalaska/Dutch Harbor to manage

and process the volume of vessel garbage deposited in accordance with new regulations. The objective of this task is to evaluate the extent of the solid waste disposal problem within this region, examine legal policy and efficient disposal methods, and discuss waste management options including the procurement of facilities and equipment as necessary, to recycle and dispose of materials brought ashore.

Status: A grant to perform this task was awarded to Southwest Alaska Municipal Conference of Anchorage, Alaska. Work was completed and the final report to the MERP manager was published as a NWAFC Processed Report. The study concluded that the Unalaska, Kodiak, and Bristol Bay coastal communities generate more garbage per capita than the average lower 48 coastal cities. Unalaska's garbage generation rate has increased to 540% of the national norm as vessels are bringing their garbage ashore (in compliance with MARPOL regulations). The Unalaska landfill has nearly reached capacity, with 3 to 5 years left. The report recommends to begin an engineering feasibility study to evaluate incinerator disposal with energy recovery and for beginning a solid waste collection and management study for the Bristol Bay area. Copies of the report are available from the MERP manager, reference:

Bayliss, R. and C.D. Cowles. 1989. Final Report on the Impact of MARPOL Annex V Upon Solid Waste Disposal Facilities of Coastal Alaskan Communities. NWAFC Processed Rep. 89-20, 105 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Guidelines for waste burning aboard ships, \$20.0K

The use of "burn barrels and similar low technology burning to reduce the volume of ship-generated garbage was expected to increase with the implementation of MARPOL Annex V. It had not been determined as to the extent these open burning techniques were effective in destroying various types of trash. The objectives of this task were to evaluate the efficiency of using low temperature "burn barrel" methods to destroy ship's wastes and to characterize the human and environmental hazards created by this type of refuse destruction. If warranted, a series of clear guidelines for the safe burning of trash generated aboard ships will be developed.

Status: A contract to perform this task was awarded to SCS Engineers of Bellevue, Washington. The work was performed, and two final reports were submitted to the MERP manager. One report summarized the feasibility study of burn barrels

aboard ships, and one report discussed the operating and safety guidelines for burn barrel use aboard ships. Research revealed that burn barrels are technically feasible and, when properly used, appear to comply with existing environmental and marine regulations. When operated according to the suggested guidelines, burn barrels can provide a safe, convenient, and low cost alternative to either on-shore disposal or incineration of shipboard-generated wastes. However, neither SCS Engineers or the MERP thought it appropriate to recommend use of burn barrels aboard ships. Copies of these reports are available from the MERP manager, references:

SCS Engineers. 1989. Operating and Safety Guidelines for Use of Burn Barrels to Dispose of Shipboard-Generated (MARPOL V) Wastes. NWAFC Processed Rep. 89-14, 15 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

SCS Engineers. 1989. An Investigation of Using Burn Barrel Technology to Dispose of Shipboard-Generated (MARPOL V) Wastes. NWAFC Processed Rep. 89-15, 22 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

3. IMPACTS RESEARCH AND MONITORING

a. High seas squid investigations program - framework plan, \$120.0K

In the North Pacific, drift gillnet fisheries for flying squid are operated by Japan, the Republic of Korea (ROK) and Taiwan in the transition zone between subarctic and subtropical waters. Although squid is the target species, in the northern range of the mixing zone, the gillnets inflict incidental mortality on stocks of salmon, Dall's porpoise, northern fur seals and other species protected by international treaties or U.S. law. In the southern region, there is a significant bycatch of albacore.

Information on the amount and distribution of effort and observations of net retrievals are needed to estimate bycatches. Because many non-target species are not retained, port sampling programs cannot provide needed catch information. Instead, observer placement aboard commercial fishing vessels is required and this placement must occur throughout the fishing season and fishing areas.

The objective of this task was to plan for the collection of fishery data and estimate the bycatch of salmon, marine

mammals, seabirds, albacore, and other non-target species in high-seas squid gillnet fisheries in the North Pacific.

Status: On December 30, 1987, Congress passed the Driftnet Impact Monitoring, Assessment and Control Act of 1987. This Act gave the National Marine Fisheries Service the responsibility for developing information and programs to assess the impacts of these fisheries on marine resources of the United States. Throughout the year, the program supported U.S. scientists in the development of scientific and negotiating positions for observer programs in the North Pacific squid driftnet fisheries of Japan, ROK, and Taiwan. In the spring, the U.S. and Japan agreed to field a pilot observer program involving 4 U.S. and 10 Japanese observers. This program was contingent upon the Japanese receiving a permit from the U.S. to take marine mammals incidentally to their salmon driftnet fishery in the U.S. EEZ. This permit was denied and the observer program was cancelled for 1988.

A single U.S. observer was placed aboard the ROK commercial squid driftnet vessel Oyang 53 and recorded data from 22 net sets. The results of this cruise were published as a NWAFC Processed Report, reference:

Gooder, P. 1989. Observations on Board the Korean Squid Driftnet Vessel, Oyang 53, June 9 - August 8, 1988. NWAFC Processed Rep. 89-03, 30 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

The Squid Advisory Committee held a workshop in May of 1988 to review the biological and oceanographic information relevant to North Pacific driftnet fisheries. The full report of the workshop is in preparation. This meeting was also to develop a plan for further investigation to meet the impacts assessment expectation of the Driftnet Act.

Reference:

Wetherall, J. A. 1989. Strategic Plan for North Pacific Squid Driftnet Entanglement Research. SWFC Admin. Rept. H-89-9, 51 p. Southwest Fish. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

United States Scientists took part in three cooperative research vessel cruises in the Squid fishing area in 1988 as follows:

<u>Nation</u>	<u>Vessel</u>	<u>Time Period</u>
Taiwan	Hai Kung	July - October
ROK	Pusan 851	July - August
Canada	W. E. Ricker	June - July

Reports from these cruises are available from the MERP manager.

b. Synthesis of information on entanglement of northern fur seals (continued), \$25.0K

Data analysis through 1984, along with preliminary analysis of data collected in 1985-86, suggest that mortality of fur seals caused by entanglement in trawl net fragments may have been an important if not a major factor in the recent decline in the northern fur seal population on the Pribilof Islands. These studies include modeling work by various investigators. However, in view of the most recent collection of data (1985-1987), a synthesis is needed, especially a modeling study including the more recent data. In particular, there is need to re-examine mortality estimates from entanglement in large net fragments based on data involving composition of debris observed on land and at sea, both on seals and as debris independent of seals. In view of the quantity of data collected in the last several years, it is important that a comprehensive, quantitative synthesis be conducted, involving a re-analysis of the historic data in combination with the results of the most recent studies. Such a synthesis would not be restricted to a summary of existing information, but would include an assessment of the impact of entanglement on the growth of the fur seal herd. A full assessment of entanglement-caused mortality cannot be made without an updated analysis and synthesis of the recent data covering specific needs as identified at the Entanglement Workshop held in January of 1987. This contract was to be part of the overall reassessment and synthesis effort being undertaken at the NMML, as recommended by the fur seal program review panel, in March 1987.

Status: An analysis of fur seal mortality and entanglement data was completed in early 1989. Two papers were presented at the Second International Conference on Marine Debris, which summarized portions of the finding related to this task. A complete final report was submitted to the NMFS National Marine Mammal Laboratory, and portions of that report may be published later as an NMFS Processed Report. The reports presented at the Hawaii Conference and the final report are referenced below:

Ribic, C.A. and G.L. Swartzman. In press. An Index of Fur Seal Entanglement in Floating Net Fragments. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Swartzman, G.L., C.A. Ribic, and C.P. Haung. In press. Marine Debris Entanglement Mortality and Fur Seal Populations: A Modeling Perspective. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Swartzman, G.L., C.A. Ribic and C.P. Haung. 1990. Effect of Entanglement on Populations of Northern Fur Seal Callorhinus ursinus. Unpubl. manuscript, 98 p. (Report submitted to the NMFS Natl. Mar. Mammal Lab.) Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Juvenile male fur seal survivorship and entanglement in marine debris (continued), \$20.0K

The declining population of northern fur seals may be partially attributed to mortality caused by entanglement in marine debris, especially trawl nets. The impact of this mortality may be greatest on juvenile seals, which are more vulnerable because of their relatively small size. A cooperative U.S. - Japan fur seal entanglement study has been gathering data on fur seal entanglement for three years. Data from this study provide the principle means of monitoring the juvenile male component of the northern fur seal population since the termination of the commercial harvest. The objective of this task is to continue monitoring juvenile fur seal entanglement to assess the impact of marine debris on the northern fur seal population.

Status: A total of 66 fur seal roundups were completed during July of 1988. During these studies 24,519 male fur seals of the size historically taken in the commercial harvest were examined for debris. A final report summarizing the results of this study was submitted to the MERP manager. In summary, the 1988 roundups of juvenile males indicated an entanglement rate of about half of that level observed during previous years, reference:

Fowler, C.W., R. Merrick, and N. Baba. 1989. Entanglement Studies at St. Paul Island, 1988: Juvenile

Male Roundups. NWAFC Processed Rep. 89-01, 23 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

d. Entangled and unentangled juvenile male fur seal behavior patterns, \$10.0K

Preliminary studies conducted in 1986 of onshore attendance behavior of juvenile male fur seals, indicated that males entangled in debris may spend approximately twice as much time at sea as unentangled males. The objective of this task was to assess the amount of time that entangled and unentangled juvenile males spend foraging at sea and resting ashore.

Status: This work was completed in 1988, in conjunction with the entanglement studies listed in task 3b of the FY 1988 task summary. The results of this work were included in the report referenced in the summary of task 3b for FY 1988.

e. Removal of debris hazardous to monk seals from Northwestern Hawaiian Islands (continued), \$10.0K

This task is a continuation of the annual removal of marine debris from beaches inhabited by Hawaiian monk seals, to lessen the number of seal entanglements. Removal or destruction of net fragments, line, and other flotsam from known monk seal beaches is thought to be effective in reducing observed entanglements. Nonetheless, debris continues to wash ashore on beaches and reefs inhabited by monk seals, and will continue to pose a threat unless removed.

Status: Work on this task was completed in 1988. Results of the study indicate that since 1985, the overall rate of entanglement for Hawaiian monk seals has increased tenfold. The rise in entanglement is attributed to the rise in amount of marine debris present on or around seal haul-out areas. A report on these findings is in preparation for publication, reference:

Henderson, J.R. In press. Recent Entanglements of Hawaiian Monk Seals in Marine Debris. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

f. California Channel Islands pinniped entanglement monitoring (continued), \$5.0K

This task is a continuation of the systematic collection of data on the prevalence of entangled California sea lions, harbor seals, and northern elephant seals in the California Channel Islands since late 1983. If continued, this annual collection series may develop into one of the few useful indicators of entanglement problem status.

Status: Work on this task was completed in early 1988. Research indicated that the primary material entangling California sea lions was monofilament gill net (89% of all observed entanglements). A report of this research was submitted to the MERP manager, and is available from the authors, reference:

Stewart, B.S. and P.K. Yochem. 1988. Pinniped Entanglement in Synthetic Materials in the Southern California Bight, 1986-1988. Sea World Research Institute Technical Report No. 88-210, 15 p. Sea World Research Institute, Hubbs Marine Research Center, 1700 South Shores Rd., San Diego, CA 92109.

g. Entanglement debris on Alaskan beaches (continued), \$25.0K

Plastic debris and commercial fishing gear lost or discarded at sea entangles marine mammals, seabirds, and fish; disables vessels; and degrades the scenic quality of beaches. Since most plastics eventually wash ashore, they can be inventoried by beach surveys. Debris surveys are useful in monitoring trends in abundance over time, and when combined with experiments using marked debris and debris removal, can also quantify the annual deposition rate and fate of debris washed ashore. This task would continue past surveys that have established "baseline" observations on quantities and types of debris found on many Alaskan beaches since 1972.

Status: A series of 12 beach surveys were conducted over a seven month period between 1987 and 1988. Information from these surveys have been reported in a paper presented at the Second International Conference on Marine Debris, reference:

Johnson, S.W. In press. Entanglement Debris on Alaskan Beaches, 1982-88. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

h. Effects of marine pollution on juvenile, pelagic sea turtles, \$35.0K

It has been established that the earliest developmental habitats of sea turtle hatchlings, once they leave the nesting beach, are oceanic driftlines. Loggerhead, green, hawksbill and Kemp's Ridley sea turtles are often associated with rafts of sargassum in these driftlines that provide both physical refuge and a food resource. There have been no systematic studies of sea turtles in this habitat; hence, there is much to be learned about the basic biology of sea turtles within oceanic driftlines.

This task would investigate both the basic biology of pelagic, post-hatchling sea turtles and the effects of pollutants on the biology and survival outlook of these threatened and endangered species. The task would be divided into two phases:

- (1) Investigation of the effects of marine pollutants on post-hatchling sea turtles in their pelagic habitat in the Western Atlantic (\$17.5K).
- (2) Biology of juvenile loggerheads, Caretta caretta, in a pelagic habitat in the Eastern Atlantic (\$17.5K).

Status: Work on this task was performed through a contract with the Archie Carr Center for Sea Turtle Research, through a series of cooperative interagency agreements with the University of Florida at Gainesville, the U.S. Fish & Wildlife Service, and NOAA. Due to complications arising from the transfer of funds through these organizations, the task was funded in late 1988, resulting in the work being performed during FY 1989. This work is ongoing, but preliminary results confirm a presence of many small, pelagic sea turtles in the Eastern Atlantic around the Azores. A sea turtle biologist has been collecting specimens in the Azores during the 1989 and 1990 field seasons. For further information on this task, refer to FY89 MERP task 3c.

i. National seashore debris survey program, \$40.0K

There is presently only one quantitative study of the types, amounts, and distribution of seaborne debris in the U.S. coastal zones. This work is being carried out in Alaska to assess the levels of entangling materials generated by the major fisheries operating there, which are documented to cause the deaths of birds and marine mammals. For the remainder of the country, the problem of beach litter is perceived as more of an aesthetic and health problem. Data

on the types and volumes of debris on the non-Alaskan beaches of the nation is generated primarily from voluntary beach clean-ups. While these data are useful for public education and media purposes, they are inadequate for quantitative assessment of the problem or for developing solution strategies. A quantitative study of beach debris is needed for each region of the country, because the debris problems and sources differ from area to area. Using the survey methods developed in Alaska, a national sampling system needs to be initiated. As envisioned, this system would begin to gather the data necessary to characterize the marine debris problems on U.S. shores and monitor the success of legislation to control dumping from ships.

This task would develop a program of systematic surveys in each region of the coastal United States to assess the types, quantities, sources and dynamics of debris arriving on these shores.

Status: Complications arising from the initiation of funding for this task resulted in FY 1988 funds being used for task implementation during FY 1989. A workshop was held June 6-8, 1989, in Washington, D.C. to discuss debris monitoring activities around the U.S. and resolve questions on sampling procedure, data handling, reporting requirements, etc. The workshop produced a set of guidelines for handling, analyzing, and presenting data gathered from seashore surveys. For additional information on the results of the first year of monitoring efforts, refer to FY89 MERP task 3j.

j. Debris, entanglement, strandings and causes of death in sea turtles in Gulf of Mexico (continued), \$20.0K

Beach sampling surveys conducted in 1986 and in 1987 by the NMFS Southeast Fisheries Center Galveston Laboratory (in collaboration with four other universities) documented 471 stranded sea turtle carcasses from the Mermentau River, Louisiana to the Rio Grande River in Texas. The critically endangered Kemp's ridley sea turtle comprised 239 (51%) of these carcasses. Necropsy analysis conducted on a portion of these carcasses indicated that a number of mortalities were due to entanglement or ingestion of debris. Increased strandings of sea turtles along the Northwestern Gulf coast have created conflicts concerning the roles that debris entanglement, commercial and recreational fishing, offshore petroleum platforms, and other of man's at-sea activities play in sea turtle mortalities. Settlement of these conflicts requires that beach sampling surveys and necropsies of sea turtle carcasses be continued to document the possible causes of death in stranded sea turtles.

This task was designed to compliment an interagency funded "Sea Turtle Stranding and Salvage Network" by including beach sampling for debris entanglement on stranding surveys of the upper Texas coast and the Southwest Louisiana coast.

Status: Systematic beach sampling surveys were conducted along the upper Texas and Southwest Louisiana coasts from June 1987 through October 1988. Preliminary results were reported in early 1988 during the Eighth Annual Workshop on Sea Turtle Conservation and Biology. A revised interim report on marine debris and sea turtles was submitted to the MERP manager in March, 1989. For additional information on the results of this research, refer to FY89 MERP task 3d.

k. Hawaii sea turtle stranding network enhancement, \$10.0K

Questions and concerns raised about the role of human at-sea activities (discussed in FY88 MERP task 3j) also apply to the apparent increase in sea turtle strandings in the Hawaiian Islands. Although a stranding network exists within the State of Hawaii, limited resources have prevented some recoveries and precluded complete and thorough examinations for the presence of plastic or other flotsam. This task was designed to enhance the recovery and necropsy of stranded turtles in Hawaii, to determine whether any of the strandings may be resulting from marine debris.

Status: Work on this task was completed in 1988, and the resulting data was submitted to the MERP manager in July 1989. Information collected during this task was incorporated into a paper presented during the Second International Conference on Marine Debris. Reference:

Balazs, G.H. and B.K. Choy. In Press. Ecological Aspects of Marine Turtles Impacted by Ocean Debris: A 1989 perspective. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

l. Associations of marine debris with upwelling and frontal zones (continued), \$25.0K

In recent years, researchers have recognized that oceanographic frontal zones comprise an aggregation of fishes, marine mammals, seabirds, and various types of marine debris. Not only do frontal zones influence the spatial and temporal distribution of fishery organisms, but the debris associated with these zones also has the potential to carry absorbed and adsorbed contaminants.

There has been little research relating to the possible effects of aggregated debris on aggregations of fishes. The NOAA Southeast Fisheries Center Beaufort Laboratory has been working toward understanding the factors that influence population strength of fisheries organisms. This task would assist ongoing work on the interaction of early life history stages of fish with frontal zones and in understanding the fate and impact of contaminants on fishery organisms within these zones. The task would fund three phases of research:

- Participate in three cruises along the Carolina coast and in the Mississippi River plume, sampling surface and sub-surface micro-debris in convergence and frontal zones.
- Examine and characterize particles taken from these samples.
- Conduct feeding experiments using larval Atlantic menhaden (Brevoortia tyrannus) and aged plastic particles.

Status: Work on this task was performed during FY 1988 and in FY 1989. Additional FY 1989 MERP funding was allocated to this task in support of the larval fish feeding experiments. For further information about this task, refer to FY89 MERP task 3b.

4. MANAGEMENT

a. Program management (continued), \$85.5K

The Marine Entanglement Research Program cannot function without management and direction, both of which have been provided in the past by a Program Manager and an Assistant Program Manager. This continuing need is constantly challenged by (1) growing public interest in the problem of persistent marine debris; (2) continued discovery of sources and impacts of debris; and (3) evolving national and international laws, policy, and practices to control marine debris.

Status: During FY 1988, the MERP undertook many new challenges relating to marine debris education and mitigation issues. The port refuse reception facility studies helped the port communities and the fishing industries to work together for simple, cost-effective solutions to port and vessel waste disposal problems. The MERP prepared NOAA testimony before Congress on the Marine Plastic Pollution Research and Control Act to implement MARPOL Annex V in the United States. In the development of the U.S. implementing legislation and the International

Maritime Organization's (IMO) Guidelines for the Implementation of Annex V, the MERP provided guidance to enhance the likelihood of compliance by vessel operators.

In addition to the above activities, MERP management participated as a member of the Washington State Task Force on Marine Debris. This task force developed a marine plastic debris action plan for Washington State.

MERP Management provided administrative support to three Saltonstall-Kennedy (S-K) grants in support of marine debris mitigation activities. These S-K grants were awarded to:

1. The Center for Marine Conservation for the development and evaluation of education techniques to eliminate at-sea disposal of plastics and debris by commercial and recreational fishermen.
2. Pacific Marine Fisheries Commission for the development of a west coast marine debris recovery program.
3. Gulf and South Atlantic Fisheries Development Foundation for the development of a Southeast initiative to comply with MARPOL Annex V prohibitions on at-sea dumping of plastics.

These projects continued through FY 1990, and are reported in FY90 MERP task 4a.

MERP Management participated in OCEANS 88, an international marine conference sponsored by the Marine Technology Society and the Institute of Electrical and Electronics Engineers. MERP Management presented a paper at this conference, reference:

Coe, J.M. and A.R. Bunn. 1988. Marine Debris and the Solid Waste Disposal Crisis. In Proceedings of OCEANS 88 "A Partnership of Marine Interests." October 31 - November 2, 1988, Vol. I, p. 1-5. Marine Technology Society, 2000 Florida Ave. N.W., Suite 500, Washington, D.C. 20006.

FINAL FUNDING PLAN FOR FY 1989 ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
a.	Marine debris information offices (continued)	\$60.0K
b.	Marine debris education program supplies	50.0K
c.	Marine debris education program for shipping and cruise lines; Phase II	39.0K
d.	Second International Conference on Marine Debris (continued)	31.0K
2.	MITIGATION	
a.	National beach cleanup database support	\$30.0K
b.	Debris removal from Hawaiian monk seal beaches (continued)	10.0K
c.	Advisory workshop on marine debris mitigation	32.0K
d.	Ghost gillnet mitigation experiments	15.0K
3.	IMPACTS RESEARCH AND MONITORING	
a.	High seas driftnet fisheries investigations (continued)	\$122.5K
b.	Impact of plastic particle ingestion on survival of larval fish (continued)	18.5K
c.	Effects of marine pollution on juvenile, pelagic sea turtles (continued)	35.0K
d.	Assessment of marine debris, entanglement and causes of death in sea turtles (continued)	20.0K
e.	Juvenile male fur seal survivorship and entanglement in marine debris (continued)	25.0K
f.	The effects of ingested plastic on albatross (continued with U.S. F&WS)	25.0K
g.	Ingestion of marine plastics by Western Atlantic seabirds	8.0K

h.	Bioaccumulation and buoyancy of floating marine debris	30.0K
i.	Marine debris survey of the Eastern Bering Sea shelf	5.0K
j.	National seashore marine debris survey program (continued with U.S. NPS)	33.0K
k.	Surveys of entangling debris on Alaska beaches (continued)	24.5K
l.	Channel Islands pinniped entanglement monitoring (continued)	7.0K
4.	MANAGEMENT	
a.	Program management	\$86.0K

FISCAL YEAR 1989 ACTIVITIES TO ADDRESS PROBLEMS ASSOCIATED
WITH DEBRIS IN THE MARINE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

a. Marine debris information offices (continued), \$60.0K

These offices provide the means to distribute information and materials on the marine debris problem and its solutions. Funds are used for the continuation for two such offices, one in San Francisco, California and one in Washington, D.C. These offices would be supplied by the Marine Entanglement Research Program (MERP) with the necessary materials to meet public and industrial demand. Operators of these offices are also encouraged to seek assistance from industry and public organizations.

Status: Work on this task continued through FY 1989. The Center for Marine Conservation (CMC) reported progress in the development and dissemination of information about persistent marine debris. Some of the accomplishments during FY 1989 included:

- The development of marine debris "information packets" and the subsequent dissemination of this material to 11,189 educators, government, and industry personnel.
- The creation and distribution of "information packets" about beach cleanups.
- The distribution of 15,000 recreational boating brochures for National Safe Boating Week, 8,000 recreational fishing brochures for National Fishing Week, and 2,500 copies of Citizen's guide to Plastics in the Ocean to the U.S. Navy.
- Obtaining the right to use the cartoon character "Popeye" for posters depicting the problem of plastics in the ocean. Printed 10,000 posters for distribution to educators and other interest groups.

A summary of the marine debris information office education efforts during the first year of operation is available from the MERP manager, reference:

Center for Marine Conservation 1989. Marine Debris Information Offices: Atlantic Coast/Gulf of Mexico and Pacific Coast-Annual Report (October 1, 1988-September 30, 1989). Report to the NMFS Marine Entanglement Research Program, contract 52ABNF800133 158 p.

Available Alaska Fish. Sci. Cent., 7600 Sand Point Way
N.E., Seattle, WA 98115-0070.

b. Marine debris education program supplies, \$50.0K

This is a fund used by the MERP manager to provide the marine debris information offices with materials needed to meet public and industrial demand. Task funding is used to purchase brochures, posters, photo and video materials, coloring books, stickers, etc. No new materials are developed using these funds.

Status: This funding source proved useful in providing important education materials to constituents. Some of the funds from this task were used to print the existing educational material referenced under FY89 MERP task 1a.

c. Marine debris education program for shipping and cruise lines (Part II), \$39.0K

This is the execution of the plan formulated under task 1b as described in the FY 1988 MERP task summary. The task was scheduled to last one year and include seminars, mail-outs, trade journal public service advertisements, press releases and posters or placards for shipboard display.

Status: Work on Phase II of this task was implemented in March of 1989, and continued through December 1989. Activities relating to this task included the preparation of case studies on MARPOL Annex V compliance; preparation of a model shipboard plastic control and minimization plan; development of a kit designed to assist vessel operators to comply with regulations under MARPOL Annex V; providing liaison with cruise line owners/operators; providing public service advertisements; and organizing a workshop presentation about compliance with regulations under MARPOL Annex V. This task produced many useful MARPOL Annex V education materials which are available from the MERP manager, reference:

Kearney/Centaur Division of A.T. Kearney, Inc. 1989.
Dealing with Garbage under MARPOL Annex V: Examples of Compliance Approaches Used by the Shipping Industry. Report to the Marine Entanglement Research Program, contract 52ABNF800132 62 p. Available Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Kearney/Centaur Division of A.T. Kearney, Inc. 1989.
Model Plastic Refuse Control and Minimization Plan for Ships. Report to the Marine Entanglement Research Program, contract 52ABNF800132 48 p. Available Alaska

Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Kearney/Centaur Division of A.T. Kearney, Inc. 1990. MARPOL Annex V Kit: Implementing MARPOL Annex V in the United States. Report to the Marine Entanglement Research Program, contract 52ABNF800132 306 p. Available Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

d. Second International Conference on Marine Debris (continued), \$31.0K

It has been nearly five years since the Hawaii Workshop on the Fate and Impact of Marine Debris brought this problem to light. A second conference on marine debris would raise the international level of attention to the problem by updating and refining scientific, technical and administrative knowledge gained since 1984. Seven technical sessions and eight working groups were scheduled to be held, covering topics from ghost-fishing to waste handling technology and administrative concerns.

Status: The Second International Conference on Marine Debris was held in Honolulu, Hawaii, during April 2-7, 1989. A total of 91 papers were presented covering a variety of topics relating to the problem of marine debris. The papers which were presented at the Conference are soon to be released as Conference Proceedings, reference:

Shomura, R.S. and M.L. Godfrey (editors). In press. Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

2. MITIGATION

a. National beach cleanup database support, \$30.0K

This task provided funds for the private development and maintenance of computerized databases for the storage and analyses of information collected during voluntary beach cleanups, nationwide. The MERP does not have the necessary funding to establish this capacity internally. Recently, there appears to be enough private interest that some of the costs may be borne by outside sources. This task seeks to assist that effort and to ensure that once established, the databases will be maintained. Such a database is one of the few ways that, over time, the impacts of the implementation of MARPOL Annex V may be evaluated.

Status: This task was not implemented until October 1989, due to a number of technical difficulties relating to the grant application process. A grant was awarded to CMC to support a national marine debris database. Funding for this grant was provided by the MERP (\$30.0K), and from the Office of Marine and Estuarine Protection, of the Environmental Protection Agency (\$105.2K). This project will be funded through June 30, 1993, contingent upon future funding and satisfactory performance.

A total of 70,000 marine debris data cards were produced and distributed to beach cleanup participants during the 1989 celebration of Coastweeks. A comprehensive national public awareness campaign was initiated as part of this task, which resulted in 65,000 citizens participating in national beach cleanup activities. This work was summarized in a final report on the first year of this program. The report is available from the MERP manager, reference:

Center for Marine Conservation 1990. National Marine Debris Database - Final Report. Report to the NMFS Marine Entanglement Research Program, contract NA89AA-D-FS229, 21 p. Available Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Debris removal from Hawaiian monk seal beaches (continued), \$10.0K

This task provides assistance to the research teams working to understand and protect the highly endangered Hawaiian monk seal. In the Northwest Hawaiian Islands, these teams gather, catalog, and destroy all of the entangling material washed ashore on monk seal hauling and pupping beaches they visit each year.

Status: Work on this task was completed during the summer of 1989. Research teams removed entangling debris from pupping and haul-out beaches on the islands of Kure, Laysan, Pearl & Hermes, and French Frigate Shoals. Some debris removal also was accomplished on Midway Island. A report on debris removal activity during FY 1989 and FY 1990 is planned. No date has been scheduled for the release of that report.

c. Advisory workshop on marine debris mitigation, \$32.0K

Serious difficulties have been identified with either the technology, cost, or implementation strategies for virtually all of the ideas for reducing the amount of fishing gear loss into the ocean. As long as fishing remains a legitimate enterprise, there will be a risk of gear loss. The international fisheries technology community has yet to

be convened on this problem. As a first step in addressing the fishery technology solutions for ghost fishing, the MERP commissioned a survey and evaluation of U.S. fisheries' ghost fishing problems.

Status: Budget shortfalls resulted in the withholding of MERP funds until near the end of FY89. As a result of this action, the task could not be implemented until October 1989. The contract to perform this task was awarded to Natural Resource Consultants of Seattle, Washington. The scope of work required the contractor to evaluate fishing gear loss through literature research and through contact with associated state and federal fishery management entities. Incidence of gear loss would also be identified through documentation of gear losses, ghost fishing, and vessel disablement. The project was completed in June 1990, resulting in a comprehensive report identifying 626 fishery/gear combinations in six regions of the U.S. and its territories. Reference:

Natural Resources Consultants, Inc. 1990. Survey and Evaluation of Fishing Gear Loss in Maine and Great Lakes Fisheries of the United States. Report to the NMFS Marine Entanglement Research Program, contract 50 ABNF-9-00144, 224 p. Available Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

d. Ghost gillnet mitigation experiments \$15.0K

Demersal gillnets commonly used off New England function as an invisible wall of webbing, anchored to the bottom by a continuous leadline and buoyed up to a height of two meters by a floatline. Studies undertaken since 1984 indicate that the floatline (and attached floats) of derelict or ghost gillnets continue to buoy up the net. This buoyancy is important to the continual fishing action of the net, both when actively fished and when lost. This task would provide for the evaluation of modified gillnet gear containing biodegradable materials. A series of nets would be observed over a period of one year to assess differences in vertical profile and catch.

Status: This research was undertaken by the NOAA, National Marine Fisheries Service, Northeast Region using the NOAA research vessel GLORIA MICHELLE and in cooperation with the State of Massachusetts. This work continued into the following year, and is reported in FY90 MERP task 3e.

3. IMPACT RESEARCH AND MONITORING

a. High seas driftnet fisheries investigations (continued), \$122.5K

Status: During 1989 the United States negotiated vigorously for driftnet monitoring and enforcement agreements with Japan, ROK and Taiwan. The resulting agreements included a pilot observer program in the Japanese squid fishery from June to early October with 9 U.S., 5 Canadian and 32 Japanese observers on 32 commercial vessels. Also, single observer cruises were completed on a Taiwanese and a Korean vessel. The results of the pilot program with Japan are published in two joint reports:

International North Pacific Fishery Commission. 1990. Data Summary of Squid and Salmon Observations in the Japanese Driftnet Fishery for Neon Flying Squid (Ommastrephes bartrami), July - August, 1989 Observer Program. Joint report by the National Sections of Canada, Japan, and the United States. 34 p. (Available from: Driftnet Program Coordinator, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.)

International North Pacific Fishery Commission. 1990. Final Report of Squid and Bycatch Observations in the Japanese Driftnet Fishery for Neon Flying Squid (Ommastrephes bartrami), June - December, 1989 Observer Program. Joint report by the National Sections of Canada, Japan, and the United States. 111 p. (Available from: Driftnet Program Coordinator, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.)

Cooperative research cruises were conducted in the squid fishery area as follows:

<u>Nation</u>	<u>Vessel</u>	<u>Time Period</u>
Japan	Shoyo Maru	June - July
Japan	Kaishyo Maru	July
ROK	Pusan 851	July - September
Taiwan	Hai Kung	September - October
Canada	Arctic Harvester	July - August
U.S.	Miller Freeman	October - November
U.S.	Townsend Cromwell	October - November

Fiscal Year 1989 was the last year during which the driftnet investigations were conducted under the MERP. Beginning in Fiscal Year 1990, the high seas driftnet fisheries research program for the North Pacific is operated under the Science

& Research Director of the Alaska Fisheries Science Center of the NMFS with a total annual budget of \$3.0 million.

b. Impact of plastic particle ingestion on survival of larval fish (continued), \$18.5K

Field sampling in the Gulf of Mexico has shown that fish larvae consume floating plastic particles. This behavior has been verified in the laboratory. This task would support the conduct of laboratory experiments to determine the impacts of plastic particle ingestion on growth and mortality of larval and post-larval spot and mullet. Field data on the consumption of micro-debris by commercial fish larvae would continue to be collected.

Status: Work on this task was completed during early 1989, and a portion of the results were presented at the Second International Conference on Marine Debris. A final report summarizing all task research is presently being prepared, and will be submitted to the MERP manager during late winter 1990, reference:

Hoss, D.E. and L.R. Settle. In press. Ingestion of Plastics by Teleost Fishes. In R.S. Shomura and M.L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

c. Effects of marine pollution on juvenile, pelagic sea turtles (continued), \$35.0K

The most abundant sea turtle species in the U.S. is the loggerhead. This animal apparently spends the first several years of its life in a leisurely circuit of the north central Atlantic Ocean, returning to North America as an adult about 3-4 years later. Loggerheads are a threatened species under the Endangered Species Act and are documented to indiscriminantly ingest a wide variety of floating debris. The task purpose is to study the role of floating debris of all types on the survival of young sea turtles. Collection and examination of stranded juvenile sea turtles on U.S. Atlantic and Gulf coasts will be done as will field experiments in the Azores in May and June of 1989.

Status: Research on turtles in the Western Atlantic (in cooperation with the Florida Department of Natural Resources) was conducted throughout FY 1989. Research in the Azores was conducted over a five-month period from May to September, 1989. At the Azores site, 68 loggerhead turtles were tagged, measured and released. Other turtles

observed at the Azores site included a Kemp's ridley and a leatherback. Three turtles were butchered for food by the local population during the research period. The stomachs from these animals were examined, and each contained tar balls, styrofoam, hard plastic pieces, and plastic bag material. One turtle was found alive but entangled in discarded fishing net. A report on this field research activity was submitted to the MERP manager in 1989, reference:

Bolten, A.B. and K.A. Bjorndal 1989. Task Report: Azores Trip Summary. Report to the Marine Entanglement Research Program, Research Work Order No. 66, 9 p. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv. NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

d. Assessment of marine debris, entanglement and causes of death in sea turtles (continued), \$20.0K

This task is a continuation of past sampling surveys of entangled sea turtles, in collaboration with an interagency funded "Sea Turtle Stranding and Salvage Network." This stranding network covers the upper Texas and Southwest Louisiana coast. The purpose of this task is to document the incidence number of sea turtle entanglements and/or strandings due to marine debris.

Status: Systematic beach sampling surveys were conducted along the upper Texas and Southwest Louisiana coast during 1989. Man-made debris was found in 59.4% of those animals sampled for debris ingestion. A report summarizing this research since 1987 has been prepared, reference:

Duronslet, M.J., D.B. Revere, and K.M. Stanley. 1991. Marine Debris and Sea Turtle Strandings on Beaches of the Upper Texas and Southwestern Louisiana Coasts, June 1987 through September 1989. Available National Technical Information Service, 5258 Port Royal Road, Springfield, VA 22161.

e. Juvenile male fur seal survivorship and entanglement in marine debris (continued), \$25.0K

Entanglement has been suggested to have contributed to the northern fur seal population decline since the late 1960's. This task continues the evaluation of entanglement rates and survivorship among juvenile males of the Pribilof Islands population. The 1989 field season would be the second year of collecting tags on returned animals, so that the comparative survivorship of a year class of juvenile males

can be estimated. Tagging of entangled and non-entangled juvenile males would be continued this year.

Status: Work on this task was completed during the summer of 1989. A final report on the results of juvenile male fur seal "roundups" during 1989 was submitted to the MERP manager in May 1989. Sixty-five roundups of male northern fur seals were completed on St. Paul Island in Alaska. The 1989 field season produced a second year of reduced entanglement rates and provides more convincing evidence that a change has occurred in the entanglement rates, especially since it continues to be attributable to a reduction in entanglement in trawl webbing. Reference:

Fowler, C.W. and T.J. Ragen 1990. Entanglement Studies, St Paul Island, 1989 Juvenile Male Northern Fur Seals. NWAFC Processed Rept. 90-06, 39 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

f. The effects of ingested plastic on albatross (continued with the U.S. Fish and Wildlife Service), \$25.0K

This task continues research in cooperation with the National Wildlife Health Laboratory to study the ingestion of plastic by the Laysan albatross. Recent findings have indicated that plastic consumption has no impact on the survival of albatross chicks. However, these birds were examined in the 1988 fledgling class which was measured to have, on the average, nine times less plastic in its diet than the 1987 year class. Interannual variation in the availability of plastics as food items delivered by the parent birds may be the cause of this negative finding. To evaluate the impact of this variation on the 1988 findings, another year class must be examined.

Status: Work on this task was completed in 1989, and the results published in two reports, reference:

Sileo, Louis L., P.R. Sievert, M.D. Samuel, and S.I. Fefer. In Press. Prevalence and Characteristics of Plastic Ingested by Hawaiian Seabirds. In R.S. Shomura and M.L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

Sileo, L., P.R. Sievert, and M.D. Samuel 1990. Causes of Mortality of Albatross Chicks at Midway Atoll. *Journal of Wildlife Diseases*, 26(3), 1990:329-338.

g. Ingestion of marine plastics by Western Atlantic seabirds, \$8.0K

A collection of over 1000 seabirds at the North Carolina State Museum of Natural History would be examined for presence of plastics in the stomach. These data would be correlated with health indices for the birds, the time and location of the bird's collection, the fullness of the stomach and, any gut lesions or blockage. The types, colors, sizes and shapes of the ingested particle would also be reported.

Status: Work on this task was completed, and a final report summarizing research results was submitted to the MERP manager in March 1990. Gut contents of 1,042 birds were analyzed, and 20 of the 37 pelagic seabird species and 1 shorebird species had ingested plastic. Reference:

Moser, Mary L. and D.S. Lee. 1990. A Fourteen Year Survey of Plastic Ingestion by Western Atlantic Seabirds. Report to the NMFS Marine Entanglement Research Program, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

h. Bioaccumulation and buoyancy of floating marine debris, \$30.0K

Recent findings in experiments on the performance of photodegradable plastics in sea water indicate many floating debris items are quickly fouled by algae growth and sank from the sea surface. This finding impacts the development of strategies to reduce hazard to marine life by floating debris. The experiments supported by this task would establish a basic understanding of the dynamics of fouling, floating and sinking of types of debris in tropical and temperate ocean regimes. This is viewed as a preliminary evaluation of this phenomenon, recognizing that bioaccumulation may differ considerably between ocean regions.

Status: Due to a funding shortfall, FY89 funds to implement this task were withheld from MERP use until August 1989. Upon receipt of funding, a contract to perform this task was awarded to the Research Triangle Institute of North Carolina. The two sites selected for the study were Miami, Florida and Seattle, Washington. The samples at the warm water site were fouled by algae growth and sank rapidly to the bottom. Sunken samples will be allowed to remain at the bottom for observation. Severe winter storms in 1990 damaged the Northwest observation site, and delayed release

of the final report. The final report on this project is expected Spring-Summer 1991.

i. Marine debris survey of the Eastern Bering Sea shelf, \$5.0K

Each year, the NMFS conducts a bottom trawl survey of the crab and groundfish resources on the Eastern Bering Sea shelf. The sampling net fishes hard on the bottom and samples debris as well as crabs, snails, etc. This task supports the recording and reporting of the debris taken in each of the more than 120 trawl net samples since 1988. These results would provide the first systematic assessment of accumulate debris on any of the highly utilized continental shelves of the United States.

Status: A contract to perform this task was awarded to Natural Resource Consultants of Seattle Washington. Work on this task was completed, and a report on the results of the study was presented during the Second International Conference on Marine Debris, reference:

June, J.A. In press. Types, Quantity, and Probable Sources of Trawl-Caught Marine Debris in the Eastern Bering Sea and off the Coast of Oregon in 1988. In R.S. Shomura and M.L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

j. National seashore marine debris survey program (continued with the U.S. Fish and Wildlife Service), \$35.0K

This task provides funding for a continuing cooperative agreement with the National Parks Service (NPS) for the conduct of systematic surveys of debris arriving on selected beaches in each region of the U.S. This task was approved for the FY 1988 program but was delayed due to unexpected budget cuts. The data collected in this activity would be used to systematically evaluate the sources, amounts, and distributional dynamics of seaborne debris in various regions of the U.S. These data differ from those collected by voluntary beach cleanups because the scientific methods used would allow expansion of debris arrival rates to estimate changes in regional debris loadings with time. The methods used in these surveys would be the same methods used in the on-going Alaska beach surveys funded by the MERP.

Status: Funds set aside during FY88 for the purpose of implementing this task were used in 1989 to conduct a systematic survey of eight beaches (representing four

coastal regions) in monitoring the deposition of plastic marine debris. A workshop was held 6-8 June in Washington, D.C., to summarize the debris monitoring activity at each research site, and to identify and resolve unique and common beach survey problems. A draft final report summarizing the results of this task during 1989 was submitted to the MERP manager in August 1990. The final report was published as a U.S. Department of Interior Technical Report. Reference:

Cole, Andrew C., et al. 1990. Annual Report of National Park System Marine Debris Monitoring Program: 1989 Marine Debris Survey. U.S. DOI Technical Rep. NPS/NRWV/NRTR-90/04, 29 p. Natl. Park Serv., c/o Air Quality Div. (AIR), P.O. Box 25287, Denver, CO 80225-0287.

k. Surveys on entanglement debris on Alaskan beaches (continued), \$24.5K

This is the fourth year of the systematic surveys of selected beaches in Alaska. As there are no widespread public beach cleanups in Alaska, the only way to characterize the types of entangling debris circulating in the North Pacific, such as nets, is by beach survey. These surveys have recently shown derelict trawl webbing fragments arriving at the rate of 7 fragments per kilometer per year in the Yakutat area on the Gulf of Alaska. The relationships between season, storm events, on-shore movement, and burial and exposure of entangling debris and the survey findings are beginning to emerge from these data.

Status: Field work relating to this task was completed in 1989. A NMFS final report on the results of the 1989 field season was delayed due to labor requirements related to the Prince William Sound oil spill. The final report was published as an NWAFRC Processed Report, and is available from the author, reference:

Johnson, Scott W. 1990. Entanglement Debris on Alaska Beaches, 1989. NWAFRC Processed Rep. 90-10. 16 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

l. Channel Islands pinniped entanglement monitoring (continued), \$7.0K

The rates of entanglement of harbor seals, elephant seals, and California sea lions have been estimated for the California Channel Islands populations since 1984. This task provides the funding to continue this entanglement monitoring series. The data are collected during other

research activities not funded by the MERP; this task pays only for data preparation, analysis and reporting.

Status: Travel and other commitments delayed completion of this task until October 1990. A technical report summarizing the results of 1989 and 1990 pinniped entanglement monitoring efforts is near completion, and will be available in late Spring 1991.

4. MANAGEMENT

a. Program Management

Funding for this task supports the office of the MERP manager. The manager carries out the annual program plan for MERP as well as represents NMFS/NOAA on the marine debris issue in many public and governmental fora.

Status: In addition to administrating current and continuing program tasks, MERP management provided administrative support to a number of Saltonstall-Kennedy (S-K) grants relating to marine debris mitigation activities. During FY89, the MERP manager received the final report from Northwest Marine Technology, Inc. concerning the S-K grant to study the feasibility of marking fishing gear. The report concludes it is technically possible to mark fishing gear. A major factor to be considered is the point at which the marker system will be incorporated into the fishing material. Manufacturers oppose implementation of marking systems at their level, due to cost, record-keeping, and possible technical changes. The report is available from the MERP manager, reference:

Northwest Marine Technology, Inc. and Aqua/Terra Consulting, Ltd. 1989. Final Report: Marking of Fishing Gear. Report to the NMFS Marine Entanglement Research Program under S-K Award No. NA-88-ABH-00028, 151 p. Available Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

In addition to initiating and supporting the Second International Conference on Marine Debris, MERP management assisted in the presentation of two papers at the Conference, reference:

Coe, James M. In press. Marine Debris in the North Pacific. In R.S. Shomura and M.L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

Walker, William A. and J.M. Coe. In press. Survey of Marine Debris Ingestion by Odontocete Cetaceans. (This paper is referenced in FY90 MERP task 3g.)

The MERP management provided support to a number of regional, state, and international forums addressing the problem of persistent marine debris. These forums included membership on the Washington Marine Debris Task Force, and participation at the IOC/UNEP Regional Review Workshop on Marine Pollution Monitoring, Research, Control and Abatement in the Wider Caribbean. A paper was presented at the IOC Workshop, reference:

Heneman, Burr and J.M. Coe. 1989. Persistent Marine Debris in the Wider Caribbean Area. Unpubl. manusc., 28 p. (report submitted to the IOC/UNEP Regional Review Workshop on Marine Pollution Monitoring, Research, Control and Abatement in the Wider Caribbean Region, San Jose, Costa Rica, August 24-30, 1989). Alaska Fish. Sci. Cent., 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

In an effort to develop important educational material directed at elementary and secondary school students, the MERP edited a collection of existing education materials into a marine debris coloring book. This book has been quite popular with elementary and secondary school teachers, reference:

Bunn, Alan R. and J.M. Coe. 1989. Marine Debris Education Program Supplement: Marine Debris Coloring Book. NOAA Tech. Memo. NMFS F/AKR-9. 33 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

FINAL FUNDING PLAN FOR FY 1990
ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
a.	Marine debris information offices (continued)	\$66.0K
b.	Marine debris information office shortfall for 1990	40.1K
c.	Marine debris education program supplies (continued)	50.0K
d.	Puerto Rican port project and symposium	20.0K
e.	NOAA/USCG information network	37.5K
2.	MITIGATION	
a.	National beach clean-up database support (continued)	50.2K
b.	Debris removal from Hawaiian monk seal beaches (continued)	25.0K
c.	Economic aspects of marine debris	100.0K
d.	Production of marine debris survey handbook	40.5K
3.	IMPACTS RESEARCH AND MONITORING	
a.	Surveys of entangling debris on Alaska beaches (continued)	25.0K
b.	Juvenile male fur seal survivorship and entanglement in marine debris (continued)	23.0K
c.	Effect of plastic ingestion on sea turtles	42.0K
d.	Effect of persistent marine debris on juvenile, pelagic sea turtles (continued)	38.5K
e.	Investigation of the impact and fate of commercial gillnet (continued)	16.0K

f.	National seashore marine debris survey program (continued with U.S. National Park Service)	33.0K
g.	Update information on debris ingestion by cetaceans	3.0K
h.	Impacts of entanglement of humpback whales	1.9K
4.	MANAGEMENT	
a.	Program management (continued)	88.0K

FISCAL YEAR 1990 ACTIVITIES TO ADDRESS
PROBLEMS ASSOCIATED WITH DEBRIS IN THE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

a. Marine debris information offices (continued), \$66.0K

These offices provide the mechanisms through which information and materials on the marine debris problem and its solutions are distributed. Offices are located in Washington, D.C. and San Francisco, California. These offices are supplied by the Marine Entanglement Research Program (MERP) with the necessary materials to disseminate information on the marine debris problem nationwide. Operators of these offices are also encouraged to seek assistance from industry and public organizations.

Status: This program has been overwhelmingly successful in the quantity and quality of marine debris education material delivered to the general public. These activities include the distribution of information packets, providing materials for the print and electronic media, and for educators and others conducting presentations, seminars, and briefings. The success of this program continually surpasses its budget (see task 1b, below).

A final report summarizing the year's marine debris education activities during FY 1990 was prepared by the contractor (CMC). This report is available from the MERP manager, reference:

Center for Marine Conservation. 1990. Marine Debris Information Offices: Atlantic Coast/Gulf of Mexico and Pacific Coast - Annual Report (October 1, 1989-September 30, 1990). Report to the NMFS Marine Entanglement Research Program, contract 52ABNF800133. 178 p. Available Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

b. Marine debris information office shortfall for 1990, \$40.1K

The overwhelmingly successful educational program implemented by the Marine Debris Information Offices (MDIO) have resulted in a rapidly growing public demand for marine debris education material. This increasing demand has threatened to limit services and materials available through the MDIOs. To avoid closing the doors of the MDIOs during the last quarter of the year, additional funds were required.

Status: Supplemental funding for the MDIOs for FY90 was approved and \$40.1K in additional funds were added to the program budget. The funds for this shortfall were realized by canceling a planned task to develop revised International Maritime Organization guidelines for port reception facilities. This task was re-instated in 1991.

c. Marine debris education program supplies (continued), \$50.0K

This is a fund to be used by the MERP manager to provide the MDIOs with materials needed to meet public and industrial demand. Funds set aside under this task will be utilized to supply necessary educational materials such as posters, brochures, reprints, videotapes, etc. A portion of the funds will be used to produce and distribute service announcements for television.

Status: The NOAA MDIO responded to 12,935 requests for information material during FY 1990. This is almost a 100% increase over the numbers of information requests during the previous year. The general public accounted for the largest number of material requests (4,730) followed by teachers and educators (2,260), students (1,547), organizations (1,373), and recreational boaters (1,301). A complete accounting of material distribution is contained within the contract report referenced in FY 1990 MERP task 1a.

d. Puerto Rican port project and symposium, \$20.0K

As modified by the Ad Hoc Committee on Entanglement, this task allows for the design and implementation in Puerto Rico of a model port/marina project involving marine debris education and the development of an adequate refuse reception facility. The project will place the major emphasis on Spanish speaking educational supplements, and will be modeled after the outline provided in NOAA Technical Memorandum NMFS F/NWR-23, "Dealing with Annex V - Reference Guide for Ports." A symposia will follow project implementation, to report results and address common and regional marine debris issues in the Gulf and Caribbean regions.

Status: The project continues. Marine debris educational material is being translated into Spanish. Marina Puerto del Rey was selected as the location for implementation of a model port/marina project. This marina (located in Fajardo, about a 2-hour drive from San Juan) is reported to be the Caribbean's largest full service marina and boat-yard complex. This task continued into FY 1991, and is reported in MERP task 2g.

e. Distribution of "MARPOL Information Packets" via U.S. Coast Guard networks, \$37.5K

Funds from this project are used to reprint existing educational material for distribution through the U.S. Coast Guard Auxiliary network. A mandatory and courtesy vessel inspection program is operated by Coast Guard active and auxiliary members. The Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987 directs NOAA, the EPA, and the U.S. Department of Transportation to operate a plastic pollution education program. This project would meet those requirements under the MPPRCA while disbursing important education material to boaters (the principle source of persistent marine debris).

Status: This task provides an excellent source for the distribution of MARPOL Annex V information to boaters. NOAA funds were combined with \$20.0K from the U.S. Environmental Protection Agency to allow for the printing of over 300,000 MARPOL Annex V placards and 200,000 MARPOL Annex V brochures. These educational materials are being distributed to boaters through the Coast Guard Auxiliary national network.

2. MITIGATION

a. National beach cleanup database support (continued), \$50.2K

This task provides funds for the maintenance and improvement of a computerized database for the storage and analysis of information collected during voluntary beach cleanups nationwide. This project also receives partial funding from sources outside NOAA. Such a database is one of the few ways that the impacts from implementation of MARPOL Annex V may be evaluated.

Status: Work on this project continues. The contractor (CMC) will submit a final report on the results of this task to the MERP manager sometime during Summer 1991. This report will provide an analysis of the 2.6 million pounds of debris collected by over 108,000 volunteers during beach cleanup activities as part of the 1990 celebration of Coastweeks.

b. Debris removal from Hawaiian monk seal beaches (continued), \$25.0K

This task provides assistance to the research teams working to understand and protect the highly endangered Hawaiian monk seal. In the Northwest Hawaiian Islands, these teams

make annual visits to monk seal hauling and pupping beaches to gather, catalog, and destroy all of the entangling material washed ashore.

Status: Work on this project was completed during the summer of 1990. A summary report of the debris removed from monk seal beaches will be submitted to the MERP manager in late Spring, 1991.

c. Economic aspects of marine debris, \$100.0K

This task would implement (through the Sea Grant College Program) selected research proposals presented during the Second International Conference on Marine Debris. Sea Grant and MERP will jointly select several research proposals which would address a variety of issues reported by the Economic Working Group during the Conference. The primary objective of this task is to establish a competitive research program that addresses the economic aspect of marine debris.

Status: Two marine debris economic research proposals have been selected for funding:

"Estimating the Use and Nonuse Damages of Debris for Coastal Resources and Marine (Noncommercial) Species," by V. Kerry Smith and Raymond Palmquist, Department of Business and Economics, North Carolina State University. This research will be funded for two years at a total funding of \$115,520.

"Economic Aspects of Marine Debris," by K.E. McConnell, Department of Agricultural and Resource Economics, University of Maryland; J.G. Sutinen, Department of Resource Economics, University of Rhode Island; J.Kirkley, Virginia Institute of Marine Sciences. This research will be funded for three years at a total funding of \$200,000.

d. Production of a marine debris survey handbook, \$40.5K

Funds would be made available for production of a handbook which describes individual survey methodologies, their advantages and disadvantages, design considerations, and data analysis procedures. Separate sections would be assigned to various experts, with an editor to synthesize various approaches to ensure the overall consistency of the manual. This effort is an attempt to establish national and eventually international standards for marine debris survey methods.

Status: A contract to produce a marine debris survey manual was awarded to the Center for Quantitative Science, University of Washington. Work on this project was delayed, when the principal investigator (Dr. Chris Ribic) accepted a position with the U.S. Environmental Protection Agency (EPA) in Corvallis, Oregon. MERP management reached an agreement with the Center for Quantitative Science for continuance of Dr. Ribic's services. The manual should be available for distribution by July 1991.

3. IMPACTS RESEARCH AND MONITORING

a. Surveys of entangling debris on Alaska beaches (continued), \$25.0K

This task would continue the collection of baseline data on deposition of debris on the remote beaches of Alaska. During this year the task was revised to include only a baseline survey at Yakutat, Alaska. Objectives of the task were to make the following determinations: the type and quantities of plastic debris that commonly wash ashore; the deposition rate of entanglement debris and; the feasibility of using low flying aircraft to survey beaches for plastic debris, especially entanglement items such as trawl webs and monofilament gillnet.

Status: Work on this project was completed during the Spring and Summer of 1990. A final report on the results of this research will be submitted to the MERP manager sometime late Spring, 1991.

b. Juvenile male fur seal survivorship and entanglement in marine debris (continued), \$23.0K

Entanglement has been suggested to have contributed to the northern fur seal population decline since the late 1960's. This task continues the evaluation of entanglement rates and survivorship among juvenile male fur seals of the Pribilof Islands population.

The research this year tests two hypotheses: 1) the mortality rate for entangled juvenile male fur seals is the same for non-entangled juvenile males, and 2) the current rate of observed on-land entanglement is unchanged in recent years.

Status: This work was completed during Summer 1990. The results for 1990 field studies reject the hypothesis that the entanglement rate for juvenile male fur seals is the same for non-entangled juvenile males. The study concluded that after 1 year, seals entangled in small debris (light

enough to permit animals to return to land) are reduced in numbers to about half the comparable numbers for nonentangled seals. The author also noted a continued reduction of the overall entanglement rate (from 0.4% to less than 0.34% in 1988-1990). The report may be obtained from the MERP manager, reference:

Fowler, Charles W. and N. Baba. 1991. Entanglement Studies, St. Paul Island, 1990 Juvenile Male Northern Fur Seals. AFSC Processed Rep. 91-01, 63 p. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv. NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

c. Effect of plastic ingestion on sea turtles, \$42.0K

The anatomy of the turtle gastrointestinal tract appears predisposed to obstructions. This task will assess the effects of ingestion of plastics at quantities much smaller than those necessary for gut strangulation in the sea turtle. As some sea turtles actively seek out and consume small pieces of plastic sheeting, determination of the harmful effects of this foreign material over time could prove to be another serious problem for the sea turtle.

Status: Research on this task was undertaken by the Marine Biology and Fisheries Division, University of Miami, in cooperation with the NMFS Southeast Fisheries Science Center. The study has recently been completed, and researchers found that turtles will actively approach and consume plastic sheeting. Swallowed plastic can remain in the gut for at least six months, and may lodge in the large intestine. Gas accumulation in the turtle intestine can cause positive buoyancy, which could have a serious effect in reducing the amount of submergence time. This condition could reduce the amount of feeding time or inhibit the animal from escaping predators. A report will soon be available from the MERP manager, reference:

Lutz, Peter L. and A.A. Alfaro-Schulman. In prep. The Effect of Chronic Plastic Ingestion on Green Sea Turtles. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

d. Effect of persistent marine debris on juvenile pelagic sea turtles (continued), \$38.5K

This task will combine two proposals designed to focus on the effects of marine debris on juvenile sea turtles. The study will define the little known juvenile sea turtle populations and determine the extent to which marine debris has a negative effect on the turtles within these habitats.

Primary investigation areas will be the Western Atlantic (along Florida beaches in cooperation with the Florida Department of Natural Resources) and in the Azores, where a persistent concentration of pelagic loggerhead turtles has recently been discovered.

Status: Work on this task continues. Researchers will be in the Azores from September-November 1990. Successes are reported in a cooperative program with the local commercial fishing fleet in the Azores and with the sighting, stranding, and tagging programs. A comprehensive status report on this research is available and is referenced in FY 1991 MERP task 3d.

e. Investigation of the impact and fate of the commercial gillnet (continued), \$16.0K

Funds would be used to continue an ongoing study of four experimental sections of an inshore gillnet deployed off the New England coast. The study will measure the vertical profile of each net section over time and assess the catch characteristics of each section. After documenting the impact of these gillnet sections, the researchers will interview commercial gillnet fishermen on the application of degradable materials usage in gillnets. If feasible, recommendations on degradable material use will be provided to fishery managers in order to reduce the negative impact of lost gillnets.

Status: This work is a cooperative effort of the National Marine Fisheries Service, Northeast Region and the Commonwealth of Massachusetts, Division of Marine Fisheries. Field work is expected to be completed by May 1991. A final report on the results of this project (including a videotape) will be available July 1991. A recent project summary report is available from the MERP manager, reference:

Carr, Arnold H. and A. Blott. 1991. A Study of Ghost Gillnets in the Inshore Waters of Southern New England. 10 p. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

f. National seashore marine debris survey program (continued), \$30.0K

This task provides funding for a continuing cooperative agreement with the National Parks Service (NPS) for the conduct of systematic surveys of debris arriving on selected beaches in each region of the U.S. The data collected in this activity will be used to systematically evaluate the

sources, amounts, and distributional dynamics of seaborne debris on various regions of the U.S. These data differ from those collected by voluntary beach cleanups because the scientific methods used will allow expansion of debris loading with time. The methods used in these surveys are the same methods used in the Alaska beach surveys.

Status: Work on this project continues. A draft report of the 1990 beach survey results are in preparation. A final report is expected June 1991.

g. Update information on debris ingestion by cetaceans, \$3.0K

Since this topic was discussed during the Second International Conference on Marine Debris (April 2-7, 1989), a recently collected food habits sample from 20 Bairds beaked whales became available. This new sample was collected from the southern Okhotsk Sea near Japan. An opportunity exists to compare these new data with earlier studies in the region where beaked whales were documented as having a high frequency of ingested debris due to their feeding on benthic prey.

Status: Stomach content analysis was completed on the available beaked whale stomachs. Results of this research were incorporated into the paper submitted as part of the Conference proceedings, reference:

Walker, William A. and J. M. Coe. In Press. Survey of Marine Debris Ingestion by Odontocete Cetaceans. In R.S. Shomura and M.L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv. NOAA, 2570 Dole St., Honolulu, HI. 96822-2396.

h. Impacts of entanglement of humpback whales, \$1.9K

Over the last two decades, cetaceans have been known to become entangled in marine debris and active fishing gears. One of the recommended recovery actions in the Humpback Whale National Recovery Plan is to identify the sources and rates of human induced injury and mortality in these whale populations.

This project assists a graduate research program focusing on estimating the percentage of humpback mortalities caused by entanglement in the Gulfs of Maine and Newfoundland. Evidence of entanglement will be evaluated through observation of scarring on sighted animals. A final report on this project is expected April 1991.

Status: All field work on this task has been completed. A final report to the MERP manager is expected May 1991.

MANAGEMENT

a. Program management (continued), \$88.0K

Funds allocated to this task support the office of the MERP manager. The manager carries out the annual program plan for MERP and represents NMFS/NOAA on marine debris issues during conferences and meetings with colleagues, constituents and the general public.

Status: The Marine Entanglement Research Program has been effectively managed during 1990. LCDR Jim Herkelrath replaced LCDR Alan Bunn as Assistant Program Manager. New marine debris education and mitigation initiatives have been established which utilize existing networks to further disseminate education material to the public. Relating to marine debris education, several papers were produced, reference:

Herkelrath, James M. and J.M. Coe. 1990. NOAA's Marine Entanglement Research Program. Unpubl. Manusc. 5 p. Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Herkelrath, James M. and J.M. Coe. 1990. Marine Debris Education and Public Awareness Projects by the NOAA Marine Entanglement Research Program. In Proceedings of MTS 90 "Science and Technology for a New Oceans Decade," September 26-28, 1990, Washington, D.C., Marine Technology Society, 1825 K St. N.W., Suite 218, Washington, D.C. 20006.

During the FY90 program review, the Ad Hoc Committee on Entanglement concluded that the commitment of MERP funds for studies of the squid driftnet fisheries was no longer appropriate. Subsequently, the MERP is no longer providing support for high seas driftnet research. The MERP manager has been designated "coordinator" for a new, independent high seas driftnet program. The program provides 20% of the MERP manager's salary and fully supports an Assistant Driftnet Coordinator.

The MERP management actively assisted the new Washington State Task Force on Marine Debris as that program re-established programs designed to reduce the amount of marine debris in Washington State.

MERP management also provided administrative support to three Saltonstall-Kennedy (S-K) grants in support of marine debris mitigation activities. Two of these projects resulted in a variety of useful documents addressing the marine debris problem, reference:

Kearney/Centaur Division of A.T. Kearney, Inc. 1990. Development and Evaluation of Education Techniques to Eliminate At-Sea Disposal of Plastics. Report to the Marine Entanglement Research Program under S-K Cooperative Agreement NA 89-AA-H-SK0007. 234 p. Available Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Recht, Fran. 1990. West Coast Marine Debris Recovery Project: Summary Report. Report to the NMFS Marine Entanglement Research Program, S-K Grant NA 89AA-H-SK003. 31 p. Available Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Recht, Fran and S. Lasseigne. 1990. Providing Refuse Reception Facilities and More: The Port's Role in the Marine Debris Solution. Report to the NMFS Marine Entanglement Research Program, S-K Grant NA 89AA-H-SK003. 12 p. Available Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Recht, Fran. 1990. Marine Refuse and Recycling Facilities: U.S. West Coast Ports Respond to MARPOL Annex V Requirements and Reduce Costs. (Document submitted to the International Marina Institute's Conference on Environmental Management for Marinas, Washington D.C., September 1990.) Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

The West Coast Marine Debris Recovery Project also resulted in a number of short, information notices including:

1. Port Recycling Systems around the nation.
2. MARPOL V Placard and Waste Management Plan information.
3. MARPOL V News release for newspaper, radio, and Sea Grant Agent.
4. MARPOL V information for fishermen.
5. A list of individuals (by port) involved in MARPOL V port programs and mariner education efforts.

Delays experienced by the Gulf of South Atlantic Fisheries Development Foundation resulted in a 12 month no-cost extension given to the S-K project "Southeast Initiative to Comply with MARPOL Annex V Prohibitions on At-Sea Dumping of Plastics." This project has been extended until November 1991.

FUNDING PLAN FOR FY 1991
ENTANGLEMENT PROGRAM TASKS

TASK NO.	TASK TITLE	FUNDING LEVELS
1. EDUCATION AND PUBLIC AWARENESS		
a.	Marine debris information offices, FY 1991 shortfall	\$79.7K *
b.	Marine debris education program FY 1991 supplies (continued)	\$83.4K *
c.	Distribution of "MARPOL Information Packets" via U.S. Coast Guard networks	\$8.5K
d.	Pacific regional marine debris awareness	\$9.5K
2. MITIGATION		
a.	National beach clean-up database support (continued)	\$50.0K *
b.	Debris removal from Hawaiian monk seal beaches (continued)	\$25.0K
c.	Production of a procedures manual for the safe disentanglement of cetaceans	\$0.0K **
d.	Economic aspects of marine debris (continued)	\$100.0K *
e.	Supplement for IMO guidelines for the implementation of MARPOL Annex V.	\$62.8K
f.	Continuation of Puerto Rico port project (continued)	\$20.0K
3. IMPACTS RESEARCH AND MONITORING		
a.	Surveys of entangling debris on Alaska beaches (continued)	\$42.0K
b.	National seashore marine debris survey program (continued with U.S. NPS)	\$0.0K ***

- c. Evaluation of ghost fishing of Plastic lobster traps \$20.0K
- d. Effect of persistent marine debris on juvenile, pelagic sea turtles (continued) \$38.5K
- e. Juvenile male fur seal survivorship and entanglement in marine debris (continued) \$25.0K
- f. North Pacific fisheries observer debris data collection \$28.0K

4. **MANAGEMENT**

- a. Program management \$75.4K

* Multi-year commitment.

** Not funded during FY 1991.

*** Program funded during FY 1991 using FY 1990 funding.

FISCAL YEAR 1991 ACTIVITIES TO ADDRESS
PROBLEMS ASSOCIATED WITH DEBRIS IN THE ENVIRONMENT

1. EDUCATION AND PUBLIC AWARENESS

a. **Marine debris information offices (supplemental funding),
\$79.7K**

These offices continue to provide the mechanisms through which information and materials on the marine debris problem and its solutions are distributed. They are supplied by the Marine Entanglement Research Program (MERP) with the necessary materials to disseminate information on the marine debris problem nationwide. Operators of these offices are also encouraged to seek assistance from industry and public organizations. Increased public demand for information has necessitated supplementary funding to the original funding base established last year.

Status: These offices continue to disburse information on the problem and impact of marine plastic debris in the environment. This program remains as a highly successful mechanism for distributing information to the general public.

b. **Marine debris education program supplies (continued),
\$83.4K**

This is a fund to be used by the MERP manager to provide the Marine Debris Information Offices with materials needed to meet public and industrial demand. Funds set aside under this task will be utilized to supply necessary educational materials such as posters, brochures, reprints, videotapes, etc.

Status: This project continues. Because of the successful outreach program by the contractor (Center for Marine Conservation), the demand for education materials is very high. A final report from the contractor summarizing the dispersement of educational material is expected Fall 1991.

c. **Distribution of "MARPOL Information Packets" via U.S.
Coast Guard networks (continued), \$8.5K**

Funds from this project will be used to reprint existing educational material for distribution through the U.S. Coast Guard Auxiliary network. A mandatory and courtesy vessel inspection program is operated by Coast Guard active and auxiliary members. The Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987 directs NOAA, the EPA, and the U.S. Department of Transportation to operate a plastic pollution education program. This project would meet those

requirements under the MPPRCA while disbursing important education material to boaters (the principle source of persistent marine debris).

Status: This project continues. The bulk of educational materials made available during FY 1990 are presently being distributed as part of the 1991 boating season. As there is enough material to meet the demand of the Auxiliary network, MERP management is exploring the distribution of materials during mandatory vessel inspections by the U.S. Coast Guard.

d. Pacific regional marine debris awareness, \$9.5K

This project would establish a marine debris education program in Western, Central, and Southern Pacific communities, utilizing the existing Sea Grant education network. This project would produce regionally oriented marine debris education material for distribution within diverse island cultures.

Status: Work on this project continues. A significant marine debris information education program has been developed for Pacific Island peoples, utilizing the existing Sea Grant network.

2. MITIGATION

**a. National beach cleanup database support (continued)
\$50.0K**

This task provides funds for the maintenance and improvement of a computerized database for the storage and analysis of information collected during voluntary beach cleanups nationwide. This project also receives partial funding from sources outside NOAA. Evaluation of this database is one of the few ways that changes in debris composition due to the implementation of MARPOL Annex V may be detected.

Status: Work on this project continues. A final report can be expected in the Summer 1992.

**b. Debris removal from Hawaiian monk seal beaches
(continued), \$25.0K**

This task provides assistance to the research teams working to understand and protect the highly endangered Hawaiian monk seal. In the Northwest Hawaiian Islands, these teams make annual visits to monk seal hauling and pupping beaches to gather, catalog, and destroy all of the entangling material washed ashore.

Status: Work on this task continues. The field season for this activity is from May to September.

c. Production of a procedures manual for the safe disentanglement of cetaceans, \$0.0K

Funds for this project will be used to produce a procedures manual for the disentanglement of living whales and other marine mammals.

Status: Faced with a number of question over the scope of project, and the appropriate agency to perform the research, MERP management re-directed these project funds to cover increased costs associated with the production of a supplement to IMO Guidelines for the Implementation of MARPOL V, (MERP task 2e).

d. Economic aspects of marine debris (continued), \$100.K

This task would continue funding (through the Sea Grant College Program) a selected research project on the economic impact of marine debris. Sea Grant and the MERP have jointly selected several research proposals addressing important issues as identified by the Economics Working Group during the Second International Conference on Marine Debris.

Status: Work on this task continues. FY 1991 funding will be used to complete the research "Estimating the Use and Non-Use Damages of Debris for Coastal Resources and Main (Non-commercial) Species." This research is being conducted by V. Kerry Smith and Raymond Paluquist, Department of Business and Economics, North Carolina State University.

Funds will also be used to support continuing research on "Economic Aspects of Marine Debris," by K.E. McConnell, Department of Agricultural and Resource Economics, University of Maryland; J.G. Sutinen, Department of Resource Economics, University of Rhode Island; and J. Kirkley, Virginia Institute of Marine Sciences.

e. Supplement for IMO guidelines for the implementation of MARPOL Annex V, \$62.8K

This task would synthesize all relevant information on significant issues effecting the implementation of MARPOL Annex V into clear and practical supplements for the International Maritime Organization (IMO) "Guidelines for the Implementation of Annex V of MARPOL 73/78." Emphasis will be placed on provision of adequate port reception facilities.

Status: A contract to perform this work was awarded to A.T. Kearney, Inc. of Alexandria, Virginia. A comprehensive synthesis of port waste reception information was completed, including recommended actions to supplement existing IMO guidelines for the provision of adequate port reception facilities. This report has been accepted by the U.S. Coast Guard to be presented by the U.S. Delegation as an action paper to the 31st meeting of the IMO Marine Environmental Protection Committee. Copies of the draft report are available from the MERP manager, reference:

Kearney/Centaur Division of A.T. Kearney, Inc. and Lissa Martinez. 1991. Revision of the Port Reception Facility Section of the IMO Guidelines for the Implementation of MARPOL Annex V. Report to the NOAA Marine Entanglement Research Program, contract 52ABNF-1-00058, 92 p. Available Alaska Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-0070.

f. Puerto Rico port project (continued), \$20.0K

As modified by the Ad Hoc Committee on Entanglement, this task continues work on the design and implementation in Puerto Rico of a model port/marina project involving marine debris education and the development of an adequate refuse reception facility. The project places the major emphasis on Spanish speaking educational supplements, and will be modeled after the outline provided in NOAA Technical Memorandum NMFS F/NWR-23, "Dealing with Annex V - Reference Guide for Ports." A symposia will follow project implementation, to report results and address common and regional marine debris issues in the Gulf and Caribbean regions.

Status: The project is near completion, with the workshop on marine debris scheduled April 30 (during the First International Ocean Pollution Symposium). This workshop will disseminate information learned from the two-year study. A final project report to the MERP manager is expected during the summer 1991.

3. IMPACTS RESEARCH AND MONITORING

a. Surveys of entangling debris on Alaska beaches (continued), \$42.0K

This task continues the collection of baseline data on deposition of debris on the remote beaches of Alaska. Objectives of the task will be to make the following determinations: the type and quantities of plastic debris that commonly wash ashore; the deposition rate of entanglement debris and; the feasibility of using low flying

aircraft to survey beaches for plastic debris, especially entanglement items such as trawl webs and monofilament gillnet.

Status: Research on this task continues. Field work is expected to commence May 1991. A special high resolution camera has been located for the aircraft survey portion of the research. A final report on this project is expected during the first quarter 1992.

b. National seashore marine debris survey program (continued), \$0.0K [Funded \$33.0K in FY90 Funds]

This task provides funding for a continuing cooperative agreement with the National Parks Service (NPS) for the conduct of systematic surveys of debris arriving on selected beaches in each region of the U.S. The data collected in this activity will be used to systematically evaluate the sources, amounts, and distributional dynamics of seaborne debris in various regions of the U.S. These data differ from those collected by voluntary beach cleanups because the scientific methods used will allow estimation of debris loading with time. The methodology used in these surveys was developed and is in use in the Alaska beach surveys.

Status: Work on this task continues, and a summary report is expected July 1992.

c. Evaluation of ghost fishing of plastic lobster traps, \$20.0K

The occurrence of ghost fishing through lost or discarded fishing gear has become an increasing concern to resource managers as degradable gear has been replaced by persistent synthetic materials. This project will examine the aspects of the ghost fishing problem using Hawaiian plastic spiny and slipper lobster traps tested in the laboratory and in the field.

Status: Work on this task has been completed. Research concluded that little direct mortality of lobsters is due to their inability to exit traps. Ghost fishing by these traps, therefore, is not considered a problem for Hawaiian slipper and spiny lobsters. A final report entitled "Evaluation of Ghost Fishing in the Hawaiian Lobster Fishery" is presently under review.

d. Effect of persistent marine debris on juvenile pelagic sea turtles (continued), \$38.5K

Funds for this task will provide continued research on the effects of marine debris on juvenile sea turtles. The study

defines the little known juvenile sea turtle populations and determine the extent to which marine debris has a negative effect on the turtles within these habitats. Primary investigation areas will be the Western Atlantic (along Florida beaches in cooperation with the Florida Department of Natural Resources) and in the Azores, where concentrations of juvenile pelagic loggerhead turtles have recently been discovered.

Status: Work on this task continues, with field work to commence during the summer 1991. At the request of the MERP, a comprehensive interim report has been submitted, summarizing the project findings to date. This report is available from the MERP manager, reference:

Bolton, Alan B. and Karen A. Bjorndal. 1991. Effect of Marine Debris on Juvenile, Pelagic Sea Turtles. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

e. Juvenile male fur seal survivorship and entanglement in marine debris (continued), \$25.0K

Entanglement has been suggested to have contributed to the northern fur seal population decline since the late 1960's. This task will continue the evaluation of entanglement rates and survivorship among juvenile male fur seals of the Pribilof Islands population. Work will continue toward monitoring any change in the rate of entanglement among juvenile male fur seals.

Status: Field work on this task is expected to commence during Summer 1991.

f. North Pacific fisheries observer debris data collection, \$28.0K

Attempts to develop no-cost observer data collection and archiving of marine debris information have not succeeded. During FY 1991, the NMFS will place up to 600 observers in the North Pacific under three separate programs. At present, these observers are not systematically gathering data on the distribution and density of the types of marine debris. Funds from this task will provide for the collection, evaluation, and reporting of marine debris data collected by observers at sea.

Status: Work on this task continues.

4. MANAGEMENT

a. Program management, \$75.4K

Funds allocated to this task support the office of the MERP manager. The manager carries out the annual program plan for MERP as well as represents NMFS/NOAA on marine debris issues during conferences and meetings with colleagues, constituents and the general public.

Status: The program manager's salary was partially funded through the NMFS High Seas Driftnet Program, as James Coe is also the Coordinator of the Driftnet Program. MERP management is faced with continuous new challenges, through budget reductions, changing priorities, and contracting uncertainties.

In addition to effectively running the program, MERP management has given a number of presentations on the persistent marine debris problem. These presentations have been given during national and international meetings, to educators and students, and recreational and commercial fishermen. While these presentations are not planned for publication, discussion papers are available from the MERP management, reference:

Coe, James M. 1990. Discussion Paper on Management Options to Control Marine Mammal Mortality in Passive Fishing Gear. Unpubl. manusc. 10 p. (Document submitted during the IWC Workshop on Mortality of Cetaceans in Passive Fishing Nets and Traps, La Jolla, Calif., October 1990). Alaska Fish. Science Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Coe, James M. 1991. Discussion Paper on Persistent Marine Debris, Unpubl. manusc. 4 p. (Document prepared for Asia-Pacific Economic Cooperation: Experts Workshop on Marine Resource Conservation, Vancouver B.C., November 1990.) Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E. Seattle, WA 98115-0070.

Coe, James M. In prep. Initiatives for Port Compliance with MARPOL Annex V Regulations. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

REPORTS FROM THE MARINE ENTANGLEMENT RESEARCH PROGRAM

- Alverson, Dayton L. and J.A. June (editors). 1988. Proceedings of the North Pacific Rim Fishermen's Conference on Marine Debris. 460 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Andrady, Anthony L. 1987. Research on the Use of Degradable Fishing Gear and Packaging Materials. NWAFC Processed Rep. 87-03, 49 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Andrady, Anthony L. 1988. Experimental Demonstration of Controlled Photodegradation of Relevant Plastic Compositions under Marine Environment Conditions. NWAFC Processed Rep. 88-19, 68 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Balazs, George H. and B.K. Choy. In Press. Ecological Aspects of Marine Turtles Impacted by Ocean Debris: A 1989 perspective. In R. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.
- Bayliss, Randolph and C.D. Cowles. 1989. Final Report on the Impact of MARPOL Annex V Upon Solid Waste Disposal Facilities of Coastal Alaskan Communities. NWAFC Processed Rep. 89-20, 105 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Berger, Jerald D and C. Armistead. 1987. Discarded Net Material in Alaskan Waters, 1982-84. NOAA Tech. Mem. NMFS F/NWC-110, 66 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Bolten, Alan B. and K.A. Bjorndal. 1989. Task Report: Azores Trip Summary. Report to the Marine Entanglement Research Program, Research Work Order No. 66, 9 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Bolton, Alan B. and Karen A. Bjorndal. 1991. Effect of Marine Debris on Juvenile, Pelagic Sea Turtles. Available Alaska

Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

- Bunn, Alan R. and J.M. Coe. 1989. Marine Debris Education Program Supplement: Marine Debris Coloring Book. NOAA Tech. Memo. NMFS F/AKR-9. 33 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Cal Recovery Systems, Inc. 1988. Evaluation of Plastic Recycling Systems. NWAFC Processed Rep. 88-16, 90 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Carr, Arnold H. and A. Blott. 1991. A Study of Ghost Gillnets in the Inshore Waters of Southern New England. 10 p. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Center for Marine Conservation. 1987. A Citizens Guide to Plastics in the Ocean: More than a Litter Problem. 131 p. Center for Marine Conservation, 1725 DeSales St., N.W., Suite 500, Washington, D.C. 20036.
- Center for Marine Conservation. 1989. Marine Debris Information Offices - Atlantic Coast/Gulf of Mexico and Pacific Coast; Annual Report (October 1, 1988-September 30, 1989). Report to the NMFS Marine Entanglement Research Program, Contract 52ABNF800133, 158 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle WA 98115-0070.
- Center for Marine Conservation. 1990. Marine Debris Information Offices - Atlantic Coast/Gulf of Mexico and Pacific Coast; Annual Report (October 1, 1989-September 30, 1990). Report to the NMFS Marine Entanglement Research Program, Contract 52ABNF800133, 178 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Center for Marine Conservation. 1990. National Marine Debris Database - Final Report. Report to the NMFS Marine Entanglement Research Program, Contract NA89AA-D-FS229, 21 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Coe, James M. 1990. Discussion Paper on Management Options to Control Marine Mammal Mortality in Passive Fishing Gear. Unpubl. manusc. 10 p. (Document submitted during the IWC Workshop on Mortality of Cetaceans in Passive Fishing Nets and Traps, La Jolla, Calif., October 1990). Alaska Fish.

- Science Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Coe, James M. 1991. Discussion Paper on Persistent Marine Debris, Unpubl. manusc. 4 p. (Document prepared for Asia-Pacific Economic Cooperation: Experts Workshop on Marine Resource Conservation, Vancouver B.C., November 1990.) Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E. Seattle, WA 98115-0070.
- Coe, James M. In prep. Initiatives for Port Compliance with MARPOL Annex V Regulations. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Coe, James M. In press. Marine Debris in the North Pacific. In R.S. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.
- Coe, James M. and A.R. Bunn. 1988. Marine Debris and the Solid Waste Disposal Crisis. In Proceedings of OCEANS 88 "A Partnership of Marine Interests." October 31 - November 2, 1988, Vol. I, p. 1-5. Marine Technology Society, 2000 Florida Ave. N.W., Suite 500, Washington, D.C. 20006.
- Cole, Andrew C. et al. 1990. Annual Report of National Park System Marine Debris Monitoring Program: 1989 Marine Debris Survey. U.S. DOI Technical Rep. NPS/NRWV/NRTR-90/04, 29 p. Natl. Park Serv., c/o Air Quality Div. (AIR), P.O. Box 25287, Denver, CO 80225-0287.
- Day, Robert H., D.M. Clausen and S.E. Ignell. 1986. Distribution and Density of Plastic Particulates in the North Pacific Ocean in 1986. (Document submitted to the International North Pacific Fishery Commission, Anchorage, Alaska, November 1986.) 17 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.
- Dunford, Richard W., A.L. Andrady and L.J. Norwood. 1988. Assessment of Degradable Technologies. Chapter Six of the Report of the Interagency Task Force on Persistent Marine Debris. 170 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Dunford, Richard W., A.L. Andrady and L.J. Norwood. 1989. The Economic Impacts of Required Rapidly Degradable Plastics in Selected Products: A Preliminary Analysis. Report to the

NMFS Marine Entanglement Research Program, Contract RTI/4074/00-01F, 24 p. Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709-2194.

- Duronslet, Marcel J., D.B. Revera and K.M. Stanley. 1991. Marine Debris and Sea Turtle Strandings on Beaches of the Upper Texas and Southwestern Louisiana Coasts, June 1987 through September 1989. Available National Technical Information Service, 5258 Port Roay Road, Springfield, VA 22161.
- Fowler, Charles W., R. Merrick, and N. Baba. 1989. Entanglement Studies at St. Paul Island, 1988: Juvenile Male Roundups. NWAFC Processed Rep. 89-01, 23 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Fowler, Charles W. and T.J. Ragen. 1990. Entanglement Studies, St. Paul Island, 1989 Juvenile Male Northern Fur Seals. NWAFC Processed Rep. 90-06, 39 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Fowler, Charles W. and N. Baba. 1991. Entanglement Studies, St. Paul Island, 1990 Juvenile Male Northern Fur Seals. AFSC Processed Rep. 91-01, 63 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Gerrodette, Tim, B.K. Choy, and L.M. Hiruki. 1987. An Experimental Study of Derelict Gillnets in the Central Pacific Ocean. SWFC Admin. Report H-87-18, 12 p. Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.
- Gooder, Perry. 1989. Observations on Board the Korean Squid Driftnet Vessel, Oyang 53, June 9 - August 8, 1988. NWAFC Processed Rep. 89-03. 30 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Hare, Matthew P. and J. G. Mead. 1987. Handbook for Determination of Adverse Human-Marine Mammal Interactions from Necropsies. NWAFC Processed Rep. 87-06, 35 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Henderson, John R. 1988. Marine Debris in Hawaii. In D.L. Alverson and J. June (editors). Proceedings of the North Pacific Rim Fishermen's Conference on Marine Debris, October 13-16, 1987, Kailua-Kona, HI p. 189-206. National

Resources Consultants, 4055 21st Ave. West, Seattle, WA 98199.

Henderson, John R. In press. Recent Entanglements of Hawaiian Monk Seals in Marine Debris. In R. Shomura and M. L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Henderson, John, S.L. Austin, and M.B. Pillos. 1987. Summary of Webbing and Net Fragments Found on Northwestern Hawaiian Island Beaches, 1982-86. SWFC Admin. Rep. H-87-11, 15 p. Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Heneman, Burr and J.M. Coe. 1989. Persistent Marine Debris in the Wider Caribbean Area. Unpubl. manusc., 28 p. (report submitted to the IOC/UNEP Regional Review Workshop on Marine Pollution Monitoring, Research, Control and Abatement in the Wider Caribbean Region, San Jose, Costa Rica, August 24-30, 1989). Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Herkelrath, James M. and J.M. Coe. 1990. NOAA's Marine Entanglement research Program. Unpubl. Manusc. 5 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Herkelrath, James M. and J.M. Coe. 1990. Marine Debris Education and Public Awareness Projects by the NOAA Marine Entanglement Research Program. In Proceedings of MTS 90 "Science and Technology for a New Oceans Decade," September 26-28, 1990, Washington, D.C., Marine Technology Society, 1825 K St. N.W., Suite 218, Washington, D.C. 20006.

Hoss, Donald E. and L.R. Settle. In press. Ingestion of Plastics by Teleost Fishes. In R.S. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Ignell, Steve, J. Bailey and J. Joyce. 1986. Observations on High-Seas Squid Gill-Net Fisheries, North Pacific Ocean, 1985. NOAA Tech. Mem. NMFS F/NWC-105., 52 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

Ignell, Steve, and M. Dahlberg. 1986. Results of 1986 Cooperative Research on the Distribution of Marine Debris in the North Pacific Ocean. Unpubl. manusc., 17 p. (Document

submitted to the International North Pacific Fishery Commission, Anchorage, Alaska, November 1986.) Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

International North Pacific Fishery Commission. 1990. Final Report of Squid and Bycatch Observations in the Japanese Driftnet Fishery for Neon Flying Squid (Ommastrephes bartrami), June - December, 1989 Observer Program. Joint report by the National Sections of Canada, Japan, and the United States. 111 p. (Available from: Driftnet Program Coordinator, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.)

International North Pacific Fishery Commission. 1990. Data Summary of Squid and Salmon Observations in the Japanese Driftnet Fishery for Neon Flying Squid (Ommastrephes bartrami), July - August, 1989 Observer Program. Joint report by the National Sections of Canada, Japan, and the United States. 34 p. (Available from: Driftnet Program Coordinator, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.)

Johnson, Scott W. 1990. Entanglement Debris on Alaska Beaches, 1989. NWAFC Processed Rep. 90-10, 16 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

Johnson, Scott W. In press. Entanglement Debris on Alaskan Beaches, 1982-1988. In R. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Johnson, Scott and T. Merrell. 1988. Entanglement Debris on Alaskan Beaches, 1986. NOAA Tech. Memo. NMFS F/NWC-126, 26 p. Alaska Fish. Sci. Cent., Auke Bay Lab., Natl. Mar. Fish. Serv., NOAA, P.O. Box 210155, Auke Bay, AK 99821.

June, Jeff A. In press. Types, Quantity, and Probable Sources of Trawl-Caught Marine Debris in the Eastern Bering Sea and off the Coast of Oregon in 1988. In R.S. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Kajimura, Hiroshi. 1990. Fur Seal Investigations, 1987 and 1988. NOAA Tech. Memo. NMFS F/NWC-180, 92 p. Alaska Fish

- Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Kearney/Centaur Division of A.T. Kearney, Inc. 1989. Model Plastic Refuse Control and Minimization Plan for Ships. Report to the Marine Entanglement Research Program, Contract 52ABNF800132 48 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Kearney/Centaur Division of A.T. Kearney, Inc. 1989. Dealing with Garbage under MARPOL Annex V: Examples of Compliance Approaches Used by the Shipping Industry. Report to the Marine Entanglement Research Program, Contract 52ABNF800132 62 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Kearney/Centaur Division of A.T. Kearney, Inc. 1990. Development and Evaluation of Education Techniques to Eliminate At-Sea Disposal of Plastics. Report to the Marine Entanglement Research Program under S-K Cooperative Agreement NA 89-AA-H-SK0007 234 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Kearney/Centaur Division of A.T. Kearney, Inc. 1990. MARPOL Annex V Kit: Implementing MARPOL Annex V in the United States. Report to the Marine Entanglement Research Program, Contract 52ABNF800132 306 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Kearney/Centaur and the Center for Marine Conservation. 1989. Shipping Industry Marine Debris Education Plan. Report to the NMFS Marine Entanglement Research Program Contract 52ABNF800132, 79 p. Kearney/Centaur Division of A.T. Kearney, Inc., 225 Reinekers Lane, Suite 300, Alexandria, VA. 22314.
- Kearney/Centaur Division of A.T. Kearney, Inc. and Lissa Martinez. 1991. Revision of the Port Reception Facility Section of the IMO Guidelines for the Implementation of MARPOL Annex V. Report to the NOAA Marine Entanglement Research Program, contract 52ABNF-1-00058, 92 p. Available Alaska Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-0070.
- Kozloff, Patrick and H. Kajimura (editors). 1988. Fur Seal Investigations, 1985. NOAA Tech. Memo. NMFS F/NWC-146, 189 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

- Loughlin, Tom R. et al. 1986. Assessment of Net Entanglement on Northern Sea Lions in the Aleutian Islands, 25 June - 15 July 1985. NWAFC Processed Rep. 86-02, 50 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Lutz, Peter. 1987. Effect of Ingestion of Non-biodegradable Debris in Sea Turtles. Report to the Marine Entanglement Research Project, Contract FSN-5-0178, 50 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Lutz, Peter L. and A.A. Alfaro-Schulman. In prep. The Effect of Chronic Plastic Ingestion on Green Sea Turtles. Available Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Merrell, Theodore R. and S.W. Johnson. 1987. Surveys of Plastic Litter on Alaskan Beaches, 1985. NOAA Tech. Memo. NMFS F/NWC-116, 21 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Moser, Mary L. and D.S. Lee. 1990. A Fourteen Year Survey of Plastic Ingestion by Western Atlantic Seabirds. Report to the NMFS Marine Entanglement Research Program, Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Neilson, Judie. 1986. Final Report - Get the Drift and Bag It. NWAFC Processed Rep. 86-11, 23 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Natural Resources Consultants, Inc. 1990. Survey and Evaluation of Fishing Gear Loss in Maine and Great Lakes Fisheries of the United States. Report to the NMFS Marine Entanglement Research Program, Contract 50 ABNF-9-00144, 224 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Parker, Nancy R., S.C. Hunter, and R.J. Young. 1987. Development of Methodology to Reduce the Disposal of Non-Degradable Material into the Marine Environment. Report to the NMFS Marine Entanglement Research Program, Contract 85-ABC-00203, 50 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Pacific Associates. 1988. The Effects of MARPOL, Annex V, on the Ports of Kodiak and Unalaska. NWAFC Processed Rep. 88-

26, 64 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv.,
NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Project Wild. 1990. Get The Drift: Cleaning Up Plastic
Pollution for People and Wildlife. 38 p. Project WILD,
P.O. Box 18060, Boulder, CO 80308-8060.

Recht, Fran. 1988. Dealing with Annex V - Reference Guide for
Ports. NOAA Tech. Memo. NMFS F/NWR-23, 132 p. Alaska Fish.
Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point
Way N.E., Seattle, WA 98115-0070.

Recht, Fran. 1988. Report on a Port-Based Project to Reduce
Marine Debris. NWAFC Processed Rep. 88-13, 75 p. Alaska
Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand
Point Way N.E., Seattle, WA 98115-0070.

Recht, Fran. 1990. Marine Refuse and Recycling Facilities:
U.S. West Coast Ports Respond to MARPOL Annex V Requirements
and Reduce Costs. (Document submitted to the International
Marina Institute's Conference on Environmental Management
for Marinas, Washington D.C., September 1990.) Alaska Fish.
Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point
Way N.E., Seattle, WA 98115-0070.

Recht, Fran. 1990. West Coast Marine Debris Recovery Project:
Summary Report. Report to the NMFS Marine Entanglement
Research Program, S-K Grant NA 89AA-H-SK003, 31 p. Alaska
Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand
Point Way N.E., Seattle, WA 98115-0070.

Recht, Fran and S. Lasseigne. 1990. Providing Refuse Reception
Facilities and more: The Port's Role in the Marine Debris
Solution. Report to the NMFS Marine Entanglement Research
Program, S-K Grant NA 89AA-H-SK003, 12 p. Alaska Fish. Sci.
Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way
N.E., Seattle, WA 98115-0070.

Ribic, Christine A. and L. J. Bledsoe. 1986. Design of Surveys
for the Density of Surface Marine Debris in the North
Pacific. NWAFC Processed Rep. 86-12, 69 p. Alaska Fish.
Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point
Way N.E., Seattle, WA 98115-0070.

Ribic, Christine A. and G.L. Swartzman. In press. An Index of
Fur Seal Entanglement in Floating Net Fragments. In R.
Shomura and M.L. Godfrey (editors) Proceedings of the Second
International Conference on Marine Debris, April 2-7, 1989.
Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab.,
Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI
96822-2396.

- SCS Engineers. 1989. Operating and Safety Guidelines for Use of Burn Barrels to Dispose of Shipboard-Generated (MARPOL V) Wastes. NWAFC Processed Rep. 89-14, 15 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- SCS Engineers. 1989. An Investigation of Using Burn Barrel Technology to Dispose of Shipboard-Generated (MARPOL V) Wastes. NWAFC Processed Rep. 89-15, 22 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Shomura, Richard S. and H.O. Yoshida. 1985. Proceedings of Workshop on the Fate and Impact of Marine Debris, 26-29 November 1984, Honolulu, HI. U.S. Department of Commerce, NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.
- Shomura, Richard S. and M.L. Godfrey (editors). In press. Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.
- Shoop, Robert C. and C.A. Ruckdeschel. 1989. Analyses of Sea Turtle Gut Contents for Nonfood Components. Report to the NMFS Marine Entanglement Program, Contract 52-EANF-7-00067, 16 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Sibley, Thomas H., R. M. Strickland. 1989. Potential Effects of Marine Debris on Benthic Communities. Report to the NMFS Marine Entanglement Research Program, Contract 40-ABNF6-2619, 37 p. Alaska Fish. Sci. Cent., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.
- Sileo, Louis. 1987. The Prevalence and Effect of Plastic Ingestion in Hawaiian Seabirds from October 1986 to January 1987. Progress Report for NWHC Work Unit 20. 15 p. Natl. Wildlife Health Res. Cent., U.S. Fish and Wildlife Serv., 6006 Schroder Rd., Madison, WI 53711.
- Sileo, Louis, P.R. Sievert, and M.D. Samuel. 1990. Causes of Mortality of Albatross Chicks at Midway Atoll. *Journal of Wildlife Diseases*, 26(3), 1990:329-338.
- Sileo, Louis L., P.R. Sievert, M.D. Samuel, and S.I. Fefer. In Press. Prevalence and Characteristics of Plastic Ingested by Hawaiian Seabirds. In R.S. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest

Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv.,
NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Stewart, Brent S. and P.K. Yochem. 1988. Pinniped Entanglement in Synthetic Materials in the Southern California Bight, 1986-1988. Sea World Research Institute Technical Report No. 88-210, 15 p. Sea World Research Institute, Hubbs Marine Research Center, 1700 South Shores Rd., San Diego, CA 92109.

Swartzman, Gordon, C.A. Ribic and C.P. Haung. 1990. Effect of Entanglement on Populations of Northern Fur Seal Callorhinus ursinus. Unpubl. manusc. 98 p. (Report submitted to the NMFS Natl. Mar. Mammal Lab.) Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-0070.

Swartzman, Gordon, C.A. Ribic, and C.P. Haung. In press. Marine Debris Entanglement Mortality and Fur Seal Populations: A Modeling Perspective. In R. Shomura and M.L. Godfrey (editors). Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Walker, William A. and J. M. Coe. In Press. Survey of Marine Debris Ingestion by Odontocete Cetaceans. In R.S. Shomura and M.L. Godfrey (editors) Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989. Honolulu, HI, Southwest Fish. Sci. Cent., Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

Wetherall, J. A. 1989. Strategic Plan for North Pacific Squid Driftnet Entanglement Research. SWFC Admin. Rep. H-89-9. 51 p. Southwest Fish. Sci. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.