Northwest and Alaska Fisheries Center

National Marine Fisheries Service

U.S. DEPARTMENT OF COMMERCE

NWAFC PROCESSED REPORT 87-15

Description and Status of Tasks in the National Oceanic and Atmospheric Administration's Marine Entanglement Research Program for Fiscal Years 1985-1987.

July 1987

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

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 - 1987

JULY 1987

by

James M. Coe
and
Alan R. Bunn

NOAA
National Marine Fisheries Service
Northwest and Alaska Fisheries Center
7600 Sand Point Way N.E.
BIN C15700
Seattle, WA 98115

DESCRIPTION AND STATUS OF TASKS IN THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S MARINE ENTANGLEMENT RESEARCH PROGRAM FOR FISCAL YEARS 1985 - 1987

July 1987

INTRODUCTION

In response to public concern over the impacts of marine debris on wildlife, Congress appropriated $1,000,000 in Fiscal Year 1985 and $750,000 in 1986 and 1987 for the National Oceanic and Atmospheric Administration (NOAA) Marine Entanglement Research Program. The program is divided into three major areas of activity. Impacts and research monitoring accounted for nearly one half of the funds, while a little less than one quarter of the funds are spent on each of the remaining two activities, mitigation and education. Roughly 10% of the funds were spent on project management.

The research and impacts assessment 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 three 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. FCZ; (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 is designed to increase the knowledge of both industrial and commercial contributors about the impacts and control of marine debris. The educational tasks for the three fiscal years include: (1) education program development and implementation for the Gulf of Mexico, Atlantic, and North Pacific regions; and (2) beach clean-ups and reports; (3) developing a manual of standard methods for assessment of debris in the marine environment; and (4) evaluations of education program effectiveness.

Mitigation projects are directed towards reducing the amount of non-degradable material that is disposed of directly or indirectly into the sea. During the three fiscal years, 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; and (8) development of guidelines for the implementation of international regulations to control vessel sources of marine debris (MARPOL Annex V). In addition to these activities, the National Marine Fisheries Service (NMFS) has initiated efforts to coordinate research.

NMFS is participating in the Pacific Rim Fishing Industry Symposium on Marine Debris meeting in October 1987 in Hawaii. This is an international fishing industry meeting for which there are plans to establish guidelines for fishing vessel management of marine debris. NOAA is also actively working with the appropriate international organizations and federal agencies on many aspects of the plastics pollution issue. The following three sections provide a description of the tasks comprising the Marine Entanglement Research Program for each fiscal year since its inception, including a note on the status of each as of July 31, 1987 and a summary table showing the distribution of funds.

FINAL FUNDING PLAN FOR FY85 ENTANGLEMENT
PROGRAM TASKS BASED ON A $1 MILLION AUTHORIZATION

NOAA SHORTFALL ADJUSTMENT (-10%)	-$100.0K
TOTAL FY85 FUNDS AVAILABLE	$900.0K

NO.	TASK DESCRIPTION	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 materails,	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.	Dynamics 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. 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, $144K

With primary reference to the North Pacific basin, the objectives of this project are 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 include: 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: The FY85 educational contract with Natural Resources Consultants was completed in March, 1987 and the FY86 revised Marine Debris Education Program for the North Pacific began. Educational products completed during the contract period include:

1. Three technical papers (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 actions taken in 1984 by the State of Oregon to increase

public awareness of the problem were discussed at length. On October 13th of that year, approximately 2,100 volunteers collected more than twenty-six 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 is planned for the entire West Coast and the New England Coast on September 21st, 1985. Project support is for a report on the materials collected and the activities necessary to organize and evaluate the project. As in the case of Oregon, it is anticipated that while the project will have transitory benefit in terms of beach clean-up, even greater long-term benefits will be realized as a result of the greatly heightened public awareness of the problem.

Status: The National Volunteer Beach Cleanup Days were held in September and October of 1985. Eleven coastal states participated in the Cleanup 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 NMFS Entanglement Research Program Manager, reference:

> Neilson, J. 1986. Final Report - Get the Drift and Bag It. NWAFC Processed Report 86-11, 23p.

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 Commission 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 (editors), Proceedings of Workshop on the Fate and Impact of Marine Debris, 26-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. 1985.

2. MITIGATION

These projects are directed towards 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,

$66K (FY85)
18K (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 is 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 of over 6 million tons per year will continue unchecked.

Status: In September 1985, a contract was let to synthesize available information on existing refuse handling technology applicable to shipboard circumstances. This includes a survey of what has been used and what is now in use and the technical capabilities and characteristics of each system. The product of this task will identify, for vessel operators, the most appropriate exisiting waste management system(s) for their type of vessel and waste production. Obvious gaps in technology and reasonable approaches to addressing these gaps will 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 delays task completion.

b. Research on the use of degradable materials, $49K

The purpose of this study is 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 the materials and components used.

Status: The funding for this task was carried-over into fiscal 1986 and the contract was let in March to the Research Triangle Institute in North Carolina. The task identifies the range of polymers and mechanisms for degradation (if any) for each. 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 NMFS Entanglement Program Manager, referenced as:

> Andrady, A. L. 1987. Research on the Use of Degradable Fishing Gear and Packaging Materials. NWAFC Processed Report 87-03, 49 p.

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 is 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 is anticipated that the product of this second review will be a series of detailed specific actions to be pursued under existing authority, and that the report will also include, where appropriate, specific recommendations for changes in the text of international conventions, domestic statue, 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 whereby it may be controlled.

a. Northern fur seal entanglement research, $106K

Participants at 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 subadult 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 were completed between June and November, 1985. The report of these research activities and their preliminary results will be included in the NOAA Technical Memorandum entitled "Fur Seal Investigations, 1985" edited by Pat Kozloff and available from the National Marine Mammal Laboratory. 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 final report is being edited and should be ready for distribution in September 1987.

b. Northern sea lion entanglement research, $85K.

A recent survey indicates that the sea lion population in the eastern Aleutians is declining at a rate comparable to that observed in the northern fur seal population. The study is to provide information on the rate of entanglement of all age and sex classes of the northern sea lion population, and will concentrate on entanglement effects on the survival of sea lion young of the year. If this research provides 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 authors 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 National Marine Mammal Laboratory, reference:

> Loughlin, T., P. Gearin, R. DeLong and R. Merrick. 1986. Assessment of Net Entanglement on Northern Sea Lions in the Aleutian Islands, 25 June - 15 July 1985. NWAFC Processed Report 86-02, 50p.

c. Establishment of a reference collection and development of expertise to identify marine debris, $48K

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 Northwest and Alaska Fisheries Center (NWAFC) 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 staff at NWAFC is accepting materials for identification and may be contacted for information on procedures for delivery of specimens at:

> Marine Debris Reference Center
> 7600 Sand Point Way, N.E.
> Seattle, WA 98115
> ATTN: Mr. Phil Wyman

d. Accumulation and disappearance rates of marine litter on beaches in Alaska, $35K

Marine litter, including derelict net fragments, accumulates on beaches where it can be inventoried. A recent study in Alaska indicates 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 is 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 will be 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 should be 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 is presently underway and a Processed NWAFC report should be available by August 1987. A draft report is available for informational purposes only.

Merrell, T. and S. Johnson. 1986. Surveys of Plastic Marine Debris on Alaskan Beaches in FY 1985. NWAFC Processed Report (in press).

e. Compilation and analysis of U.S. fishery observer data on marine debris in the foreign and joint venture groundfish fishery, $23K

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, have yet to be tabulated and evaluated. The objective of this study is 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 NWAFC, reference:

Berger, J. and C. Armistead. 1986. Discarded Net Material in Alaskan Waters, 1982-84. NOAA Tech. Mem. NMFS F/NWC.

f. Survey of high seas squid gillnet fishery, $100K

A large squid fishery has been developing 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 gear found in Alaskan waters. Unfortunately, virtually nothing is known about the fishery

and recent attempts to put observers on vessels in the fishery have failed. Therefore, it is appropriate and necessary to determine the feasibility of monitoring this fishery by direct observations from small charter boats. Not only will the information collected by observers on this initial charter boat survey provide very rough estimates of loss rates, entanglement of non-target species in actively fishing and lost gear, and the fate of lost gear, it will, even 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 mitigating 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 five 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 the authors at NWAFC, Auke Bay, Alaska, 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.

g. Identification of sources of fishing debris affecting endangered marine animals in the northwestern Hawaiian Islands, $13K

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 will be cataloged and identified as to the possible source fishery and location, and (b) estimates of the current rate of accumulation will be made. If this work is not done, the type of debris responsible for entangling endangered and threatened species in the Hawaiian area will 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 principal fishing

gear found to entangle monk seals is trawl webbing fragments of north Pacific origin. Details of these findings are available from the principal investigators at the NMFS Hawaii Laboratory. 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, $27K

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 is to develop information on the ghost fishing profile of derelict gillnets in the north Pacific. The information will come primarily as a result of intentionally setting gillnets adrift and then following them to determine changes in the physical characteristics of the gear during the early, mid, and late stages of dereliction. If this is not done, we shall 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 is continuing on target. Five of the driftnets released last summer with satellite tracking systems have been recovered. The last one was recovered in June, and analyses of these data will begin in July.

The report of findings for this task will be available in the Fall of 1987.

i. Impact of ingested debris on sea turtles, $27K (FY85)
10K (FY86)

The growing volume of long-lived 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 present, there is no information on the effects of ingesting plastic on the longevity and reproductive potential of turtles. Under this project, experiments on captive animals would be 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 let in December of 1985 to a Florida research company that already had a stock of captive turtles. The feeding experiments are

on schedule and the report of results is anticipated in August, 1987.

j. Impact of ingested plastics on sea birds, $30K

Observers have recorded ingestion of plastics in fifty 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 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 is 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 FY86 and FY87 activities.

k. Method for surveying at sea distribution and abundance of marine debris, $20K

The purpose of this study is to test the utility of carrying out surveys in the Bering Sea and/or Gulf of Alaska to determine the abundance and distribution of marine debris at or near the surface. Different survey methodologies will be developed for quantitatively estimating debris density in total and by type. Whatever biases may exist with differing methods will be described as will the comparative cost of each. The study will evaluate the relative merits of platforms of opportunity in addition to using dedicated vessels. Previous field experiments will be 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 NMFS Entanglement Program 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 Report 86-12, 69p.

l. Expansion of information collected by stranding programs, $8K

Information and samples of value in investigating entanglement and debris ingestion can be collected from marine mammals, birds, and turtles found dead on the beach. Under this project, the National Marine Fisheries Service 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 engaged 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, or from the NMFS Entanglement Program Manager, referenced as:

> Hare, M. P. and J. G. Mead. 1987. Handbook for Determination of Adverse Human-Marine Mammal Interactions from Necropsies. NWAFC Processed Report 87-06, 35 p.

m. Evaluation of aerial techniques for assessing debris density, $8K

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: Flights from 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 Entanglement Program 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

FINAL FUNDING PLAN FOR FY86 ENTANGLEMENT PROGRAM
TASKS BASED ON A $750K AUTHORIZATION

G-R-H ADJUSTMENT (-4.312%)	- $32.0K
NMFS SHORTFALL ADJUSTMENTS (-4%)	$-28.7K
TOTAL FY86 FUNDS AVAILABLE	$689.3K

NO.	TASK DESCRIPTION	FUNDING LEVELS
1.	EDUCATION AND PUBLIC AWARENESS	
	Marine debris Education - Continued	$112.0K
2.	MITIGATION from the FY86 Entanglement Program budget was 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	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	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.	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, $112K

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 will voluntarily reduce their output of debris. The task as envisioned in FY86 is 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 may be made considerably easier and cheaper by the experience gained from the North Pacific efforts. This task may include the development of video and radio public service messages which can continue to be run at intervals to maintain public awareness. Efforts to coordinate and report the results of voluntary public beach clean-up efforts may 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 contractor 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 have subsequently been approved, and Marine Debris Education Program activities are progressing through both contractors. Efforts are being made to produce a video of our existing slide show. Trade journal advertisements and brochures indicating the severity of the problem are being synthesized. An assessment of the North Pacific Education Plan has been finalized and the findings and recommendations incorporated into a revised plan. Organization of a Pacific Rim Commercial Fishermen's Forum on Marine Debris for this fall is well underway. Participants are anticipated from Canada, Japan, Taiwan, South Korea, China, and the United States.

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

2. MITIGATION

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

a. Disposal Methods Development, $97K

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 is 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 for this reduction is at-sea disposal of some type, the hardware will be built and proven; these results will be widely publicized through the Education Contractor (see I. A., above). 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.
To be contracted by NWAFC.

Status: The development of a prototype port-based refuse reception and disposal system is being pursued under this task. A cooperative agreement between NOAA/NMFS and the Port of Newport, Oregon is in place to support this development as a feasibility study for all the port cities in the U.S.. This task will provide important information on vessel-generated refuse management that is mandated for port entities in MARPOL Annex V, which the U.S. is currently considering for ratification. The study began in January, 1987 and will run for approximately one year. Several posters, brochures, and newspaper articles have been released on the program, resulting in a high level of acceptance and utilization.

b. Fur Seal Rookery Clean-up, $5K

A cooperative task between U.S. and Japanese fur seal research teams, they 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. The work has been completed and a report drafted. A final report should be available in September 1987.

c. Photodegradation Processes in the Marine Environment, $24K

Wider use of plastic materials in society has led to various hazards for living marine resources. Entrapment in plastic materials such as six-pack holder, 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. 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 will be conducted in both a land based and marine environment for analogy. A list will 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, and the task commenced January, 1987. The one year project is on schedule.

3. IMPACTS RESEARCH AND MONITORING
NOTE: FY85 sea turtle ingestion research contract was augmented with $10K from the FY86 program funds.

a. Alaskan Beach Debris Survey Methodology, $35K

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 was begun in FY85 and continued in FY86 as the precision of the methods need to be validated and the statistical relationship between assessments of accumulation and loss are developed. Infrared spectrometric methods for determining the longevity of various types of debris was assessed during FY86 and will continue into FY87. The ability to age debris will enable a broader understanding of the "life history" of the various types thus improving the ability to assess changes in the debris population and

better focusing mitigative measures on 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 are funded and are being carried out at the NWAFC Auke Bay Laboratory in Alaska. Reports of results of these activities will be available in the Fall of 1987 (Note FY85 activity 2d.).

b. Survey of High Seas Squid Driftnet Fisheries, $95K

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 will make estimates of the annual incidental and accidental take of target and non-target species in these fisheries. The fishing patterns and techniques will be elucidated and the feasibility of locating and marking derelict gear will be determined. One or more vessels were 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 was 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.
To be done by NWAFC-ABL or by contract.

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 are hosting one U.S. biologist on a squid fishing vessel after intense, last minute negotiations. Both Taiwanese and Korean research vessels are 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 to remedy these difficulties are continuing in an effort to fully conduct these objectives during FY 87.

Associated reports and results include:

Ignell, S., M. Dahlberg. 1986. Results of 1986 cooperative research on the distribution of marein debris in the North

Pacific Ocean. (Document submitted to the International North Pacific Fisheries Commission, Anchorage, Alaska, November 1986. 17p. Northwest and Alaska Fisheries Center, Natl. Mar.. Fish. Serv., Natl. Oceanic Atmos. Admin., Auke Bay Laboratory, P. O. Box 210155, Auke Bay, Ak 99821.)

Day, R., D. Clausen, S. 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. 17p. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., Natl. Oceanic and Atmos. Admin., Auke Bay Laboratory, P. O. Box 210155, Auke Bay, Ak 99821.)

c. Hawaiian Island Endangered Species Monitoring (continued), $15K.

As was done in 1985, in 1986 beaches and nearshore reefs in the Northwestern Hawaiian Islands (Kure Atoll, Pearl and Hermes Reefs, Lisianski Island, Laysan Island and French Frigate Shoals) will be regularly monitored for presence of entangled seals and turtles. Personnel will note the presence and accumulation of nets and lines, and such flotsam will be measured, sampled, cataloged, and burned. Nets found on reefs within the lagoon at Kure Atoll, Pearl and Hermes Reef, and French Frigate Shoals will be checked for entangled animals, but will not be regularly removed or sampled. This work will be piggy-backed with other tasks for existing personnel already on these Islands.
To be done by SWFC, Hawaii Lab.

Status: As described in Appendix 1, this task supports the continuing evaluation of the role of debris in the recovery of the Hawaiian monk seal. Haul-out and rookery sites are being cleaned of hazardous debris that washes ashore and entangled animals are rescued wherever and whenever possible. A report of activities under this task is available from the authors or the Entanglement Program 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. Southwest Fisheries Center Administrative Report H-87-11, 15 p.

d. Fur Seal Responses to Large Pieces of Derelict Fishing Gear, $35K

This proposed task will attempt to elucidate 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 kind of question will help to sharpen our understanding of the causes of the recent declines in the Northern fur seal population. The experiment is 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 will be devised and reviewed during the 1986 field season.
To be done by NWAFC, NMML.

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

e. Entanglement Rates of Female Northern Fur Seals, $25K

During July through September, 1985, the NMML has conducted surveys of entangled female fur seals on three separate rookeries on St. Paul Island. These surveys will 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 will assess 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 its impact on foraging energetics and survival. The intraseasonal results of this experiment show that these animals are capable of disentangling themselves. For 1986, this task will support the continued monitoring of the experimentally entangled females to assess their interseasonal survival and disentanglement rates.
To be done by NWAFC, NMML.

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

f. Northern Fur Seal And Sea Lion Pup Entanglement Assessment, $35K

This task is designed to assess the role of entanglement of pups in 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 be come 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 will 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 will be surveyed during November of 1985. For Northern fur seals, the surveys will 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 mentioned in FY85 activity 2b.

g. Study of the Extent and Effect of Plastic Ingestion by Hawaiian Seabirds, $20K

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. The task will 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 will be determined and the effects of this ingestion on survival, growth and reproduction will be assessed.

Status: Using funds carried over from FY85 ($30K) combined with the 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. The work is in progress and will encompass two Laysan albatross breeding seasons (January to May, 1986 and 1987) with the final report due in the Spring of 1988.

h. Studies of the Dynamics of Gillnet Gear (continued), $15K

Begun in FY85 at the Hawaii Laboratory of the SWFC, this task is designed to develop a model for the life history of gillnet debris in the Pacific. The model will 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 is principally to take advantage

of free vessel time available on the NOAA Ship Townsend Cromwell which can be used to extend the experimental observations over many months, thus strengthening the assumptions employed in the model.

Status: The FY86 funding for this continuing research task has been used to purchase fishing gear to be set adrift, satellite linked buoys and computer time. The task is on schedule and will not be completed until late 1987.

i. Benthic Impact of Marine Debris, $19.8K

The U.S. government and its ocean and pollution agencies presently tolerate the disposal of a wide range of non-degradable materials into the ocean from ships and from shore-based plants. 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 ton which to base an evaluation of the biological and commercial consequences of this physical pollution. This task will 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 has been let to the University of Washington Fisheries Research Institute to organize and carry out the mini-symposium on the impacts of debris in the benthic environment. The contractor is presently preparing the background materials for the participants. After conferring with a number of experts in the field, it was established that a symposium on the subject seemed inappropriate at this time due to a lack of information pertaining to benthic marine debris. It was decided that a working group be established to develop conceptual models. A report on the results is anticipated in the Summer of 1987.

j. Cetacean Ingestion, $23K

The proceeding of the Hawaii Workshop on the Fate and Impacts of Marine Debris contain thorough reviews of the

impacts of ingestion of debris by seabirds and sea turtles. This information has been invaluable in the development of Entanglement program design and direction. There has been no review of this nature for cetaceans informal although discussion with researchers reveal that a tremendous volume of data exists on the stomach contents of many cetacean species. This task will produce an extensive review of the available data on the incidence of debris ingestion by cetaceans and the mechanisms and extents of its impacts.

Status: A contract was awarded the task in September 1986. The project is due to be completed Fall, 1987.

k. Infrared Spectrophotometric Analysis of Derelict Fishing Net Material on Alaskan Beaches, $37K

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 scheduled for FY87.

4. PROGRAM MANAGEMENT, $73.7K

The responsible obligation of funds to accomplish the FY85 Program tasks (14 of them) required 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. A priority level billet was established for a NOAA Corps Officer as an Assistant Program Manager. 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 will be covered under this task as well. Contracts management, inter and intra-agency research coordination and public contact for the program will all be done under this task. In short, the concept of the Entanglement/Debris Program will become reality through this task.

Status: On-going

ANTICIPATED FUNDING PLAN FOR THE FY 1987
ENTANGLEMENT PROGRAM TASKS
BASED ON A $750K AUTHORIZATION

Fiscal Year 1987 Appropriation	$750.0K
Assessment for NOAA/NMFS Shortfalls (6.7%)	-50.2K
Authorized FY87 Funding Level	$699.8K

TASK NO.	TASK TITLE	RECOMMENDED FUNDING
1.	EDUCATION AND PUBLIC AWARENESS:	
	Marine Debris Education (cont.d) By contract through NWAFC	
	a. Pacific debris education program	40.0K
	b. NW Atlantic debris education program	40.0K
	c. Gulf of Mexico debris education program	40.0K
	d. North Pacific education program evaluation	15.0K
	e. Marine debris treaching unit development for Project WILD	15.0K
	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 proctection and evaluation	10.0K
	c. Dynamics of gillnet gear	15.0K
	d. Alaska beach litter index	30.0K

e.	Sampling survey of impacts of marine and coastal debris and entanglement on sea turtles	12.0K
f.	Norther fur seal entanglement studies	
	(1) Workshop to guide entanglement research on northern fur seals	20.0K
	(2) Modeling and anlysis 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	21.0K
j.	Marine debris in upwelling and frontal zones in the Gulf of Mexico	31.0K
k.	Assessment of floating plastic particulates	21.0K
l.	Completion of Hawaiian seabird plastic ingestion impacts study - continuance of letter of agreement with USFWS National Wildlife Health Laboratory	18.7K
m.	Support for Pacific Fisheries Conference on Marine Debris	5.0K
4.	PROGRAM MANAGEMENT	
	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 will be continued in FY87 in the form of three separate tasks with the following objectives:

a. Pacific debris education program, $40K

Taking into consideration the FY85 and FY86 program results and the FY 87 program evaluation report, a contractor will be selected to continue and expand the education program previously established for the Pacific.

b. NW Atlantic debris education program, $40K

An increased effort will 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, $40K

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

Status: Solicitation for these three educational tasks is progressing.

d. North Pacific education program evaluation, $15K

A marine debris educational program was developed in late 1985 and implemented in 1986 for the North Pacific area. For FY87, NMFS intends 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 will be conducted to produce cost-effective recommendations for present and future educational efforts.

Status: Solicitation of bids from qualified organizations is in progress.

e. Marine debris teaching unit development for Project WILD, $15K

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 recently 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 should include a series on plastic pollution and its implications for living marine resources.

Status: A cooperative agreement is presently being finalized between the Western Regional Environmental Education Council and the National Marine Fisheries Service to design and produce one or more sets of instructional support materials on marine debris for inclusion in the curriculum sections of the Project WILD Aquatic Educational program. It is anticipated that the work items will be completed within one year.

f. Development of a manual on procedures for monitoring plastic debris on beaches and at sea, $2K

During the past several years, numerous efforts have 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 is a need to develop a procedural manual. The manual will outline a standard set of procedures for collecting and recording data that will be comparable with existing data sets and that will be responsive to information needs for management purposes.

Status: The Marine Entanglement Research Program's Management office is in the process of reviewing available literature on procedures for collecting data on large and small particulate plastic debris at sea and on beaches. An effort is being made to identify the most appropriate and useful types of data and sampling techniques. Field procedures and equipment are being identified as well as other information necessary or appropriate to provide guidance in collecting, synthesizing, and reporting useful data. The manual should be available for distribution in early 1988.

2. MITIGATION

a. Plastics research steering group meeting, $2K

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 debris mitigation

activities. To reasonably assess the perceived need and potential resources for mitigation R&D, 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 December, 1986 by NMFS in Seattle 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 revised report will be used by NMFS to assist in the development of debris mitigation tasks for FY88 and beyond.

b. Evaluation of plastic recycling systems, $48K

Recycling is often mentioned as a suitable means for changing the flow patterns of waste plastics. This task's objective is 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: Contract proposals are to be received for this task by June 29, 1987. The contract will be awarded in July, 1987 with the work commencing shortly thereafter. The period of performance is for six months with a final contract report due at that time.

c. Vessel refuse reception problems in Alaskan ports, $25K

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. is nearing ratification of Optional Annex V of the Convention for the Prevention of Pollution from Ships (MARPOL). Annex V is entitled "Regulations for the Prevention of Pollution from Ships by Garbage" and prohibits, with certain exceptions, the disposal of all garbage, particularly synthetics, from ships. The objective of this task is to evaluate the adequacy of the waste management systems in selected remote Alaskan seaports which will receive the increased volume of refuse expected to be landed as a result of Annex V.

Status: A draft cooperative agreement between NMFS and the Alaska Department of Environmental Conservation is presently being reviewed. The period of performance is for nine months. A report of findings should be available for distribution by summer 1988.

3. IMPACTS RESEARCH AND MONITORING

a. High seas squid fishery impacts, $150K

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 sheer size of the squid fleets, and the characteristics of their driftnet gear coupled with the possibility that they may entrap marine mammals and seabirds and intercept North American salmon creates great concern to the U.S. This concern is well-founded, because the 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 regarding the circumstances leading to and the volumes of discarded or lost gillnets in the fisheries.
(3) Estimates on the catch of target and non-target species.

Status: Arrangements are being finalized on the placement of at least one scientist each aboard a Canadian, ROK, Taiwanese, and Japanese research ships to participate in cooperative research on the squid resources. Information will be collected on marine mammal and seabird entanglements, catches, gear losses, environmental conditions, and fishing operations. Scientists will also conduct several ancillary studies to support research on marine debris. Negotiations are continuing to secure a position for an observer during a single cruise aboard a commercial Japanese Squid vessel. The completion of the task by Auke Bay Laboratory (NMFS) is scheduled for late fall 1987.

b. Hawaiian monk seal entanglement protection and evaluation, $10K

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 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 in FY86 with excellent results at minimum costs.

Status: Funding has been transferred to continue the effort by NMFS field biologists throughout FY87.

c. Dynamics of gillnet gear, $15K

The "Dynamics of Gillnet Gear" experiment is a continuation of a study established in FY85 and continued through FY86 to recover nets of known age and history. Besides providing estimates of ghost-fishing and mortality rates of other marine organisms, the recovered nets will provide ancillary information on changes in buoyancy, deterioration of netting, growth of fouling organisms, association of fish around floating debris, etc. This information will greatly increase our understanding of the fate and hazard dynamics of derelict nets.

Status: The FY86 task is nearing completion with the recovery of the gear. The FY87 funds have been transferred and the Honolulu NMFS lab will be analyzing and processing the data acquired from the derelict gear (note the FY86 status summary).

d. Alaska beach litter index, $30K

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 form the beginnings of an index of debris populations in the north Pacific and will be used to track changes in apparent rates of input.

Status: In 1987 the Auke Bay Laboratory (ABL) intends to continue past surveys that have established "baseline" observations on quantities and types of litter found on many Alaskan beaches. Surveys are continuing on schedule and many trawl web samples are being collected for spectrophotometric analysis by another Entanglement/Debris task at ABL. First estimates of arrival rates of derelict trawl webbing fragments are now being made.

e. Sampling survey of impacts of marine and coastal debris and entanglement on sea turtles, $12K

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 have been transferred and coastal surveys begun by the SEFC-Galveston to systematically patrol, sample, and document these observations and events and describe the problem as it relates to the fate of sea turtles. A report of findings and accomplishments will be available upon task completion in the summer of 1988.

f. Northern fur seal entanglement studies

(1) Workshop to guide entanglement research on northern fur seals, $20K

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 nature and magnitude of this mortality. However, as yet, there has not been adequate research to assess directly the magnitude of mortality at sea nor 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 the costs and logistics of conducting pelagic research, as well as 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 appears to be numerous and conflicting opinions by recognized experts on the type and amount of research needed to address the problem of entanglement, the National Marine Mammal Laboratory proposes to host a workshop to guide future research to assess entanglement of northern fur seals.

Status: Requests for bids from qualified workshop organizers are in preparation. Contracts will be let by 1 October, 1987.

(2) Modeling and analysis of effects of entanglement on northern fur seals, $25K

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 need to reexamine 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 the quantity of data collected in the last several years, it is important that a comprehensive quantitative synthesis be conducted involving a reanalysis of the historic data in combination with the results of the most recent studies, surveys, and experiments. The objectives are 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: Requests for bids from qualified analysts are in preparation. This contract will be let prior to 1 October, 1987.

g. Channel Islands pinniped entanglement index, $5K

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: The procurement request has been forwarded and advertisement for the contract is forthcoming. Analysis of the data should commence by July, 1987 and be completed by Spring, 1988.

h. Analyses of sea turtle stomachs collected from strandings on the Atlantic coast, $20K

The consequences of entanglement, incidental catch, and ingestion of debris by sea turtles are 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 have been transferred to the NER to commence this task and determine the levels and types of plastic debris in loggerhead and leatherback turtles' stomachs and to develop baseline information on frequency of plastic

ingestion, materials ingested, and apparent damage. A final report should be available Spring, 1988.

i. Composition and weathering of derelict trawl web collected from Alaskan beaches: Analyses by FTIR, $21K

Previous work in this area indicates that weathered trawl web and other persistent plastics become brittle and loose strength over time due to weathering effects, oxidation, and ultraviolet exposure. 1986 results of fourier transform infrared spectrophotometric (FTIR) analyses of derelict trawl fragments collected in Alaska indicate 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 has begun. Samples of trawl web collected from fishing vessels of the region are to be 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 will be submitted by February 1, 1988, and a final report suitable for publication by June 30, 1988. Results are also anticipated to be prepared and submitted to a formal scientific journal for publication in late 1988.

j. Marine debris in upwelling and frontal zones in the Gulf of Mexico, $31K

A variety of sealife has been found to associate closely along 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 the aggregated debris on the aggregations of marine life. This task is 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 various marine life associated with these frontal zones.

Status: A scientific cruise aboard the NOAA Ship OREGON II will be conducted in the Gulf of Mexico this summer. Work is ongoing to augment certain NMFS field activities to maximize sample and data collection, thus utilizing some existing data and oceanic models. Cruise reports and a final task report should be available Spring 1988.

k. Assessment of floating plastic particulates, $21K

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 icthyoplankton 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 his 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: Funds have been transferred to the Auke Bay Lab for contracting this task. The period of performance is outlined to last approximately one year.

l Completion of 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 will extend the project biotechnician's appointment and do a statistically adequate survey of the mortality caused by plastic and other problems in albatrosses at Midway. A diagnostician to conduct postmortem examinations on the island will also be funded.

Status: The cooperative agreement extension has been signed and program objectives for FY87 are on track.

m. Support for the Pacific Fisheries Conference on Marine Debris, $5.0K

The fishing industry associations in the U.S., Canada, Japan, Korea, Taiwan, USSR, and possibly PRC and Poland initiated this conference and NOAA provided these funds to assist in the production of the proceedings.

Status: The Conference is scheduled for October 12-16, 1987 in Kona, Hawaii, and will include sessions on law, technology, industry policy and government programs.

4. PROGRAM MANAGEMENT

Program management, $80K

Successful planning and execution of the fiscal year 1985 and 1986 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 has successfully 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 acts 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 continues to be provided to the U.S. delegation to the International Maritime Organization regarding the implementation of MARPOL Annex V. The planning cycle for the FY 88 program was put in motion in April. The next meeting of the Ad Hoc Committee on Entanglement took place on June 30 - July 1, 1987.