MFR PAPER 1100

Increased utilization of latent and underutilized fish stocks—these are the objectives of the . . .

New England Fisheries Development Program

WARREN F. RATHJEN

INTRODUCTION

Solutions to the basic problems confronting the New England fishing industry are being addressed, but actions to secure control over resources off the U.S. coast and correct other root problems plaguing the area will not take effect immediately. In the interim, the National Oceanic and Atmospheric Administration (NOAA), in partnership with the fishing industry, is responding to this challenge through appropriate short-term approaches to increase the availability of latent or underutilized fish stocks which will help alleviate the existing resource crises and aid industry in reversing the decline evidenced in most New England fisheries. The principal departure from traditional approaches is that the program will utilize the direct input of industry in concert with the resources of NOAA's National Marine Fisheries Service (NMFS) and Sea Grant and of other entities in accomplishing mutually agreed on objectives.

The plight of the New England fishing industry is well known. The accelerated international exploitation of fishery resources off the New England coast, however, has contributed to problems which have grown numerous and at times seemingly intractable, particularly during the last decade. Industry in New England has felt the full effect of these problems and the resource crises whose aftermath will affect this industry for some time to come. The impact of the influx of fishing fleets from 20 countries onto grounds traditionally fished by the United States may be best measured in the drastic decline in the catch of food fish by New England fishermen. The quantity of fish landed in 1970 and 1971 dropped 46 percent from the 1962 and 1963 landing figures.

Efforts (bilateral and ICNAF—International Commission for Northeast Atlantic Fisheries) to control high seas fishing in areas of interest to U.S. fishermen have been of limited success in that most stocks of principal U.S. interest continue to be depressed or declining. The Law of the Sea Conference deliberations hold some eventual promise for coastal state preference, but agreements appear several years off.

Certain segments of this industry cannot continue without improvement in resource availability. NMFS believes the most effective interim effort to offset the economic decline of the New England fishing industry lies in fuller use of fish presently harvested (incidental catch) and diversification of fishing effort to harvest stocks not now fished to potential.

Resources such as squid (two species) with an estimated potential annual harvest in excess of 100 million

Figure 1.—Typical catch of "mixed" species taken off southern New England. Quite often 20-30 percent of trawl catch is discarded owing to the small size of the fish or the lack of a traditional market. Changes in handling and processing technology could reduce this waste to a neglible figure.

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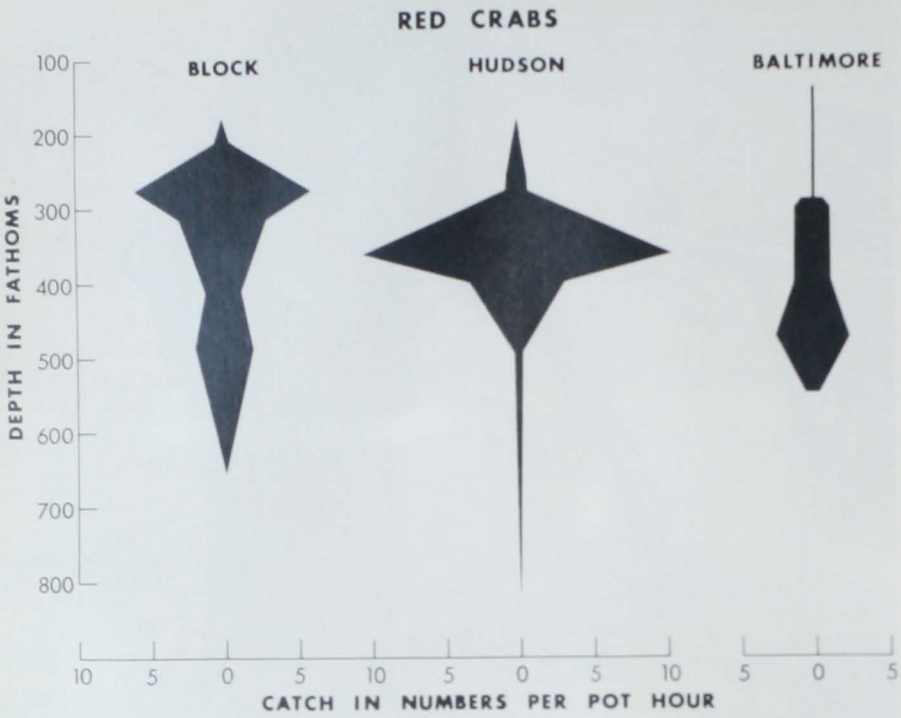

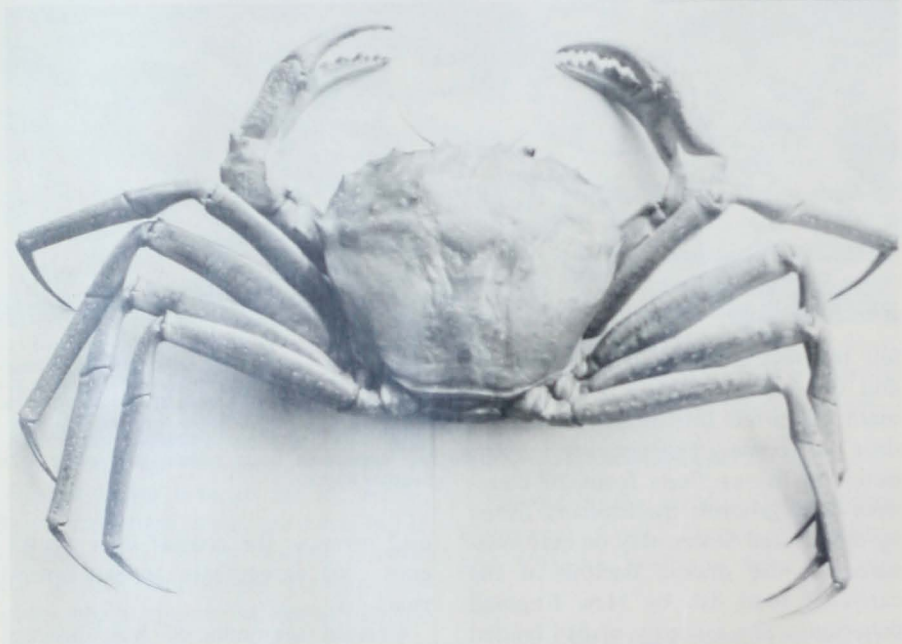

Figure 2.—The red crab (top) with a graph showing experimental catch rates at three locations off the coast of the northeastern United States. Red crabs sometimes reach a weight of more than 2 pounds. Most of the catch probably average 1.5 pounds. The crab depicted has a carapace width of more than 6 inches.

pounds, ocean quahogs with a potential of at least 100 million pounds, and red and Jonah crabs with a possible catch in excess of 10 million pounds, offer significant opportunity for increased landings. Besides these, various other kinds of fish such as dogfish, grenadier, saury, sea robins, etc. offer additional opportunities. Full utilization of fish presently caught, but not landed because of low value or little market acceptance, could add significantly to vessel and fishermen earnings. A quantity approximately equal to 50 to 75 million pounds, 20 to 30 percent of present trawl landings, is now thrown overboard. Discarded species often include: small silver hake, red hake, small butterfish and flounders, ocean pout, dogfish, and quantities of other species (Fig. 1).

NOAA has responded to this challenge by implementation of a comprehensive joint government/industry effort to increase the utilization of latent and underutilized New England fish stocks.

OBJECTIVE

To develop at least a $3 million per year industry, in sales of processed products, within 3 years, for the three targets—squid, crabs, and discarded fish—through development and demonstration of the technical and economic feasibility of harvesting, processing, and marketing. It is anticipated that industries for these products collectively will further expand to the $10 million per year level by the end of 5 years. Part of the project benefit will be derived through the transfer of excess effort from overfished stocks to the resources indicated.

PROGRAM APPROACH

This cooperative industry/NOAA effort, resulting from several months of joint planning, represents a multidisciplinary approach which will draw upon the resources of NMFS and the industry.

A working group has been formed, consisting of six key industry advisors, each representing significant geographic and operating segments of the industry. Officials of the marine fisheries agencies of the States of Maine, Massachusetts, and Rhode Island also participate in a supplementary capacity.

A Program Manager has been appointed by NMFS to oversee projects and to supply the group with access to programs and expertise available within NMFS. Contact with other agencies (i.e., Sea Grant, National Science Foundation, States, and various universities) and individuals who might make effective contribution has also been established.

Through a series of group discussions and review of existing material, agreement was reached concerning problem definition and priorities for target species. In addition to NOAA/NMFS reprogrammed funds totaling $400,000 made available to the pro-

Figure 3.—An experimental 18-hour set of a modified Alaska style king crab pot captured more than 800 pounds of red crab. Typically large offshore style lobster pots catch about 40 pounds per 24 hours' fishing. The New England Fisheries Development Program is working with industry to develop more efficient pots.

gram, numerous ongoing NMFS activities have been identified as contributing to the project and are being coordinated with specific program objectives. Cooperating NMFS elements are the Northeast Utilization Research Center in Gloucester, Mass., the Northeast Fisheries Center—Woods Hole, Mass., and the Marketing, Surveillance, Statistical, Extension, and Administrative personnel of the NMFS Northeast Region. On occasion assistance from other NMFS units both within and outside the region is called on. Industry has also demonstrated a willingness to contribute to vessel time, use of equipment and facilities, and labor.

Each "underdeveloped" fish stock has a unique set of problems of varying magnitude, generally related to the economics of harvesting, processing, or marketing. The target species for 1973-1975, red and Jonah crabs, mixed species (incidental catch), and squids, were selected because it was believed they can be caught by New England vessels with minimum modification to gear, and the obstacles holding up development appear tractable within the minimum budget available.

Developmental efforts will be tailored to the needs of each species and include activities such as: reviews of existing data on resource availability and harvesting technology to establish availability and optimum catch rates; development of mass handling and sorting methods for vessels and shore plants; investigation of processing technology and product engineering problems as necessary to permit efficient preparation of traditional as well as new products; and marketing studies to determine acceptance of various product forms in domestic and export markets.

Red and Jonah Crabs

The red crab, *Geryon quinquedens*, (Fig. 2) ranges from southeastern Nova Scotia to Cuba. It is abundant on the continental slope off the Middle and North Atlantic states. The extent of the red crab resource was only realized in the 1950's when it was encountered by fishermen fishing for offshore lobster (*Homarus americanus*). At least two other species of red crab (*Geryon* sp.) occur in Atlantic waters, including some ranging to South America, Africa, and Europe.

The red crab has not been heavily exploited in the past owing to a lack of processing capability, relative resource inaccessibility (deep water), and a lack of established market.

Red crabs are generally found where the water temperature is between 38° and 42°F. South of New England, the crabs are found at depths of about 170 fathoms and the larger concentrations appear at depths of 250 to 500 fathoms. At some locations the crabs will be found at depths to 1,000 fathoms.

The red crab is commonly caught along with lobsters in deep-water lobster pots. Some crabs are caught by trawlers dragging for lobsters. Exploratory fishing with Alaskan-style crab traps has also met with good success (Fig. 3).

In the northwest Atlantic an experimental fishery for the red crab was conducted from Nova Scotia during 1970 and 1971. This effort was discontinued. In 1973 two pilot process-

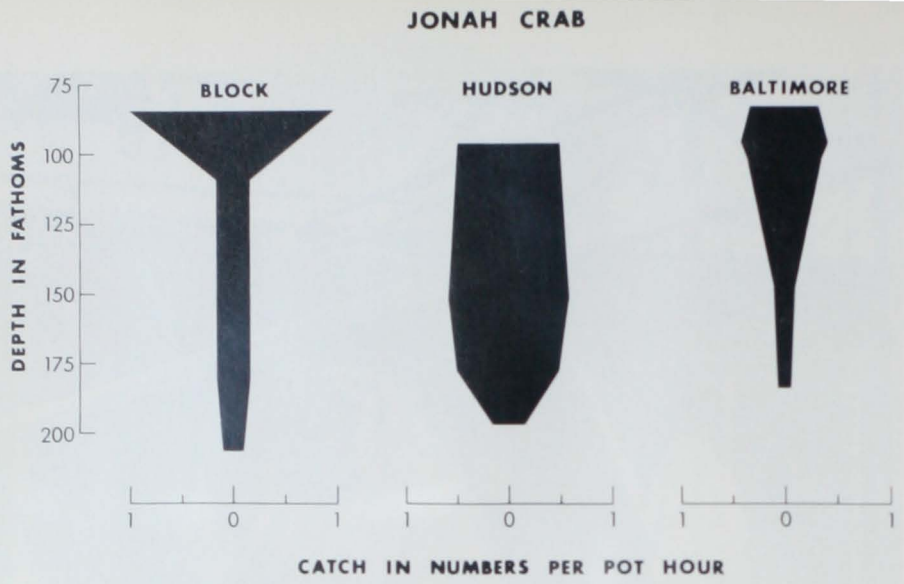

Figure 4.—The Jonah crab, sometimes reaching a weight of more than 1.5 pounds, is closely related to the Dungeness crab of the Pacific Northwest. This resource is broadly scattered over the continental shelf area off the eastern portion of the United States. The catch rates indicated are from experimental fishing by *Delaware II* near Block, Hudson, and Baltimore Canyons in 1971.

ing operations were undertaken in southern New England; a third was added during early 1974. These facilities received intermittent landings from a number of deep-water lobster fishing vessels.

There are many questions which must be answered in the development of this fishery. Possibly the most important is the extent of the resource and its ability to withstand heavy exploitation. It is probably reasonable to suggest a modest start with, say, 4-6 vessels producing a total of about 5 million pounds of live red crab. Careful monitoring should provide background for modification of this total as the resource condition and fishery dictate. Early experience also suggests that warm-weather mortality on vessels and ashore is a major problem. Other important considerations include the possible ability to transport live crabs over considerable distances by truck or other means. Some plans to address these critical areas have been developed.

The Jonah crab, *Cancer borealis*, ranges from Nova Scotia to the South Atlantic states but is probably most abundant off the New England and Middle Atlantic coasts. It has scarcely been exploited commercially, primarily because of a lack of processing capability, and lack of interest on the part of the fishermen.

Jonah crabs (Fig. 4) are found from low-tide level to depths over 100 fathoms with larger crabs being found at greater depths. They appear to be abundant between Georges Bank, Mass., and Cape Hatteras, N.C. Owing to the broad dispersion of the resource, some suggest that the Jonah crab resource is substantially greater than that for red crabs.

Jonah crabs are commonly caught along with lobsters in lobster pots, and the few individuals who fish exclusively for these crabs in New England often use modified lobster pots instead of crab pots. Some of these crabs are also taken by trawl gear when fished over the continental shelf. Recently lobster and trawl fishermen have been landing the larger Jonah crabs taken while fishing for other species.

Program Highlights—Red and Jonah Crabs

1. Working with industry (New Bedford, Mass.; Galilee, R.I.; Gloucester, Mass.) on vessel and shore handling techniques with particular reference to mortality.
2. Looking into modification of crab gear (traps) to optimize crab fishing techniques.
3. Working directly with industry to meet processing and production problems as they develop.
4. Establishing contract arrangements (State of Rhode Island) to acquire biological and related data on resource as it is extracted.
5. Working with the Northeast Fisheries Center (Woods Hole) to establish size and potential of resource.
6. Maintaining an overview of marketing picture.
7. Developing conceptual design for red crab meat extraction (picking) machine.

Long- and Short-finned Squids

Long-finned squid (Fig. 5) range from Nova Scotia to the Gulf of

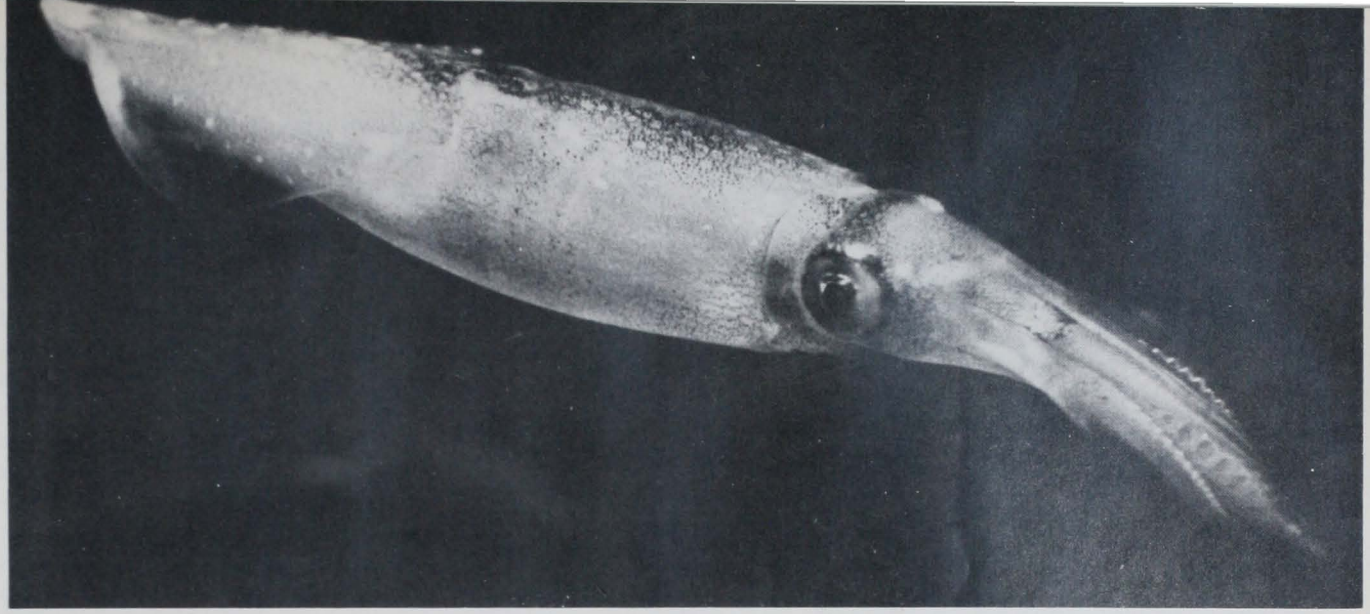

Figure 5.—The graceful long-finned squid in life is the object of a growing fishery off the eastern United States. Foreign trawlers take heavy tonnage of this species during the winter, when temperature conditions aggregate the squid near the edge of the continental shelf. The species is of interest for purposes other than food. Major contributions to neurophysiological knowledge have developed as a result of work on the giant nerve fibers of this species.

Mexico. They are essentially an animal of the continental shelf distributed inshore (in New England) from May to November and in deeper water for the remainder of the year.

Historically, U.S. fishermen have taken some squid as incidental catch while fishing for other species. Trap nets sometimes took large amounts for short periods in the spring and early summer when squid were abundant along the shore. Incidental quantities of squid have also been taken by vessels operating trawls between Cape Cod and Cape Hatteras. Since about 1968 a number of foreign nations have been harvesting squid along the edge of the continental shelf in the general vicinity of Hudson Canyon. Japan, Spain, Italy, and others have been taking substantial amounts of squid using trawl gear. During recent months, our own fishermen have been directing their efforts to squid as traditional fish species become less available and markets for squid begin appearing. Domestic East Coast production for the 4-year period 1970-1973 has doubled, from just over 1 million pounds to well over 2 million in 1973.

During January 1974 the New England Fisheries Development Program chartered a New Bedford trawler, the *Valkyrie*. About 24 days' fishing near Hudson Canyon produced over 168,000 pounds of squid. Some of this was prepared for sale overseas (in Europe) and some entered domestic markets.

The value of squid as food in this country has never been fully realized and it is considered an underharvested resource. The demand for squid will grow, however, as consumers become aware of this delicacy. Because squid are short-lived, there can be more intensive harvesting than in the case of long-lived or overfished species. Adequate consideration must be given to proper management of the resource, however, to avoid overfishing and to assure a continuing supply.

Squid is considered a gourmet or specialty item and has long been popular with Mediterranean, Oriental, and Mexican cooks. Squid has a delicate flavor and is delicious when fried or baked with a stuffing and may also be used in salads, sauces, or combination dishes. Whole squid is available fresh in some areas and frozen in most.

The short-finned squid are directly comparable to the long-finned squid discussed above. Principal differences have to do with the shape and size of the fins (which are shorter) and the color, which tends to be darker (rather rusty in hue) than that of the long-finned squid.

Short-finned squid are considered to be oceanic animals during a part of their (short) life history. In Newfoundland the inshore appearance of the short-finned squid can be expected in summer. Newfoundland fishermen traditionally took quantities of this species with squid jigs during this period. Also, in the Newfoundland area large quantities of this squid are consumed by blackfish (or "pilot whales"). Southwest of Newfoundland short-finned squid can be locally abundant as caught by trawls. This has been the case during May and June along the southern portion of Georges Bank and westerly along the continental shelf.

"Jigs" have been the most important traditional fishing gear for this species. Traps along the shore may occasionally take large quantities, but this is irregular. Recently (1973) trawl catches by Polish vessels off Southern New England have been substantial. Intermittent quantities are sometimes available during the summer in the general vicinity of Cape Ann. Little is known about the ability to catch these in quantity.

South of New England a rapidly developing fishery has been prosecuted primarily by the Spanish (see Fig. 6). Experimental fishing by the Japanese for this species has included the use of lights to attract and aggregate these animals (Fig. 7).

Similar observations which were made with respect to the long-finned squid probably apply for this species. Traditionally large quantities of the short-finned squid were caught and sold as longline bait (cod fish) in the Northwest Atlantic waters. Some has been used in more recent years by the Japanese as longline tuna bait. There is a strong suggestion that short-finned

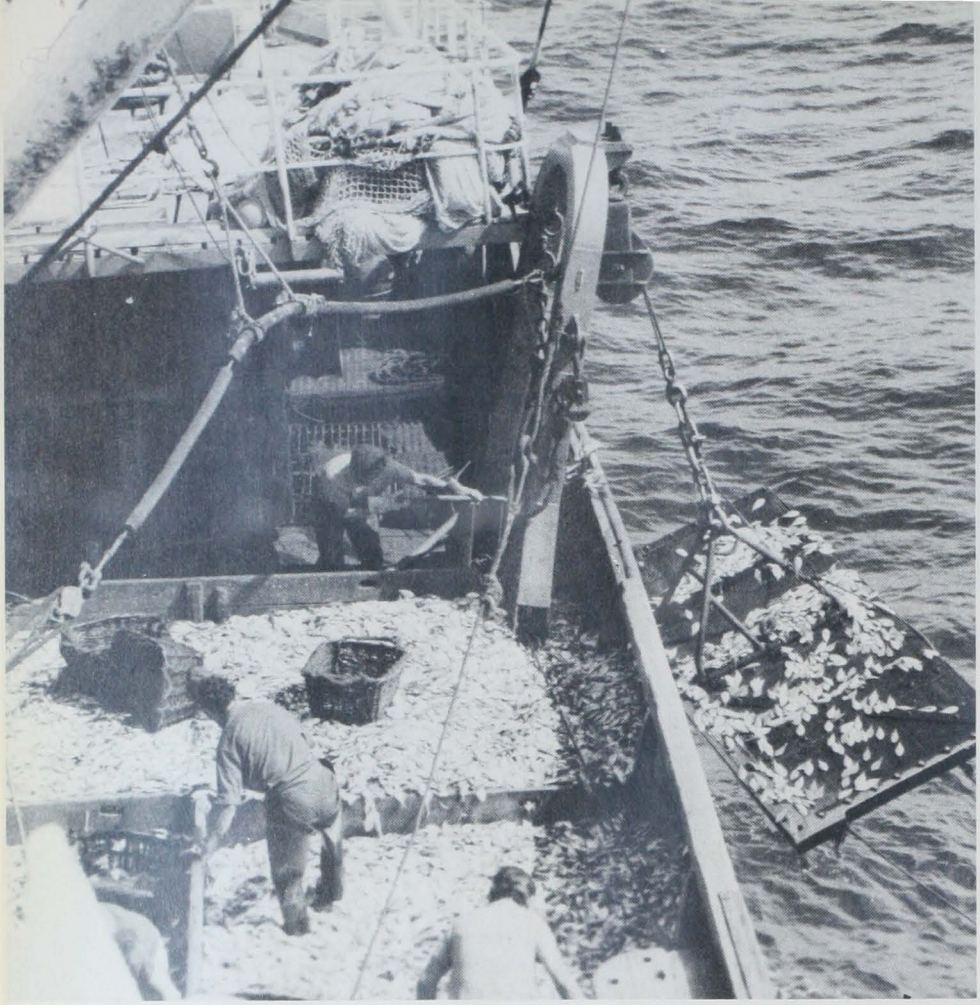

Figure 6.—About 8 tons of mixed squid and small butterfish on deck of a Spanish side trawler near Cape Hatteras in the fall of 1973. Spanish fishing efforts on long- and short-finned squid have dramatically increased in 1973 and 1974. There is some reason to expect even further developments in this acceleration of the squid harvest.

squid are as acceptable as the long-finned variety as food. Ultimately, this will have to be demonstrated in the market place.

At present there is speculation regarding the possibility of developing a U.S. fishery for squid. There is only little U.S. experience in the Northwest Atlantic waters from which judgments can be made. The Japanese and others have an established fishery for squid in the North Atlantic and full evaluation will be made of the experience developed in this fishery with application to our needs. With a carefully planned experiment it may be possible to determine the feasibility of a seasonal inshore fishery directed primarily for squid. Quantification (vessel involvement, employment, export trade) cannot be realistically done at this time.

Program Highlights—Squid

Long-finned

1. Fishing demonstration studies conducted in cooperation with industry (New Bedford).
2. In conjunction with 1 (above), conducting experiments on holding of squid in ice and frozen form (shelf life).
3. Working with gear technologists at the University of Rhode Island in development of improved squid fishing gear.
4. Looking into foreign and domestic market opportunities. Some cooperative effort with industry in product form development.
5. Looking into potential for improved harvesting technology; i.e., light attraction.
6. Refining estimates of stock potential—Northeast Fisheries Center (Woods Hole).

Short-finned

1. Planning demonstration fishing.
2. With studies on long-finned variety, will examine potential for light attraction in southern New England.
3. Looking into foreign and domestic market potentials.

Mixed Species

Wherever trawl operations are conducted along the continental shelf throughout the New England area a substantial portion of the catch is discarded. At some ports those fish normally discarded are taken ashore for use as industrial fish. At other locations fish not accepted in the market as food are taken for use in pet food. More recently, consideration is being given to the use of certain species as food for zoos and aquariums.

As a result of the adoption of techniques used in the meat packing industry, it has become possible to inexpensively separate fish flesh from the skeletal parts of dressed fish. This process opens the potential for extensive use of a great variety of species now discarded.

Controlled studies are needed to determine the best approach for handling at sea bulk catches of fish, some of which may be utilized in the preparation of minced fish blocks. In 1974 a vessel was adapted to conduct pilot operations with a suitable system. Research will also be necessary to develop an automated processing line capable of heading and gutting large quantities of small irregular sized fish.

If bulk handling at sea and automated processing of these mixed species becomes practical, it appears quite certain that a large portion of the catch heretofore discarded or sold as industrial fish may be available as food fish, thereby raising its value up to five times (over the price of industrial fish).

The potential benefits (income) to a large percentage of our trawler fleet could increase dramatically, if the research outlined can be accomplished.

A world shortage of supplies of traditional blocks (i.e., cod) used in processed fish has caused a rapid rise in price and substitution of other species (Alaska pollock and silver hake). In the past year a large percentage of the fish blocks utilized have been manufactured from minced fish. A fer-

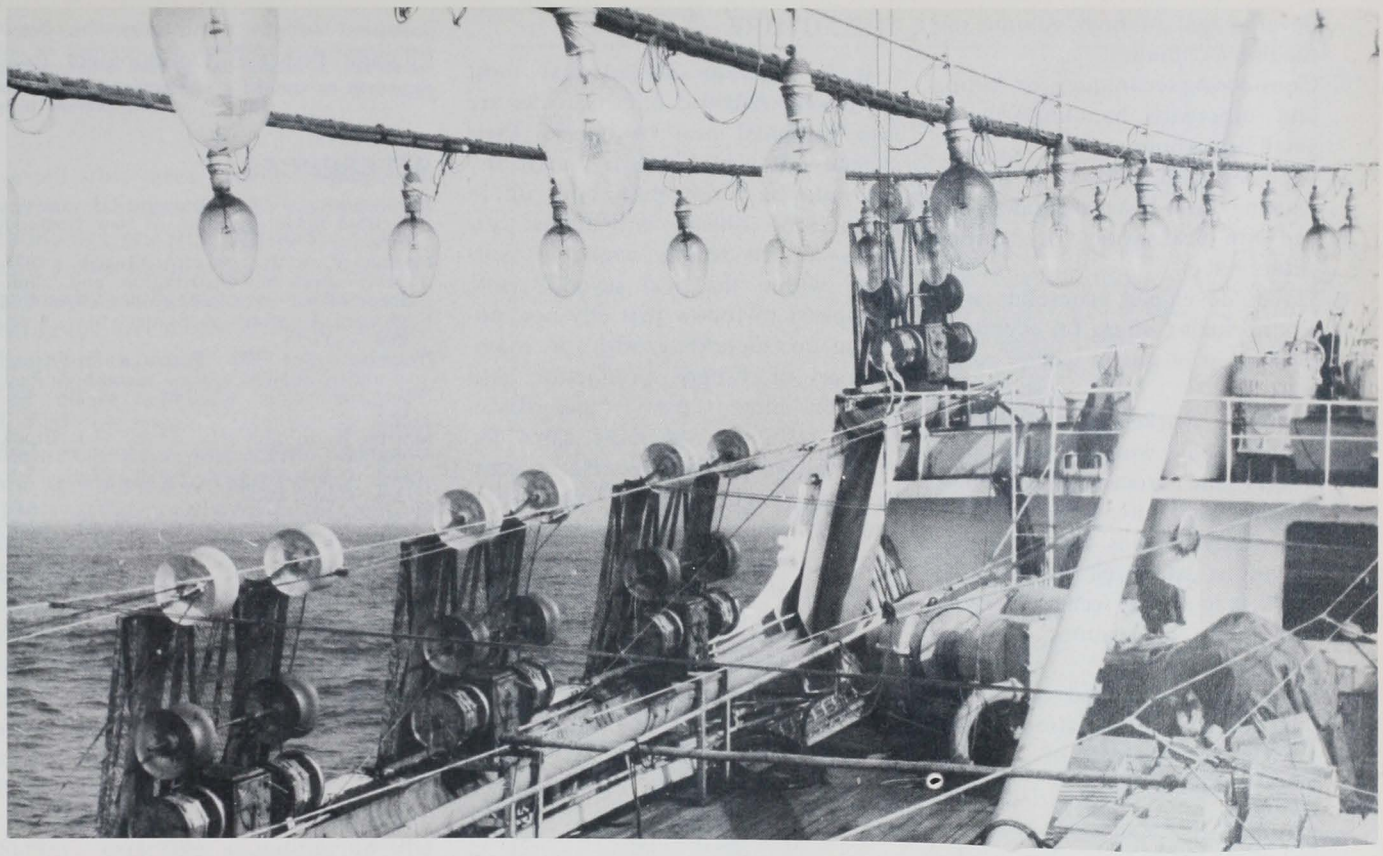

Figure 7.—On board an experimental Japanese squid fishing vessel south of Nantucket Island in the fall of 1973. This method utilizes lights to attract and aggregate the squid at night, after which they are harvested with automatic jigging devices, shown here mounted on the rail. The same basic approach was scheduled for experiment in inshore application during 1974.

tile climate exists for introduction of other species (Fig. 8), possibly even mixtures of species if certain technical problems can be worked out.

Program Highlights—Mixed Species

Mixed species include: red, silver, white hakes; ocean pout; small flounders, butterfish and other species; dogfish; and others.

1. Cataloging and estimating resource stock size and availability in progress. (Gloucester—Woods Hole).
2. Conducting feasibility experiments on techniques for bulk handling of fish at sea. Evaluating tests. (Pt. Judith—Gloucester).
3. Looking into modification and

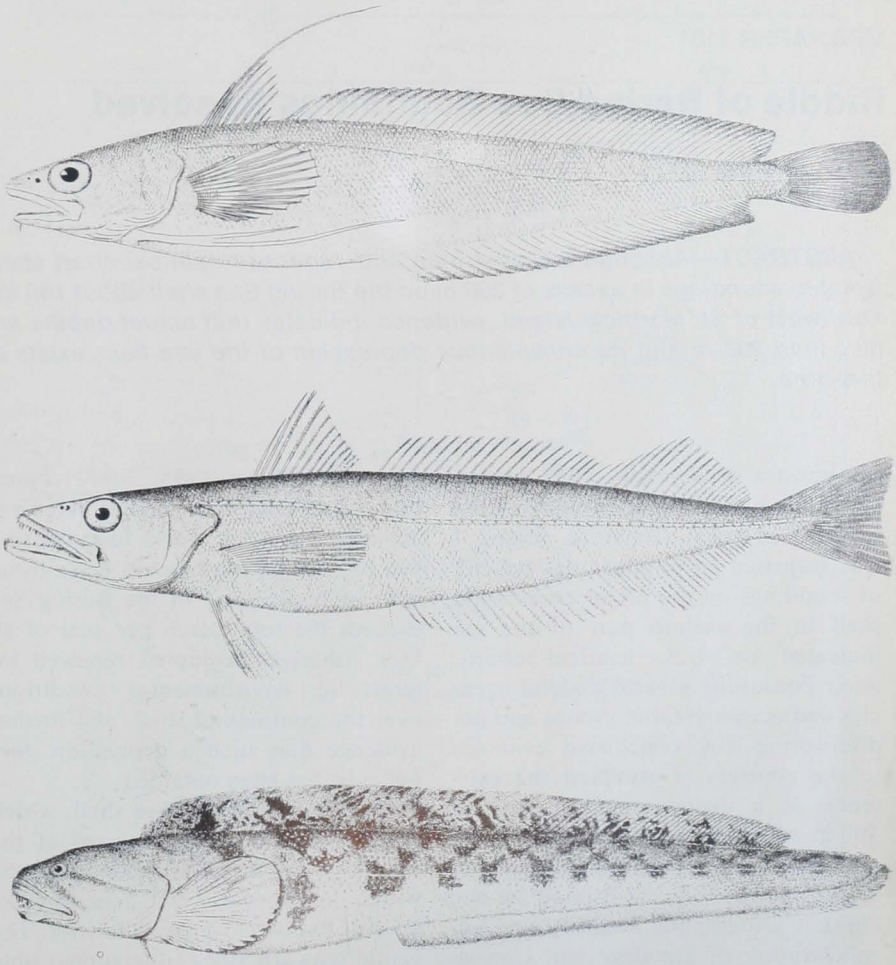

Figure 8.—(Top to bottom) Red hake (*Urophycis chuss*), silver hake (*Merluccius bilinearis*), and ocean pout (*Macrozoarces americanus*) all have some potential for exploitation under the mixed species heading. Initial experiments with minced flesh from silver hake have yielded a number of attractive products.

development of high volume unloading techniques.

4. Considering techniques for sorting and otherwise handling diverse small fish ashore.
5. Working with industry to modify existing flesh-bone separators for use with local species: i.e., whiting (silver hake).
6. Have developed contract with Connecticut College for economic evaluation of mixed species parameters.
7. Through marketing and liaison channels have worked to alert producers and processors of plans, progress, and potentials.
8. Have active plans for marketing survey to determine the potential markets in animal feeding (zoological parks, aquariums, seaquariums, and related).
9. Pilot studies initiated on use of containers for preservation of fish.
10. Looking at methods of skinning dogfish shark.

THE FUTURE

It is generally agreed that most Northwest Atlantic finfish stocks are now exploited near or beyond their capacity. It would appear that if any are not, the momentum built up in the present fisheries will almost certainly absorb readily available "surplus" within the next several years. It appears to follow that any new potential to support growth or maintenance of fishery production will probably come from "underdeveloped" resources. In most cases the exploitation of these requires a comparatively high input of risk, fishing and processing technology, and marketing. These must be blended into a coordinated effort; it is this approach in spirit which dominates the New England Fisheries Development Program.

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Riddle of Bering Sea Soundings Resolved

FELIX FAVORITE

ABSTRACT—Although a Soviet map and Japanese nautical chart show isolated soundings in excess of 300 m on the Bering Sea shelf about 160 km northwest of St. Matthew Island, evidence indicates that actual depths are less than 200 m and no conspicuous depression of the sea floor exists in that area.

Almost a decade ago, when writing an article on the oceanography of the Bering Sea basin (Favorite, 1966), I was surprised to discover the paucity of soundings on the broad continental shelf in the eastern part of the sea indicated on U.S. nautical charts. After consulting several Federal agencies and oceanographic groups and not discovering any conclusive evidence to the contrary, I accepted the existence of a depression in excess of 300 m northwest of St. Matthew Island as shown on one panel of a large map of the USSR (Fig. 1) printed by the Omsk Cartographic Plant, Main Administration of Geodesy and Cartography, (27 June, 1955, 3,000 copies) that I had acquired. Recent extensive exploitation of fish stocks in the Bering Sea by foreign mothership fleets (total fish catch per year in the Bering Sea exceeds the total catch per year of all U.S. fisheries) prompted renewed interest in environmental conditions over the continental shelf, and further evidence that such a depression does not exist has been obtained.

The eastern Bering Sea shelf, which extends over 600 km seaward of the west coast of Alaska, is not only the widest in the world but generally devoid of bathymetric irregularities. The gentle seaward slope, interrupted only by several isolated island groups, is so slight that if sea level were reduced and man were able to walk on the shelf, the terrain would appear flat in all directions. Ice cover during winter lowers water temperatures to nearly $-2°C$. In spring, extensive runoff from coastal rivers and increased insolation increases the stability of the surface layer and retards the penetration of summer heating into the water column, resulting in an annual range of temperatures at depths greater than 75 m of only a few degrees. In the area between St. Matthew and St. Lawrence Islands, negative temperatures can occur year round; thus, evidence of a depression of the sea floor in excess of 300 m as shown in the Soviet map implied the existence of not only an unusual bathymetric feature, but also an area of year-round temperatures near the ice point ($-2°C$), a rather unique, isolated, benthic environment.

For nearly 200 years man has tra-

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