FROM CAPE HATTERAS TO CABOT STRAIT

THE HISTORY OF THE SOVIET FISHERY ON THE ATLANTIC CONTINENTAL SHELF OF THE UNITED STATES AND CANADA

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National Marine Fisheries Service

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A Soviet fishing vessel off the shore
of North America. Photograph provided by the author.

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PREFACE

For those of us interested in history, an opportunity to see an important world event or era in human or national endeavor recorded for future reading, reference, and posterity is welcomed with excitement. It is all the more gratifying to actually participate in the process of capturing into print an episode of recent history, particularly when that event encompassed part of one's professional career. This was clearly the case for the author of this book, Dr. Yury Chuksin, whose recollections and writings in the subsequent several hundred pages involved him personally. Although not specifically mentioned in the text, Chuksin, a marine scientist, participated in many of the scientific, exploratory, and scouting activities that supported the distant water fleet fishery of the Union of Soviet Socialist Republics (U.S.S.R.) in the waters of the Northwest Atlantic off the east coast of the United States from 1961 to 1977 described in this book.

Yury Vladimirovich Chuksin was born on 22 April 1933 in Smolensk, a town in the center of Russia. In 1956, he received the diploma of engineer of oceanology, the first of four academic diplomas he earned, and began work in Kaliningrad, Russia, in "Baltrybtrest" (Baltic Fishery Trust) as an engineer-hydrologist. Two years later, he began working for "Zaprybpromrazvedka" (Western Basin Fish Scouting Service) and during 1971–79 served as Deputy Chief of the "Zaprybpromrazvedka" fishing industry board for the Northeast Atlantic area. During this time, he participated in numerous scientific expeditions to various parts of the Atlantic Ocean investigating commercial fishing areas. In 1971, Chuksin received a Doctorate in Biology from Moscow State University. From 1979 to 1982, he headed a group of Soviet specialists providing technical assistance to the Cuban Fishery Research Center. In 1982, Chuksin was employed in the Department of International Cooperation at the Atlantic Research Institute of Marine Fisheries and Oceanography (Atlant-NIRO) in Kaliningrad, and served as the Department's Chief from 1991 until his retirement in August 2004. His research dealt with the utilization, conservation, and management of living marine resources, the conduct of scientific investigations under the Law of the Sea, and international fisheries policy and activities. His published scientific papers numbered over 100 and were used widely by the Soviet fishing industry.

As a young fisheries stock assessment scientist at the Woods Hole (Massachusetts) Laboratory of the National Marine Fisheries Service (NMFS), I too played a role, albeit rather small, in the story that unfolds in this book. Arriving late in 1970 and a year out of graduate school, I joined the Laboratory staff that was about 4 years into the Soviet-American scientific cooperation described in Part IV of this book. My first interaction with Soviet scientists and sailors was in August 1971 when the *Blesk* arrived from Kaliningrad to participate in the joint bottom trawl survey with the *Albatross IV*. Two years later in the fall of 1973, I was part of a group of U.S. scientists assigned to the *Belorgorsk* during that year's survey.

As mentioned by Chuksin in this book, the annual excursions by the Soviet research vessels to Woods Hole were always received with excitement and curiosity by both the Laboratory staff and the residents of Falmouth and Cape Cod. Then and throughout the 1970s until the joint program concluded in 1981, long-term friendships were established and renewed each year.

During research cruises aboard both foreign and domestic vessels during the 1970s, I witnessed firsthand the vast armadas of distant water fleet fishing vessels, many of them Soviet, operating on Georges Bank and in adjacent areas. At night, we could count scores of vessels on the radar screen and also see the glow of their lights around us. It was indeed a very busy place, as the author frequently attested to in this book.

My other encounters with Soviet scientists during this era occurred at meetings of the International Commission for the Northwest Atlantic Fisheries (ICNAF). In spite of our adversarial positions on the status of most fish stocks and recommended total allowable catch levels, close friendships developed and have been maintained to this day.

In August 1995, I had the pleasure of being one of the first U.S. fisheries scientists to ever travel to AtlantNIRO. During the Cold War, Kaliningrad was a "closed city" because of its many military facilities. Together with colleagues Dr. John Everett, Milan Kravanja, and Jack Green, we discussed with our Russian counterparts possible data rescue projects that might be supported by funds garnered by Everett from the Environmental Services Data and Information Management (ESDIM) program administrated by the National Oceanic and Atmospheric Administration's (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS). Agreements were concluded during that trip to fund two projects. As manager of the ESDIM data rescue projects conducted by AtlantNIRO, I was able to fund a total of seven projects between 1995 and 2000. One idea for a project, conceived by Everett during the 1995 trip, was a history of the Soviet fishery in the Northwest Atlantic. This came to fruition during a second trip to AtlantNIRO in November 1997 when I was accompanied by Dr. Robert Edwards, retired former Director of the NMFS Northeast Fisheries Science Center in Woods Hole and chief architect in the 1960s of the joint Soviet-American research program in the Northwest Atlantic, and by Jack Green. The trip, the first by Edwards to Kaliningrad, resulted in a formal agreement in which the Russians would prepare a history of the former Soviet fishery from 1961 to 1977. The plan was for a book, written in "best-seller" format, which would recount all aspects of the fishery from its initial planning stages through its various phases until its termination following extension to 200 miles of the U.S. Exclusive Economic Zone in 1977. Always curious how the Soviet fishery had been organized, managed, and conducted politically, economically, and scientifically, we were anxious to see what an "insider" would write, hoping to gain fresh insight into Soviet thinking, strategy, and philosophy relative to their distant water fishing operations.

Indeed, this book meets our expectations and provides a comprehensive accounting of the impressive, but relatively short-lived (17 years) phenomenon of the world's largest distant water fishery. Considerable historical information, data, and photographs are presented chronicling the development and eventual demise of that fishery. There are some rather interesting revelations regarding both the strengths as well as the weaknesses of this massive food-producing effort by a socialist country.

Dr. Chuksin undertook a 5-year effort to assemble and write this history in the Russian language and then have it translated into English. In the Foreword, he acknowledged his various colleagues who assisted in the project. In addition to them, I wish to express thanks to Robert Edwards for his willingness to serve as a consultant on this project and for his numerous constructive comments on the organization and content of the text. David Stanton of the NMFS Scientific Publications Office in Seattle and I worked jointly for the past several years on the final editing of this book. His contributions in this regard, and in all the other aspects of the publication process, have been enormous and greatly appreciated. During the editing process, Dr. Chuksin was very patient in answering my many e-mail messages seeking clarification on the meaning of particular words and phrases.

Regrettably, Dr. Chuksin did not live to see his book published in the U.S. He died unexpectedly in early July 2005 and was buried in Zelenogradsk, a small town north of Kaliningrad on the shore of the Baltic Sea where he had lived in recent years.

Lastly, I wish to acknowledge the kind assistance of several individuals who helped provide newspaper articles from the *Cape Cod Standard Times* in the 1970s to verify the precise wording of various passages from those articles that are cited in the text of this book: Jill Erickson, Head of Reference and Adult Services, Falmouth Public Library, Falmouth, MA; Brenda Figuerido, NMFS Northeast Fisheries Science Center, Woods Hole, MA; and William Mills, Editorial Page Editor, *Cape Cod Times*, Hyannis, MA. In addition, Pat Rothenberg, Reference Librarian, Atlantic City Free Public Library, Atlantic City, NJ, assisted in providing several May 1960 newspaper articles from the *Atlantic City Press* cited in part in the book.

Emory D. Anderson
Marstons Mills, MA
August 2005

FOREWORD

The expeditionary oceanic fishery conducted by the former Union of Soviet Socialist Republics (U.S.S.R) has left an indelible mark on the history of the development of the world's ocean by mankind.

The development of the industrial fishery and of the commercial fleet as its basic constituent achieved an unprecedented scope. The range of the search for and exploitation of living marine resources boggles the imagination. The geography of the fishery encompassed every one of the most prolific fishing areas in the ocean.

For decades, regulative mechanisms were being improved in order to keep the complicated economics of the sea and the oceanic fishery running and properly managed. Future generations can profit from the huge amount of experience accumulated over these years.

The exploitation of the living marine resources in the eastern United States and Canadian coastal waters from Cape Hatteras to Cabot Strait represents an impressive page in the history of the Soviet fishery. This page is illustrative of the first scientific and scouting expeditions of the nearly 20-year-long trajectory of the fishery and of its dramatic finale. The history of the events inherent in these years is of non-transient interest from different viewpoints. Efficiently arranged, the state-run fishery was prosecuted by large groups of vessels of various types and extended over the entire ocean. All resources of abundant fish species were drawn into the range of the activities of these vessels. This unusual and extraordinary fishery has resulted in the collection of comprehensive information on the potential of regional resources, the production of the fishery by ships of medium and large tonnage, the distribution pattern of the resources, and so on.

The purpose of this book is to recreate the picture of this remarkable fishery that was the product of a planned economy.

This book is one of the products of a collaboration between the Russian Government's Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO) in Kaliningrad and the U.S. Government's National Marine Fisheries Service (NMFS). The foundation for this work was laid in 1995. AtlantNIRO has completed a series of projects funded by NMFS for the purpose of creating mutually beneficial scientific databases (e.g., mesozooplankton, Soviet fishery catches, microzooplankton, ichthyoplankton, phytoplankton, fish parasites, oceanographic observations). Compiling and publishing the history of the Soviet fishery in U.S. and Canadian waters of the Northwest Atlantic was one of those projects.

Aside from writing, a book is not easily put together. It takes much effort on the part of many people. The author is grateful to NMFS and AtlantNIRO, whose cooperation made the publication of this book possible.

The author particularly appreciates the helpfulness of Dr. Emory D. Anderson and Dr. Robert L. Edwards, whose ideas and encouragement contributed to the success of this project.

The author is indebted to all who have assisted in the implementation of the project: the AtlantNIRO scientists Dr. Yury A. Vyalov and Dr. Vladimir A. Rikhter for valuable advice, Valentina N. Novikova for translation of this book from Russian into English, Loudmila E. Sazonchik and Valery I. Gorchakov for design work, and Boris Kuleshov for kindly submitted photos.

INTRODUCTION

A quarter century has elapsed since the echoes of the 17-year-long epic of the Soviet fishery on the U.S. and Canadian shelf from Cape Hatteras to Cabot Strait have died away. This span of time, now belonging to history, was full of dramatic events: the labor exploits manifested by Soviet fishermen in the course of harvesting the living marine resources, the conflicts with local fishermen, the struggle of the coastal states for control of the fishery and restrictions on other nations, and the cooperation in the field of marine research. The role these long-past events have played in the changes that have taken place in the legal regime of world ocean utilization is difficult to overestimate.

The years that flew past, the still-growing time gap since then, and many accumulated changes all make for a better understanding of what happened, and reverberations of the past can still be heard today.

Creation of the scientific and technical base, as well as the industrial base, which enabled a breakthrough to the fishery resources of the world's oceans, was one of the most impressive accomplishments of the former Union of Soviet Socialist Republics.

Before its disintegration in 1991, the Union of Soviet Socialist Republics, alias the U.S.S.R., alias the Soviet Union, was the first socialist multinational state, with 15 Union Republics combined into one.

Councils of People's Deputies, with the Supreme Soviet of two chambers as the higher State power, were the political basis in the U.S.S.R. Socialist ownership of the means of production, State ownership being the principal form, was the basis of the economic system.

The Council of Ministers of the U.S.S.R. Government was the higher executive and administrative body of State power. The Council of Ministers, formed by the Supreme Soviet, coordinated and directed the activity of All-Union and Republic Ministries. The U.S.S.R.'s economics represented a uniformly complex national economy that encompassed all links of production, distribution, and exchange everywhere in the U.S.S.R.'s domain. Economic management was executed based on State plans of national economic development that took account of the branch and territorial principles.

Gosplan, the State planning committee of the Council of Ministers of the U.S.S.R., accomplished general State planning of national economic development in the country, and exercised control over fulfillment of national economic plans. Similar structures of State power existed in each of the 15 Union Republics. All the processes that took place in the life of the Soviet State were directed by the Communist Party of the Soviet Union.

The program aimed at organizing the oceanic fishery began implementation in the late 1940s. The plans were notable for their grandeur. The fishing industry was in for a noble task—replenish the food balance for the population of the immense country at the lowest possible labor and capital costs. The goals were clear-cut: conduct the expeditionary fish-

ery in all parts of the world's oceans; freeze fish on board ships; deliver fishery products to home ports; and create the shore bases. The structure of the fleet under construction was in line with the above-mentioned goals: "weatherproof" fishing ships of medium and large tonnage, motherships, receiving transport refrigerator ships, tankers, rescue ships, etc.

Information on the potential of the ocean resources was scanty. A search for sources of fish supplies lay before us, but the plans and hopes for success of the enterprise had been first and foremost associated with freedom of the seas. That era was still in progress. The open sea was common property, and fishermen all over the world could fish everywhere beyond the narrow "belts" which fell under jurisdiction of coastal states. Also, the access to extensive, barely explored shelves where great discoveries had been awaiting the pioneers was still free.

Extensive fish-searching activities undertaken in the 1950s and 1960s resulted in discovery and exploitation of large, often virgin, resources of Clupeidae, Scombridae, Carangidae, Gadidae, flounder, redfish, and many other fish species. It appeared that small pelagic schooling species (herring, sardine, mackerel, horse mackerel, etc.) ranking among the fish of lower marketable value accounted for a considerable part of the potential for the fishery. However, being a valuable source of fish protein, they became the basic component of the fish stocks sought after by the Soviet expeditionary fleet. That was how a choice in favor of this resource niche in the Atlantic Ocean was made. High abundance and extended distribution of these schooling fish species enabled the allocation of a large fishing fleet and firmly keeping the catches at a high level. The competition for utilization of many of these stocks was mild, and besides, the fish sizes perfectly matched the capabilities of the freezing plants on the Soviet ships.

At the First U.N. Conference on the Law of the Sea held in 1958 in Geneva, the principle of freedom of the high seas and the ensuing principle of freedom of fishing were consolidated by way of adopting the Convention. This act became another argument in favor of developing the expeditionary fishery. In the 1960s, the U.S.S.R. attained indisputable leadership in this sphere of activity, having left Japan, Spain, and the other countries behind.

It was in 1961 when the first Soviet vessels made their appearance on Georges Bank. In a short time, the Soviet fleet there numbered more than 100 ships, including 20 large freezer trawlers (the BMRTs [the letters in Soviet ship acronyms are kept identical to the Russian spelling]). They followed in the footsteps of the British stern freezer trawler *Fairtry* which had opened a new era of high-tech large trawlers and fished the Grand Banks, off Newfoundland, in 1954. In those years, no one could have anticipated that the appearance and active operation of these ships would play a decisive role in the introduction of 200-mile fisheries zones by the U.S. and Canada, which would de facto put an end to the era of freedom of the high seas. The historical course of an uninhibited fishery lasted another few years. That time was swollen with changes. The world fishery was developing impetuously. Many fish stocks were overexploited. The reduction of the fish stocks was becoming

evident. Accusations of preferential use of the principle of freedom of fishing were brought against the nations engaged in the expeditionary fishery.

The Third U.N. Conference on the Law of the Sea, convened in 1973, had been fated to alter the legal regime for the world's ocean most radically. Heated arguments flared up in the course of the Conference. A number of participating states, the former U.S.S.R. and the other socialist countries among them, spoke in favor of keeping the principle of freedom of high seas intact, but they failed. After negotiations lasting almost 10 years, a new U.N. Convention on the Law of the Sea was adopted in 1982, according to which the coastal states were conceded the sovereign rights of management of the fish resources in their 200-mile exclusive economic zones. But the U.S. and Canada had long anticipated the resolutions of the Third Conference; it had been already 6 years by then that their continental shelves were washed by the 200-mile-zone waters.

This brief excursus gives an idea of the events that concurred with the beginning and end of the Soviet fishery in the area under consideration. All but two decades fitted between these milestones. Year after year, large groups of fishing vessels from the U.S.S.R. ploughed the local waters to harvest hundreds of thousands of tons of fish. The intention of this book is to show what that period had been like.

The waters off the U.S. and Canadian east coasts were just one of many areas that experienced the pressure of the Soviet expeditionary fishery of unequalled scale. Elucidation of the events that occurred there, in that one separate area, would be incomplete if not viewed from four aspects: a historical scenario of the building up of the Soviet fishery phenomenon, the adaptation of this gigantic mechanism to the world's oceans, the development of the fleet management system, and the maneuvering of the fleets in the vastitude of the ocean. That is why we considered it expedient to examine these aspects in this book.

The Soviet fishery in the area under review was comprehensive. The fishermen extracted and dominated biological resources all over the high seas area. Over the entire period, groups of vessels of various type and class were engaged in fishing the areas with the wherewithal that yielded catches large enough to meet the requirements of the State plans. Unwittingly, the pattern of fishing operations followed by the vessels in those days calls forth an association with a non-stop survey: commercial monitoring of the living marine resources within a large area. The fishermen kept in close contact with land, informing the persons concerned on the scope of work done by means of their radio reports and accounts of the fleet structures. Later, some materials from this so-called "survey" were incorporated into the papers drawn up by the fishery economists; the catch and the fishing effort statistics were used in publications of the International Commission for the Northwest Atlantic Fisheries (ICNAF), and the data on the distribution of the fishery—in annual atlases.

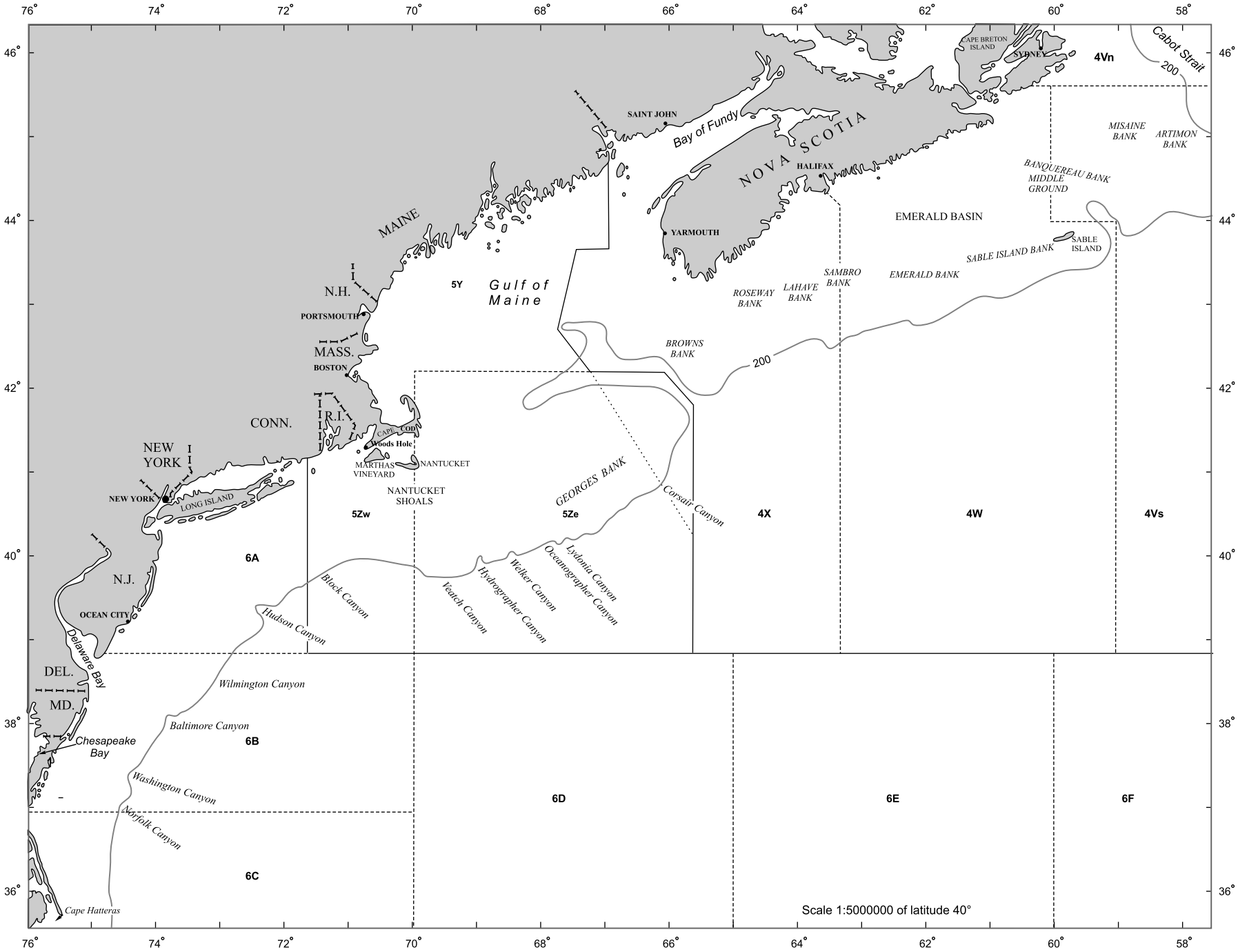
These publications and data made it possible to study the production activities of the fishing vessels, the peculiarities of exploiting the biological resources, the intrayear chang-

es in the distribution of the fishery, and the fishing effort. These items are detailed in the appropriate parts of this book.

It should be noted that, unfortunately, the data on the fishery presented in various parts of this book may differ. This can be attributed to the fact that the information from different fishing areas was processed in various institutions. In the 1960s–70s, when the expeditionary fishery spurted into the lead, it took much time before the technological facilities for collecting, accumulating, and processing the incoming information became available. For example, in the Western Basin, it was not until 1972 that the "FLOT," the first automated system for collecting and processing the operational source information coming in from the oceanic fleet, supported by the electronic data processing machine "Minsk-22," began to be introduced. The insignificant statistical discrepancies, however, do not detract from the authenticity or integrity of the overall picture of the Soviet fishery.

Inevitably, the problem of duplication of information arises in this book, especially when the subject matter of several parts is closely related.

We hope that this book will be of interest to a broad enough circle of people whose lives are tied up with the sea in one or another way: the fishermen and those who enjoy sport fishing, the fishery managers, the scientists, and just the residents in the maritime states who are fascinated by the sea they live with side by side.



The area of the Soviet fishery on the U.S. and Canadian shelf, and boundaries of subareas and divisions of the Northwest Atlantic Fisheries Organization (NAFO).

PART I

IN NEW AREAS OF THE NORTHWEST ATLANTIC

FIRST EXPEDITIONS

Herring were "ab origine"

Since time immemorial, herring have been present on the tables of Russians. Herring have been folk-fish indeed. Fat and salted, they were a perfect appetizer in taverns and pot-houses. Also, in lean years, so frequent in Russian history, they helped people out.

Herring were caught in the north, in the south, and in the east. In the years when Norwegian herring spawn off the Lofoten Islands, enormous numbers of larva drift to the Barents Sea where the fry stay during the first years of their life. Periods of high occurrence of herring in the Barents Sea last 5–6 years, being alternated by periods (2–3 years) of low occurrence. When abundant, herring in mass approach the coastal areas and find their way to the bays and gulfs of the White Sea. Large numbers of herring were observed in the Gulf of Zapadnaya Litza in 1933–35. About 350,000 tons (t) of herring were caught in Murman during that period (here and hereinafter, 1 ton = 1 metric t = 1,000 kilograms).

Such migrations to the coasts have been taking place for many a century, and for Russian settlers, who inhabited the coast of the White Sea in the 12th–18th centuries, herring was one of the main commercial fishery species in the sea fishery. In due course, they became a commodity article and began to show up on the Russian markets in increasing numbers. But in pre-revolutionary Russia, the bulk of Clupeidae was supplied to the markets from the Caspian Sea—one of the most prolific basins in the world in terms of commercial fishing. The Caspian blackback shad rated particularly high. A lot of herring were also fished in the seas of the Russian Far East. They were harvested in the Seas of Japan and Okhotsk. In the Sea of Okhotsk, they inhabited the inshore waters and formed large aggregations in the gulfs and bays.

In 1913, the share of herring in the total Russian catch of 1,048,000 t amounted to 341,000 t. The Caspian roach, used for vobla (a dried and salted delicacy), was second to herring in the catches (146,000 t). Herring, together with sturgeon and large chastikovye (carp and bass), belonged to the fish of value. But herring imported from the European fishery were also favored in Russia. As far back as the 12th century, fat North Sea herring, together with other commodities, were brought over to Russia from the Hanseatic towns Lübeck and Bremen.

The peak in catches in the European herring fishery was recorded at the beginning of the 20th century. In 1907, the British landings of herring made up about 400,000 t, and a greater part of them was destined for the Russian and German markets.

Fishing for Atlanto-Scandian herring at the beginning of the expeditionary fishery. Ships of the SRT class with full cargos of herring are alongside the Kaliningrad mothership *Zapolyarje*.

As a result of a breakdown of the fishing industry in the mid-1990s in Russia, the catches and the fish supply to the home market sharply declined. It had been estimated that the supply of fishery products in 1994 lagged behind the demand by approximately 2 million t. The fish market began to be filled from external sources, herring and North Atlantic mackerel being the major species that accounted for a rapid growth in the volume of imports.

This brief historical excursus provides a better understanding of the reason why the leaders of the fish branch pinned their aspirations on herring in particular. At the zenith of Russian fishing for Atlanto-Scandian herring, the heads of the fishery complexes in Murmansk and Kaliningrad, not without pride, named themselves "herring kings." Besides being the fishery leaders, they were bearers of a peculiar herring-permeated mentality. One gained an impression that nothing else but herring determined their vital interests and way of thinking. Seemingly, the same, in no lesser degree, could have been applied both to the fishermen who were sturdily enduring torments of struggle for fulfillment of the State plans, and to the scientists who were striving to contribute to the same goal.

During the post-war years, a herring syndrome formed in the branch. Since 1948, the new countdown began for the Soviet fishery. The fishing schooners from Murmansk and Kaliningrad put out to the Norwegian Sea, to Iceland, to harvest large herring.

Fishermen's luck. Today there were a lot of large fat Norwegian herring in the drift nets.

The first success achieved by the expeditions in 1948 appeared to be a powerful impetus for construction of medium trawlers (SRTs)—the loggers (acronyms of the Soviet fishing vessel types are kept identical to their spelling in Russian). They were designed for drift-net and trawl fishing. As early as 1950, the first SRTs (39.2 m length, 450 t displacement, 300–400 hp main engine) were built in the shipyard of Stralsund, in the former German Democratic Republic (GDR, East Germany). From 1956, the SRTs as well as medium fishing refrigerated trawlers (SRTRs, 43.6–50.8 m length, 540–730 hp main engine) were built in the U.S.S.R. shipyards. All these ships, those of the SRT type in particular, were intended "to point at herring," and to be operated in "herring seas"—the Norwegian and Greenland Seas.

After the developmental stage of the herring fishery came to an end in 1952, the fishery continued on a year-round basis. The prospects were most optimistic, and dozens of loggers were launched from the shipyards. By 1960, the Soviet fishing fleet numbered up to 800 SRTs engaged in drift-net fishing. Productivity of the fishery grew during 1949–53. The annual average catch per ship increased from 200 to 550 t. In 1954–56, total catches of herring by all nations made up 1.28, 1.21, and 1.45 million t, respectively. The U.S.S.R. catches reached 300,000 t.

A strong gale in the Norwegian Sea. The fishermen have a day off.

The stock exploited by the fishing fleet was predominantly represented by herring of the 1950 year-class, considered to be the richest during the last 60–65 years. Absolute abundance of the spawning herring population in 1956 was estimated at 11.9 million t.

Everything seemed to go well. However, the scientists and fishery managers began to take notice of symptoms of changes for the worse in fishing conditions. In 1952–55, a marked reduction of foraging areas for herring, especially those in the northernmost waters in the Spitsbergen Current area, was observed.

Although technical capacities of the fleet continued to build up, the incremental increases in the catch per ship were leveling off. From 1953 to 1959, the average catch per ship increased by only 90 t. The proportion of large catches in the total yield also diminished. In 1952, catches over 20 t per haul made up 28%, and in 1955 they were 7.3%; in 1952, catches of 11–20 t amounted to 30%, and in 1955 they fell to 18.8%.

In 1958, the abundance of the spawning herring population decreased to 6.6 million t. Recruitment of the 1950 year-class to the spawning stock ceased. There was every reason to beat an alarm. Collapse of the herring stock would have entailed laying up the Soviet fleet. As an afterthought, it should be mentioned that the concerns of the scientists had not been unfounded.

The spawning stock kept decreasing. By 1962, the stock abundance showed a fourfold

An exchange of fishery information. Captain Valentin Polulikhov, an award-winning famous master in the Norwegian herring drift-net fishery, in the chart house of his SRT.

decline as against 1954. True, the appearance of a strong 1959 year-class of herring saved the day for some time, and a collapse of the stock was delayed. However, the Norwegian and Iceland purse-seine fleets simply destroyed the stock in the northern part of the Norwegian Sea. Schooling herring were so accessible for purse-seine fishing that the commercial stock was in fact completely removed. In 1969, the total catch made up just 70,000 t. It seemed impossible that a huge and widely distributed stock like this could have been exterminated. However, super-equipped ships and the rate of exploitation resulted in the stock's inclusion in the category of overexploited fish resources.

There was another reason for the fishermen to seek an alternative to the Norwegian herring fishery. It was the fishery of a strongly pronounced seasonal character. The largest herring catches were taken during their wintering and spawning periods, while in April to June, drift nets just strained water. A fishery with the intermittent rhythm like this adversely affected the economics of enterprises.

A search for new areas for the armada of medium-tonnage vessels was becoming a deliberate necessity. In 1957, the Gosplans of the Soviet Union and the Russian Soviet Federative Socialist Republic (RSFSR, the original and current nation of Russia) held a meeting of fishery managers and fishermen in Riga where it was decided to establish a joint exploratory and fish scouting long-term service in Kaliningrad. On 1 January 1958, the

Atlantic Exploratory and Fish Scouting Long-Term Service was founded by the Kaliningrad Council of National Economy with BaltNIRO (AtlantNIRO since 1963). In addition to controlling the state of the fish resource base in existing fishing areas, its functions included the discovery of new fishing areas. Thirteen SRTs were given over to that enterprise.

At the meeting of the branch workers held in 1959 in Riga, the All-Union (VNIRO), Polar (PINRO), and Baltic (BaltNIRO) Institutes for Marine Fisheries and Oceanography were instructed to work out the plan and procedures for scientific and scouting work to be carried out in the northwestern sector of the Atlantic Ocean. Discovery of areas for the herring fishery was the principal task.

Drift nets, barrels, salt, motherships—all this circled around herring. The herring syndrome was inexterminable.

Utilization of the fleet of medium tonnage vessels had been seen first and foremost in the light of fishing for herring. What is more, herring became a target of belated measures taken for fishery development in the richest area of the contiguous North Sea. Drift net fishing in the North Sea dated from 1955, and it was only 10 years later that the medium tonnage fleet was involved in the Gadidae (haddock and saithe) fishery.

At the meeting in Riga, it was decided that a scientific and scouting expedition of four vessels would be sent on May 1, 1960, to the far northwest to explore the areas of Nova Scotia and the waters off the U.S. eastern coast. By that time, the Soviet fishery expeditions had already taken a turn at exploratory fishing in the Northwest Atlantic.

A source of fish was needed for large fishing freezer stern trawlers (BMRTs). Design work for construction of such vessels had already been underway in East Germany and the U.S.S.R., and the vessels were at the point of serial construction.

The first Soviet fish reconnaissance expedition of large fishing side trawlers of Belgian construction (BRTs Sevastopol and Odessa) was performed in spring 1954. The southern part of Grand Bank, off Newfoundland, was explored. The cod, haddock, and redfish populations discovered there held out hope of successful trawl fishing for the Soviet ships. Two and a half years later, another expedition located strong redfish aggregations in the Flemish Cap area, the industrial fishery of which began in August 1956 by the BMRT Sverdlovsk.

The Soviet scouting or fishing vessels had never been seen in the Nova Scotian and U.S. waters before 1959.

Fish reconnaissance

In 1959, two scouting vessels from the Northern Fish Scouting Service in Murmansk, the SRTRs Professor Somov and Anchous, made a reconnaissance of the Nova Scotian shelf. It had been at the initiative of the Polar Institute (PINRO). Its administration, in striving to extend the areas of the Soviet herring fishery, speeded up the course of events.

No investigations had been planned; the only task that faced the expedition directed by Georgy Shapovalov, the chief of the Northern Fish Scouting Service, was to perform searching activities and detect herring aggregations, if any.

Dispersed aggregations were encountered off Sable Island. Fish reconnaissance operations drew towards completion when commercial herring aggregations were detected on May 3 on the southeastern slope of Georges Bank. A trawl haul in position 41°10′N, 66°10′W brought in 500 kg of herring. A night drift with nets with 24-mm mesh size resulted in catches of about 200 kg per net. The fish caught were 19–36 cm in length, with specimens of 24–26 cm predominating. The biological analysis made ashore showed that the herring were mainly at the age of 4–5 years and, judging by annual ring patterns on the scales and the state of gonads, were summer spawners.

In PINRO, the results of the reconnaissance, which had not been substantiated by commercial fishing, were obviously considered too modest and were not advertised.

According to a decision to launch the first scouting expedition in 1960, PINRO and BaltNIRO were supposed to work in close contact both at the preparatory stages and in the course of the expedition. However, it did not materialize. The vessels of the two institutes worked by themselves and occasionally exchanged information on operation areas and the course of the work.

The nature of preparation for the expedition also differed. BaltNIRO began its organizational matters too late. By March, it was found that the information on the fishery, fish biology, and habitat in pre-planned areas of work available in the Institute was not adequate. The Institute and its library were too young. Besides, at that time, the right of purchasing foreign literature by discipline was only granted to several State libraries, the institutes with the Academy of Sciences of the U.S.S.R., and the departments of the Ministry of Defense. Rigid control of currency expenditure had been set.

Two specialists from the Atlantic Fish Scouting Service were urgently forwarded to Leningrad. The search for and the analysis of required materials were made within the precincts of the Saltykov-Shchedrin State Public Library and the library of the Zoological Institute with the Academy of Sciences of the U.S.S.R. Their work was successful, and, in addition, in the Saltykov-Shchedrin Library, the visitors were even presented with spare copies of the books on the fishery published in Canada and the United States. Half a sack was stuffed with them.

However, only just enough time was left to prepare for the expedition. The expedition was in danger of failure. And then a forced decision was made. Two ships from the Atlantic Fish Scouting Service, SRT-4170 and SRT-4177, worked in the Newfoundland area together with the commercial fleet. By an order issued by the Fish Scouting Service administration, these two ships were assigned to perform as the expedition. The tasks of the expedition were outlined as follows: to investigate the area southwest of Newfoundland from 46 to 36°N and from 50 to 74°W; to detect herring and menhaden aggregations; to collect the

results of commercial fishing; and to study the fish biology and habitat in order to obtain preliminary data on the state of the fish stocks. However, there was no one aboard these ships with any knowledge of the operation area, and there was neither fishing gear nor the required scientific equipment.

Gennady Parfenov, a hydrologist who was the appointed head of the expedition, and two women—a biologist and a hydrobiologist—having hastily collected the necessary equipment, set off to Newfoundland on board a passing ship. The ship brought them to a mothership serving fishing vessels on Flemish Cap.

On May 2, 1960, the scientists transferred to the Atlantic Fish Scouting Service ships, and the expedition set off to execute its task. Now there were nine specialists from the Institute and the Fish Scouting Service on board, and the drift nets were waiting in the holds. The newcomers were equipped with the information derived from the papers by American and Canadian investigators, and from FAO collections of statistical data on the fishery. With all that, the work could be planned on grounds of expedience.

The data on the Clupeidae fishery along the east coast of North America were indicative of a small-scale fishery for sea herring, alewife, and shad. Herring catches from the coastal U.S. and Canadian zone ranged from 135,000 to 180,000 t a year, which was incommensurable with the catches of the Atlanto-Scandian herring. But menhaden yields were impressive. In some years, the U.S. catch reached the level of 1 million t.

The books procured in Leningrad told of the fishery in the coastal waters of the New England states, Mid-Atlantic region, Chesapeake Bay, and the South Atlantic area. A chain of states stretching from Florida, North Carolina, and Maryland to Delaware and Maine was distinguished by peculiarities in the fishery, commercial ichthyofauna, and environmental conditions of their habitat. The areas and periods of sea herring fishing and spawning in the waters of the United States and Canada were known.

Virtually no data had been available on the high-seas areas, except fragmentary communications relating, for instance, that the American fishermen, while fishing silver hake with trawls on the northern slopes of Georges Bank, encountered dense herring aggregations. Sometimes, when trawls contained herring, the fishermen threw them overboard because they were paid more for silver hake than for herring. The American scientists supposed that, unlike the inshore areas, entries of herring in the open waters of the Gulf of Maine and onto the banks were irregular, and less abundant. They referred to information gained from the American fishermen who operated trawlers and drift-net seiners and had taken herring catches incidentally on Georges Bank.

Also, participants on the expedition were informed of menhaden. They knew that up to 50% of the total catches in the U.S. came from the Mid-Atlantic area (the states of New York to Virginia), that the fishing was conducted in territorial waters, and that no data were available on the occurrence of menhaden schools in the high-seas waters. They knew that menhaden were bony fish, with an oily smack, and were not on the diet of Americans

because of excessive fat content. All catches were reduced to fish meal and oil. But the Russian consumers never neglected fat and salt in herring, therefore menhaden were much cherished.

Scouting transects were considerably limited. They were to be made no closer than 40–50 miles from the U.S. and Canadian coasts. This condition might have been dictated by the Soviet authorities for political reasons. Besides, the expedition pursued the objective of searching for herring only in the high-seas waters, along the routes of their feeding and pre-spawning migrations. In their deliberations on possible herring habitats in the Northwest Atlantic, the scientists tried to draw an analogy with the Norwegian herring. Herring were to be sought in places where warm and cold currents interact. In the scientists' opinion, such zones could also exist beyond the shelf, above large depths.

Scouting transects were made perpendicular to isobaths and flows of the main currents. In southeastern and southern directions, transects were interrupted after the ships entered the warm and saline Gulf Stream waters. Oceanographic stations were made along transects every 40 miles, down to a 500 m depth. Zooplankton and phytoplankton were collected with plankton nets by stratum to depths of 200 m and 100 m, respectively. Bathythermograph casts in a 0–200 m stratum were made every 20 miles. Echo sounders were permanently in operation. Visual observations of bird, dolphin, and whale aggregations were made.

The southwestern slope of Grand Bank, off Newfoundland and the Nova Scotian shelf, was explored in the first 10-day period of May. No herring stocks were detected. On 11 May, fish reconnaissance was continued on Browns Bank. Dusk was falling when the southwestern scan of the echo sounder recorded fish shoals in their daily vertical migration from an 80–120 m depth to surface layers. In deck lighting, silvery fish could be seen sweeping past the ship's side. A drift net was promptly cast overboard and lifted shortly after. There were some dozens of herring. This finding filled the crews with enthusiasm. Very soon the ship was set adrift with its drift nets in the water. The nets lifted in the morning were sparkling with silver. The catch brought in by 20 nets made up 2.5 t. Some nets contained up to 200 kg of herring.

Two nighttime drifts that followed were poor. Tidal currents in the area folded up the drift lines. The herring behavior also changed. The shoals did not rise to the surface closer than 40–80 m. However, the third drift brought in a catch of 2 t. The herring were 16 to 34 cm in length, but specimens of 23–27 cm predominated. They were foraging and fed intensively on pink *Calanus finmarchicus* and euphausiids.

After developing an idea of the fishery possibilities of the area, the expedition continued the exploration of the U.S. shelf. Shoals of small herring were observed at the sea surface in the southern part of Georges Bank. Twenty-four schools were recorded within a radius of 4–5 miles from the position of 40°31′N, 67°30′W, some of them exceeding 50 m across. Subsequently, the area extending to 37°N was searched. All attempts to locate menhaden were to no avail.

The endurance of SRTs, 400 hp vessels, was 25 days. Time was pressing, and the ships headed back for motherships laying off Labrador, conducting fish reconnaissance in transit.

As a result of the expedition, a conclusion was made that, with herring concentrations detected on Browns Bank and in the northeastern part of Georges Bank, 20 vessels could be allocated there with drift net lines consisting of 80 nets. Average catches of 75–100 kg per net could be expected. Prospects of trawl fishing for the groundfish species were considered to be poor.

Both the members of the expedition and the administration ashore considered the expedition as one of fish reconnaissance. It lasted but a month. No detailed investigation was carried out on the banks and other areas with prospects for the formation of fish aggregations. The longest recorded distances between searching transects were 60–80 miles.

The ships carried out just 11 drifts with the nets and 19 trawl hauls. But the collected data on the environment were extremely helpful for planning scouting operations for the next expeditions.

First encounter with America

No port calls in the United States and Canada were envisaged for the expedition ships. However, at times, eventualities can frustrate any plan. And sure enough it did happen to the expedition.

A sonarman from one of the ships, the *Masalsk*, was taken badly ill. His high fever was not going down. There was no physician in the expedition. Recommendations of physicians from the Soviet motherships sent over the radio were being followed, but the patient was not getting any better. Immediate hospitalization was needed. Six hundred miles separated the ship from the motherships, while the nearest U.S. port—Atlantic City—was within easy reach, just 60 miles away.

A decision was made in favor of Atlantic City. The Soviet authorities gave a permit for a port call, and communication with the port of call was established. The approach chart was not available onboard, so the ship had to sail blind. The crew was literally stunned at the news of the forthcoming encounter with America. No one had ever been abroad before. Everybody anticipated something extraordinary to occur. And they did not fall short of their expectations. A warm serene evening was setting in. The sun began to dip into the sea against the skyline when motley, rapidly approaching lights showed up against the melting sunset. A flying object looking like nothing on earth was growing bigger and bigger every second, and soon a dirigible was hanging over the ship. It was about two times the size of a small ship and seemed to be enormous. Night was falling over the sea. On having received the required information sent from the ship with a bull's-eye, the dirigible signaled the ship

to follow it. When the ship was approaching the shore, the speedboats of the U.S. Coast Guard rushed to her. They swung around sharply right in front of the ship's bow and proceeded towards shore. Coast Guard crewmen motioned the ship to follow them.

The captain ordered his ship to follow one of the three boats. Soon the people aboard felt a shock—the ship had run aground. As it proved later, it was low tide, and beaches normally under water stood bare. A towline was used to set the ship afloat. Soon a boat with armed Coast Guardsmen approached the ship to take aboard the patient and a crew member who accompanied him. The ship was moored to the Coast Guard's quay, and sentries were posted at the ship's bow and stern.

The following morning, a small inelaborate ship, pretty well battered by storms, lay before the eyes of the Americans. Its design was hardly a pleasure to the eye. The superstructure was covered with rust all over, and the sides were an unthought-of rufous color. Limousines were driving up one after another. Americans were viewing the ship.

But Russians, undoubtedly, were the most intriguing part of the event for them. The "cold war" was in progress. America was catching the Russian spies. The Russian fishermen clad in dark coarse garments looked somewhat dreary. However, beaming amiable smiles illuminated their faces making it obvious that they were open for contact.

An executive from the Embassy of the U.S.S.R. arrived from Washington. He conveyed a demand from local authorities that a barrel with herring salted on Georges Bank be lifted from the hold and handed over for analysis.

The military, equipped with instruments, wandered aboard ship from cabin to cabin looking into lockers and measuring the radioactivity level. On the pier, a medical technician "x-rayed" everyone who left the ship.

Cars kept driving up to the ship. By noon, there was no room left for parking, and Americans just slowly drove by. Cars were moving in an endless stream until the port authorities shut off the access road to the pier.

On the seaside, pleasure boats were trying to sail up to the ship, but a cruising Coast Guard boat shoved them off. Also, the shore across the channel was packed with people from morning until night. With cheers and gestures, Americans were trying to draw the Russians' attention. The seamen answered them with gestures of welcome. The ship was visited by experts, businessmen, and journalists. Many asked one and the same question: how Russians happened to be in U.S. waters and what their aims were. The explanation that the ship came in search of menhaden was accepted with sceptical and incredulous smiles.

Evenings, the American Coast Guardsmen crowded alongside the ship. Both parties tried to start a conversation; however, pantomime was the only "language" in common. Nonetheless, the air was unrestrained and friendly. The sailors exchanged souvenirs, swapped some trifles.

A chance port call at Atlantic City was an invaluable gift for the crew. Who would have dreamt of being there? For a full 2 days, they stayed in America, delighting in the warm

May air and extraordinary quietude. No exhausting rocking, silenced engines, no hull vibration whatsoever.

They met true Americans, watched a glow over the night city.

They were not allowed to go ashore, but they did not take offence.

In 2 days, the patient was brought back with a stock of medicines and a pile of letters and postcards. Those were get-well cards and letters with the wishes of good health from Americans. Last words of gratitude for assistance rendered were spoken. The American coast was left behind.

The *Atlantic City Press* did not pass over a port call of the Russian ship in silence. Ever-present and meticulous reporters traced the element of surprise and sensation in this seemingly insignificant event. The 22 May issue of the *Atlantic City Press* reported:

> A Soviet fishing trawler flying the hammer and sickle moored at the U.S. Coast Guard lifeboat station here after entering port Saturday to land a sick crew member.... Only the leaders of the fishing expedition were permitted to leave the vessel.... Twenty-six young Soviet men and two Russian women scientists spent the day staring back at thousands of resorters who were staring at them from the shore and from hundreds of boats.... [The Soviets] appeared a motley crew in their strange collection of sailor's and land-lubber's clothes.... The *Masalsk* left its home port of Kaliningrad on March 9 to fish off the Grand Banks ... decided to change course and fish in this area for menhaden.... [The Soviets] appreciate the friendliness they have been shown."

The narrative could have been closed here were it not for some involuntary questions: How on earth has this ship found herself in isolation here, on the other side of the ocean, 5,000 miles away from her port? Where do they refuel, and where do they get their water and food supply? The ship's papers certify that the Atlantic Fishery Reconnaissance Service is the shipowner. What kind of reconnaissance activities are pursued by this ship in our waters? Why on earth do they need these menhaden which no American would ever touch? Do they also wish to reduce it to fish meal and oil? And what happens after they find their fish? All these questions remain unanswered. But when a lone reconnaissance craft shows up in our waters, be sure—another Red Square will emerge here in no time.

Russian wheel

In 1959 and 1960, the fish scouting vessels from Murmansk and Kaliningrad made two fish reconnaissance surveys. Herring shoals were detected on Georges Bank; the time and places coincided in the two surveys. No sizeable aggregations were found. The results of the surveys were more than modest from a practical point of view.

Thorough preparations preceded launching the 1960 expedition by PINRO. Two almost-new ships, the SRTRs *Balaklava and Bogutchar*, were perfectly equipped with scientific inventory and fishing gear. The crews and scientific groups were manned with qualified personnel. The expedition was headed by Ivan Yudanov, a renowned scientist who had investigated Atlanto-Scandian herring. The cruise lasted 5 months, from 15 April to 11 September.

When outlining the scope of objectives and tasks for the expedition, searching for herring on Georges Bank in 1959 was considered unimportant. A search for commercial herring and menhaden aggregations in the high-seas waters beyond the shallow zone of the shelf extending from Newfoundland to Florida and as far as Bermuda in the central part of the Sargasso Sea was the principal task for both ships. The research program was based on a working hypothesis according to which, by analogy with the Atlanto-Scandian herring, the foraging stocks of Clupeidae were expected to be distributed at greater depths, in the zone of mixed waters of warm and cold currents in that part of the ocean as well. Today, these expectations would have seemed naïve. The summaries made later have proved that the spread and migrations of sea herring in the basins of the Atlantic and Pacific Oceans are solely dependent on the presence of steady water gyres (counter currents).

The majority of herring populations inhabit closed circulations of the shelf waters. The only region where they are confined to the ocean circulation formed by the Atlantic and polar waters is the Northeast Atlantic. No other gyres with the conditions required for herring exist in the Atlantic or Pacific Oceans. That is why most populations of sea herring are not found in oceanic bodies of water and their streams and currents.

During the first fish reconnaissance expedition executed by BaltNIRO, the hydrographers were astonished at enormous temperature gradients observed in the zone adjacent to the Gulf Stream. It was then that, on having recorded drops in temperature up to 8°C within a distance equal to the ship's length, they suggested that, like in the Norwegian Sea, such gradients were barriers preventing marine organisms from migrating. Further investigations showed that the Gulf Stream, besides being the insurmountable barrier for herring, was also responsible for localization of commercial ichthyofauna on the Nova Scotian and U.S. shelf.

From 29 April to 24 August 1960, the PINRO expedition, by having made fish scouting transects, explored the Northwest Atlantic area which extended from the continental slope across the entire Gulf Stream and up to the central part of the Sargasso Sea. The extensive research program included deepwater oceanographic stations and searched for fish aggregations with the use of hydroacoustic equipment.

Thirty-five fish scouting transects of 16,790 miles total length and 452 deepwater stations were made, and 1,660 plankton, ichthyoplankton, and phytoplankton samples were collected by both vessels. High professionalism of the scientists—the oceanographers and hydrobiologists—must be attributed to the expedition's merits.

Dynamic processing of the hydrographic observations resulted in producing a scheme of currents at the ocean's surface (Appendix Figure 1). The depth of 1,000 m was taken as zero surface. To complete the picture of movement of water masses in the areas of the Nova Scotian shelf and Grand Bank, the data from the special literature were used.

Undulated movement of the Gulf Stream system from the southwest to the northeast can be clearly seen on the scheme, with peculiar southward deviations in places of intensive efflux of relatively cold and desalinated waters from the Grand Bank and the Gulfs of St. Lawrence and Maine, and Delaware Bay.

Along the 60°W meridian, a powerful cyclonic circulation was recorded. According to hydrographers, a powerful intrusion of cold and desalinated waters along the undersea depths of the Nova Scotian shelf was one of the reasons for the Gulf Stream meandering in the horizontal plane. Deviations like this in a latitudinal part of the Gulf Stream during the spring-summer period were so forceful that they swung the current in some places, causing eddy formation. Meridional bends of isotherms and isohalines also confirm this.

The above-mentioned gyre was a relatively cold and desalinated patch against the background of Gulf Stream and Sargasso Sea waters. The water masses of the nucleus were formed from mixing of the inshore waters with those of the Gulf Stream. At the surface, the temperature and salinity in the nucleus were 18.22°C and 35°/₀₀, respectively. The Gulf Stream velocity reached a maximum in the current of the stream. Down stream it diminished from 204 cm/sec at 73°W to 38 cm/sec at 50°W.

Hydrobiological investigations and volumetric assessment of the plankton biomass (ml/m^3) by depth were indicative of extreme scarcity of plankton in the main Gulf Stream flow both in composition and quantity. Its biomass was primarily represented by tropical and subtropical species. In the zone where the Gulf Stream water becomes mixed with the cold waters of the Labrador Current, as well as in the inflows originating from the Gulf of St. Lawrence and coastal waters along the North American shelf slopes, a marked rise in the plankton biomass—food supply for pelagic fish—was observed.

On the Nova Scotian shelf, where large crustaceans of subtropical and boreal faunas prevailed, the food plankton biomass was as high as 0.6 ml/m^3 in summer months. Farther on, in a region inhabited by boreal and subtropical faunas, it did not exceed 0.25 ml/m^3. However, with a change of boreal fauna to subtropical and tropical faunas, a certain increase in the plankton biomass was recorded.

During the first trip, the expedition did not find positive prospects for expanding the herring fishery in summer in the mixed high-seas waters beyond the Continental Shelf bordering on the Gulf Stream. But in that same area, during the daytime, the hydroacoustic equipment showed dense readings extending for 10 miles or more in the layers deeper than 300–500 m from the surface. In most cases, numerous aggregations of marine animals (hundreds and thousands of individuals), primarily diverse dolphin species, also occurred there. They were either feeding or rapidly moving in a definite direction. Steady concentra-

tions at a 300–500 m depth from the surface were inaccessible to a mid-water trawl, for its wires, about 1,000 m long, reached just 200–250 m below the surface at the deepest. Fishing at night, when the aggregations lifted to upper levels, was also not successful because of their high mobility.

In September 1960, the ships of the expedition returned to Murmansk, and in November of the same year, two vessels of another expedition, the SRTs 4170 and 4234, put out to sea from Kaliningrad. This expedition lasted from 26 November 1960 to 26 March 1961. The crew numbered 50 men, including 8 scientists from BaltNIRO and the specialists from the Atlantic Fish Scouting Service. Yury Vyalov was appointed head of the expedition.

The goal was invariable—to discover herring for the Soviet fishing fleets. A choice of operation areas was suggested by information on the areas and time periods of the inshore fishery off Canada and the United States, and by the materials obtained in May 1960.

The areas covered by the expedition are depicted in Appendix Figure 2. Area 1—from Sable Island to the northeastern slope of Georges Bank inclusive—was chosen as the most probable foraging area for summer-spawning herring from the coasts of Nova Scotia and Gulf of Maine. Area 2—northeast of Sable Island to the southwestern slope of the Grand Bank, Saint-Pierre and Green Banks inclusive—was considered to be a possible foraging area for summer-spawning herring from the Nova Scotian coast and a wintering area for spring-spawning herring from the Gulf of St. Lawrence and herring from the southern Newfoundland coast. Area 3—Georges Bank and the areas adjacent to it on the north and southwest—contained herring concentrations from the Gulf of Maine that were supposed to be found there during feeding and wintering.

According to the program, hydrographic and hydrobiological research was to be performed in order to discover the most favorable areas for fish concentrations of commercial quantity, and followed by detailed scouting with the use of acoustic devices and drift-net sets and trawl hauls.

Nineteen thousand miles were covered by the ships in the course of fish reconnaissance. Thirty-five hydrographic transects and 96 stations for phyto- and zooplankton sampling were made in total. Herring aggregations, recorded by sonar, were detected in late December on the northeastern slope of Georges Bank at a 30–60 m depth in the same fishing plots where herring had been found in 1960. A control drift with the use of nets with different mesh sizes revealed that nets with a 26-mm mesh size had the highest catchability (50 kg per net, 50-m-long leaders). Control trawl hauls in the light hours of the day brought in catches represented by a few individual specimens. Herring schools kept to the bottom during the daytime and moved to the surface at night.

A more thorough search showed that herring occurred in the area as separate shoals in the surface layers. During the reiterated survey of the area made in the third 10-day period of February, only individual shoals were detected near the bottom at a distance of 0.5 mile from each other. Control hauls of these small dispersed shoals were not successful. No

Man and fish after having maneuvered into a large school.

fishable herring concentrations that could have been large enough for a control drift were detected in February. An assumption that the bulk of the herring had migrated to the southern slope of Georges Bank and eastward to Sable Island Bank was checked. However, herring were not found there as well.

On Georges Bank, herring occurred in waters with both a temperature of 6–7°C and a relatively high plankton biomass (up to 400 mg/m^3). The biological analysis revealed that herring were foraging and fed intensively; in addition to juvenile *Calanus finmarchicus*, the stomachs contained *Themisto* sp. and Euphausiacea.

Banquereau Bank was the second area where herring were found. On January 31, considerable herring aggregations were recorded on its slope at a depth of 25 m and down to the bottom. Fifty kg of herring were captured with a mid-water trawl during a control tow. After a careful search of 2 days' duration, a conclusion was made that herring forming a band about 2 miles wide and 15 miles long were distributed along the Bank slope.

Shoals were keeping to a depth of 5–6 m off the bottom; therefore, the attempts to use bottom trawls were to no avail. A mid-water trawl, by virtue of its design peculiarities, also did not bring in commercial catches. The echo sounds (Appendix Figure 3) were similar to those obtained for winter Norwegian herring. As a result of a short control drift made against the background of continuous readings, a catch of about 200 kg per net was taken in 3.5 hours. Leaders 10 m long appeared to be the most efficient. Herring "fell off" the nets with the 30–36 mm mesh size because of a large number of specimens over 33 cm (up to 39 cm) in length. Unfortunately, bad weather conditions prevented the expedition from conducting a full-scale drift there.

At night, herring were confined to 45–50 m depths, moving deeper towards the Bank slope (100–150 m) in the daytime. The moment the deck lighting or a searchlight was

switched on, they rushed to deeper layers. A 12-hour-long station showed that the food (zooplankton) migrated with a change in illumination intensity, and were followed by herring. Thus, vertical movements of herring were determined by changes both in illumination and in the food location. Evidently, tidal currents also affected horizontal movements of herring from shallower to greater depths.

Stable herring concentrations on Banquereau Bank were recorded from mid-February to the end of the first 10-day period of March. Herring stayed there throughout this period. In February, herring moved southwards slightly. In March, they moved back to the north and settled on the eastern and southeastern slopes of Banquereau Bank forming concentrations spread over 50 miles. According to the sonar readings, some herring schools were of remarkable sizes (up to 3 miles long). But as a whole, the concentrations were represented by individual, dense, frequently distributed shoals extending for 0.7–1.5 miles. The total area inhabited by herring aggregations was estimated at about 800 square miles.

Herring on Banquereau Bank turned out to be cold-loving fish. The most extensive and dense aggregations were confined to the waters with temperatures ranging from 0 to –0.5°C. During daily migrations, herring moved from the waters with positive temperatures (0.2°C) to those with negative temperatures. Higher values of plankton biomass (up to 400 mg/m^3), and blooming phytoplankton accumulations, unusual for winter time, were characteristic of these waters. Those were summer-spawning herring, and cold waters were their foraging grounds in January–March. They fed intensively in the low-temperature waters.

The head of the expedition reported to shore that a new area of abundant herring concentrations of indubitable interest for the Soviet oceanic fishery had been detected. The period from January to May was suggested as the optimum time for fishing activities. Recommended types of vessels and fishing gear were SRTs with drift nets and BMRTs with mid-water trawls.

As for the expedition, its members were obviously out of luck. Fishing with drift nets in January–February was of incidental character, which allowed only to identify herring aggregations. In the Banquereau Bank area, the ships faced highly unfavorable weather conditions—the winter in 1960–61 was abnormally severe. According to Halifax old-timers, they had not witnessed a winter like this since 1922.

In January, the number of stormy days with Wind Force 7 or more amounted to 34%, the average air temperature being –1.4°C. Most heavy weather conditions fell on the period from 9 January to 7 February. Westerly and northwesterly winds prevailed. At times, these cold winds caused drops of temperature to –12°C. Low air temperature and gales often impeded the activities of the expedition. Moreover, it sometimes happened that all work had to be completely stopped, for fishing gear and ships got frosted, and heavy rolling prevented the fish scouting equipment from being used. From time to time, to avoid complete icing, the ships were compelled to sail southwards to warm Gulf Stream waters. Nevertheless, it was beyond any doubt for the expedition members that the average multiyear

weather conditions permitted the fishery to be conducted in wintertime. The BaltNIRO expedition was still working when the ships *Balaklava* and *Bogutchar* of the PINRO expedition headed towards the investigation area. Their voyage lasted 5 months (from mid-February to 11 July 1961).

Yury Vyalov, head of the BaltNIRO expedition, reported to Vladislav Pakhorukov, head of the PINRO expedition, the area on Banquereau Bank with the herring aggregations that were discovered. The leaders of the fishing industry and the chiefs of fishing enterprises kept a close eye on the course of events in the new area. They held that the efforts of science and the Fish Scouting Service were inadequate and that despite the discoveries, there was no ground for arranging a large-scale fishery, and directed more and more scientific and scouting vessels to that area.

In May–December 1961, the SRTs 4170, 4191, 4379, and 4234—the ships of the Atlantic Fish Scouting Service—continued the fish reconnaissance there, with the PINRO vessels *Balaklava* and *Bogutchar* having seconded them in October–December.

In 1962, the scientific and scouting work was carried out by nine vessels from Kaliningrad and four vessels from Murmansk. Appendix Figure 4 gives an idea of the scope of the oceanographic research accomplished in 1960–62 by the Murmansk ships alone.

During the PINRO and AtlantNIRO expeditions executed in 1960–61, the annual cycle of scientific and scouting work in the Georges Bank area was fulfilled. The Nova Scotian shelf was investigated to a lesser extent. Fairly voluminous scientific information on the hydrographic conditions, nutrition base, commercially viable concentrations, and biology of West Atlantic herring was obtained. The hypothesis of possible widespread distribution and large-scale migration by herring was refuted by the investigation results. Quite the contrary, herring were found to perform relatively limited feeding migrations and to be represented by local stocks inhabiting the shelf. That was one piece of evidence indicative of the fact that herring abundance in the western sector of the Atlantic was incommensurable with the number of herring inhabiting the northeastern part of the Atlantic Ocean.

The investigations were in progress. Exceptionally favorable conditions for the commercial fishery in the Georges Bank area were recorded in May–June 1961. The commercial vessels switched over to drift-net fishing in that area and were bringing in sizeable catches.

It was the beginning of the development of a vast and productive area for the Soviet oceanic fishery.

For many consecutive years, the waters off Nova Scotia and the U.S. coasts would receive the Russian fleets arriving from the north, west, and south of the U.S.S.R.

PICTURE OF DEVELOPMENT

Industrial experiment

Late in March 1961, the BaltNIRO scientific and scouting expedition consisting of the SRT-4170 and SRT-4234 arrived at its home port of Kaliningrad. On April 12, Yury Vyalov, head of the expedition, reported the expedition's results to the scientific council of the Institute. The council was attended by Valery Giaparidze, leader of the fishing industry in the Kaliningrad region. This person, who had never attended college, belonged to the post-war cohort of Soviet directors authorized to transform the enormous country.

They were not intimidated by difficulties, and native sharpness and tough-minded reckoning enabled them to take conscious risks and arrive at important decisions. Giaparidze was also a man of humor. When salted herring from Georges Bank was being tasted, he but raised slightly a dish with herring and said, "Rich flavor. Do we accept American aid?"

The day after the council meeting, the urgent arrangement of the first expedition aimed at a West Atlantic herring fishery was announced. Three SRTs were rigged out in double-quick time. Crews were manned with experienced seamen, old salts. They had been accustomed to voyages to the Norwegian Sea. But this new assignment was a cherry pie for them, as people were eager to sail to the American coast. The unknown was tempting, and they felt like pioneers. Discoveries awaited them. But there was also a prosaic reason in the background for their excitement: they were promised good earnings if they scored big successes.

Early in May, three vessels were already crossing the ocean at full speed, heading to Grand Bank, off Newfoundland. Yury Vyalov was aboard one of them.

Already in passage, the seamen ran into the first adventure—they witnessed a spectacular picture behind a fogbank. An iceberg, dazzling white in the rays of the spring sun, glared in close vicinity, and a small toylike ship lay immobile at its very foot. It appeared to be an SRT from Riga. The captain of that ship, having noticed that a lakelet had formed on top of the iceberg in the bright sun, decided to fill a water tank with the crystal-clear fresh water. The seamen climbed the almost precipitous cliffs of the ice mountain to the top, dragging the firehoses along.

The captain's actions were an outrage to the regulations of safe navigation. Closing in on an iceberg, which can capsize at any moment, is extremely dangerous. But captains are risky people. They knew the fresh water's worth if any man did. The captains of the three expeditionary vessels also dared danger. Alternatively, the firehoses were thrown over each vessel. After 3 hours, all empty tanks were filled with water, and the group of ships proceeded towards Newfoundland. It took 2 weeks to cross the ocean. The mothership, which served the vessels, topped off their fuel tanks. Another week was required to reach Georges Bank.

Things were looking grim on the Bank. Thick fog was curling above it. The ship's position could only be fixed by radio beacons; however, interference distorted their signals. The first settings of drift net sets were a failure: the lines folded, the nets crossed over and tangled, and in short, they failed. The reason was evident: strong tidal currents and vertical water movements caused the problems. But herring were available on the Bank. Some nets that withstood the elements brought in about 500 kg of fish.

The captains soon adapted to the complicated conditions, and found solutions to the unforeseen problems. The drift net lines had to be anchored to the first buoy, and after all the nets were set, the ships dropped anchors. Now all the nets were open for herring. The saying goes that fortune favors the brave. And favors "the improvisors," it should be added. The next morning, when the nets were being hauled, the fishermen stood amazed. Each net brought in over a ton of fish. But even success turned out to be a problem.

The nets with catches like this could only be hauled by means of a trawling winch and a cargo-runner. The fish got squashed, lost quality, and many were thrown overboard. But again the captains were up to the mark. The number of nets in a line was decreased, and their height reduced from 10 to 5 m. The nets were set before supper, and in two hours the fishermen began hauling. The catches per net made were 200 to 600 kg. The ships had a full cargo in 4–5 days. The plans were exceeded by 200–300%. It was a success. The catches per net taken in the same time period in the Norwegian Sea were 10 times less.

The news of the Kaliningrad ships' successful operation on Georges Bank passed round all economic councils in the north and west of the country. In July, four drifters and several vessels of the BMRT type left Murmansk for Georges Bank. In August–October, the number of vessels of large tonnage on the Bank amounted to 17 units.

Meanwhile, the unsatisfactory conditions on the herring fishing grounds in the Norwegian Sea persisted. The fishing industry of the Northwest Basin failed to fulfill the plan for the third quarter of the year. In late September, representatives of the economic councils responsible for the fishery in the Norwegian Sea met in Moscow at the Gosplan of the U.S.S.R. where a number of measures aimed at improving fleet activities in the remaining months of 1961 were worked out.

It was decided that 111 out of 715 vessels of medium tonnage engaged in the commercial herring fishery should be put into operation on Georges Bank. Four motherships, two tankers, and a rescue tugboat were allotted to work together with the fishing vessels. Normally, SRT trips lasted 105 days. It was suggested that, by an agreement with the trade unions, the trips of all the vessels could be prolonged and their arrival at home ports postponed until January 1962. There was no doubt that the consent of the trade unions would be obtained. In view of the extended stay in the fishing areas and the prolonged trips, the need for a better supply of fresh food, essentials, and movies from motherships had been foreseen, and a regular delivery of personal mail, the latest news, newspapers, and magazines to the seamen was added. Observance of safety regulations for navigation and a safe fishery was to be checked by the

Drift nets have sunk into oblivion. A trawl is being hauled.

inspectors from the Gosrybflotinspektziya (State inspection for fishing fleets). This measure was not superfluous. With frequent thick fogs in the Georges Bank area, visibility often dropped to the minimum: 0.5–1.0 cable (1 cable = $^{1}/_{10}$ of a nautical mile, or 185 m), and a few ship collisions that entailed serious damages had occurred in the fall.

Port calls in foreign countries were forbidden for the vessels even in cases of emergencies. Only tankers were given special permits to visit ports to take potable water. The BMRTs which had been working on Georges Bank had to move to other areas.

Execution of decisions taken at high-level meetings like this was under the strict control of the economic organizations and Party authorities. In late September–October, the vessels of medium tonnage poured into the Georges Bank area, and in November their numbers reached 130. There were ships from Murmansk, Tallinn, Riga, Klaipeda, and Kaliningrad. This was the first time in its history that the Bank had played host to such a great number of visitors from the other side of the ocean—up to 5,000 Soviet citizens were gathered there together at the same time. They ran no risk of infringing the visa regime. No visas were required to work on the Bank.

Never before had a virgin herring stock on Georges Bank encountered so many nets in its habitat. In November, drift nets were set every day by approximately 80 ships. One drift-net line numbered 40–60 nets, the standard length of one net being 30 m. Walls of nets 5–10 m

Table 1. Soviet drift-net fishing for herring on Georges Bank, 1961.

Month	Average number of ships fished	Average catch per ship-day fished (t)	Average catch per net (kg)
May	0.6	7.7	85
June	1.0	13.4	364
July	4.6	8.5	470
August	2.2	10.8	621
September	1.0	9.2	236
October	35.4	6.0	131
November	83.5	5.6	109
December	3.4	12.6	127

high and 100–140 km long were "shot" into the water every day. Table 1 shows the results of drift-net fishing for herring on Georges Bank. A large-scale experiment of trawl fishing for herring was made by the ships of the BMRT type. The results are shown in Table 2.

Not everything went smoothly during that first year of commercial exploitation of the Georges Bank resources. A large group of SRTs was transferred across the ocean in October and November. It was then that spent herring were leaving the Bank and the number of aggregations was steadily decreasing, which led to a decline in drift-net catches. In December, there were actually no ships left in the Georges Bank area.

The final result of the fishery was relatively low compared to the standards of the Soviet fishery of those years. The catch totaled 67,000 t. The significance of that "experimental" year lay in the fact that the expanded fishery made it possible to answer many questions that had remained open since execution of the first scientific and scouting expeditions.

A group of eight scouting ships was formed to explore the area off Saint-Pierre Bank, the entire Nova Scotian shelf, and the shallow waters off the U.S. coast. No commercial fish concentrations were discovered, except for large garfish stocks on several fishing plots on the Nova Scotian shelf.

Three months of scouting and exploiting herring resources showed that, in September–November, the commercial herring concentrations were only being formed in the area northeast of Cape Cod and on the northwestern, northern, and northeastern slopes of Georges Bank. In the fall, the total area of herring aggregations did not exceed 400–500 mi^2. On completion of spawning, that area was reduced to 100–300 mi^2. The number of aggregations and their density decreased. In their recommendations, the fish scouts indicated the number of vessels to be allocated for the herring fishery: 80–100 drifters and 20–25 BMRTs. From the fishery managers' viewpoint, 100–150 drifters could be used in the area.

In the plans for fishery development drawn up for the next year, herring again topped the

Table 2. Soviet trawl fishing for herring by BMRTs on Georges Bank, 1961.

Month	Number of ship-days fished	Average catch per ship-day fished (t)	Average catch per 1 hr of trawling (t)
August	308	29.0	3.0
September	493	24.7	2.3
October	329	19.1	1.5

list of industrial species. Their potential yields were being estimated. However, the fish scouts, although in a gingerly manner and in passing, mentioned other prospects. Their reports, based on the annual results, indicated that fairly large aggregations of groundfish, namely, cod, haddock, redfish, and silver hake, occurred on Georges, Banquereau, and Green Banks and in the Sable Island area. The conditions on Georges Bank favored the development of trawl fishing for groundfish species, and fishing for herring by the SRTRs. Some commercial silver hake catches had already been taken by the BMRTs. The SRT-4379 detected argentine aggregations on Browns Bank slope and on the northeastern slope of Georges Bank. The catches per trawl haul at 160–230 m depths reached 1.5–3.0 t. Several plots of the fishery development scenario in the new area were looming ahead.

Unraveling the plot

In 1962, many fishery enterprises ventured on Georges Bank herring. More and more groups of vessels were bound for Georges Bank from the beginning of the year. However, herring aggregations were scanty and dispersed at that time. The ships of large tonnage failed to take high catches and switched over to fishing for silver hake and other groundfish species in February–March.

Poor yields baffled medium trawlers as well. In April, a large group of these trawlers left Georges Bank for Nova Scotia where about 125 SRTs were fishing herring aggregations on Banquereau Bank. Herring migrated to coastal waters early in May, and the ships had to sail back to Georges Bank. But herring were not abundant that year. A small stock was distributed over an area of some dozen square miles. Naturally, 200 drifters which had arrived at Georges Bank in summer were not in a position to set their nets within such a limited area. Drift net lines got entangled everywhere, accidents happened, and sizeable losses of fishing gear occurred. The results of the fishery were disappointing. The herring stock abundance on Georges Bank turned out to be lower than anticipated. The fishing effort by the fleet of medium tonnage vessels increased five times in 1962, and that by the fleet of large tonnage vessels—nearly three times, while the herring catches yielded by

these two fleet types were upward just 2.8 and 1.2 times, respectively, compared to 1961. A total of 150,000 t of herring was captured in 1962 on Georges Bank.

At the same time, trawl fishing for silver hake by BMRTs and SRTs was rapidly developing. The fishery managers came to the conclusion that drift-net fishing should be replaced by trawl fishing. In November–December, BMRTs from Murmansk succeeded in fishing for silver hake off Sable Island and on Middle Ground. In 1962, silver hake catches exceeded 50,000 t. Thus the fish resource base was made ready in 1962 for a rapid fishery development in 1963.

This book will attempt to outline the peculiarities of the Soviet fishery and the utilization of biological resources in the areas under consideration in the 1960s–70s. All catch statistics that were analyzed were submitted to ICNAF (NAFO) and refer to Subareas 4, 5, and 6, which in the U.S.S.R. were tantamount to the Nova Scotia, New England and Norfolk areas, respectively. For convenience, the entire area from Cabot Strait to Cape Hatteras has been named "the Region."

This book will revert to the subject of the fishery once again in Part II "The Epoch of the Soviet Fishery" and present some results made by fishery economists on the analysis of productivity and economic efficiency of the fishery conducted by the fleet of large tonnage vessels.

There existed certain discrepancies between the statistics submitted by the U.S.S.R. to ICNAF and the data used by the economists who obtained the information from the fishing enterprises, territorial fishing industry boards, and head offices of the northern, western, and southern basins of the Soviet fishing industry without delay, as these organizations were "hot on the trail" of the past year. They faced the task of providing the fishermen with recommendations on the use of the fleet in the forthcoming year as soon as possible.

Prior to having been submitted to ICNAF, the statistics that flowed to Moscow passed through a long process of cross-checking and amending in the hierarchy of all the management links. In terms of analysis of productivity of the fishery by vessel, the range of discrepancies recorded was quite permissible.

The data on the catches of principal industrial species and on the fishing effort both by subarea and by the Region as a whole are illustrative of the picture of commercial exploitation of the Region's resources by the Soviet fleet (Appendix Tables 1–9).

The first 3 or 4 years of the Region's development revealed fishing plots from which the most steady catches were yielded. The Norfolk area (35–41°N) explored by the scouting ships was recommended to the fishing industry in 1963 as a prospective fishing ground. Its resources included commercial aggregations of alewife, mackerel, sea herring, fish species of the Sparidae family, silver hake, red hake, black seabass, Atlantic searobin, and spiny dogfish. In particular, fishing for black seabass on the shelf at 85–100 m depths was recommended. Predicted catches for medium trawlers in winter were up to 6–8 t per fish-day fished.

Table 3. Catch data for Soviet fleets in three areas and the Region as a whole (thousand t), 1961–77.

Area	1961	1962	1963	1964	1965	1966	1967	1968
Nova Scotia	–	30	165	115	140	101	11	66
New England	67	209	231	336	500	456	268	282
Norfolk	–	–	8	28	33	131	47	53
The Region	67	239	404	479	673	688	326	401

Area	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nova Scotia	151	284	270	199	423	250	264	160	59
New England	380	166	293	407	390	299	268	160	63
Norfolk	107	102	114	81	61	52	45	45	38
The Region	638	552	677	687	874	601	577	365	160

The results of the fish reconnaissance and the fishery were summarized in the second half of the 1960s. The fishermen received detailed information on when and where commercial fishery species were found. In addition, regular checks of the Region by scouting and research ships provided fishermen with not only operative information on the density of concentrations and optimal fishing plots, but also information on the recruitment or absence of new year-classes to the stocks. Therefore, the fleet was in a position to turn up in the right place at the right time and take advantage of the periods of increased abundance of one or another fish species or stock.

The forecasts of the fish stocks made by AtlantNIRO 3 months or a year in advance, coupled with the recommendations of the fish scouting service given on a monthly or yearly basis, equipped fishery managers with the necessary knowledge that allowed them to make correct decisions as to where the fleet should be directed and what kind of fishery tactics should be employed. As a rule, the number of vessels in the Region increased after a successful fishing season or year.

Table 3 shows the data on total catches by the Soviet fleets over the 1961–77 period in the three areas and in the Region as a whole (thousand t). To judge from these data, the New England coastal waters were a major field for the Soviet fleets in the 1960s. In the 1970s, Nova Scotia and New England almost equally contributed to the U.S.S.R. "catch-box" in the Region. The Norfolk area played a prominent role during "shoulder" periods—winter and spring.

By and large, the Soviet catches in the Region held at high levels, except in 1967 and 1968. Reduced catches in those years were caused by diminished fish resources and the transfer of many vessels of large tonnage to coastal waters of Argentina and Uruguay where they harvested merluza or Argentine hake (*M. hubbsi*) and other commercial species. The 200-mile fishing zone, extending throughout the length of the eastern South American coast line, was introduced in 1968–69, which resulted in another rise in the fishing effort in the Region.

A trawl bag full of fish.

All of a sudden, the biological resources in the Region had been given a chance to recover for 2 years. It was not until the second half of the 1970s that another chance like that was offered.

Commercial exploitation of the resources in the Region had been influenced by a number of factors. The capabilities and power of the vessels, and high State plans for fishing were, perhaps, the most significant among them. Raises in fishermen's wages were directly associated with fulfillment of the plans. Therefore, each captain and each ship was striving to find dense aggregations of abundant fish species. Silver hake, herring, mackerel, red hake, haddock, and flounder in some years turned out to be such species. As a matter of fact, this spectrum of fish species met the requirements of the huge Soviet market. From time to time, though, it happened that the market became overstocked with small silver hake, lean herring, or small mackerel.

It is worth noting that the fish species mentioned above matched the technological equipment on board the ships in the best way possible. No fish dressing machines were available on the ships, and it had been due to small fish that the freezing plants were used at full power. The Party and the government demanded more genuine table fish from the fishermen; therefore, cod, redfish, argentine, and ocean pout were not disregarded.

The peculiarities of the fish aggregations' distribution and behavior on the Region shelf simplified the problem. The stocks of several fish species form there in relatively limited fishing plots within the waters known for higher biological productivity. Some species

The operation of emptying a purse seine. Not a bad catch. The captain's concern is to hand the catch over to a fish processing ship as soon as possible.

dominated these mixed aggregations, yet the trawls brought in less abundant but valuable fish as bycatch. There was no question of arranging a selective, directed fishery for the dominant species by the vessels of large tonnage, for they had been destined to take their everyday share of 30–50 t.

The results of the 17-year-long large-scale Soviet fishery in the Region are of interest from many different viewpoints. The majority of the fish resources in the shelf waters between 46–35°N and 56–76°W were covered by the fishery. During the "pre-Soviet" period, the fish stocks were primarily subjected to the influence of natural factors. The overall fishing effort exerted by Canada and the United States in the high-seas waters was negligible compared to that by the Soviet Union and others. The fishery was of a selective character: small fishing craft harvested crustaceans, mollusks, and valuable demersal fish species. The only thing the local fishermen could complain of was that their little boats were obsolete and decrepit. The waters teemed with fish, and many stocks virtually remained virgin.

With the appearance of Soviet vessels in the Region, the situation sharply changed. From its very first steps, the scope of the fishery grew. The operation of large groups of vessels of two classes—medium and large tonnage—became a common phenomenon. In terms of their dimensions and tactical and technical characteristics, the Soviet vessels of

A "bridle" for a purse seiner. A receiving-processing ship has sailed towards an SRTR to receive the catch.

medium tonnage had a great advantage over the craft of local fishermen. As for the vessels of large tonnage, they were beyond any comparison.

The local ships worked alone. The skippers operated their boats individually, guided by their seafaring and fisherman's experience. Usually, they plied their trade in their few, favorite places, sailing from one to another in search of fish. The Soviet vessels practiced a group fishery. Numerous management links were aimed at operating the groups of vessels and the fleet as a whole. The scouting ships informed the fleet of the whereabouts of fish, and the fleet purposefully maneuvered within vast areas. The captains were bound by a common goal—to be continually on fishing grounds with dense concentrations of abundant fish species.

The Soviet fishery in the 1960s–70s was utterly unique in terms of its impact on the stocks. Practically all the commercial species were under controlled harvesting. The level of impact on the resources was dictated by economic expediency. A weakened stock with

Handing over the next catch to a production refrigerator ship. It is hard to imagine SRTs and SRTRs without barrels on board.

aggregations of low density was erased from the target list. A new target—a new stock—which would serve to fulfill the State plan would then have to be found. That was the way the fish stock endurance test worked. The results of the fishery made it possible to gain insight into what levels of exploitation and removal were close to the optimum and what levels were critical and may endanger stock reproduction.

The lessons of the Soviet fishery are also useful in another respect—they give the correlation between density levels of fish aggregations and catches per effort by various types of vessels and different fishing gear. The data on the levels of fishing effort by the Soviet vessels of various classes that were operated in the Region in different years also will be helpful for the development of measures for fishery management.

The commercial ichthyofauna of the Nova Scotia and New England areas is localized due to peculiarities of the shelf structure, the dynamics of the Region's waters, the presence of numerous barriers formed by sea bed topography, and the influence of water masses of different origin. The cross-boundary species are only represented by mackerel, cod, haddock, and pollock. The other species in these waters represent confined local groupings. Considerable differences in the ichthyofauna composition exist in particular between the adjacent areas of New England and Norfolk. The presence of these spatial heterogeneities in the structure of the resources calls for analyses of their exploitation not only in the Region as a whole, but also separately by subarea.

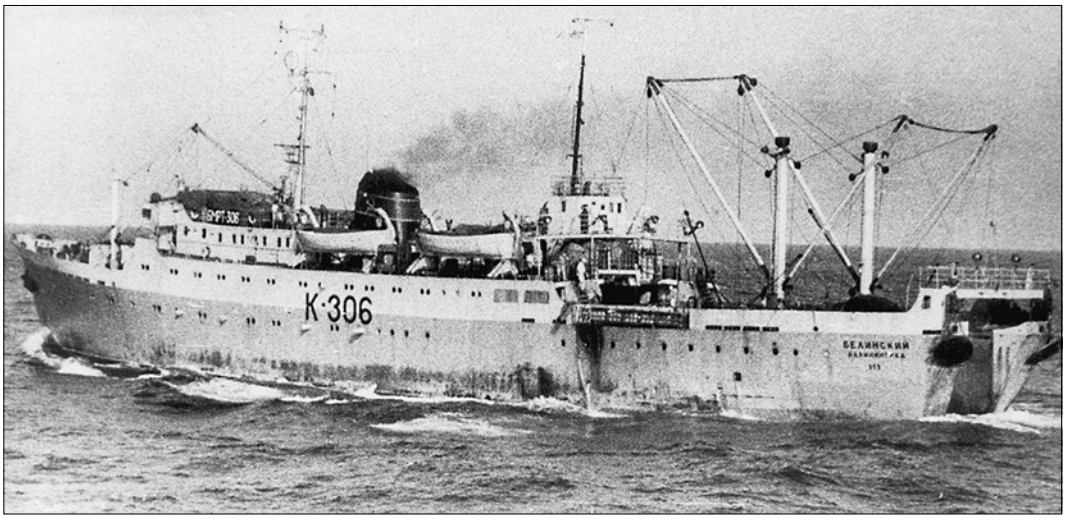
As we have already mentioned, the Nova Scotia area was firmly holding second place in the Soviet fishery in the Region up to 1969. It was only in 1963 that the volume of catches reached 40% (Appendix Figure 5). In other years, the share of catches from Nova Scotia did not exceed 25%. The fishery was based on demersal fish stocks: cod, haddock, redfish,

Deck team handling a catch of groundfish.

silver hake, and flounder. Their abundance was relatively low, and limited the scope of the Soviet fishery. The significance of one or another species increased in some years, but they did not contribute much to the catch volumes. Exceptions, though, were the silver hake catches of 123,000 and 81,000 t taken in 1963 and 1964, respectively (Appendix Table 1).

A weighty haddock catch of 45,000 t was taken in 1965, and 30,000 t of flounder were harvested in 1968. In 1967–68, the Soviet fleet fished the Nova Scotian waters only incidentally. In 1968, just four large-tonnage vessels fished on average, and no vessels of medium tonnage were engaged in the fishery (Appendix Figures 6 and 7, Appendix Tables 2 and 3).

The 2-year suspension of the large-scale fishery off Nova Scotia contributed to rehabilitation of the silver hake stocks. The fishing effort was growing. In 1970–72, the average number of vessels of large tonnage fishing in these waters annually was 13 to 18. The silver hake catches ranged from 114,000 to 169,000 t. The stock was manifestly gaining in abundance, and by 1973, 26 vessels of large tonnage were fishing there. A peak in silver hake catches amounting to 299,000 t was achieved that year. All the catches were taken by the



The BMRT *Belinsky* from Kaliningrad moving to a new fishing ground.

fleet of large tonnage vessels (Appendix Table 4). In 1974–75, a triple decline in the silver hake catches was recorded.

The herring fishery had been developing since 1969. In March, the vessels of large tonnage harvested herring on the eastern slope of Banquereau Bank with mid-water trawls; the vessels of medium tonnage used pair trawls and purse seines. The fishery lasted until mid-May. The annual herring catches constituted 65,000 t. From 1969, purse-seine fishing for herring began to develop in that area. The vessels of medium tonnage yielded annual catches ranging from 18,000 to 57,000 t (Appendix Table 5). In 1970, the herring fishing ground extended to Emerald Bank and the catch went upward, reaching 72,000 t.

The mackerel fishery was being developed in 1973–76. Redfish, flounder, argentine, and squid contributed significantly to the catches taken off Nova Scotia in the 1970s. This area took up the front line in terms of catch quantities and fishing effort.

Among observed changes in the resources, a total absence of haddock from the catches and a reduction of cod catches since 1967 can be mentioned. The total haddock catch by all nations reached 85,000 t in 1965 followed by a downtrend and a decrease in the total catch to just 18,000 t in 1972.

The importance of the Nova Scotia and New England areas for the Soviet fishery in the Region varied; but, for some reason, the fishermen gave preference to fishing off New England. This area provided more options for the fishery, as there were more commercial fishery species with stocks of higher abundance. As a whole, according to the captains, there were more aggregations and their density was higher. Indeed, unlike the Nova Scotian waters, where silver hake had been a cardinal industrial fishery species, the New England

The sea generously shares its riches with fishermen.

fishing ground offered a complete assortment of species. In the 1960s, the fishermen encountered dense aggregations of haddock, silver hake, red hake, and herring. In some years, cod, flounder, ocean pout, mackerel, alewife, and argentine accounted for the increase in total catches (Appendix Table 6).

Peak catches of several fish species were recorded simultaneously in 1965–66: silver hake (281,000 t), cod (17,000 t), haddock (81,000 t), red hake (83,000 t), and argentine (34,000 t). In subsequent years, the abundance of all these species sharply declined, causing a drop in catches. Cod and haddock were practically absent from the catches. The haddock catches by all nations during 1965 and 1966 were 155,000 and 127,000 t, respectively. This was an increase of 2–3 times the estimated maximum catch size and the actual catches in former years (50,000–60,000 t). As a result, the ability of the stock to reproduce was upset and the annual catches by all countries subsequently decreased to 5,000–7,000 t.

The peak in U.S.S.R. herring catches (150,000 t) was achieved in 1962. From then through 1969, the annual catches varied between 97,000 and 130,000 t, except for 1965 when a small catch of herring (36,000 t) was taken. This was due to the return of the Soviet fishing fleets to the Norwegian Sea where the last strong 1959 herring year-class entered the fishery before the final stock collapse. A sharp decline in Soviet herring catches off New England was observed after 1970.

Pouring catch out of the trawl.

Thus, the Soviet fishery off New England was in its prime in 1965–66. The reduced scale of the fishery that followed in 1967–68 resulted in a decrease in the area's importance to the Soviet fleet. In 1970, the share of catches taken there dropped to 30%. In subsequent years, catches from the New England and Nova Scotia areas held at approximately the same level.

A slight rise in silver hake abundance and a spasmodic growth in mackerel abundance were observed in the 1970s. These two fish species made up the bulk of the catches. Red hake and herring were the next species of significance. It can be concluded that during this period, the Soviet fleet harvested weakened fish stocks. However, this did not apply to mackerel.

The fishing effort by the fleet of large tonnage vessels reflects the changes that occurred in the state of the fish resources. The largest number of vessels engaged in the fishery was in 1965–66: 23 units on average. The lowest recorded number was in 1967–68 and 1970. In

subsequent years, the number of vessels involved in the fishery in these areas increased considerably (Appendix Figure 6, Appendix Table 2).

The average number of vessels of medium tonnage fished varied between 22 and 62 a year. The lowest recorded numbers were in 1965, 1966, and 1976–77. Large groups of ships worked there in 1962, 1967–69, and 1972 (Appendix Figure 7, Appendix Table 3). Herring was a principal industrial species during the entire period of the fishery by vessels of medium tonnage. In 1962, 1964, and 1967–69, the fleet of medium tonnage vessels yielded 77,000 to 106,000 t of herring. Over the 1963–67 and 1971–75 periods, the medium trawlers brought in sizeable catches of silver and red hake, and sizable catches of cod and haddock in 1965–66. From 1968 to 1974, they also conducted a directed mackerel fishery with annual catches of 15,000 to 52,000 t. In 1968–70, the vessels captured 5,000 to 16,000 t of alewife, and 2,000 to 3,000 t of Atlantic saury in 1971–74 (Appendix Table 5).

The productivity of the Norfolk area was inferior to that of the New England waters. A relatively small fishing area, limited number of commercially important fish species and stocks, their low abundance, seasonal character of formation of aggregations—all that did not favor large-scale fishery development.

An intensive fishery for silver and red hake, two groundfish species, resulted in maximum catches of 92,000 and 26,000 t, respectively, during 1966. The abundance of these species sharply diminished thereafter. In 1969–71, up to 75,000–90,000 t of herring and mackerel were caught followed by a decrease in the catches of these species. The catches of all fish species in quantities exceeding 100,000 t were taken only in 1966 and in 1969–71 (Appendix Table 7).

The maximum number of vessels of large tonnage—8 units—worked there in 1966. In other years, they numbered 2–5 units at most (Appendix Figure 6 and Table 2). Silver and red hake and mackerel were the major commercial species caught by the vessels of large tonnage (Appendix Table 4).

The average number of vessels of medium tonnage fished in 1969–71 in the Norfolk area was 20–29 (Appendix Figure 7 and Appendix Table 3). They mainly harvested herring and mackerel (Appendix Table 5).

From the analysis of the results of industrial extraction of the biological resources over the 1961–77 period by area, and after summing up these results for the entire area covered by the Soviet fishery from Cabot Strait to Cape Hatteras, i.e. for the Region, the conclusions in the following paragraphs can be made.

The activity of the Soviet fleets, likewise in all other regions of the world's oceans, was in the image of the Soviet Union's unique pattern of phenomenal fishery development. The government, in striving to improve the food supply problem in a huge country, staked its hopes on an oceanic fishery for abundant fish species. Most of these ranked among the species of low food value.

The Soviet fishermen harvested three fish species in the Region's waters—silver hake,

A large catch is expected. The bobbins and floats are on the BMRT's deck, while the bag full of fish is still in the water.

Barrels of fish crowd the deck of this SRT with a net in the water.

herring, and mackerel—which had been supporting the fishery for many years. Red hake was the fourth species of importance among the principal industrial fish. The share of these species in the annual catches from the Region never fell below 67%, reaching almost 90% in some years (Appendix Figure 5).

Individual local silver hake stocks existed in the three areas under consideration, and individual herring stocks were available off Nova Scotia and New England. The changes in abundance of these stocks occurred in a kind of reverse phase which allowed the fleet to "jump" the fishing effort from one area to another, making up for lost catches and avoiding total failure. Thus, weakened silver hake and herring stocks off New England in the 1960s were abandoned for the more plentiful stocks of the same species off Nova Scotia in the 1970s.

Red hake resources that yielded considerable catches now and then, as well as mackerel, which was responsible for a successful fishery in the 1970s, reinforced the positions of the Soviet fishery in the Region.

The Soviet fishery could be compared to an invisible front. The army of ships and fish-

Table 4. Percentage of catch by medium trawlers, 1961–77.

1961	1962	1963	1964	1965	1966	1967	1968
46	49	26	22	18	16	44	38

1969	1970	1971	1972	1973	1974	1975	1976	1977
35	40	24	25	20	22	21	6	1

ermen championed the interests of the government. Fighting with nature for unconditional fulfillment of the State plans was incessant. The battle's results were summarized every year. In a current year, any concerns about the next battle were put off until later. First and foremost, the current-year plan was to be fulfilled at any price. That was why the fish stocks of higher abundance and greatest density of concentration were harvested at the maximum, carelessly, with no regard for tomorrow. Inconceivably high silver hake catches taken in 1965 off New England (281,000 t), in 1973 off Nova Scotia (299,000 t), and in 1966 off Norfolk (92,000 t) are the proof. The catch sizes declined several times in the years that followed a year with peak catches. The same happened to red hake, and to herring, and to haddock, etc. Such tactics of resource exploitation were feasible exclusively because of the State monopoly of the entire fleet. The State established the rules of the game, provided high-level fleet management, fish scouting, information on the source of fish stocks, etc., while the fishermen were the cavalry of a well organized army. Obedient to the orders of their commanders, they easily found their targets, using the advantages of their "steel horses" in full until major victories were scored. More laborious matters and battles were in store for them. But they were ready for action. The high rank of a Soviet fisherman imposed a high responsibility. They were destined to furrow the ocean.

The apogee of the Soviet fishery in the Region was in 1965–66 and 1971–73 (Appendix Table 8). It was in these years that record catches of abundant fish species were taken. The achievements of the fishermen in other years were less spectacular. The bulk of the catches was taken by vessels of large tonnage, which exerted their highest fishing effort in these years (Appendix Figure 8). The contribution by the medium trawlers was also significant. The share of their catches in the total catch was 40% or more during a number of years (Table 4).

The data contained in Appendix Table 9 give an idea of the diverse fishing techniques and fishing gear used by the Soviet vessels. Expanded development of the pelagic fishery by the vessels of large tonnage was initiated in 1972. Drift-net fishing by the vessels of medium tonnage came to an end in 1963, and 1968 marked the beginning of purse-seine fishing off Nova Scotia. Pair-trawl fishing did not expand for a number of organizational reasons. Good results were shown by medium-tonnage freezer stern trawlers (the SRTM-Ks)

which used mid-water trawls. Electric-light fishing never passed the bounds of the experimental stage.

To make the picture of the development of the Soviet fishery in the Region complete, this book presents some summarized data. According to the reports for the period of 1961–77 submitted to ICNAF, the U.S.S.R. catch in the Region totaled 8,408,000 t of fish, of which 2,688,000 t (32%) were taken off Nova Scotia, 4,775,000 t (57%) off New England, and 945,000 t (11%) off Norfolk. Shares of silver hake, herring, mackerel, and red hake in the Soviet total catch taken in the Region were 36, 20, 13, and 7%, respectively. The New England area had been the most productive area. Forty-eight percent of the total silver hake catch, 74% of herring, 63% of mackerel, and 73% of red hake were taken there. The overall success of the Soviet fishery had been predetermined by the Region as a whole, while the Nova Scotia, New England, and Norfolk resources were components of this success.

PART II

THE EPOCH OF THE SOVIET FISHERY

BIRTH OF A FISHING SUPERPOWER

The spasmodic development of the Soviet fishing industry, which took the leading position in the world's fisheries in the shortest possible time, was one phenomenon of Soviet economics during the postwar years.

Preparations for a leap forward began as early as the first postwar years. The devastation caused by German troops was terrifying. The war damage dislocated both industry and agriculture, having cut gross output of the latter to 60% of the prewar records by the end of 1945.

Joseph Stalin, in his historical speech delivered in February 1946, defined the tasks of the socialist country: "50 million tons of cast iron, 60 million tons of steel, 500 million tons of coal, and 60 million tons of oil must be produced to be secured against any eventuality." In March, the law of the fourth 5-year plan of reconstruction and further development of U.S.S.R. economics in the years 1946–50 was passed at the Session of the Supreme Soviet of the U.S.S.R. Notwithstanding all difficulties, industry reorganization was picking up speed. The period of 1946–53 was notable for integral and rapid industrial growth, and in 1948 it managed to exceed the prewar level.

The situation in agriculture took a different shape. Revitalization of this branch turned out to be an extremely complicated task, and after the disaster and famine of 1946, its growth rate was very modest. A trend towards a decline in growth rate became evident early in the 1950s. In 1953, the industrial gross output showed an improvement of 2.5 times over 1940, while in agriculture it hardly exceeded the recorded 1940 level. The disproportion between development in industry and agriculture, which had already manifested itself during the prewar years, was increasing.

At the Plenary Session of the Central Committee of the Communist Party of the Soviet Union (CPSU) held in September 1953, Nikita Khrushchev portrayed a fairly grave picture of the state of affairs in agriculture, which had been catastrophic indeed.

The reforms carried out in the countryside along with the development of virgin lands improved the situation to a certain extent. On 22 May 1957, Khrushchev flung a slogan that became notorious worldwide—"catch up with and pass America," meaning the United States. In that particular case, it was all about competition with the United States in two concrete departments: production of meat and production of dairy products.

However, over the course of the 7-year plan's (1959–65) fulfillment, the gross yield of grain went down again and the production of animal husbandry products slackened. At the

Table 5. Consumption of food products by the Soviet Union (kg/capita per year).

Year	Meat & meat products	Milk & dairy products	Fish & fish products	Eggs, pieces	Bread & breadstuff	Pota-toes	Vegeta-bles & gourds	Fruit & berries	Sugar
1950	26	172	7.0	60	172	241	51	11	11.6
1955	32	183	9.1	89	183	151	69	16	18.0
1960	40	240	9.9	118	164	143	70	22	28.0
1965	41	251	12.6	124	156	142	72	28	34.2
1970	48	307	15.4	159	149	130	82	39	38.8
1975	57	316	16.8	216	141	120	89	39	40.9
1980	57	314	17.0	238	139	112	93	34	42.2
1985	61	323	18.0	260	133	104	102	46	42.0
Projected for 1990	70	336	19	263	135	110	130	68	45.5

same time, the population had increased by 11.4 million since 1958. The urban population became predominant. The rate of consumption of principal food products by the U.S.S.R. population (kilogram per capita/year) was rising slowly (Table 5).

This 7-year plan should have provided an increase in heavy industry by 85%, in light industry by 62%, in public revenues by 65%, and in real wages by 40%. Such accomplishments should have enabled the U.S.S.R. to "catch up with and pass America" by 1965 and forge ahead both in the absolute volume of production and per capita production. The output (Table 6) of the most important kinds of industrial products by the close of the 7-year plan significantly exceeded the outline that had been given by Stalin.

As is known, the Soviet Union did not succeed in catching up with America; however, the country did manage to take second place in the world in terms of industrial production (second to the United States) around the mid-1970s.

Thus, after World War II, the problem of the food supply shortage in the Soviet Union remained as keen as during the prewar time. Therefore, it was not mere chance that the idea of increasing the role of the fishing industry as the remedial means for this problem was

Table 6. Soviet output of industrial products, 1928–70 (million t).

Product	1928	1940	1945	1958	1965	1970
Oil	11.6	31.1	19.4	113.0	243.0	353.0
Steel	4.3	18.3	12.3	54.9	91.0	116.0
Coal	35.5	166.0	149.0	493.0	578.0	624.0

Table 7. Capital investments to the material-technical base of the oceanic fishery.

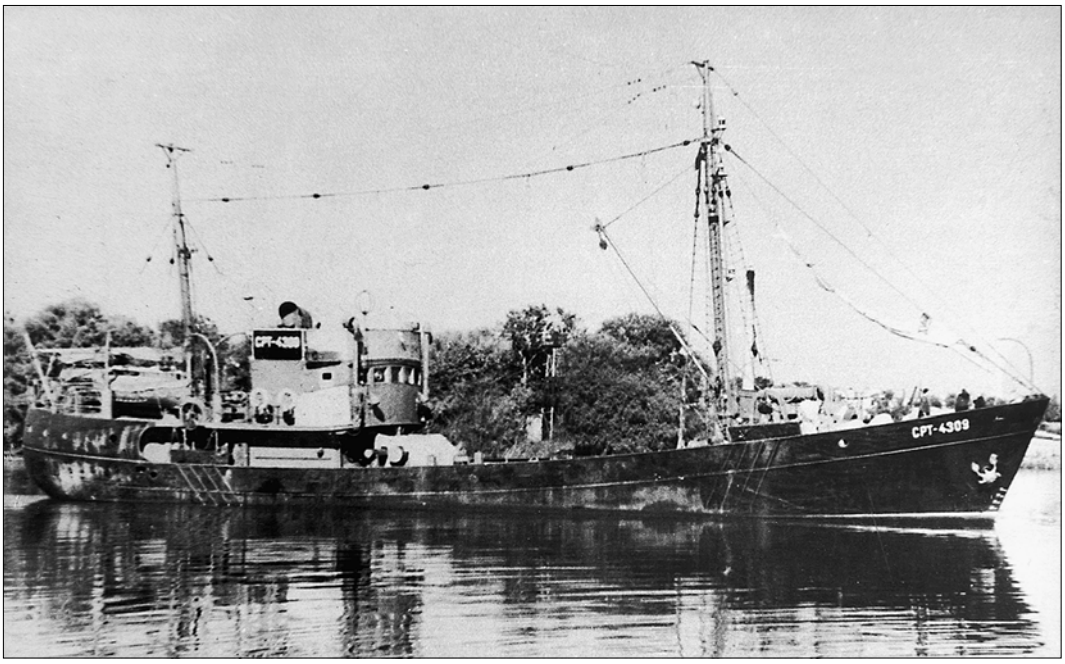
Period	Total (million rubles)	To fleet		To onshore base	
		million rubles	% of total volume	million rubles	% of total volume
1928–32	22.0	2.0	9.1	20.0	90.9
1933–37	55.0	5.0	9.1	50.0	90.9
1938–42	77.0	6.0	7.8	71.0	92.2
1943–45	66.0	16.0	24.2	50.0	75.8
1946–50	366.0	218.0	59.6	148.0	40.4
1951–55	721.0	386.0	53.5	335.6	46.5
1956–60	1,187.0	933.4	78.6	253.6	21.4
1961–65	1,731.5	1,346.3	77.8	385.2	22.2

brought forward and matured. In 1946, the government allotted the money for construction of a series of fishing trawlers of medium tonnage (the SRTs)—the first fishing ships designed to catch fish in the open ocean waters. In 1947, the fishing industry had already achieved the prewar catch level of 15.3 million metric centners (this measure of weight was used formerly in the statistical accounts in the U.S.S.R.; one metric centner is equal to 100 kg).

In 1948, the first expeditions put out to sea from Murmansk and Kaliningrad to fish herring in the Norwegian Sea. Late in the 1940s, more SRTs (loggers) were added to the fleet. The results of their performance were reassuring. In 1950, the total catch amounted to 17.5 million metric centners. It was then that capital investment to the fishing industry began to pick up speed followed by a marked trend towards faster growth of the fishing fleet. The fishing fleet became a major component of the material-technical base of the oceanic fishery (Table 7).

There will be more mention in this book of the cost, price, etc., given in rubles. Rubles were not convertible currency. The rates of foreign currencies, the U.S. dollar inclusive, were fixed by the State Bank of the U.S.S.R. During the 1946–61 period (prior to monetary reform), the quotation of US$1.00 varied within the range of 4.00–5.30 rubles. In 1961–77, US$1.00 cost 0.90 rubles. In 1977–85, the quotations of US$1.00 fluctuated between 0.83 and 0.73 rubles. The capital investment for fleet development kept growing in the years to follow: 2.42 billion rubles in 1966–70; 2.57 billion rubles in 1971–75; 3.26 billion rubles in 1976–80; and 3.51 billion rubles in 1981–85.

Behind the above figures there arises a picture of the birth of a fishing superpower, the creation of the mightiest branch on the tree, with a huge up-to-date fleet designed to conduct an active expeditionary ocean fishery. The fishing vessels of large tonnage, mothership, production refrigerator ships, and fish transport refrigerator ships were added to numerous serial-production medium side trawlers both of foreign and domestic manufacture.



A modest toiler of sea takes a rest. Hundreds of medium fishing trawlers (SRTs) worked off the coasts of Norway, the United States, Senegal, and Angola. Length: 34.7 m. Main engine power: 400 hp. Speed: 10.0 kn. Navigation area: unlimited.

By the beginning of the 1950s, the design limitations of side trawling became the unsurmountable obstacle for further development of ocean fisheries. The construction of a large freezer stern trawler (the BMRT) marked a great qualitative advance towards the development of ocean fisheries. According to plans developed by the British, East German, and Soviet designers, the first BMRT of the *Alexander Pushkin* type was built in East Germany, and the first BMRT of the *Mayakovsky* type was launched from a U.S.S.R. shipyard.

In 1955, the first BMRT of the *Alexander Pushkin* type arrived at Murmansk. In the same year, new medium trawlers of the *Ocean* type with refrigerated holds (the SRTRs) began to arrive from the German Democratic Republic. The first medium freezer side trawlers, followed by the medium freezer stern trawlers (the SRTMs) and large freezer trawlers of the *Tropik* type (the RTMTs), had been available since 1962, and those of the *Atlantik* type (the RTMAs) since 1966.

The development of the expeditionary type of fishery predetermined construction of fishing vessels of large and medium tonnage and various specialized service vessels (motherships, production refrigerator ships, fish transport refrigerator ships, etc.). As early as 1960, the U.S.S.R. fishing fleet numbered 57 vessels of the BMRT type and 1,107 units of

Table 8. Some types of fishing vessels available in the fishing industry.

Type of ship	1960	1965	1970	1975
Large freezer trawlers of the *Leskov*, *Pushkin*, and *Mayakovsky* types (designs 394 and 399)	57	160	320	435
Fishing freezer trawlers of the *Superatlantik* type	—	—	—	43
Fishing freezer trawlers of the *Atlantik* type	—	—	83	124
Fishing production refrigerator ships of the *Groumant* and *Rembrandt* types	—	—	26	28
Fishing freezer trawlers of the *Tropik* type	—	60	70	65
Medium fishing refrigerating trawlers of the *Ocean* type, 540 hp	142	131	138	138
Medium fishing refrigerating trawlers of the *Bologoye* type, 400 hp	136	184	185	181
Medium trawlers without hold refrigeration, 300–400 hp	829	798	605	242

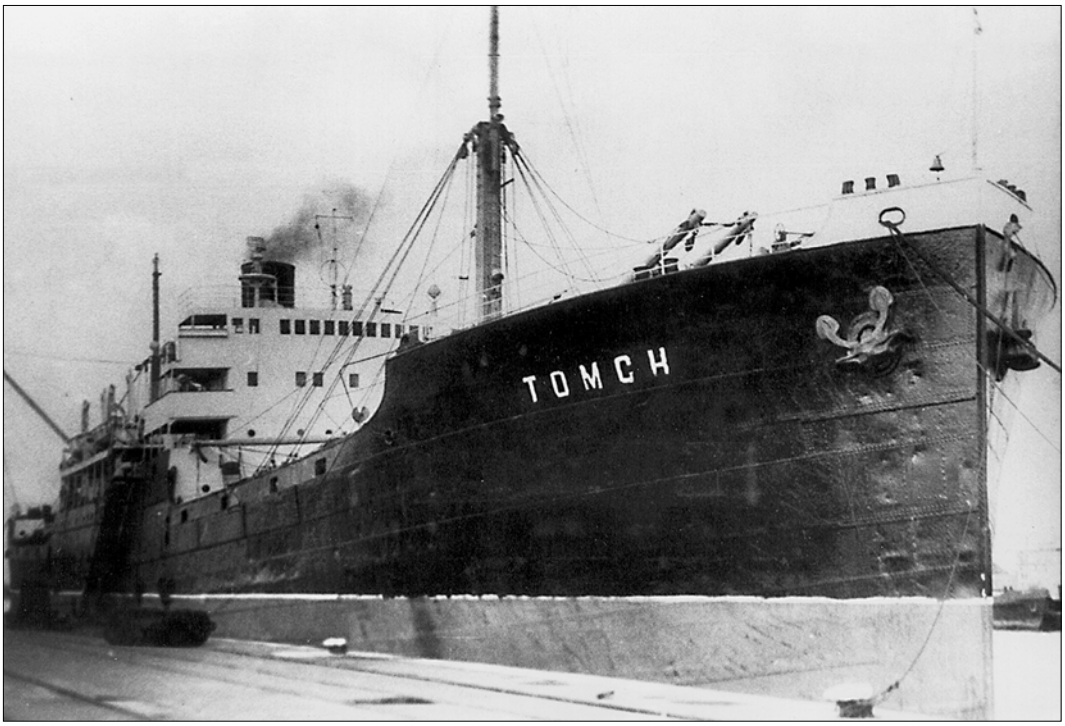
the SRT and SRTR types, which had main engine power of 300–540 hp. In 1975, 700 vessels of large tonnage of different types were engaged in the fishery (Table 8).

Over 300 fish processing refrigerator motherships of large tonnage, production refrigerator ships, and receiving transport refrigerator ships processed fish at sea and transported fishery products to ports. Several specialized fleets were engaged in whaling and fishing for tunas.

The capital funds of the fishing industry were growing like they were made with yeast, and by 1968 the fishing industry possessed 2.4% of the total capital funds allotted to all industrial branches of the U.S.S.R. The fishing industry appeared to be quite fund-intensive. However, the return was worthwhile. By 1975, the U.S.S.R. catches exceeded 10 million t (Table 9).

Table 9. Soviet catches and their proportion of the world's fishery yield.

Year	U.S.S.R. catches (thousand t)	U.S.S.R. share in world yield (%)
1948	1,575	7.6
1950	1,755	7.7
1955	2,737	8.6
1960	3,541	7.5
1970	7,828	10.7
1975	10,357	14.5



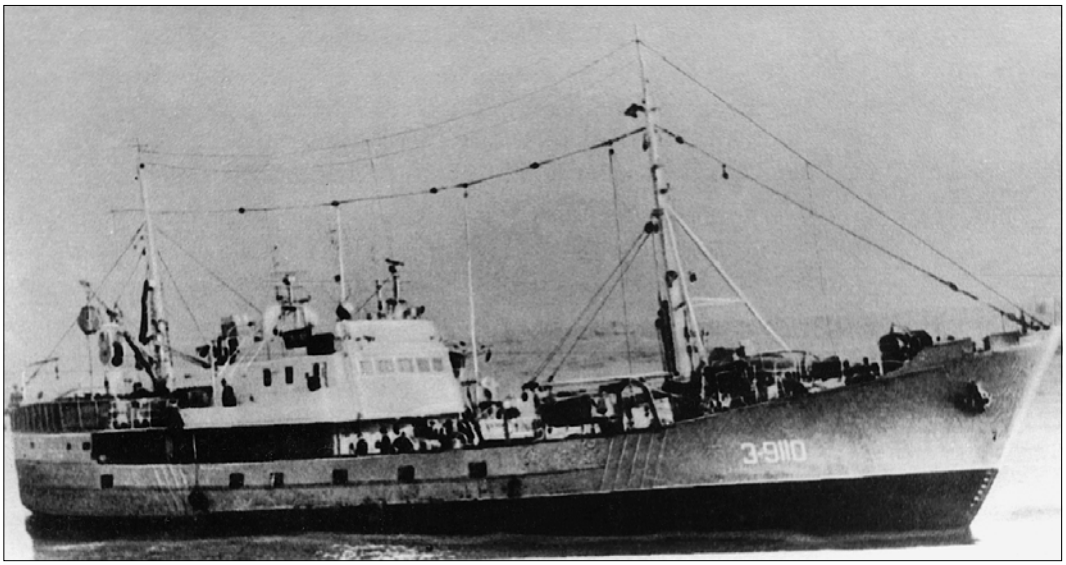
The *Tomsk*, a transport ship reequipped as a fish salting mothership, is preparing to sail during the first years of fishing in the Norwegian Sea.

In 1975, the gross output of the fishing industry was estimated at 8.8 billion rubles, and the profit—at 1.08 billion rubles.

The formation of the fishing industry in the U.S.S.R. during the postwar years falls into a phenomenal category of one of the Soviet wonders. But what had promoted this phenomenon? What kind of covert and overt wires had been pulled to call forth the heyday of the fishing industry? What factors had benefited it? Most likely, it must have been the nature of the administrative-command system or, to put it in other words, the State non-market socialism that lay behind the fabulous takeoff of the fishing industry in the U.S.S.R.

Huge investments were required to do away with the postwar devastation in agriculture. But no such means could be raised at that time. The inflow of resources to agriculture comparable to those invested in the military-industrial complex was to be started much later. Meanwhile, the lack of foodstuffs in the country was intended to be met, to a certain extent, by the fisheries, the development of which required much less resources. That settled the matter.

The administrative-command system mastered the tasks of restoration and development of heavy industry. This was due to the high concentration of the public accumulation fund



A medium fishing refrigerating trawler (SRTR) of the *Okean* type, a junior brother and immutable companion of the SRT. Length: 44.4 m. Main engine power: 540 hp. Speed: 11.0 kn. Navigation area: unlimited. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

and the centralized approach to its utilization. The centralized State redistribution mechanism entered the fishing industry onto the list of elite branches. In the Soviet industrial complex, the 1958–65 period was marked by a significant increase in capital investment and a rapid growth in credits as well as a steep rise in the industries that manufactured the means of production.

Exports of petroleum products accounted for the increase in monetary inflow. By 1970, the Soviet Union exported 96 million t of oil and oil products (almost triple that of 10 years before). Since 1973, there had been a sharp increase in prices for oil. By 1980, the Soviet exports of oil and oil products had increased to 160 million t.

The establishment of whole industrial branches—the monopolies shaped as branch ministries—was a natural function of State non-market socialism. Thus, the steel, oil, chemical, and electrical industries, and the powerful military-industrial complex, were created. Diverse types of ships designed for the commercial fishery were built in foreign shipyards during the postwar years. Large series were also launched from home yards.

The Gosplan of the U.S.S.R. (the State Planning Committee) and the other high authorities were in command of the funds for capital investment, while the Communist Party of the Soviet Union was a leading and guiding power of society. Having a leading role in the development of national economics allowed the Communist Party to advocate the principle

The captain, the most preoccupied person on board.

of unity between political and economic administrations. However, the struggle between competing branches for the funds for capital investment was violent.

According to Menshikov (1990) in his book "The Soviet Economy: Catastrophe or Catharsis?" the distribution of funds was governed by the relative power of the industrial and territorial departments. On one hand, this power was based on the standing and former accomplishments of the industrial branches, and supplemented with the personal abilities of their ministers for "beating out" or "finding the way" to the funds, as well as with their ability to hold sway over "bigwigs." On the other hand, the relative power was determined by a comparison of the importance of each industrial branch, personnel inclusive, by a rather narrow circle of political leaders. At that, the maximization of production, either in natural or monetary form, manufactured by the branches was a key problem for the ministries and departments. The gross output was a factor of primary importance. To get stable funds for development, a branch had to fulfill the State plans. The more capital funds that were accumulated by the industrial branch, the more capital investments that were allotted for its future development. The "report-intensive" and fast growing industries enjoyed a special authority.

These exact features distinguished the fishing industry. Since the 1930s, it had been steered by Alexander Ishkov, the People's Commissar in 1940–46, later the U.S.S.R. Minister of Fisheries up to 1979.

Ishkov was born in 1905 in a worker's family. He began as a worker himself. In 1927 he joined the Communist Party. He had been holding leading positions in the fishing industry since 1930. He did not receive a higher education until 1957, graduating from the Rostov Teacher's Training Institute.

A thickset, sturdily built man with the heavy features of a typical Russian face, an open and imperious look in his gray eyes, and a reserved manner, he had been known for native

wit, firmness of purpose, and business acumen and sharpness. He was in his element among simple fishermen, in the corridors of power, and in the society of foreign diplomats. He absorbed new trends and ideas like a sponge, but was also capable of generating his own projects. He was one of those statesmen and national economy figures who was up to most complicated tasks related to the construction of the new society.

Under his leadership, the fishing industry fulfilled and exceeded the State plans and always justified the confidence of the Party and the government. The fishing industry was a graphic example of a "report-intensive" industrial branch. Ishkov was decorated with four Orders of Lenin, and in 1975 he was given the most honorable title of Hero of Socialist Labor.

The services of Alexander Ishkov are difficult to overestimate; however, the fishing industry as a national economy branch would have never succeeded had it not been backed up by such prominent statesmen of the U.S.S.R. as Anastas Mikoyan and Alexey Kosygin. The preferences of Kosygin, the Chairman of the Council of Ministers of the U.S.S.R. since 1965, were given to light industry, the basic branch responsible for the increase in the standard of living of the country's population. But his concern addressed the food problem as well, and he always rendered invariable and effectual assistance to the fishermen.

FLOATING CITIES IN THE ATLANTIC

Thus, the development of the material and technical bases in all branches of the national economy and the progress in commercial fishing technology created the conditions for extending the area of fleet activity in the ocean in the 1950s. Upon arrival of the first BMRT at Murmansk, the Northeast Atlantic and the Newfoundland area were being regarded as regions for her service.

In May 1957, the residents of Kaliningrad rejoiced at the sight of the first BMRT, the *Kazan*. The local Party authorities and economic executives decided to dispatch the vessel to the West African coast. It was a revolutionary step indeed as, actually, there had been no information available on fish resources in African waters. Two small seiners included in the expedition were equipped with drift nets. The experience of drift-net fishing for herring gained in the cold waters of the Norwegian Sea was supposed to be duplicated in the tropics and the equator. Later, there would be many more blunders like this.

Nevertheless, the beginning of the "conquest" of the ocean was marked. Late in the 1950s, hundreds of SRTs were fishing for Norwegian herring in the Northeast Atlantic, at times incredibly close to each other. Sometimes up to 600–700 ships, with their drift net lines, converged upon small fishing plots. At the same time, more and more BMRTs arrived at the ports of Murmansk, Leningrad, Kaliningrad, and at Soviet ports of the Baltic Sea. The Party approved of the fishermen's aspirations to set out farther and farther from native shores; however, the Party also demanded hard work and still higher catches.

Table 10. Soviet wholesale price for major types of fishery products, 1968.

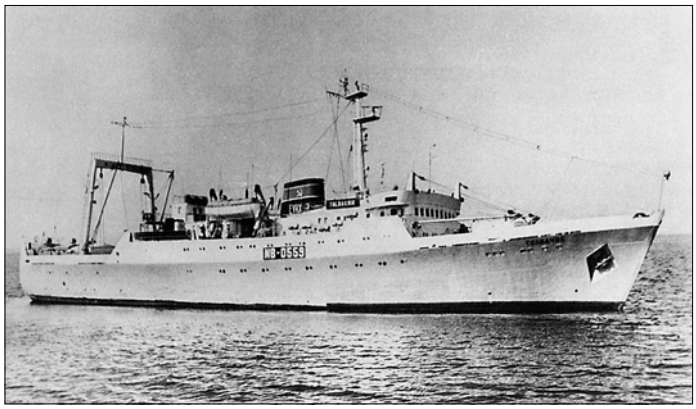
Product name	Wholesale price per 1 metric centner (rubles)
Frozen fishery production	
sardine	60.97
horse mackerel	43.55
bream (Sparidae)	42.68
merluza (*Merluccius capensis*), ungutted	26.13
merluza, gutted	43.55
merluza, fillet	56.61
herring	62.00
argentine	47.90
silver hake	52.26
red hake	34.84
cod, ungutted	32.23
cod, gutted	43.55
cod, fillet	56.61
Salted production (accounting price)	
herring, semi-finished	55.20
ready herring, processed ashore	70.40
ready herring, processed at sea	78.86
Fish meal	55.00

Large freezer trawlers (the BMRTs) had been designed as refrigerator ships for relatively small fish. Their rate of freezing, 30 t/day, was considered high at that time. Somewhat later they would be compared to empty drums for their lack of fish processing equipment, filleting machines in particular.

In the early stages of the ocean fishery, the theory was generally accepted that the fleet and the fishery were objectively intended to meet the requirements of society by providing a relatively uniform food source. Besides, it was deemed that there was no reason whatsoever to set high prices for unique delicacies, as there was no social inequality or stratification for the poor and the rich in Soviet society. The wholesale prices for fishery products seemed to be set once and for all. They could hardly be changed.

The wages and the living standard of the people in the Soviet Union have never been high. As compensation, the Party exercised strict control over the prices for food products. To a certain extent, they could only be increased for new nontraditional fish species. Wholesale prices for major types of fishery products in 1968 are given in Table 10.

As can be seen from the above data, the prices, besides being made level, were also askew. Merluza and cod, the species regarded as high-value products worldwide, were cheaper than the low-value sardine and horse mackerel, while the prices for herring were the



The 1960s. "Sea Iron," a key chessman on the fishery chessboard: a large freezer trawler (BMRT) of the *Pioner Latviyi* type. Length: 75.0 m. Main engine power: 2,000 hp. Speed: 12.3 kn. Berths: 97. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

highest. By just changing the name of merluza to silver hake and hake caught in the Northwest and Southeast Atlantic, the Minister of Fisheries managed to insist on setting higher prices for these fish species. The prices for food products, fish inclusive, emphasized the non-market nature of State socialism. The absurd situation persisted when a number of valuable groundfish species had been considered to be not profitable enough for the fish branch and were neglected by the oceanic fleet.

Thus, the principal species harvested during 1958–62 on the Grand Bank, off Newfoundland, were redfish despite the presence of dense cod and flounder concentrations. In the Southeast Atlantic, the fishermen captured nothing but horse mackerel and South African pilchard (*Sardinops sagax*) while merluza, before it was given the new name of hake, was not fished at all. This approach was responsible for the fact that a directed single-species oceanic fishery took the lead at the first stage of ocean development: herring in the Baltic, Norwegian, and North Seas; redfish on the Grand Bank; sardine off Northwest Africa, etc. The populations of these abundant fish species ensured high catches and supplied large quantities of cheap frozen fishery products so much in need at that time in the country.

In 1961, the extensive development of the Southeast Atlantic began; and in 1962, the U.S. and Canadian shelf and the Central Eastern Atlantic, which turned out to be the main fishing areas for the Soviet fishery in the Atlantic Ocean. In 1964–66, up to 80% of the fleet's fishing activity was concentrated in these areas. The groups of newly built ships of large tonnage arrived in the fishing areas. The catches were growing, and the small-size frozen pelagic fish were being supplied to the Soviet market in great numbers.

Meanwhile, the tension from the food shortage in the country was markedly reduced. The enormous quantities of frozen small-size pelagic fish supplied to the market exceeded the consumers' demand. The problem of commanding a ready market intensified it. The consumer preferences shifted to groundfish species. A demand for the so-called "table fish," more valuable in terms of gustatory qualities, sharply increased. Since 1965, fishing for

Table 11. The ships of large tonnage of the three head offices on 1 January 1973.

Type of ship	HO Aztcherryba	HO Sevryba	HO Zapryba
Large freezer trawlers (the BMRTs)	3	81	146
Large freezer trawlers of the *Altay* type	–	21	–
Large fish canning fishing trawlers (the BKRTs)	3	–	–
Fishing production refrigerator ships (the PPRs)	8	19	–
Fishing freezer trawlers of the *Atlantik* type (the RTMAs)	61	–	26
Fishing freezer trawlers of the *Tropik* type (the RTMTs)	46	–	23

horse-mackerel and pilchard in the Southeast Atlantic had been forbidden, and the fleet reoriented to a hake fishery.

From the mid-1960s, some areas were getting increasingly oversaturated by the fleet, and by the end of that decade, fisheries on the entire shelf of the Atlantic had been developed by the Soviet fleet.

The fleet began to utilize the fish resources in all the areas on a regular basis. The planned division of the fleet into areas of the fishery was being undertaken with respect to the predicted state of the stocks. The administrative structures had already taken shape by that time. In 1962, the head offices (HO) of the basin fishing industry were established: Head Office of the Northern Basin in Murmansk (HO Sevryba) in the north; Head Office of the Western Basin in Riga (HO Zapryba) in the west; and Head Office of the Azov and Black Seas Basin in Sevastopol (HO Aztcherryba) in the south. HO Zapryba encompassed the Kaliningrad, Leningrad, Lithuanian, Latvian, and Estonian fishing industry boards. The data on the structure of the fishing fleet of large tonnage as of 1 January 1973, given in Table 11, is an eloquent testimony of the might of the three head offices.

This great Soviet armada in the Atlantic Ocean numbered over 430 vessels altogether. Not infrequently, one of the fishing areas was jammed with a hundred or so ships of large tonnage and plenty of ships of medium tonnage. They were escorted by fleets of auxiliary ships. A myriad of lights lit up the night sky in different latitudes. They were Russian cities floating in the ocean. Their population reached ten thousand men. The air was filled with Russian speech. Fishery councils held by different fleets were endless. In radio rooms, the information on fish availability was picked up carefully, and the ships, single and in groups, set in motion eager not to waste precious moments. Everything was subjected to a sole

purpose—be continually "on fish," and never stay empty handed. Never before had Russia seen so many seafarers.

In 1975, the industrial and production staff in the Ministry of Fisheries totalled 425,000 persons (181,000 being employees of the above-mentioned head offices). The majority of this contingent, approximately 250,000 men, was bound up with the sea.

The life of Russian seamen has always been harsh. The lack of refrigerators on the ships of the SRT type, for example, was commonplace, and the seamen used to eat salted beef. Those trips lasted three and a half months. The work of the fishermen handling drift nets in the stormy Atlantic defies description. For the first time ever, some conveniences were introduced on the vessels of large tonnage. However, in the beginning of the fishery era, the fishermen were deprived of any contact with shore, with the earth, during the 4–6 month long trips. In fact, they gave themselves up to voluntary confinement. They were not aware how dangerous those prolonged trips were.

It was only in 1966 that a resolution of the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the U.S.S.R. passed, according to which, in addition to measures aimed at developing fishery economics and improving the quality and assortment of fishery products, the Ministries of Public Health and Fisheries of the U.S.S.R. were entrusted with investigating the working conditions and leisure opportunites of the crews on commercial fleet ships and approving recommendations ensuing from such investigations. The experiment was carried out in the Northwest Atlantic area. The choice was not incidental. In winter, sailing there meant facing heavy weather conditions, strong northerly winds, storms, icing of the ships, etc. The crews of three ships of the BMRT type (a total of 250 seamen) were kept under observation. The trips lasted 175 days, and one port call in a foreign country was planned after 90–100 days at sea. Normally, a trip duration there used to be 135 days with no port call. What did the results of the experiment show? After 80–100 days at sea, changes in psycho-physiological functions were observed, particularly in the central nervous system, in the nervous-psychical sphere, in the cardiovascular system, in the system of blood factors, etc. Proceeding from the physiological criteria, the physicians concluded that the maximum permissible trip duration in that area, which was unfavorable in terms of the weather conditions, must be 140 days. But as it turned out, a way was found to prolong the trips. In the physicians' opinion, after 80–90 days at sea, a port call of 3-days duration, with a special recreation program (collective walks, city tours, movies, shopping, general relaxation) could be a perfect prophylaxis for the crews with this condition. In this connection, the final recommendation stated: a BMRT trip could last 150–160 days, back passage inclusive, provided that there was a port call for recreation of the crew.

During 1973–77, new trip schedules were introduced in all the enterprises of the Western Basin. The country was supplied with more fish, and the fishermen had to be content with a port call in a foreign country and a delayed return to the homeland and their families.

August 1966, early in the days of the Soviet fishery. Astronaut Alexey Leonov and regional leaders of the Communist Party and fishing industry in the Kaliningrad fishing seaport after their visit to the mothership *Pionersk*.

They had no idea that any experiment had been conducted, they just proceeded with their protracted odysseys. Thousands of miles away from their native shores, somewhere between the Arctic and Antarctic, they set and hauled their trawls day after day, sought fish, found them, and unloaded them to be shipped to their country. The U.S.S.R. catches in the Atlantic Ocean increased 9.5 times from 1950 to 1980 (Table 13).

Table 13. Soviet catches, Atlantic and total, 1940–90 (thousand t).

Catch	1940	1950	1960	1970	1980	1990
Atlantic Ocean	243	402	1,717	3,823	3,812	3,852
Total catch	1,309	1,655	3,509	7,783	9,486	10,561

Early in the 1970s, the fishing areas of the Atlantic Ocean became "saturated" with the Soviet fishing fleet. The tactics and specialization of each of the three head offices in the development of these areas was earmarked, and the expeditionary oceanic fishery came into being. Its scope involved the following areas:

- the Northwest Atlantic (Grand Bank, and off the coasts of Newfoundland, Labrador, West Greenland, Nova Scotia, New England, and Norfolk);
- the Northeast Atlantic (the Barents, Norwegian, and North Seas, and off the coast of East Greenland);
- the Central Western Atlantic with the Gulf of Mexico;
- the Central Eastern Atlantic with the banks for commercial fishing in the open ocean;
- the Southwest Atlantic (beyond national fishing zones);
- the Southeast Atlantic;
- the near-Antarctic areas (the krill and finfish fishery); and
- the Indian Ocean (the province of the HO Aztcherryba activity).

The Grand Bank, off Newfoundland, and the Labrador waters of the Northwest Atlantic were developed by the Soviet fleet first, followed by the Nova Scotian Shelf (NAFO Subarea 4), New England (Subarea 5) and Norfolk (Subarea 6). For the purposes of analysis and management of the fishery, the Ministry of Fisheries and head offices often considered the latter three areas a single entity. As distinct from the Grand Bank and Labrador, they were known under the name of Northwest Atlantic.

Hereinafter, wherever the Nova Scotia, New England, and Norfolk areas are mentioned as a single entity, the term "the Region" will be applied for convenience.

GRAND MANEUVERS

The fishing industry of the U.S.S.R. experienced a number of reorganizations and transformations in the course of its development. In 1957, by resolution of the Central Committee of the CPSU, the Ministries of different industrial branches were replaced by regional Councils of National Economy ("sovnarkhozes"). The model of centralized planning and management of complicated and diversified national economics seemed to become obsolete. By 1962, however, the fishing industry was withdrawn from the Councils of National Economy, and the central administration structure was reestablished—and additional basin formations arose between the center and the fishing companies. In 1965, as a result of the reform carried out by Alexey Kosygin, control of the industrial branches reverted to the center.

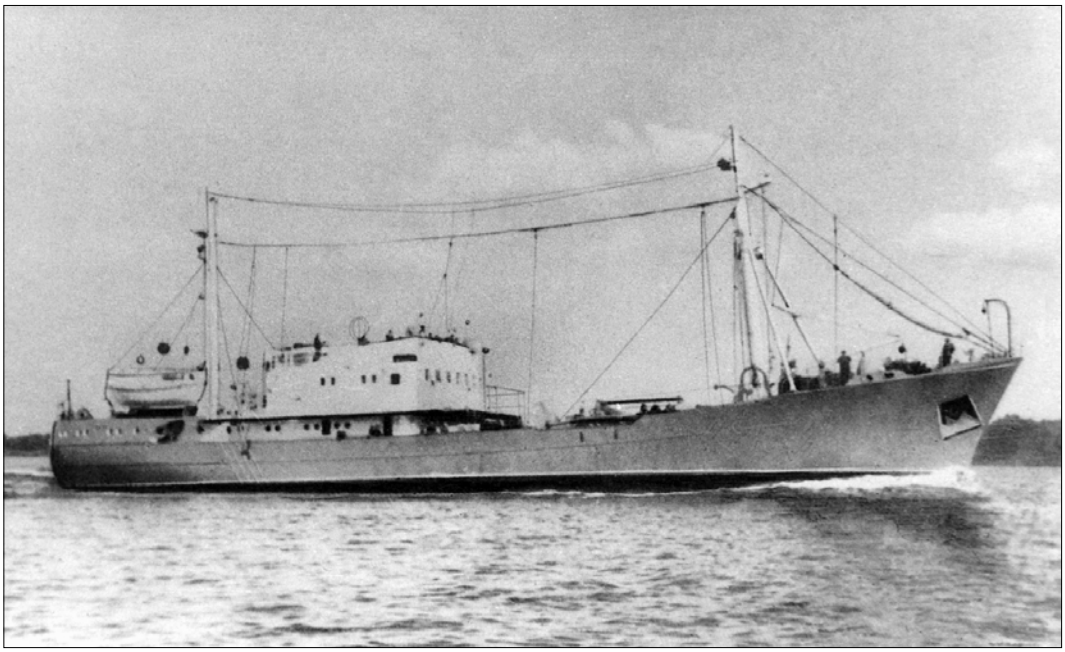
In the first half of the 1960s, the economic criterion was of no great importance for assessment of fleet operation. The allocation of the fleet by fishing area was determined by

Right in the middle of the burning sun in the Gulf of Guinea.

catch size. The records of economic indices were only present in final reports of the fishing companies, the territorial fishing industry boards, and the fish branch. Transition of the fishing industry to the economic methods of planning took place after the September plenary session of the Central Committee of the CPSU (1965). The directives for industrial companies involved the following: quantity of products produced; principal nomenclature of goods; volume of centralized capital investments; terms of putting production capacities and capital funds into operation in line with centralized investments; plans for development and integration of the new technique; volume of fish harvested, materials, and equipment supply; wage fund; revenue (profitability volume and level); and indices of relations with the budget.

Thus, the activity of the companies, the head offices of the basin fishing industry, and the fishing industry as a whole became subjected to the task of producing adequate product volume to meet the requirements of the consumer. The revenue and wage funds became important indices. All major economic indices of industrial production assumed the value (monetary) form. Therefore, special attention was given to the problem of price improvement.

In view of the reform and introduction of the new planning system, the Ministry of Fisheries. developed differentiated standards for the catch and output of fishery products per day while on the fishing ground by vessel type, fishing area, and fish species. To substantiate these standards, vessels of different types put out to sea for experimental trips. The standardization system encompassed practically all aspects of vessel operation. So, even standard distances from home ports to fishing areas were introduced, along with standard annual average operational vessel speed and average sailing speed by season. For example, the standard distances from the ports of Kaliningrad, Riga, and Tallinn to Norfolk Canyon were estimated at 4,000; 4,173; and 4,230 miles, respectively.



A medium freezer trawler (SRTM) of the *Mayak* type. The waters off the U.S. east coast had been the most preferable fishing area during the 1960s–70s. Length: 50.2 m. Main engine power: 800 hp. Speed: 12.0 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

The Ministry was given the task of ensuring the maximum yield of fish and the production of high-quality fish, food, and nonfood products to meet the requirements of the population of the country—all with the minimum expenditure of social labor. The reform served as the impetus for rapid development of research involving economics, organization, and planning of the fishing industry. In a number of institutes pertaining to the fish branch, such as AtlantNIRO, PINRO, and the State Commercial Fleet Design and Engineering Institute ("Gyprorybflot"), laboratories of economic research were founded. The school of the fishery economists was being created.

The problems of economic assessment of fish resources under exploitation, and the study of the factors influencing the efficiency of the fleet operation, were put forward as those of paramount importance. But at first, as usual, the ideological platform had been furnished for fishing industry economics. Such a scientific-methodical foundation, also used in economic research carried out by any other branch, was Marxist-Leninist dialectical materialism.

In a fishery, the productive forces, by making use of the means of labor, deal with "the articles of labor given by nature itself" (Karl Marx)—the fish and the marine life. To put it

in other words, in this sphere of activity the people have to do with the articles of labor that exist immediately in nature, ready-made: a human being does not take a hand in their creation. The term "raw materials" can be applied to any article of labor for the yield or production for which a human being uses his hands. The harvested fish, the marine life, the whales, and the products of the sea are raw materials for the fishing companies.

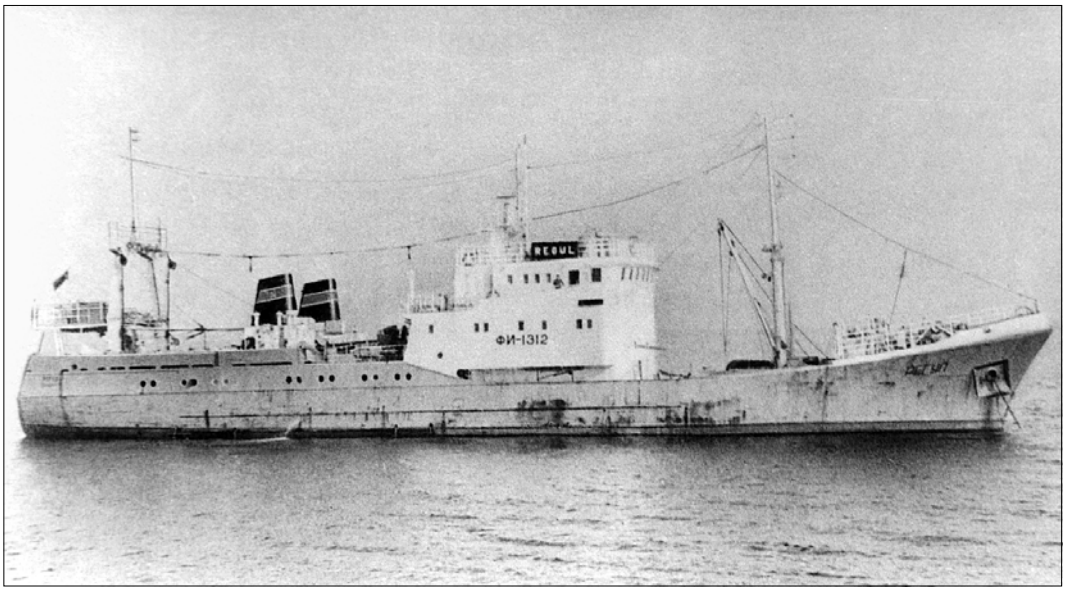
Since the commercial fleet produces raw materials by way of extracting natural resources from the sea, the availability of raw materials is an indispensable condition for its operation. In the 1970s, the source of raw materials for the fishing industry was defined as "… the maximum accessible and economically expedient part of the natural stocks of definite fish and sea animal species in a body of water which can be utilized by a given state without prejudice to natural reproduction. The amount of raw materials available is equal to the entire resource, but will be unreachable given a rational fishery. It is not a diminishing value; it shows a trend towards expansion related to continuous development of productive forces" (Sysoyev, 1970a).

By that time, "a given state" (i.e. the U.S.S.R.) had been making use of enormous productive forces and means of production in the ocean. Besides, during the historical period of extensive growth of communism, the country had been in a permanent state of peaceful competition with capitalism. As far as the ocean was concerned, such "competition" took place in neutral waters. According to the Soviet specialists in international law, the commercial fishery species were "no man's" before the harvest because the natural environment that had supplied them belonged neither to the socialist nor to the capitalist countries. Under the conditions of such competition, the ocean's living resources experienced heavy fishing pressure worldwide.

Since January 1, 1965, the U.S.S.R. fishing fleet operations had already covered 20 fishing areas. This provided an opportunity to make a comparative analysis of fleet activity and investigate the factors that influenced the efficiency of this activity. These could be reduced to several major groups.

Group 1 included the factors of productive time. Loss of time for repair and time lost for passage to and from the fishing areas was noted. Lost time in the fishing areas (unloading the fishery products to motherships and transport refrigerator ships) caused considerable variation of ship-days fished per average-on-list ship (total calendar time of the ships on the company roster—a year—and their average number over the calendar period). Downtime during repairs (non-operational time) and the time lost in transit to fishing areas were the most important factors within this group.

Group 2 involved the natural factors affecting the state of the fish stocks in the fishing areas. Biological productivity, stock size, distribution and behavior pattern, and density of various fish populations determined productivity per ship-day fished, the value of the seafood products, and the profit. The fleet placement factors or the factors of fleet division into areas of fishing, a term adopted by the economists, were indicative of the distribution of the



A medium freezer stern trawler (SRTM-K) of the *Zhelezny Potok* type. The waters off the U.S. east coast had been an optimal fishing area during the 1970s. Length: 49.4 m. Main engine power: 1,000 hp. Speed: 12.0 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

fleet by fishing area throughout the year. Cost factors per average-on-list ship reflected the interrelations between the fishing industry and other branches of the national economy and showed in the prices of the vessels proper, as the principal means of production, and of the materials, fuel, and so on.

With an excessive proportion of the fishing fleet operating in the Atlantic, making economic assessments of the resources in different fishing areas and giving detailed recommendations on fleet allocation were among the tasks of the economists. Of course, the forecasts of fish stock sizes made by the biologists, the seasonal character of the fishery in one or another area, and the production and technical factors were taken into account in their estimates and recommendations. The seasonal character of the fishery, which had been assumed as one of the causes for the development of the Soviet expeditionary oceanic fishery, was given much prominence.

Fish populations are notable for differing rhythmical changes in physiological processes and biological activity timed to recurrent environmental changes. Fish behavior, density of populations, etc., undergo changes in the course of their annual life cycle. The level of productivity of the fishery changes accordingly. When the fishing flotillas harvest stocks in several oceanic areas in which the fish aggregate densely, at different times, the fleet has an

opportunity to maneuver and to select the most expedient option, from the economic viewpoint, for fleet allocation throughout the year.

A scrupulous analysis of fleet activity was required for economic evaluation of the fishing areas. Results of the analysis were opportunely sent to the fleet organizations in the form of recommendations, and their chiefs were always well informed and could make decisions as to when and where their vessels should be directed.

Concentrating the fleet on the largest fish resources and taking the largest possible catches became the principle, as well as the result of dividing the fleet into different areas of the fishery. The fishery managers were roughly aware of what kind of fish were in the areas, what quantities would be captured, what kind of products would be manufactured, what the expected profit would be, and how many service vessels would be required to deliver the fishery products from the fishing areas to ports of destination.

The estimate of efficiency of vessel utilization was based on quantitative and cost indices. The most important of those were the following:

- catch of fish (metric centners);
- manufacture of products (metric centners);
- commodity output (thousand rubles);
- production costs (thousand rubles); and
- profit from manufactured products (thousand rubles).

In order to estimate the results of operating single-type vessels from different fishing bases, standard units were compared:

- per ship-day fished: a measure of the direct productivity of the fishery;
- per day of operation: a measure of the productivity of the fishery with regard to fleet time used (peculiarities of fishing conditions and geographic locations of the fishing areas relative to ports of register); and
- per average-on-list ship: a complex final index indicating results of fleet activity for a given period.

The indices calculated as per average-on-list ship gave the most thorough and complex idea of the use of the commercial fleet by the company as a whole. They showed the results of operating a single-type vessel group converted to one average-on-list ship—and this indicated the degree of efficiency in utilizing the main industrial funds.

Relative indices were used to demonstrate the influence of factors affecting the economic results of vessel operations: the coefficient of the fishing time used during the vessel operation period, the coefficient of the raw materials used, the average price of 1 metric centner of finished product, and so on.

Profit was the basic cost criterion used to assess and compare the work of fishing vessels. The complex economic analysis of the work of the fishing vessels revealed the interre-

lationships of quantitative and cost indices and their influence upon profit. The quantity of commodity output immediately related to the productivity of the fishery (catch per ship-day fished) exerted a direct influence on the profit level.

The relationships between catch and product output in bodily form and in terms of money were stipulated by the following:

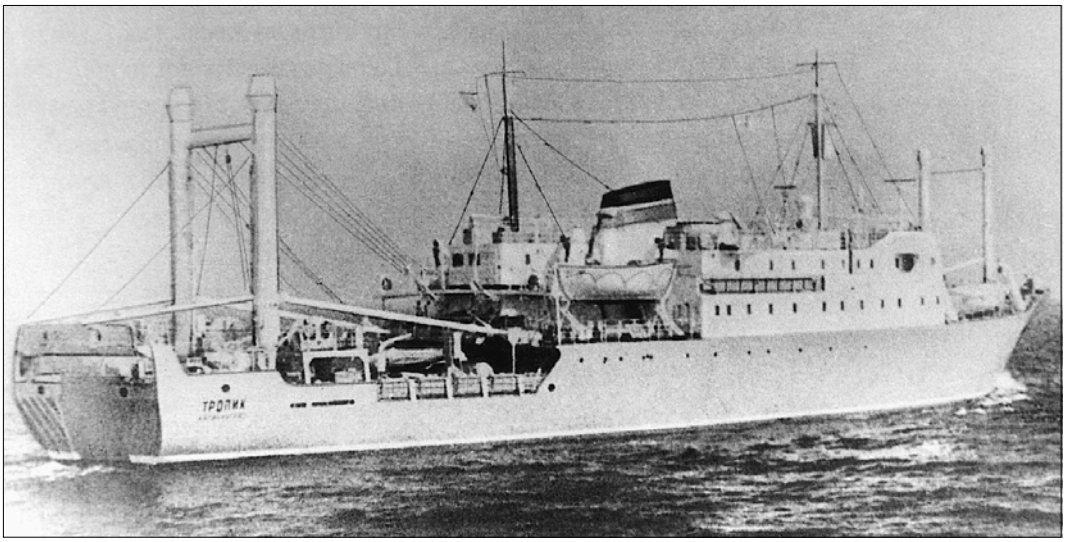
- the quantity of manufactured product, which, as far as the large tonnage fleet was concerned, was related both to catch size and to species composition of the catch (the coefficient of natural resource utilization). This quantity was determined both by the amount of fish intended for reduction to fish meal and the amount of fish processed aboard ship (gutting or filleting) depending on the vessel operation area. For the medium-tonnage fleet, the coefficient of natural resource utilization depended on the type of primary fish processing (salting or delivery of refrigerated or frozen fish); and
- the average price for 1 metric centner of product being a derivative of the species composition of the catch and of the fishing area in the long run.

The quantity of commodity output per ship-day fished was a qualitative estimate of productivity of the fishery which directly stipulates profitability or unprofitableness of the fleet operation.

The indices obtained in terms of cost were compared with the expenses of the fleet, which involved these expenses:

- direct manufacturing expenses immediately related to the product output (these expenses had been rated and calculated in advance per 1 metric centner of products produced by a definite vessel type in a definite fishing area);
- average operating expenses of the ship per trip; and
- all kinds of expenses incurred on shore (repair, management, and procurement).

The index of economic efficiency of ship operation in the fishing areas equalled the difference between the commodity output and the operational-temporal and direct manufacturing expenses. The ships put out to sea year-round, and the economists arrived at a simple solution: link the fishing areas to the specific date of the ship's departure. For this purpose, the average results of ship operation in the fishing area per average ship-day fished recorded in the previous years were reduced to the average number of days per trip (the BMRT trip duration was 135 days in the Northwest Atlantic and 175 days in the Central Eastern and Southeast Atlantic). Tables and diagrams were then drawn up in which the expected average indices per trip were indicated against each month of the forecasted period (1 year) for a ship scheduled to leave that same month. For example, the best trip indices for the ships departing between January and mid-March were expected to be achieved on the Irish shelf, while for the ships departing after mid-March it was in "the Region" (i.e. the area between Cabot Strait and Cape Hatteras).



A new ship series of the 1960s. A fishing freezer trawler (RTMT) of the *Tropik* type. Length: 71.0 m. Main engine power: 2 × 670 hp. Speed: 12.45 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

Division of the fleet fishing effort into areas of fishery, i.e. its alternation by fishing area and period (season), became the major factor that predetermined the productivity of the oceanic fishery. In some cases, when, for instance, the fishing conditions in one of the areas deteriorated for a long time, large groups of vessels were switched over to other fishing areas.

UP PRODUCTIVITY OF LABOR!

The fleet was the core of the fishing industry, and the steady source of raw materials (i.e. fish) was the basis for its activity. However, when the productive forces and the means of labor reached such a high level, the problems of their management—gaining optimal proportionality between all the links of the complicated economics—and provision for permanent growth of labor productivity took on a special significance.

Multilateral economic investigations were required to solve these problems. The problem of optimally planning capital investments was studied in detail. Unfortunately, the investigations lagged behind the development of the fishing industry, and very often problems such as incompatibility of production capacities of interrelated fishing and transport fleets, incompatibility of fishing and processing fleets, incompatibility of the fleet and the

A festive occasion on the equator in honor of Neptune. The ultimate aim of this BMRT cruise is fishing off Namibia.

shoreside fish processing facilities, and incompatibility of the fleet and the ship-repair plants were recorded with hindsight.

Economic and mathematical simulation was a proviso of paramount importance for improving the methodology of both the national economic plans and the plans of separate industrial branches. For this purpose, the economists developed a number of models: models of long-term planning of the development and distribution of the material and technical basis for the oceanic fishery, models of optimal fishing fleet structure to match the peculiarities of the natural resources in all Atlantic areas, models for optimizing the interaction between the fishing and processing ships for product manufacturing, and so on.

Labor productivity was one of the principal subjects of research. The economists singled out several factors responsible for the increase in this index. The improvement in fishing fleet structure and the addition of new, more efficient vessel types was of principal importance.

Bringing the fleet operation calendar to perfection by way of reducing the time lost for ship repair was the second factor aimed at increasing labor productivity in the fish extractive branch. In this respect, updating the technological level of the ship-repair base was determinant.

Introducing advanced technology for catch processing based on the use of state-of-the-art technology, which led to the rise in price for products manufactured from fish, was the third factor contributing to the increase of labor productivity.

To secure the rise in labor productivity in the future, increasing the degree of mechanization and automation of fishing and fish processing techniques on board ships was recommended. This increase in mechanization and automation was deemed necessary to reduce the expenditure of manual labor in the oceanic fishery.

The duty of providing the Western Basin with all necessary analytical information was imposed upon AtlantNIRO. At the request of HO Zapryba, the Institute committed itself to a detailed analysis and interpretation of the activity of all the basin companies and to developing recommendations for improving their efficiency.

The economists studied the problems of concentration, specialization, and cooperation of production. In 1970, HO Zapryba had 47 companies, 183 large-tonnage fishing vessels, and 534 medium-tonnage vessels. It was a branch within the branch, with a broad network of fishing companies and subsidiary production facilities.

The study of the economic activity indices of the companies with varying levels of production concentration showed that the process of concentration could not be infinite in terms of efficiency. The optimum level of production concentration implied minimum aggregate expenses incurred by the company for annual production costs and capital investments per unit gross output. The base of the trawling fleet in Riga, a highly specialized fishing company and owner of 18 BMRTs, was the example of such production. By having taken advantage of specialized and concentrated industrial production, it achieved the highest indices of labor productivity with the lowest numbers of industrial production personnel. The concentration of the receiving-transport and processing fleets, with a detached fishing fleet, contributed to the increase in operational and economic indices and reduced the downtime of fishing ships pending unloading of the fishery products to the transport ships.

The entire course of Western Basin development from the moment of acquisition of the first BMRT (1957) to the mid-1970s can be subdivided into two stages: first—the introduction of scientific and technological accomplishments, the growth of capital funds, and the addition of new types of fishing vessels; and second—the economic return. The first stage lasted approximately 10 years; but during 1967–73, the output increased by more than 50%.

Producing great quantities of relatively uniform frozen (or salted) fishery products was one of the most important problems. The marketing agency "Zaprybsbyt" in Riga, with production facilities in Kaliningrad, Klaipeda, Riga, Tallinn, and Leningrad, was in charge of fish deliveries to the State within the Western Basin. From Kaliningrad, agents responsible for fish production supplied fish to 111 regional centers and to all Soviet Republics, from Lithuania to 98 regions, and from Estonia to 91 regions. The railroad was the principal means of transport. Annual deliveries of fishery products by fish production agencies in the Western Basin exceeded 800,000 t. For this purpose, hundreds of thousands of refriger-

The guards of the fishing fleet in Kaliningrad. The motherland highly appreciated fishermens' labor, and these men were "Heroes of Socialist Labor" (left to right, top to bottom): Captain Avenier Sukhondiayevsky, Chief Mechanic Boris Suprunenko, and Captains Nikolay Sizov, Georgy Prokus, Ivan Alekseev, Arkady Tsygankov, and Nikolay Zakharov.

ator cars were used. One of the tasks consisted in establishing territorial relationships between suppliers and consumers by means of improved planning.

However complicated the economics of the fish branch, the fishing fleet had always been the center of all the efforts. All other links were urged to ensure its uninterrupted operation. In addition to mere economic solutions aimed at increasing fleet efficiency, the Party made wide use of social, economic, and ideological incentives. Fishermen's wages were relatively low, one and a half or two times higher than the average wages in the country as a whole. During 1965–69, average annual wages on board vessels of 300 hp and larger varied between 3,500 and 5,500 rubles per person. One of the primary lines the Party adhered to was that the growth of wages should not exceed the growth rate of labor productivity. For some vessel types, the wages, instead of being raised, were even permanently cut during a number of years.

But then, other economic incentives were being activated, such as free vouchers to sanatoriums and holiday homes, a chance of being granted free living quarters in the long run, and so on.

Fidel Castro (left) and Ivan Shinkarev, Chief of HO Zapryba.
Soviet fishermen were frequent guests in Cuba.

Since fishermen had to be inspired to perform dedicated labor every hour and every day, the ideological means for labor stimulation had been developed. For instance, there was a different kind of socialist endeavor to reduce the cost per ruble of commodity output, for maximum extraction of fish, for a 2-year working cycle without withdrawing the ship from operation, and the like. Hundreds of ship crews participated in this effort. Dozens of them competed to take maximum catches: the BMRT crews, for example, pledged to take annual catches of 100,000 metric centners of fish or more. In each fishing area, the ships with leading crews of Communist labor were appointed model vessels to be held up as examples for other vessels. The foremost crews were honored with Red Banners by the Soviet of Ministers of the U.S.S.R., the Ministry of Fisheries, and the Central Council of Trade Unions. Fishermen were awarded orders and medals. In 1975, every third employee of the Western Basin was conferred the honorary title of "Communist-way Worker." But the title of "Hero of Socialist Labor" was the most honorable of all. Possessors of this highest title were awarded the Order of Lenin and a Golden Star of the Hero.

Table 14. Soviet catches, per type of ship, 1964–69 (thousand metric centners).

Type of ship	1964	1965	1966	1967	1968	1969
PPR	–	87.0	73.4	104.1	74.8	90.7
BMRT	69.0	73.2	70.8	68.1	61.2	66.9
RTM (*Atlantik* type)	–	–	–	79.2	69.0	72.4
RTM (*Tropik* type)	47.1	52.9	51.9	51.1	42.2	39.1
SRTM	5.5	4.2	6.3	6.1	5.9	8.7

Performing good and conscientious work is in the nature of most people, and the fishermen were good toilers. The catch data per average-on-list ship for 1964–69 is given in Table 14. The annual catches taken by some BMRT and RTM crews were as high as 120,000–135,000 metric centners.

When working in various fishing areas, captains, navigators, and trawl-masters gained a huge amount of experience in fishing and in the knowledge of peculiarities in behavior and distribution of commercial fishery species. This also contributed to the increase in labor productivity. In the 1960s, the cost of ships was relatively low: a BMRT of the Mayakovsky type cost about 2.4 million rubles, and an SRT—0.3 million rubles. High catches ensured recoupment of one BMRT after 2.5–3.7 years of operation.

THE REGION

During the period of intensive fishing by the U.S.S.R. in the Northwest Atlantic, Cabot Strait was a kind of barrier separating the Grand Bank, off Newfoundland and Laborador, from the areas of Nova Scotia, New England, and Norfolk. These two groups of areas significantly differ in weather conditions and in ichthyofauna composition. Soviet fishery managers and economists subdivided these two groups into two separate fishing areas. The first was known as the Grand Bank-Labrador area, and the second as the Northwest Atlantic area. As we have already mentioned, the second area was named “the Region” for convenience. Hundreds of miles separating the Nova Scotia area from that of New England were no hindrance for the Soviet fishermen, and their ships freely sailed all over the area entering the waters farther south, to Norfolk, during their maneuvers.

It took a certain amount of time for the fishermen and economists to realize that the Region was the best among the other fishing areas in the Atlantic. Rich and very special fish resources which favored the large-scale fishery were the main merits of the Region. The Soviet fishermen crossed the ocean on small and large ships, and the crews were well aware of the final destination: Georges Bank—the El Dorado of herring.

Somewhat later, the fishermen discovered there a whole world of fish dwelling at different depths. The aggregations of groundfish and pelagic fish species scattered throughout formed a kind of living mosaic, and soon the ships' captains knew exactly what, where, when, and in what way they would be fishing.

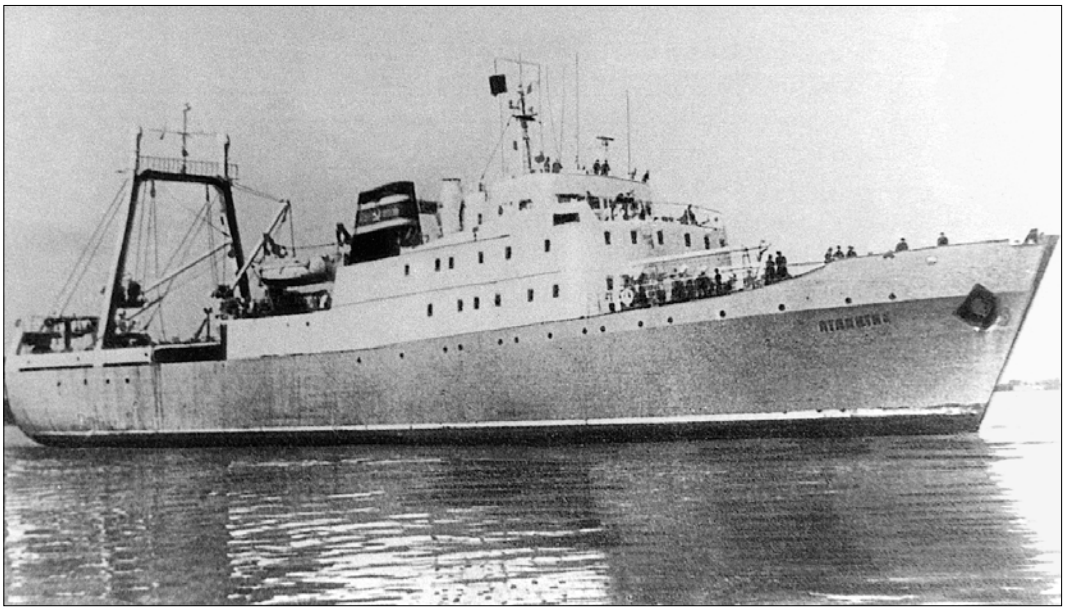
Off Nova Scotia, they captured hake, other cod, flounder, herring, and mackerel; off New England, in addition to the above-mentioned species, red hake, alewife, butterfish, and ocean pout were caught; and off Norfolk, mackerel, herring, silver hake, red hake, and scup were harvested.

Several fish species made up the bulk of the catches taken in the Region, namely, herring, mackerel, silver hake, red hake, and flounder. However, the resources of cod, haddock, redfish, and argentine were also a great help to the fishermen. Besides, the Region was the only fishing area where the fleets could harvest squid, which mainly occurred in mixed concentrations together with fish.

The Region was ideally suited to the construction peculiarities and requirements of the ships both of large and of medium tonnage. At that time, the large tonnage ships were mainly represented by the following types: the BMRTs (large freezer trawlers) of different modifications with maximum length of approximately 85 m, main engine of 2,000 hp, freezing plant capacity of 30 t/day, and fish meal plant capacity of 25 t/day (raw material); the RTMAs (fishing freezer trawlers of the *Atlantik* type), 73.0 m in length, main engine 2 × 1,160 hp, freezing plant capacity of 45 t/day, and the fish meal plant capacity of 35 t/day; the RTMTs (fishing freezer trawlers of the *Tropik* type) 71.0 m in length, main engine of 2 × 670 hp, freezing plant capacity of 30 t/day, and fish meal plant capacity of 20 t/day. The RTMAs, though the same size as the BMRTs, had higher power, a more powerful high-speed trawling winch, a greater working deck area, and better fish scouting equipment. Compared to the BMRTs, the RTMAs and RTMTs were a better fit for pelagic fishing which made for higher productivity in the fishery for pelagic fish species. Over the entire period of their operation in the Region, all the RTMAs, RTMTs, and BMRTs could rely on a steady fish resource base which, in terms of the shape and size of the fish species, perfectly matched the processing equipment on those ships lacking filleting lines. No gutting was required, and the bulk of the catch was simply frozen.

The fleet of medium tonnage ships also had every possibility for an efficient fishery. The SRTs and SRTRs, in addition to purse-seine and pair-trawl fishing in pelagic waters, could also conduct trawl fishing for groundfish. As is evident from the industrial fishery practice, catches of the fleet of large tonnage ships sharply decreased in areas with dispersed fish aggregations, while medium trawlers carried out productive trawl fishing under the same conditions. That is why medium trawlers had always been successful in areas of low density of such fish species as herring, mackerel, cod, haddock, silver hake, and red hake. Medium freezing side and stern trawlers always profited by trawl fishing.

The commercial fishery used concentrations of many species. The size and density of



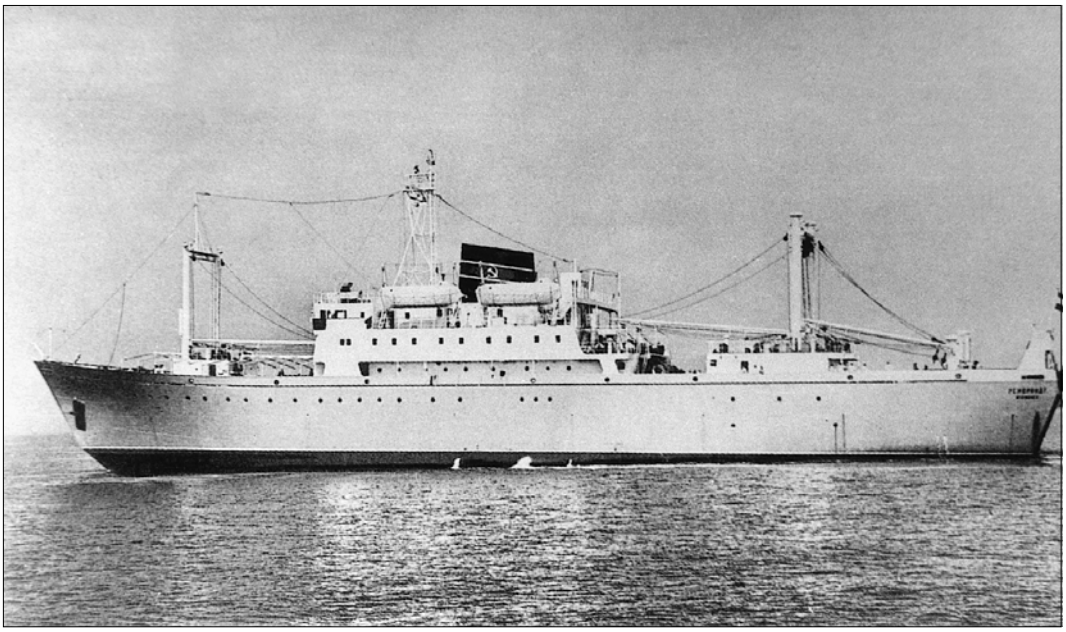
A fishing freezer trawler (RTMA) of the *Atlantik* type. Length: 73.0 m. Main engine power: 2 × 1,160 hp. Speed: 13.7 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

the abundant fish stocks in the Region's subareas varied considerably by season and year; nonetheless, some stocks which allowed for maintaining a high fishing level were always available. The Region was where one of the major principles of the Soviet fishery precisely snapped into action—to harvest the most abundant populations by "changing horses in mid-stream."

In 1964, work on the development of methods of optimal planning for Soviet oceanic fleet allocation was initiated in the AtlantNIRO Laboratory of Economic Research. Even as early as that, a comparative analysis of the operation of the fleet of large tonnage ships revealed the advantages of the Region compared to other Atlantic areas.

During 1962–64, the fleet spent more time fishing there and had the lowest nonproductive time expenses on ground. More trawlings and trawling hours per ship-day fished were recorded there, and the catch per effort was markedly higher (by 20–30%) than in other areas. The same applied to catch per day fished and per day on ground. Nearly 70% of the catch was frozen, and the remaining 30% was reduced to fish meal.

The economists noted that the quantity of fish species reduced to meal was high. During 1963 and 1964, 50% and 70% of the fish species, respectively, were utilized for fish meal production, while waste dressing contributed to only 2.5%. At the same time, in the Region, production capacities of the ships in terms of freezing were at 75–86%—more than in



A large freezer trawler of the *Rembrandt* type. Length: 91.0 m. Main engine power: 3,000 hp. Speed: 14.0 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

other areas. Analysis of the expenses showed that the fishing costs and the final product manufacturing costs were the lowest there. These results attracted more and more fishing vessels to the Region, and the fleet's oversaturation of the area in 1965–66 gave rise to a serious concern on the part of the branch leaders.

In subsequent years, the Region, as before, held a leading position among the other fishing areas in the Atlantic. The only exception was the years 1967 and 1968 when the fleet, numbering many large trawlers, was flung to the South Atlantic coastal waters to fish for Patagonian hake. However, following the extension of the national jurisdiction zone by Argentina, the Soviet fleet was forced out of these waters and the Region regained its role as the front line for the Soviet expeditionary fishery during 1969–74. In the two best years, the U.S.S.R. catches taken in the Region reached 776,000 t (1975) and 874,000 t (1973) (Table 15).

The above figures may differ from those already published. They were obtained much later from bookkeeping accounts, statistical data of the Central Statistical Department of the U.S.S.R., and operational assessment materials based on the analysis of indices of activities of the fleet and the companies of the Ministry of Fisheries.

Over the 1965–75 period, the relative importance of the Region in terms of the U.S.S.R. catches in the Atlantic Ocean varied between 13% and 36%; and in terms of the total U.S.S.R.

Table 15. Soviet catches in the Region, 1961–77 (thousand t).

1961	1962	1963	1964	1965	1966	1967	1968	1969
67	239	404	479	673	688	326	401	638

1970	1971	1972	1973	1974	1975	1976	1977
552	677	687	874	743	776	506	147

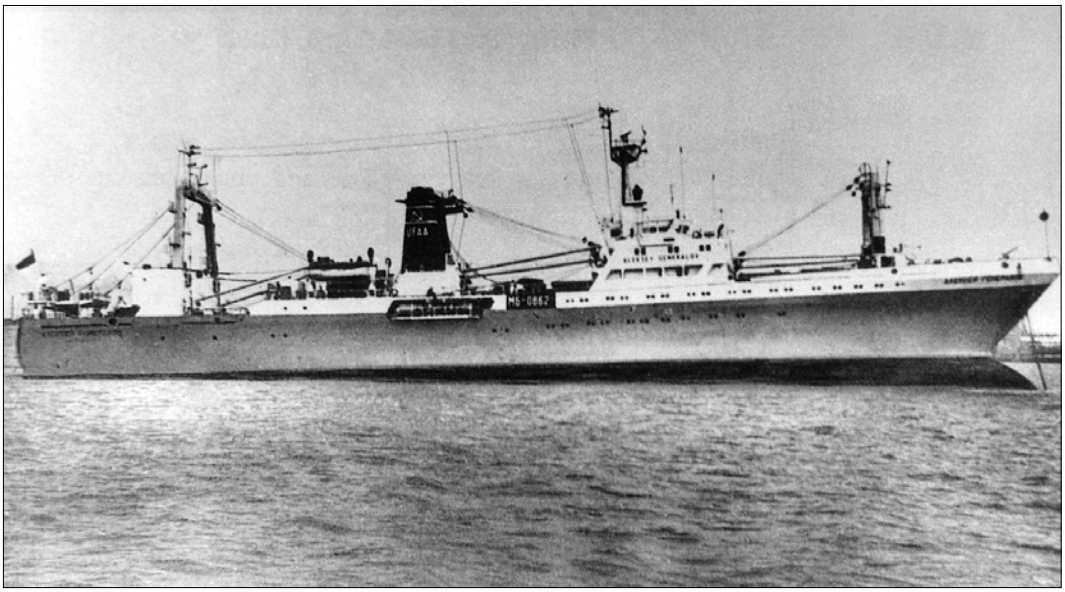
catch in the world's ocean as a whole—between 7% and 11%. The results of a comparative analysis of the operation of the large tonnage fleet during 1968–71 made by AtlantNIRO economists are worth noting. The Region topped the list of all fishing areas in all quantitative indices (catch per effort, fishery products manufacturing, etc.). From the economic viewpoint, it had been second to none.

Because of negligible differences in prices for silver hake, red hake, flounder, mackerel, herring, and ocean pout, the average price per unit product was one of the lowest in comparison with other areas. However, due to high productivity of the fishery and high rate of raw material utilization (70–73%), the indices of commodity output were higher by 3–20%. During the period under review, the average price per unit product on ships of the BMRT and RTMA types was increasing (Appendix Figure 9) which could be attributed to utilizing fish species of higher cost.

A diversified assortment of fish species used for freezing was needed to satisfy the domestic Soviet market. The products from herring, mackerel, silver hake, red hake, and flounder were supplemented with ocean pout, argentine, cod, haddock, pollock, redfish, butterfish, and squid. However, large supplies of frozen silver hake and mackerel often faced a sales problem ashore. The consumer demand for silver hake was lower than that for large Cape silver hake. Mackerel captured in the Region are notable for better gustatory and food qualities than those caught in the Central Eastern Atlantic and, given intense processing, can be ranked as a product of fairly high quality. But wholly frozen mackerel of Region origin quite often remained on store counters unpurchased.

Also, a comparative analysis of the food value of the fish caught by the BMRTs in various areas (pure flesh, protein, fat, and calorie content in 1 metric centner of the fish captured and in 1 metric centner of final frozen products) was made by the AtlantNIRO fishery technologists. It showed that the flesh content in 1 metric centner of fish from the Region was 7–12% higher than in fish from the other areas; the protein and fat content was of lower quality; and the calorie content was the lowest.

When the fishing ships of large tonnage were dispatched to the Region from their home ports or from Havana, where the RTMAs and RTMTs were based, the captains were aware that they would be fishing in the Region's three, or at least two, subareas. They knew all too



A fishing freezer trawler (super trawler) of the *Gorizont* type. Length: 99.9 m. Main engine power: 2 × 3,500 hp. Speed: 15.0 kn. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

well that the success of the voyages was dependent on their skill and ability to maneuver, search for, and catch the fish. All types of ships, be they BMRT, RTMA, or RTMA, were good enough to achieve acceptable results.

The analysis of the data for 1968–75 contained in Appendix Tables 10–16 gives an idea of the results of HO Zapryba vessel activity. They are representative enough, for the companies of this head office harvested more fish in the Region compared with those of other head offices, and their catches varied between 200,000 and 500,000 t in the 1960s, and between 350,000 and 550,000 t in the 1970s. As of 1 January 1977, the HO Zapryba fishing fleet numbered 254 large and 269 medium vessels.

The productivity of the major contingent of large tonnage vessels—the BMRTs—somewhat declined during the observation period, but the volume of the manufactured product held at approximately the same level. In the 1970s, the value of commodity output increased. Changes were also noted in the frozen product structure. The proportion of herring, red hake, flounder, and ocean pout diminished from year to year, while the significance of silver hake and mackerel was growing.

The trend towards an increase in productivity of RTMA operations, a greater scale of natural product manufacturing, and a growth in commodity output were obvious. During the period under review, the share of frozen herring, flounder, and ocean pout decreased in favor of mackerel and silver hake.

Table 16. Percentage of fish harvested by the large tonnage fleet in the Region, 1965–73.

Share	1965	1966	1967	1968	1969	1970	1971	1972	1973
Share of total effort in the Atlantic	50	45	14	13	19	15	23	22	20
Share of catches taken by the large tonnage fleet in the Region	82	84	56	62	65	60	76	75	80

The catch per RTMT fish-day fished declined markedly by the end of the observation period. The product output, frozen fish inclusive, was also reduced. In fact, the fishery products did not include herring, red hake, flounder, and ocean pout. Mackerel and silver hake predominated in the frozen products. The value of commodity output also diminished notably.

Thus, the trends towards change in the frozen product structure were identical for all three vessel types. The structure of the frozen products tended towards simplification in 1968–75, and was gradually changing to include only two species—mackerel and silver hake. Certainly, these changes were also indicative of the altered structure of harvested resources and of the state of the fish resource base.

Appendix Table 12 and Figure 10 are indicative of intrayear and year-to-year variations of fishing effort by large tonnage fleet, and of variations in catch per fish-day fished by the BMRT type vessels owned by HO Zapryba. A seasonal trend in the fishing effort was especially pronounced in 1971–73. The greater share of fishing effort was applied by the BMRTs, as during these years, their fishing season lasted from March to August. This also contributed to a higher productivity of the fishery.

The vessels of other classes, such as the PPR (fishing production refrigerator ship), the RTM of the *Super Atlantik* type, and the BMRT of the *Altay* type also operated in the Region. They represented a new generation of larger vessels with more powerful engines and trawling winches, larger hold capacities, and so on. Their lengths were 91, 91.8, and 97.8 m, respectively, and their respective main engine powers were 3,848, 3,800, and 5 × 1,000 hp.

Fishing effort by the large tonnage Soviet vessels in the Region varied within a wide range in 1965–73 (Table 16). The lowest recorded number of trawlers fishing the Region waters was in 1967 and 1968, while in the peak years of fleet concentration (1965, 1966, and 1971–73) 30 to 40 fishing units fished there on average. In 1965, 50% of the total fishing effort by large trawlers operating in the Atlantic Ocean was applied in the Region. The large tonnage fleet accounted for 60 to 80% of the fish harvested in the Region.

Appendix Figures 11 and 12 show the data on fishing effort during 1968–76 by vessels of different type owned by all head offices and the catch per effort taken in the Region dur-

ing 1968–75. The latter was a domain of the BMRTs as well as the RTMAs and the RT-MTs. During 1968–71, all vessel types showed a decline in catch per effort followed by a growth in catch, with the peak in 1973, and then another drop. The PPRs and RTMAs had the highest productivity of the fishery.

As we have already mentioned, directing the fleet to fishing areas based on scientific recommendations was one task of the fishery economists. It was especially true of the Region, owing to its attractiveness for the company chiefs and the captains. It had been a lure for all three head offices, and the ships, with departure schedules in March–July, were usually directed there from the base ports. The threat of oversaturating the Region arose every year. Economists faced an almost impracticable task of developing the scientific methods to calculate the optimal number of vessels to operate on one fishing ground at the same time. In 1971, the total number of large tonnage vessels available in the Region varied between 70 and 80, of which 50 or 60 fished from April to August. Such a concentration of vessels was considered to be the norm, and the simultaneous presence of 90–100 fishing units was assumed to be a permissible limit. But there had always been misgivings that some 120–130 vessels might converge on the Region during the fishing season, withdrawing the lion's share of the resources and jeopardizing the productivity of the fishery the next year.

Recommendations on allocating and dividing the fleet into areas of the fishery worked out by the economists were based on predictions of the status of the fish resource base made by the biologists of the fishery institutes, whose functions included providing the fishing fleet with data on stable fish resources. These predictions, founded on the results of research and stock assessments, were guarded enough. As a rule, they warned the fishery managers against excessive pressure on the resources, especially those which had been overfished. All predictions were carefully considered at fishery councils in the Ministry, in head offices, and in the companies. The fishery managers assigned primary importance to the annual catch plan, which had to be fulfilled at any price. The predictions were regarded just as a key for solving the annual puzzle: where should the fleet be sent? What areas would be best for an easier fulfillment of the plan?

The fishery economists endeavored to solve the same tasks. In addition to forecasts, they analyzed the fishery and economic indices of the fleet for the past year. If the area, after having undergone powerful pressure from the fishery, endured the ordeal, it was recommended that the level of the fishing effort applied there could be maintained or slightly diminished in the current year.

One of the tasks pursued was to determine the fleet's saturation limit in the fishing areas, the point above which fishery resources could be seriously endangered or undermined. Attempts were made to define a bound between the stable state of the stock and overfishing. For this purpose, the concepts of "economic overfishing" and "biological overfishing" had been introduced, which implied a productivity drop for the fishery in the first

case and a disturbance in reproductive ability of a given stock in the second. The logic of reasoning was approximately as follows: if economic overfishing occurs prior to biological overfishing, then fishing a given stock may become self-regulated on the objective basis; i.e. be ceased when economically inexpedient and resumed when once again profitable. If economic overfishing (persistent, high catches resulting in a sizeable reduction in stock abundance) occurs after biological overfishing, then compulsory measures for fishery regulation must be taken.

Proceeding from these assumptions, the impact of the fishery and the means for its regulation were considered as applied to several groups of species; for instance, the abundant pelagic and groundfish species, the species subjected to sharp fluctuation in abundance (North Sea haddock), and local stocks of groundfish species (flounder, Sparidae, Lutjanidae, and so on.).

Regarding the latter group, overfishing to the point of complete and irreversible extermination of the stock had been assumed to be quite probable. In the case of exploiting local stocks of high density, economic overfishing would have occurred much later than biological overfishing, and no bound could exist between them. Regulation of the fishery by means of a fixed maximum allowable annual catch size was admitted to be reasonable. Unfortunately, at that time, such a recommendation sounded at least naive, for it was unrealistic and impracticable. Occasions for restricting the freedom of the fishery were episodic. With the "offensive on a wide front" by numerous vessels, small groundfish stocks had been taken incidentally, and "one fine day" it became evident that the catches were missing Sparidae, Lutjanidae, flounder, and many other fish species. It is a fact of common knowledge that even stocks of high density happened to be "scooped out at one go." The North Sea herring is a typical example. In 1965, fishing intensity in the North Sea sharply increased primarily due to the Norwegian purse-seine fishery. The catch increased about twofold as against the previous years and amounted to 1,200,000 t. Maximum fishing effort persisted in the years that followed. Beginning in 1965, herring abundance rapidly diminished, and both the herring stock and its structure were destroyed by the end of the 1960s—having escaped the economic overfishing stage. It had been medium tonnage vessels that caused irreplaceable damage to this large pelagic stock. In the Region, where the fishery was multispecies and where several abundant fish species retained their reproductive ability within a vast area, no total economic overfishing had been recorded over the period under review. The groups of large and medium tonnage vessels "reaped the harvest" there year after year and fulfilled their State plans. But a number of less abundant groundfish stocks were totally annihilated and fell victim to biological overfishing.

Fish aggregations were present in the Region throughout the year. The Soviet fleets could work simultaneously off Nova Scotia, off New England, and in the Norfolk area. The latter area that encompassed ICNAF Divisions 6A, 6B, and 6C was also called the "U.S. shelf" by fishery managers and scientists. Appendix Figures 13 and 14 give an idea of

The receiving-transport refrigerator ship *Noginsk* of the *Aktiubinsk* type is ready to receive fishing vessels. Length: 118.0 m. Main engine power: 4 × 1,800 hp. Speed: 16.6 kn. Carrying capacity: 3,150 t.

fishing productivity changes recorded by the large tonnage vessels in the three areas. During 1968–70, the BMRTs showed the highest productivity in all three areas. The low point of the slump was 1971, rising again to a high in 1973, followed by a decline that was especially drastic off Norfolk. However, the pattern of changes was similar in all the areas.

In 1972, catch per effort by the RTMAs off Nova Scotia dropped to minimum values after peak yields had been taken in 1969; catch per effort increased in 1973, but then kept declining in the following years. Off New England, catch per effort had been increasing since 1968, reaching a peak in 1974–75. Peak catches in the Norfolk area were in 1970 and 1973–74, followed by a decline. The main fishing seasons off Nova Scotia and New England were in March–August, and off Norfolk in November–April.

During the first years of the Region's development, when the BMRTs predominated in the large tonnage fleet, they were fishing off the U.S. coast year-round. In November–March, their activities were confined to the southwestern fishing plots of New England and to the Norfolk area, and in April–October to New England waters. However, in ensuing years, the abundance of groundfish species, which made up the bulk of the BMRT catches off Norfolk, diminished. Later, the restrictions stipulated in the international bilateral agree-

ments between the U.S. and U.S.S.R., and those imposed on a unilateral basis by the U.S., came into force. Fishing for spawning herring on Georges Bank in September–October came to an end. As a result, the fishery by BMRTs off the U.S. coast assumed a seasonal character and was timed to March–August. But fishing opportunities during the same period still existed in the Nova Scotian area which had been gaining importance for vessels of this type since the early 1970s.

For the RTMAs, which had been launched since 1966 from German Democratic Republic shipyards, as well as for the RTMTs, November–April turned out to be the most productive fishing season off the U.S. coast. Mackerel, with the highest recorded concentration density from November to July, were mainly caught in the Norfolk and New England areas. Productivity by these vessels decreased in May–August, and the worst conditions for the fishery fell in September–October.

Data on the fishing effort, catch per effort, utilization of raw material, structure of catches and frozen products, fishery economics, and so on by separate area are of interest. As regards the Nova Scotian area, data mainly cover BMRT activities, but for the 1968–71 period, data are also available for the RTMAs and RTMTs (Appendix Figures 15–18 and Tables 17 and 18). Productivity by BMRTs in 1968–76 was at the level of 38–43 t per fish-day fished. Data on the seasonal trend in catch per effort (see Appendix Figure 15) indicate that catches by year differ mainly at the peak of the season, i.e. May–August. The highest recorded productivity during this period was in 1969 and 1970. Silver hake predominated in 1969–72, their catch having reached a peak in 1970 and 1972 (see Appendix Figures 16–18).

The year 1968 was extremely unfavorable for silver hake, and this species was replaced in the catches by flounder. The increased catch of the latter was recorded in 1969 and 1971. The share of herring was insignificant during all years, except for several months in 1969. The RTMAs had profited from the "outburst" in herring abundance in the winter of 1968–69 on Banquereau Bank.

Changes in the volume and structure of frozen products from the fishery off Nova Scotia had been observed. Annual production of BMRTs per fish-day fished fluctuated between 23 and 28 t during 1968–76. Silver hake made up the bulk of the frozen products (except in 1968). Flounder, herring, mackerel, and red hake were supplementary components with ever diminishing shares, and bycatch was used (redfish, argentine, and squid) (Appendix Tables 17 and 18). Commodity output varied between 13,000 and 17,000 rubles per fish-day fished, and the profit—between 4,500 and 6,300 rubles per average trip day.

Seasonal variations in productivity by the BMRTs off New England are shown in Appendix Figures 19–24. The highest productivity was observed in April–August. Silver hake, herring, red hake, mackerel, and flounder were the principal species in the catches. The months of April to August were the main season for the silver hake fishery. The largest recorded catches of this species were in 1971. The share of herring was significant in May–

September, though their quantity was diminishing from year to year, having dropped to the lowest value in 1972. The fishing season for red hake lasted from May to November. Larger red hake catches were taken in 1972. Mackerel and flounder were of lesser importance. The largest catch of flounder was recorded in 1969. Higher mackerel catches were taken by the RTMAs in November–May (Appendix Figure 25) and those of herring—in April, July, and September–October (Appendix Figure 26).

In the structure of the frozen product output by the BMRTs, with volumes ranging from 24 to 27 t per year, silver hake was a predominant species. In some years, the proportion of herring, flounder, red hake, and ocean pout increased. But these fish, including mackerel and the bycatch of other fish species, accounted for stability in the frozen product structure by year (Appendix Table 19).

The volume of frozen products manufactured by the RTMAs ranged from 24 to 28 t and was represented by the same fish species as on the BMRTs, except that mackerel, herring, and silver hake were prevailing. The share of flounder was insignificant (Appendix Table 19).

Commodity output per fish-day fished by the BMRTs was 14,000–15,000 rubles, and by the RTMAs—13,000 to 16,000 rubles. Indices for vessels of the RTMT type were compatible with those of the BMRTs and RTMAs, except in 1971. Vessels of the RTMA type failed to use their constructive advantages off New England resulting in practically identical indices for the BMRTs and RTMAs. The averaged data mask the true picture of the vessels' activity and their use of the fish resources in specific areas. Data in the reports by trip make it possible to fill in the gaps in the analysis.

The species composition of the catch taken by the RTMT *Dobrovolsk* engaged in the fishery in the New England area from 13 June until 30 November 1968 is given in Table 17. This vessel fished a total of 87 days, during which time it caught 3,057 t of fish and produced 2,021 t of frozen fish and 175 t of fish meal. The catch consisted mainly of six fish species, and bycatch accounted for 30% of the total catch.

The Norfolk area was mainly harvested by the RTMTs (up to 60% of total fishing effort by the RTMTs in the Region) and the RTMAs (up to 42%) over the period October–May. As a matter of fact, this area was of secondary importance, being supplemental to more important areas off New England and Nova Scotia. Compared to BMRTs, productivity and volume of frozen product manufactured by the RTMAs were higher there due to pelagic fishing for mackerel.

The volume of frozen product manufactured by the BMRTs, RTMAs, and RTMTs in different years fluctuated between 26 and 33 t, 26 and 39 t, and 27 to 30 t, respectively. The significance of individual fish species in the array of frozen product manufactured by the BMRTs varied by year. Ocean pout were numerous in the catches taken in 1968 and 1969; herring in the 1968 catches; mackerel and silver hake in the 1970 catches; and red hake in the 1969 catches. Among the species frozen by RTMAs and RTMTs, mackerel led in quan-

Table 17. Catch composition by RTMT *Dobrovolsk* of New England, 13 June–30 November 1968.

Catch	Quantity (t)
Silver hake, small	530
Silver hake, large	171
Mackerel	324
Flounder	355
Butterfish	205
Red hake	328
Herring	200
Ocean pout	11
Cod, large	8
Small fish, group III	5
Bycatch, different species reduced to fish meal	920
Total	3,057

tity, while herring, silver hake, red hake, and flounder filled up frozen product volumes. In some years, the bycatch of other species gained importance in frozen fish production by the RTMTs. The commodity output by BMRTs in the Norfolk area was 15,000 to 18,000 rubles; by RTMAs 16,000 to 26,000 rubles; and by RTMTs 15,000 to 18,000 rubles (Appendix Table 20).

The analysis of BMRT and RTMA activity during 1972–76 covering the entire area off the U.S. coast, i.e. Subareas 5 and 6, was done in 1977 (Appendix Tables 21 and 22). Those were the years when the Soviet fishery experienced the growing pressure of limitations of all kinds. At that time, the amount of frozen product manufactured by BMRTs was approximately 25–30 t, with mackerel and silver hake predominating. Flounder were actually missing, and the share of herring was low. The commodity output was 16,000–19,000 rubles per fish-day fished, and the economic efficiency was 5,000–6,000 rubles per average trip day.

The volume of frozen product manufactured by RTMAs and represented mainly by mackerel and silver hake was within the range of 30–40 t. By the end of the period under consideration, the frozen product consisted of only these two species. The commodity output varied between 17,000 and 23,000 rubles, with the economic efficiency ranging from 6,000 to 9,000 rubles.

In the fishery institutes, the economists gave special attention to the large tonnage fleet. The analysis of exploitation of the medium tonnage fleet was of sporadic character, although the contribution of these vessels to the "catch-box" from the Region was weighty enough. The share of catches there by medium trawlers in the 1960s was estimated at 44–49%, and in the 1970s varied within the range of 20–40%.

Table 18. Fishing effort by Soviet medium tonnage vessels in the Region as a percentage of Soviet medium tonnage vessels in the whole Atlantic.

1965	1966	1967	1968	1969	1970
17	7	12	20	26	21

Data on fishing effort by medium tonnage vessels in the Region compared to total fishing effort by the Soviet fleet of medium tonnage engaged in the fishery in the Atlantic during 1965–70 are given in Table 18. In some years, 60–80 medium tonnage vessels on average fished in the Region, which made up 20–25% of the total fishing effort by ships of this class. According to some recommendations, 150 or more medium tonnage vessels could operate there simultaneously.

Medium fishing trawlers with the following technical specifications worked in the region: 39.2 m in length, main engine power of 300 and 400 hp, non-refrigerated holds (the SRTs); medium fishing refrigerating trawlers: 44.4 m in length, main engine power of 540 hp (the SRTRs); medium side and stern freezer fishing trawlers: 49.4–50.4 m in length, main engine power of 800–1,160 hp (the SRTM-Bs and SRTM-Ks).

The specific feature of the SRTs and SRTRs was that they had not been intended for a complete cycle of fish processing. They were designated to capture and salt herring in the North Atlantic areas. In the Region, vessels of the SRT type specialized in drift-net and purse-seine fishing for herring, and trawl fishing for herring, mackerel, alewife, and cod-like species.

The SRTRs were engaged in trawl and purse-seine fishing, the latter being predominant. The analysis showed that, in 1963–64, the use of SRTs for fishing lean herring on Georges Bank was unprofitable in May–July, but compared to other areas, the economic losses were minimal. Profitability of fishing increased in August–October when fat herring prevailed. After the vessels encountered large aggregations of silver hake and began harvesting them on a large-scale basis, the captured fish, like the herring before them, were salted in barrels. In 1963, the SRTs and SRTRs caught and salted over 40,000 t of silver hake. However, salted silver hake as a food product did not suit the taste of Soviet consumers. Large amounts of this product had no market. A ban was imposed on the production of salted silver hake, which resulted in a drop in silver hake catches by medium trawlers in 1964 to 8,000 t.

Later, the SRTs and SRTRs resumed fishing for groundfish. They worked together with receiving-transport and processing ships, unloading fresh fish aboard these ships. During 1965–67 and 1971–75, trawl fishing brought in significant silver and red hake catches, and in 1965–66, cod and haddock catches. But herring, mackerel, and alewife had been the principal species throughout this period. Catches of these species underwent initial processing on board ships: whole, headed, or gilled fish were either packed in barrels in dry

salt or processed with the use of mixed technology. On having taken full loads, the vessels approached the motherships to unload semi-finished herring. On motherships with refrigerated holds, semi-finished herring were processed into a stage of final product and either taken ashore or unloaded to a transport ship.

In summer, the final product on motherships without refrigerated holds consisted only of hard-cured herring; and from October to March, also medium-salted herring. Portions of the herring catches were processed to a semi-finished stage and delivered to shore-based plants for further processing.

Catch sizes in the herring purse-seine fishery varied within a wide range, reaching 50 t or more per set. When large catches were taken simultaneously by several vessels, the receiving ship was not in a position to handle all the fish from these vessels at the same time. In such cases, the captains of the fishing vessels faced several alternatives:

- take a certain quantity of fish aboard and keep them in barrels filled with water until the vessel approaches the receiving ship for unloading, and discard the remaining fish; or
- wait where they are for a receiving ship to come in order to unload the whole catch from the purse seine. In this case, there is a strong probability that part of the catch will spoil because of the delay in waiting for the receiving ship.

Motherships, production refrigerator ships, or large freezer trawlers could function as receiving ships. Unevenness of catches and lack of receiving-transport ships resulted in large discards in the purse-seine fishery.

The development of trawl and purse-seine fishing in the Region was speeded up in the 1960s, but in the 1970s, trawl fishing was on the wane. Trawl fishing was conducted by the SRTs and SRTRs year-round (with the most productive period being February–May) and purse-seine fishing, from March to August. In trawl fishing, catch per fish-day fished ranged annually from 6 to 9 t, and in purse-seine fishing from 12 to 22 t.

Over the 1969–71 period, trawl fishing was profitable most of the year, except for the fourth quarter. The commodity output per SRT fish-day fished ranged from 2,500 to 2,800 rubles, while that per SRTR fish-day fished was from 3,300 to 4,200 rubles, the profit per operation day being 600–700 rubles and 900–1,200 rubles, respectively. In purse-seine fishing conducted by vessels of the same type, the commodity output per fish-day fished was 8,300–9,600 rubles, and the profit per operation day being 2,100–2,600 rubles.

In the 1970s, the volume of fishing effort exerted by trawlers gradually decreased. The North and Barents Seas became the major fishing areas for the Soviet medium tonnage vessels (except for the SRTMs). By 1975, fishing effort by the trawlers in the Region went down to 11%. Fishing effort by purse-seine vessels in 1972–75 remained fairly constant (Table 19).

Indices for the operation of the HO Zapryba SRTRs in the purse-seine fishery in the

Table 19. Fishing effort by purse-seine vessels in the Region, 1972–75.

	1972	1973	1974	1975	1976
Number of fish-days fished	3,535	3,667	3,740	3,679	267

Region during 1972–75 are given in Appendix Table 23. Herring predominated in the catches. The annual catch per fish-day fished ranged from 13 to 18 t, the commodity output from 6,100 to 7,800 rubles, and the profit per operation day from 1,300 to 2,800 rubles. A sharp decline in the economic efficiency of purse-seine fishing occurred in 1975 when just 12% of the total effort in purse-seine fishing in the Atlantic was used in the Region.

For a long time, the Region had been the only area which provided a break-even operation for the SRTM type vessels. Most of them (53 units in 1975) belonged to HO Zapryba and were used for trawl fishing in the Region. The vessels were initially oriented to the herring and mackerel fishery in January–September, but later they were also widely used to fish for groundfish. Annual productivity of the fishery by these vessels per fish-day fished varied between 6 and 11 t. The productivity by stern trawlers was higher than that by side trawlers.

In 1974 and 1975, fishing effort by stern trawlers in the Region was estimated at 4,166 and 2,419 fish-day fished, and that of side trawlers at 1,059 and 920 fish-day fished, respectively. Beginning in 1974, stern trawlers were being transferred to the fishing grounds in the North Sea and on the Grand Bank off Newfoundland. In 1974 and 1975, productivity by the SRTM-Ks was 10 and 11 t and by the SRTM-Bs 8 and 7 t, respectively.

In 1975, a group of SRTM-Bs conducted directed fishing for squid, the proportion of which in the catch increased from 10 to 51%. The share of silver hake increased in the catch taken by SRTM-Ks. In 1975, SRTMs were oriented to take on quotas of silver hake and red hake in the Region.

By 1975, trawl fishing by SRTs and SRTRs in the Region had ceased, with only SRTMs continuing their activity. In 1976, purse-seine fishing was also curtailed.

Barriers

The Soviet fishery in the Region experienced the influence of a number of restrictive factors. In some years, the fish stocks themselves played the role of a restrictive factor for the fishery. So, in 1967, the number of large tonnage vessels bound for the Region was limited compared to 1965–66 because conditions for the silver hake fishery off Nova Scotia and New England had become extremely worse. Instead of sending 18 vessels from HO Zapryba as planned, only 8 vessels worked there on average during that year.

In some years and during some periods, the fishery was limited by a lack of receiving-transport ships, as there was a disparity between catch sizes and the facilities for processing and delivering fishery products to the Soviet Union. The situation became especially aggravated in cases when enormous quantities of frozen fish landed from the fishing areas could not be sold. Situations like this often concerned principal industrial species captured in the Region—herring, mackerel, and silver hake. Lean frozen herring was not in demand, but catches of lean herring were high in 1967. There was also a low demand for mackerel and silver hake, in particular for small specimens of these species. A glut in the market was recorded in 1971 and 1973 when limitations on fish sizes were being introduced, and according to instructions given from shore, only large mackerel (at least 25 cm) and large silver hake were to be caught. In 1973, as early as May, there arose difficulties in marketing large quantities of ungutted silver hake; therefore, the catch sizes per fish-day fished in May–August were considerably lower than could have been. A limitation was also imposed on fishing for silver hake and herring. The share of these species directed to the output of fishery products was reduced. An essential part of the catch was being reduced to fish meal. Some of the fishing vessels' time was wasted for lack of receiving-transport ships. The fishing vessels left for other fishing areas; meanwhile, the ships of the transport fleet loaded with fish lay idle in port waiting for their turn to be unloaded.

The central bodies and seaside organizations responsible for marketing fish, being informed of the results of the vessels' fishing activity, sought to plan the countrywide distribution of products manufactured at sea in good time. Upon arrival in port from the fishing areas, the fishing and transport ships were unloaded directly into refrigerator cars or port refrigerators for subsequent shipment to large administrative centers or towns where industrial refrigerators and fish processing plants were available. Local production and utilization subdivisions of commerce were responsible for distributing products to food store networks and restaurants. Some of the fishery products were delivered to fish processing plants. A network of fish speciality shops, "Okean," was being established throughout the country.

Hundreds of thousands of refrigerator cars conveyed fish all over the country. But the industrial refrigerators, in particular those suitable for storage of fish, were available, as a rule, only in administrative centers. Late in the 1980s, their capacities were rated for the immediate storage of a maximum of 140,000 t of fishery products. But the volume of fresh-frozen products made up 2.6 million t by 1970, and 3 million t by 1980. With enormous quantities like this, the system of Socialist distribution was falling out of step. In the summer months, when warm weather set in everywhere in the immense space of the Soviet Union, the organizations responsible for marketing fish faced a host of difficulties. Adding slack customer demand, the fishing industry as a whole was having a real hard time.

Those were the intrinsic Soviet problems, but a wave of international problems was also building up.

The world's oceans were gaining importance as a source that could meet many of mankind's diverse requirements. The oceans had been assigned a leading role for solving the sharply increasing global requirement for food, energy, and minerals. Among other global problems at the time, the question of developing the world's oceans had been pushed into the foreground.

During the 1960s–70s, high seas fisheries became the object of intent attention on the part of the world community. Food problems were assuming an ever greater acuteness all over the world. Coastal nations encouraged the independent utilization of biological resources in the waters adjacent to their coastlines. At the same time, heavy exploitation had resulted in overfishing of the stocks. Among other urgent problems, international fishery regulation became a necessity.

In 1967, Argentina declared the introduction of a 200-mile fishing zone; in 1972, Mauritania extended its territorial waters to 30 miles; and in 1973, Morocco introduced a 70-mile fishing zone.

The Third UN Conference on the Law of the Sea convened in 1973, and its work resulted in adoption in 1982 of the UN Convention on the Law of the Sea.

The U.S. position regarding the international and legal regime of high seas fisheries during the postwar years was undergoing changes, but the first fundamental document stating the U.S. position appeared as far back as 1945. It was a proclamation of President Truman establishing conservation zones for the protection of fisheries in certain areas of the high seas contiguous to the United States. Alluding to a precedent set by this proclamation, a number of Latin American countries extended their territorial sovereignty and sovereign rights to their vast inshore sea areas.

The scale of the Soviet expeditionary fishery made the United States ponder the problem of the conservation of living marine resources off its coasts. One of the mechanisms of stock conservation under the condition of totally unrestrained fishing was limiting the fishery on a unilateral basis when separate fishing areas were declared closed. Limitations could also be imposed on fishing periods. However, the best way to reach a consensus was to conclude bilateral agreements. U.S. Presidents repeatedly emphasized the necessity for international and regional cooperation for the sake of conserving fishery resource productivity. As of 1971, the United States was party to nine international fishery agreements. These agreements encompassed areas and fishery types that provided American fishermen with catches valued at US$300 million per year.

A number of the Soviet-American agreements on fishery regulations in the Pacific and Atlantic oceans were concluded in the 1960s–70s. Some were made after the United States had extended its jurisdiction over fishing in the 12-mile coastal waters (1966). Under these agreements, limitations were imposed on the fishery for scup and flounder. For the first time, an Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics Relating to the Consideration of

The universal fish-processing mothership *Pionersk*. It was designed to receive raw fish from fishing vessels, process them into preserved and canned fish, frozen and salted fish, fish meal, and industrial fish oil, and provide all kinds of supplies, medical assistance, social amenities, and repair work. Length: 149.0 m. Main engine power: 7,200 hp. Speed: 15.1 kn. Carrying capacity: 4,685 t.

Claims Resulting from Damage to Fishing Vessels or Gear and Measures to Prevent Fishing Conflicts was signed 21 February 1973. The agreement engendered new limitations on the Soviet fishery.

The first quotas for fishing certain fish species by zone and subarea were introduced in the ICNAF (International Commission for the Northwest Atlantic Fisheries) Convention Area in 1973. The annual catch of one or another commercial fishery species was determined by the sizes of established quotas. In ensuing years, all fish species and fishing grounds fell under the introduced quota system. Quota sizes were regularly reduced. Adaptation to limitations being introduced proceeded quite painfully for the Soviet fishery. Optimum tactics and organization were needed in order to harvest all quotas allocated for the various species.

In 1975, the Region lost its premier position for the Soviet fishery in the Atlantic. How-

ever, the Fishery Conservation and Management Act (FCMA) passed in April 1976 in the United States and the Act on the Territorial Sea and the Fishing Zone approved by the Governor-General of Canada in November 1976 were the last straws for the U.S.S.R. fishery in the Region.

Under the U.S. act, the 200-mile zone, with exclusive rights to the United States for living marine resources, was to be introduced on 1 March 1977. In Canada, the 200-mile fishing zone was introduced on 1 January 1977.

In Section 2 of the U.S. act, it was emphasized that, by having passed this act, the U.S. Congress pursued a number of goals, the adoption of immediate measures for conservation and management of the fish resources off the coasts of the United States being one of these. This act assimilated major provisions contained in Public Law 89-658, extending the U.S. fisheries zone 9 miles beyond the 3-mile territorial sea on 14 October 1966, and in the rules of fishing living organisms of the Continental Shelf dated 18 June 1971. Pursuant to Section 201 of the act, fishermen of other nations were forbidden to conduct fishing operations within the 200-mile zone beginning 28 February 1977.

The Canadian act, in which the authority of Canada over the 200-mile zone was defined in detail, reserved the right for a licensed fishery for foreign fishing vessels with observance of catch quotas, restricted fishing periods, areas, fishing gear, and reduced fishing effort. Both the U.S. and Canadian acts were passed at the time when the Third UN Conference on the Law of the Sea was in full swing.

Many countries, the U.S.S.R. inclusive, responded negatively to these unilateral actions taken by the United States and Canada. The Soviet Union defined this demarche on the side of the United States as an "illegitimate action."

It was a natural reaction considering the scale of losses incurred by the U.S.S.R. in the Northwest Atlantic.

Compared to 1975, the catch of fish in the Region in 1977 showed a fivefold decline. The introduction of limitations in the Northwest Atlantic coincided with the introduction of the economic zone by the European Economic Community (EEC). All these limitations caused serious problems in allocating the fishing fleet by fishing area, and resulted in a significant decline in the catch of fish taken by the U.S.S.R. The catch taken in 1977 was 800,000 t less than in the previous year.

The species composition of the fish captured also changed for the worse. The proportion of valuable fish species—mackerel, cod, redfish, and herring—sharply diminished, having been replaced by species of low value like capelin, sardine, and krill. These changes adversely affected the cost indices envisaged in the State plan (average price for fishery products, cost of food fish products, product marketing, profitability, return, and productivity of labor).

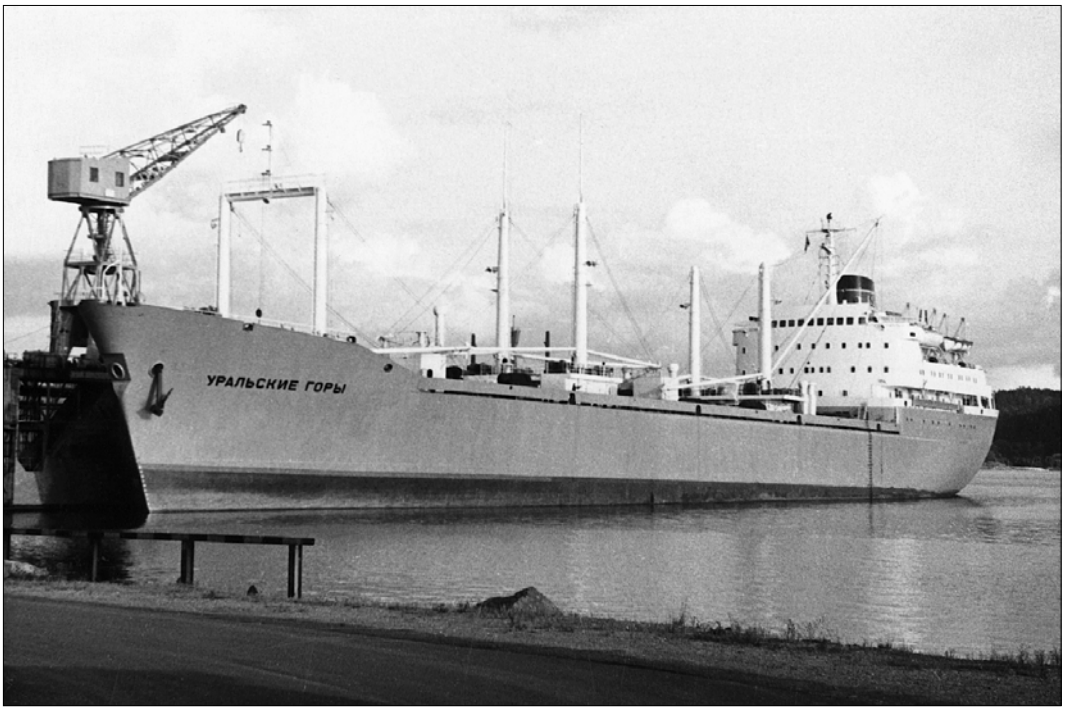
There came a sad time for the Soviet fishermen to bid farewell to the Region, the matchless fishing area.

The universal mothership *Leninskaya Iskra*.

The memory of the Region has remained with them. Their youth was bound with it, for many it had been their second home over the years. "We are sailing to Georges Bank—Georka," they used to say leaving their native ports. Many captains and mates knew the Region like the back of their hands. "Plough-seamen" forever, they were inspired with love for it. Romanticism was still alive in those times, that is why the memories of the fishermen are so sweet.

Forecasts

It was around the late 1960s when the faint notes of reality began to ring amidst the euphoria caused by the rapid growth of the fishing industry and the great fishermen's discoveries in the Atlantic. A train of discoveries was coming to an end. The development of "rough" oceanic areas like the Mid-Atlantic Ridge, the other ridges and underwater mountains, and high-seas open areas off Chile and Peru looked prospective, though. But the continental shelves had already been developed, and the fleet was so large that the fish stocks could hardly satisfy its appetite. What kind of reference points should be chosen for subsequent development? What kind of fleet is required? What are the limits of potential of the fish stocks in each fishing area? These questions kept coming into the minds of the fishery managers and the economists.



The receiving-transport supply refrigerator ship *Uralskiye Gory* of the *Kamchatskiye Gory* type. It received fish products on the fishing grounds and transported them to the port of destination, as well as provided fishing vessels with all kinds of supplies. Length: 140.0 m. Main engine power: 8,750 hp. Speed: 17.4 kn. Carrying capacity: 5,700 t.

In 1968, the first long-term forecasts for the fish stocks appeared from the fishery economists. The potential Soviet catch in the Northwest Atlantic was estimated at 1.45 million t, of which 0.55 million t were expected to be harvested off West Greenland, Labrador, and Newfoundland—and 0.9 million t in the Region.

Since 1973, work on detailed forecasts for the long-term period ending in 1990 had been underway on the economic and social development of the U.S.S.R. fishing industry as a whole, and separately by basin, fishing fleet structure, catch by fishing area, and so on.

Moscow economists drew up the report entitled "Scientific Foundations for Fishery Economics Allocation for the Period up to 1990." This effort was a State order to execute the directives of the XXIV Congress of the CPSU for the 5-year plan (1971–75) of national economic development. These directives envisaged the improvement of methods for the People's economic planning based on accomplishments of economic science. In particular, it had

Table 20. Catch forcasts for the Northwest Atlantic, 1970–90 (million metric centners).

Area	1970	1975	1980	1985	1990
U.S.S.R. catch world-wide	77.8	95.0	102.0	113.0	125.0
Northwest Atlantic total catch	8.0	11.3	10.6	10.7	11.4
West Greenland, Labrador, and Newfoundland	2.5	–	4.0	4.0	4.0
Nova Scotia, New England and Norfolk	5.5	–	6.6	6.7	7.4

been postulated that the prospective planning should not be limited to 5-year periods only, but that the forecasts and planning should be made for more extended terms.

For the period up to 1990, the U.S.S.R. fishing industry had been given the task of manufacturing a quantity of fishery products large enough to meet the demands of the population of the country for fish and fishery products at a rate of 18.2 kg per capita per year as recommended by the Institute of Nutrition of the Academy of Medical Sciences of the U.S.S.R. To produce 18.2 kg of marketable fish and fishery products, 22.9 kg of raw fish material was required.

Guided by the data from the Central Statistical Department of the U.S.S.R. and from the Gosplan of the U.S.S.R. on potential population numbers in the country (1980: 268 million; 1985: 283.1 million; 1990: 297.7 million), one could calculate the quantity of fish needed to manufacture the food products: 1980: 61.4 million metric centners; 1985: 64.8 million metric centners; and 1990: 68.2 million metric centners.

These quantities were to be supplemented with the additional fish required to meet the the Ministry of Agriculture's demand for fish meal. This demand had been estimated at 15–20 million metric centners for 1980–90. Such a quantity of fish meal could have been produced from 75–100 million metric centners of whole fish. Considering that 30% of the total demand for fish meal could have been met by way of processing the waste from the fish gutted for manufacturing other food products, the catch size of whole fish to be reduced to fish meal in 1980–90 should have been 52.5–70.0 million metric centners. Thus, the total catch during 1980–90 should have amounted to 113–136 million metric centners.

In the forecasts made by VNIRO, the 1990 catch was estimated at 125 million metric centners, and the forecasted catch from the Northwest Atlantic was estimated as shown in Table 20.

According to this forecast, the Soviet fleet in the Northwest Atlantic should have yielded about 10% of the total U.S.S.R. catch, with the majority of the Northwest Atlantic catch to be taken in the Region.

A detailed forecast of the HO Zapryba fleet allocation in the Atlantic until 1990 was made by the AtlantNIRO scientists in 1973–75. The forecast was based on the analysis of Western Basin development for the 1968–72 period as well as on data on the existing fleet structure and addition of new vessels.

A comparison of fishing vessels by their most important technical and operational factors which reflected the basic trends in the improvement of the fleet during the period under consideration is given in Appendix Table 24. These factors are: improvement of fish processing technologies; automation and mechanization of the fishing processes and fish processing aimed at reducing crew numbers and increasing productivity of labor; increase in ship horsepower and pulling power of trawl winches; increase in size of holds of freezer trawlers; and so on. The increase in ship and ship fishing mechanism traction characteristics exerts immediate influence on daily catch rates owing to better ship maneuverability, greater speed and range during fishing operations, and a possibility of using larger trawls and fishing schemes which ensure higher productivity of fishing operations.

Productivity of the fishing fleet was predicted as a potential mean annual catch taken by a ship in a definite fishing area. The mean annual catch of a ship was calculated based on the forecast of two values: a probable catch per fish-day fished and the number of days fished during a year. For assessing the productivity of fishing vessels, statistics from past years were studied, trends in daily catches were shown, and forecasts were made for the state of the stocks of principal industrial species and for the influence of technological progress.

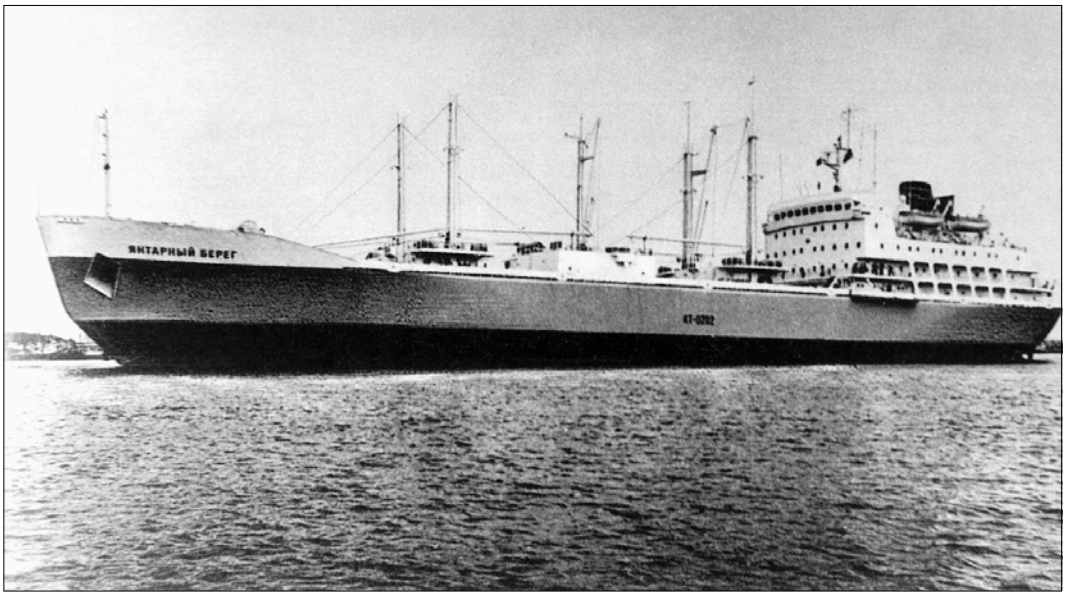
Two forecast options were being considered: stabilizing development of the oceanic fishery, with limited possibilities of increasing catches; and the assumption that technical improvements in the fleet and fishing techniques would lead to an increase of catch per fish-day fished.

The final data of the forecasted productivity of fishing vessels in the Region are contained in Appendix Table 25. The differences between the catch to be taken by the existing fleet and newly built vessels are appreciable.

The forecasted species composition of the catch from the Region is given in Appendix Table 26. Silver hake, herring, and mackerel top the list. The importance of other fish species is relatively low; nonetheless, taken together they account for more than 20% of the entire catch.

The final data of the forecasted catch that could be taken by the fleets of the Western Basin by fishing area and forecasted relative importance of the fishing areas are presented in Appendix Tables 27 and 28.

In 1974, when the processes leading to more limitations were in motion and the introduction of the zones of extended jurisdiction was being discussed at many international forums, the economists still forecasted retention and even development of the expeditionary fishery (in the Northeast Atlantic). According to these forecasts, the fishermen of the Western Basin of the U.S.S.R. might have harvested over 5 million metric centners in the Region in 1990; and among other areas, this share could have been retained at the 20% level. But in less than 3 years, the introduction of exclusive economic zones would be declared.



A receiving-transport supply refrigerator ship of the *Karl Libknekht* type. Length: 141.9 m. Main engine power: 9,000 hp. Speed: 17.3 kn. Carrying capacity: 6,425 t. Photo: Stages of Russian Commercial Fishing Fleet Development (1996).

PART III

MANAGEMENT PROBLEMS

FLEET MANAGEMENT: ON SHORE

Development of the Soviet fishery in the world's oceans, with the fabulous growth of its fleet, had become possible because of the number of seaports in the north, west, south, and east of the country. In the north and west, such seaports were located at Murmansk (beyond the Arctic Circle), Arkhangelsk, Riga, Tallinn, Ventspiels, Liepaja, Kaliningrad, and Leningrad. It was in these cities that the fleet had been concentrated and fish industrial complexes formed.

The management of the fish branch "isles" was based on the territorial principle. Five head offices of the vaious basins of the Soviet fishing industry had been established in large sea regions of the country by 1962. Zapryba, the head office of the Western Basin industry, directed industrial activity in the Basin via territorial fishing industry boards located in Kaliningrad, Lithuania, Latvia, Estonia, and the Leningrad base of the oceanic fishing fleet.

The principal tasks of the head office consisted of the following: further development of the fishery; development of new fishing areas and exploitation of new species in the world's oceans; securing a proportionate growth in the fishing, processing, and transport fleets; pursuing a common technological policy in the basin industry; and integrating the scientific, technological, and advanced experience achievements to provide high technological and economic indices of production.

The head office functions also extended to arranging the most efficient utilization and rational allocation of the fishing, processing, and transport fleets by fishing area as well as keeping these fleets in sound technical condition by timely repair and accident-free use of the vessels.

The oceanic fishery of the Soviet Union was a gigantic industry, the world's oceans being the realm of its activities, and the fishing fleet was its dominant production component. The management of this huge and versatile fleet and economy required non-standard approaches to and forms of production organization.

The division of labor, and the socialization of labor and production in the commercial fishery, became concentrated, specialized, and cooperative. Mainly, large fishery enterprises were being created. In 1971, in the U.S.S.R. fishing industry as a whole, the industrial and production staff at one enterprise averaged 4,400 men, with gross production of up to 120 million rubles. In head offices Zapryba and Sevryba, the same indices were 4,560 and 7,053 men and 116 and 193 million rubles, respectively. Within the limits of the planned economy, such a high level of production concentration was considered to be not only

SRTs at home port waiting for repairs.

admissible, but also necessary. Some technical and economic advantages of large fishery enterprises over small ones seemed to be obvious. It had been easier for larger enterprises to allocate fishing vessels by area and fishing season, to organize their fishing activities, and to operate them. It had been also easier for higher authorities to take control of fewer enterprises.

On the other hand, for lack of proper office equipment and computers, the concentration of a great number of vessels at one enterprise caused the swelling of managerial and service personnel. Several hundred people were usually engaged in the problems of managing the ships, their fishing activities, supply, repair, and fleet administration. Situations like this had been typical of all 11 fishing enterprises belonging to Zapryba.

The managers of the branch paid special attention to the specialization of individual enterprises. In the fishery sector, the enterprises (fleet bases) had been specialized by vessel type and fishery product. Medium trawlers of the SRT, SRTR, and SRTM types landing fresh, salted, and frozen fish (the SRTMs) were concentrated at one enterprise. Other enterprises operated the large tonnage ships of the BMRT and RTM types, which produced frozen fish.

Fish receiving and transport ships, processing ships, and tending ships were also pooled at enterprises of their own, usually named refrigerator fleet bases (RFBs). There existed a

close cooperation between the latter and fishing enterprises. Such specialization of vessels according to their functions contributed to the increased level of fleet management and to the efficiency of the fleet's utilization.

Fleet organizations cooperated with fishing harbors, ship-repair plants, fishing gear factories, and supply and product marketing agencies.

Seeking new forms of industrial management had been a continuous process. For example, the establishment of the Estonian Joint Fish Industrial Organization (EJFIO) "Ocean" in 1970 led to closing down five independent industrial enterprises, with the resultant reduction by half of the number of services, departments, and sections in the administration. The managerial staff number decreased by one third. EJFIO was the first organization in the fishing industry that accomplished direct management of production structural subdivisions and fleet vessel activities. This organization had been notable for the integrated combination of mutual interests and coordination of fishing, production, and transport fleet activity, on the one hand, and the work of the fishing harbor, ship-repair plant, and other services intended to meet the needs of this fleet, on the other hand.

Management of the long-range ships had been executed from a single center, according to a single chart schedule, and for the sake of a single goal—the most efficient utilization of the fleet for the benefit of the organization as a whole. This had made it feasible to eliminate contradictions between the goals and tasks that had been observed earlier in the independent fleet bases. Production indices and annual catches by vessel markedly increased already in just the first year of EJFIO.

There existed two principal schemes of fishery organization in the Soviet Union's fishing industry: the "autonomous," in which the vessels both conducted the fishery and delivered the catch to port; and the "expeditionary," which included specialized vessel types to perform the fishing, processing, and transportation. The fishing and transport vessels, fish scouting service vessels, tankers, water-carriers, floating workshops, and rescue ships could all be involved in the expedition. Both schemes had a number of options for the fishing fleet's operation.

In the autonomous fishery, two options were mainly used: fishing factory ships delivering to land, and fishing ships delivering to land.

The first option had been used in the fishing areas located at a distance of 1,000–3,500 miles from the base ports. The ships of large tonnage delivered finished products to any port. The second option had been mainly applied to the ships of small and medium tonnage engaged in the inshore fishery. Trip duration, given that fresh or chilled fish were to be landed, varied between 2 and 10–13 days. When salted fish were to be produced, trip duration was dependent on the ship's hold capacities and sea endurance.

The options used in the expeditionary scheme had the following sequences: fishing factory ship to transport ship to land; fishing ship to fish processing ship to land; and fishing ship to fish processing ship to transport ship to land.

Table 21. Profitablility (%) by schemes of BMRTs from Zaryba.

Fishing area	Autonomous scheme	Expeditionary scheme
Labrador	16.39	15.19
Newfoundland	16.02	18.68
Nova Scotia	7.51	12.10
New England	25.30	36.55
Central Eastern Atlantic	20.10	24.98
Southeast Atlantic	4.25	29.07

In the first case, the fishing factory ships of different classes operated in fishing areas at a distance of 1,500–3,500 miles from the base ports and unloaded their products to large high-speed refrigerator ships whose freight-carrying capacity allowed them to take on-board 3,500–6,000 t of frozen fish. In the second case, the fishing vessels, as a rule, unloaded fresh fish or semi-finished products to fish processing ships. A fish processing ship manufactured ready products and transported them to the port for marketing. This option had usually been applied to medium trawlers working in conjunction with motherships. The third option was a modification of the second one.

The expeditionary fishery predominated, bringing over 80% of the total catch to the country. The processing fleet was growing at a good pace. The growth of the transport refrigerator fleet was somewhat lagging behind.

In 1969, over 100 motherships, production refrigerator ships, and transport refrigerator ships in the head office of the Western Basin were designed to serve its 147 large trawlers and 616 medium trawlers. The total freight-carrying capacity of these ships exceeded 300,000 t.

A choice between the autonomous and expeditionary schemes and, consequently, the development of different fleet categories, had been determined by economic reasons supported by appropriate calculations.

In the long run, the efficiency of the autonomous scheme was dependent on the distance between the vessel operation area and the port of delivery for the fishery products. In their turn, the distances at which the autonomous trips became expedient depended on the productivity of the vessel activities, species composition of the catches, assortment of released products, costs of vessel maintenance, and so on.

The data on profitability (%) of operation of the Zapryba vessels of the BMRT type by fishing area are given in Table 21 for each scheme.

Comparative analysis of the economic indices for the two organizational schemes shows insignificant differences in profitability in the Labrador and Newfoundland areas, higher profitability of the fishery and a greater discrepancy of the indices in the New England area and the Central Eastern Atlantic, and a sharp decrease in profitability of autonomous trips made to the Southeast Atlantic, too distant from the base ports.

The availability and capacity of refrigerated holds in fishing vessels was the essential factor that allowed fishery managers to determine the best plan for organizing the use of trawlers and factory ships.

The expeditionary scheme required day-to-day planning and control of fleet movement at sea and ashore (in ports and ship repair plants).

Fulfillment of the State fish yield plans had been the cardinal objective for fleet management. This objective could be achieved if the operation and fishing time of the vessels were used to the maximum, if the optimum fleet allocation by fishing area and season were figured out, if the largest possible quantities of fish were caught and processed, and if the finished products were delivered to the ports of destination.

Planning the optimum allocation of fishing and service ships by area and fishing season was one of the most important reasons for the increase in the volume of captured fish and for the growth of the fleet's operational efficiency. Execution of plans like these was a fairly complicated matter because of difficulties related to peculiarities in the fish stocks, the already existing disproportion in the growth of the fishing, receiving, and processing fleets, and the time-consuming nature of the work.

The summed catch yielded in the "autonomous" and "expeditionary" fisheries had been the total value of optimum fleet allocation by area. Permanent miscalculations made when planning, and underused possibilities of rational fleet allocation, required optimized approaches to solve these problems.

In the 1970s, work on application of mathematical methods and models and the use of electronic data processing machines for planning the allocation of the fishing fleet was placed on a broad footing in the research and industrial organizations.

However, the Soviet fishery practice abounded with situations that utterly disagreed with the principles of the planned economy.

Ship repair had been one of the everlasting problems of the Branch. The disproportion between the through-put capacities of ship repair plants and the growing fleet was increasing. Sometimes, the ports were congested with a multitude of ships under repair and those in need of repair. Quite often, this had been caused by the irregular addition of newly-built ships to the fleet. Vessels were being launched from shipyards "in packs," and the same "packs" filled the ship repair plants. The outdated fleet was in need of running repair and a major overhaul. The ship repair plants were not in a position to handle the accumulating glut of ships. Demurrage of ships in want of repair had been rated at hundreds and thousands of vessel-days. Among the fishermen, who were waiting months for the departure of their ships, the jest of "the great power under repair" was common.

During some periods of time, and in some years, the problems of transporting and marketing fishery products became acute. Huge "jams" had accumulated in the ports. Berthed receiving and transport ships with fish on board lay idle; and far off, fishing vessels with holds full of fish were drifting at sea awaiting a chance to unload.

Garlands of fenders, essential for the expeditionary fishery, adorn the receiving-transport refrigerator ship *Aktiubinsk*.

Nevertheless, the advantages of the expeditionary system more than compensated all losses and enabled the fleet to obtain enormous catches of fish in areas located at a distance of thousands and thousands of miles from the base ports.

In 1975, the catch taken by the Zapryba vessels in the ocean exceeded 2.5 million t. The catch of the same size was yielded in 1995 by Argentina, Brazil, and Ecuador taken together. That same year (1975), the Kaliningrad vessels captured 920,000 t, the Lithuanian vessels—500,000 t, the Latvian vessels—600,000 t, and the Estonian vessels—300,000 t.

The structures, forms, and methods of fleet management were developed over the years. The Ministry was at the top of the hierarchy of the management links, with the fleet base being at the bottom. The specialists in a number of services and departments of the base directed and controlled the operation of the vessels in accordance with their duties of supervision. A ship's machinery was under the supervision of the Marine Mechanical Service. The Safe Navigation Service was in charge of a range of problems related to navigation. The Fish Processing Department controlled the quality and assortment of the product output.

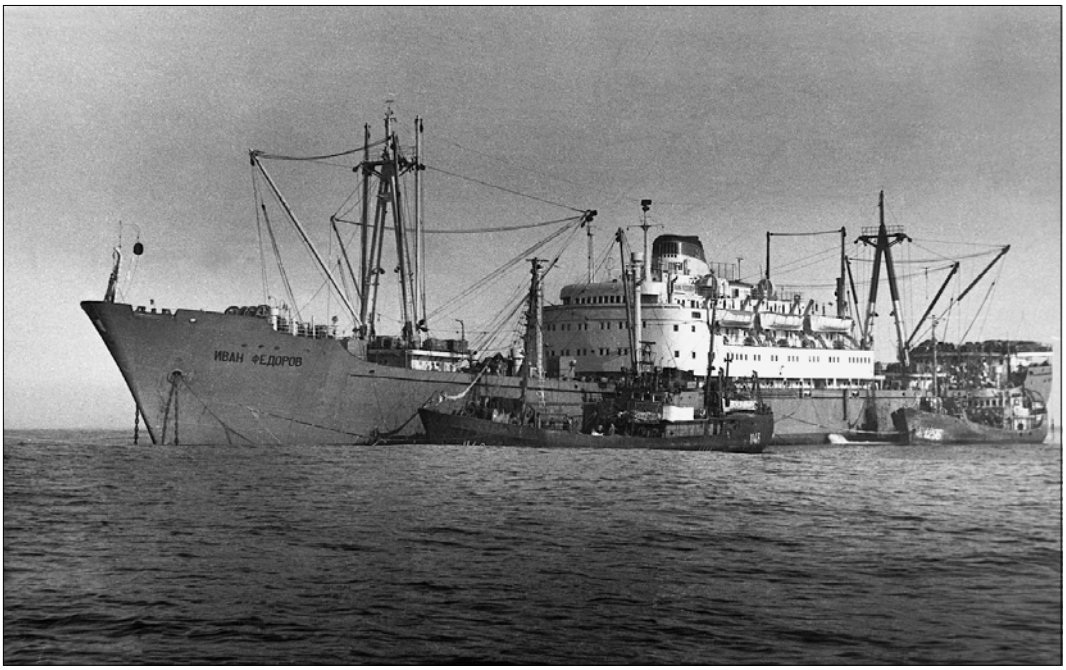
The Department of Fishing was the main structure within the fleet base. It directed and controlled the fishing activity of the vessels. The radio reports from the fishing vessels

The SRTM-K *Piotr Dernov* making fast to a receiving-transport refrigerator ship.

were analyzed there every day; the causes of unsatisfactory operation were revealed; and the instructions on eliminating the shortcomings were worked out. The Commercial Fishery Extraction Department submitted all the required materials and justifications that the administration needed in order to make decisions on placing the fleet by fishing area and on its maneuvering.

Although the specialists from that department kept in close touch with the scientific institutions and fish scouting services, they themselves were well aware of the fish resource peculiarities, fish distribution and behavior, environment, fishery conditions, and so on. A large group of trawl masters, highly trained professionals, was subordinate to them. The department submitted its appraisals of the fishing activities and the captains' reports on the trip results to the base administration. The performance of the captains was under the control of almost all services and departments of the fleet base. The fleet bases and other fishery enterprises were subordinate to territorial fishing industry boards (FIB), such as, for instance, the Kaliningrad Fishing Industry Board (KFIB).

The territorial boards had played quite an important role in the development of the fishing industry in the regions, the interests of which they vigorously defended in the Moscow



Alongside the mothership *Ivan Fiodorov*.

offices and in head offices of the basin fishing industry. Their arguments had been so cogent that they were allotted enormous funds for different purposes: the acquisition of new vessels, capital construction, and the like.

Due to the skilled actions of the boards, the factor of enterprise consolidation was gaining importance. As of 1 January 1970, 12 enterprises were integrated in KFIB, with 4 fishing and 5 fish processing enterprises among them. The organization, coordination, and control of their activities aimed at "the utmost increase in production efficiency" were the functional responsibility of the Board.

By their structure, the boards resembled the fleet bases in many respects, differing from the latter in importance of the problems raised and decisions taken.

Fishing conditions constantly changed in different oceanic areas. Any change in fish behavior and in their aggregation density immediately affected the productivity of large groups of fishing vessels. Daily catches varied markedly by fleet base. Poor fishing conditions could persist for a long time. In such cases, it was important to reveal the cause of the disturbance and make a sound decision.

Since approximately the early 1960s, fishery councils had been established with each board administration. By their status, the councils were consultative bodies with the principal functions as follows:

- decision-making for current problems regarding the operation of fishing and service fleets aimed at fulfilling fish yield plans;
- discussion and consideration of problems of the fishing fleet's long-term operation;
- discussion of measures to be taken for fleet operation and fulfillment of fish yield plans;
- discussion and consideration of problems of commercial development of new areas;
- discussion of fish searching plans and of scientific and scouting expedition programs;
- debating and approving nominees for positions of chiefs of the fishery and heads of fish scouting expeditions; and
- hearing reports and taking cardinal decisions based on results of commercial and fish scouting expeditions.

The wording of the council functions could have been more laconic and clear-cut, but that was the way they were formulated at that time.

The chiefs of the boards and enterprises and the marine chiefs of the enterprise fishery were members of the fishery council. The heads of the fishery institutes attended the council meetings which were held on a regular basis, usually twice a month. Decisions on fleet allocation by fishing area, delivery of fishery products from fishing areas, and marketing of the products ashore were made at the meetings. The question of moving the fleet groups from one area to another was also considered at the council meetings.

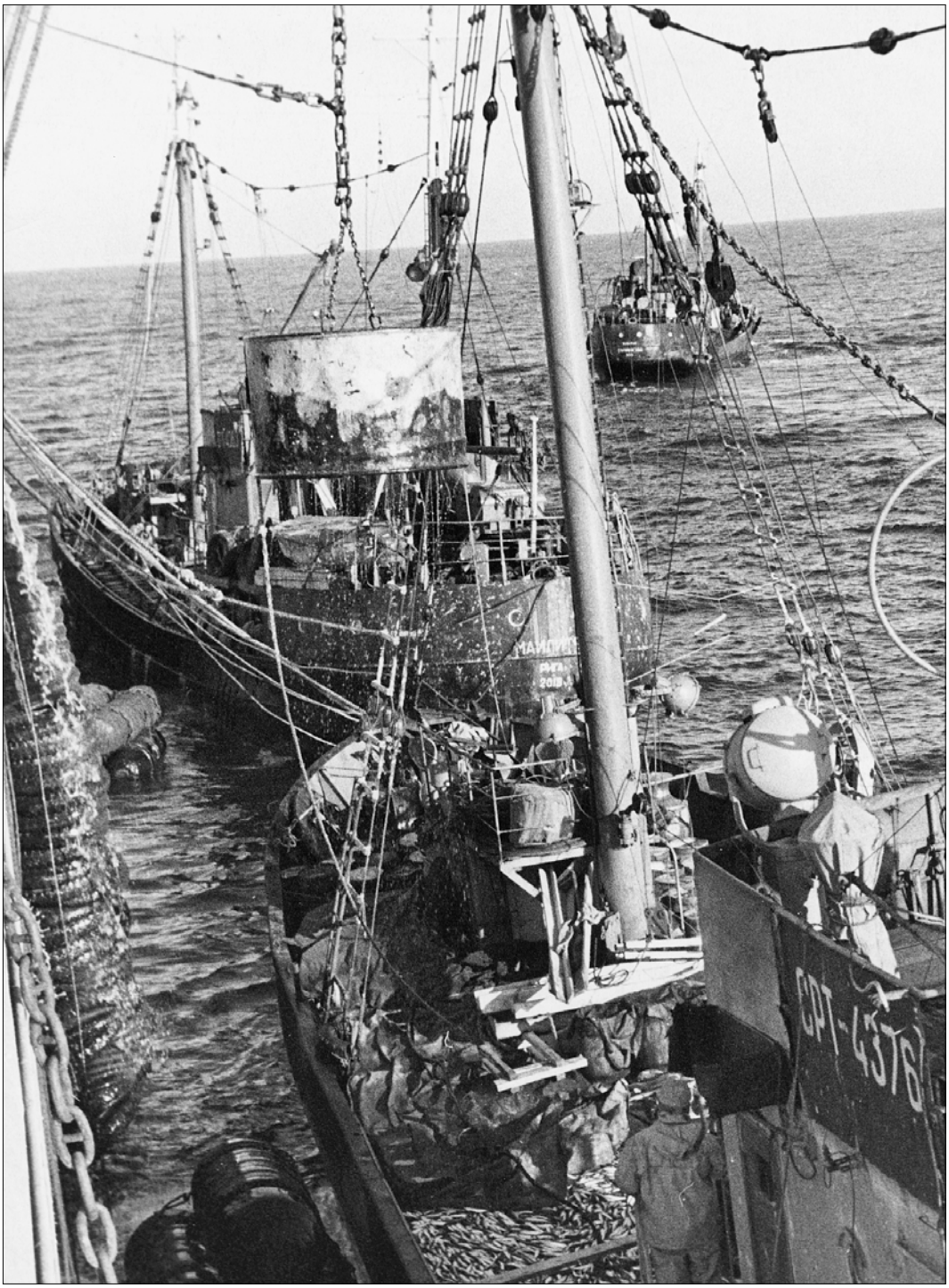
The planned economy assumed the use of definite mechanisms and forms of management, such as all kinds of resolutions, decisions, measures, etc. Thus, resolutions on fishing gear unification or pair-trawl and midwater trawl fishing development were passed. The resolutions and measures pertinent to the work of the fleet were, of course, most numerous and encompassed the entire range of problems related to its operation. "On Summary Plan of Measures for Safe Fleet Operation in the Fall/Winter Period of 1967/68" or "On Unsatisfactory Fleet Employment" are examples of such resolutions.

Special attention was given to fish processing problems. The resolutions called upon the increase in silver hake, mackerel, and horse-mackerel production; for reduction in lean herring supply; and so on.

Reports, resolutions, and decisions were piling up by the end of every accounting period (quarter year and full year). Thus, Zapryba had been used to prepare explanatory notes or decisions based on the annual results of the economic and financial activities.

With the introduction of quotas, resolutions on matters such as more complete filling of quotas on and improving the organization of the fleet operation in the U.S. and Canada waters followed.

Some measures radically changed the use of vessel operation time. So, in 1962, the KFIB chiefs put forward a proposal to introduce a new form of fleet work organization in distant fishing areas by changing crews at sea. The proposal was supported by Nikita Khrush-



SRTs delivering herring catches to a mothership.

chev, Chairman of the Council of Ministers of the U.S.S.R., who, in turn, proposed to establish external fishing bases. Both proposals were implemented. External bases were created on the island of Cuba and on the Atlantic coast of Africa. As a result, the fishing time of the ships and fish yields considerably increased.

All the activities regarding fleet management, like any other industrial activity in the country, were carried out under the aegis of the Communist Party of the Soviet Union, the CPSU. The Program of the CPSU read, "Laying the material and technical foundation of communism requires incessant improvement of the economic management and planning. In all economic planning and management links, attention must be focused on the most rational and efficient utilization of material, labor, financial resources and natural wealth, and elimination of unwarranted costs and losses."

The leading role of the Party was quite tangible. In Murmansk and Kaliningrad, in Vladivostok and Astrakhan, there existed departments with regional committees of the CPSU that had been empowered to deal professionally with the fishing industry. As soon as any enterprise began to "hobble," it immediately became the object of close attention on the part of the regional Party committee. Inspections followed one after another; measures were developed; strict resolutions were passed; and replacement of enterprise leaders was not uncommon. Calm used to set in only after the crises had been overcome.

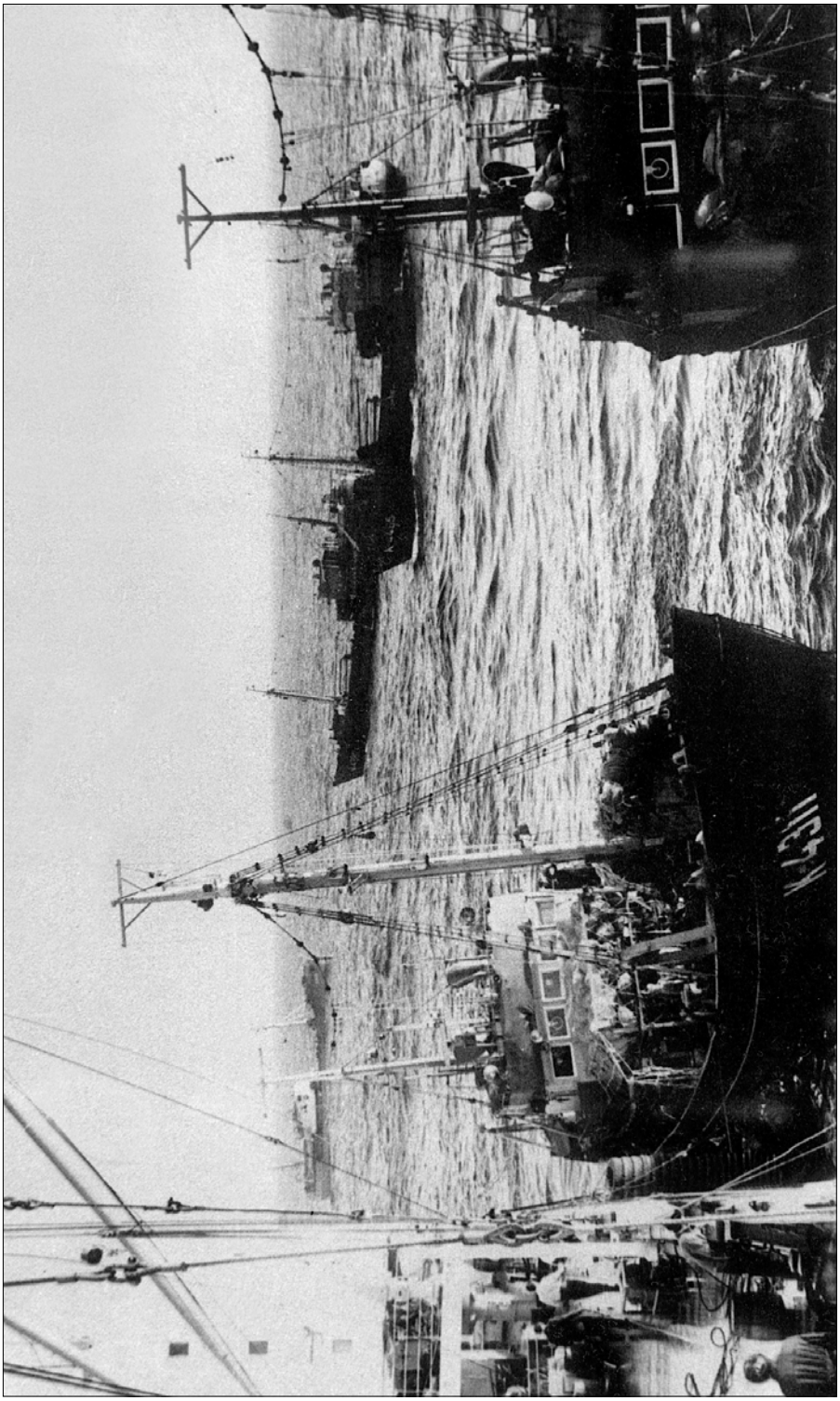
The regional Party committee often took the lead when necessary changes were about to happen. And the "First," the first secretary of the regional Party committee, was aware of what was happening in the branch. He could frequently be seen at the intercom listening to the weekly conferences in which all fishery enterprises participated.

The chiefs of the enterprises were quite afraid of regional forums—meetings of the Party and administrative "actives"—where the chiefs could have become targets for powerful charges of criticism from the "First" if they happened to have neglected their duties. The so-called Committees of People's Control also carried out inspections of the enterprise activities. One such inspection dealt with the Zapryba fleet operation.

The activity of the controlling and inspecting bodies died down somewhat when the circumstances at sea and on shore were at their best.

The upper links of the hierarchic chain, namely, the head offices of the basin fishing industry and the Ministry of Fisheries, also took part in fleet management. The chiefs and fishery specialists from the entire Baltic area met every quarter of the year in Riga, the headquarters of HO Zapryba. Fishery council meetings lasted two or three days, and the participants had enough time to exchange information on the fishery, make proposals as to the use of one or another fishing gear, and get scientific forecasts for the next quarter. The head office specialists presented their analysis of the results of the branch activity and tried to reveal hidden resources for its improvement.

Every quarter, fishery council meetings were also held at the Ministry. In addition, fleet-related matters were considered at Ministry Board meetings, which usually were held in



SRTs near the motherships are in a queue for reception.

order to discuss the operational results for each quarter, half year, and full year. The fleet was always under supervision. Hundreds and thousands of eyes of chiefs of all ranks, specialists, and functionaries were watching it.

Right up to the beginning of Perestroika, groups of scientists at several research institutes studied the problems of efficient management of the commercial fleet. To solve these problems, the methods of systems analysis and simulation techniques were used. Special attention was drawn to the problems of automated management using electronic data processing. The possibility for chief personnel to work in a dialog "person-machine" mode with video terminals displaying data on the actual state of the fishery by vessel and area, product output, etc., was studied.

In addition, the possibility of prospective control over each vessel's activity was considered. Owing to standing operation briefings (following the example of the marine fleet and inland water transport), the work of the onshore chief personnel in a dialog "person-machine" mode would have allowed them to gain relevant data on fleet operation results and results of multivariant forecast calculations, and to obtain one or more recommendations for decision-making supplemented with the assessment of the probable efficiency of a would-be decision.

If the fishing vessels were equipped with electronic data processing mini-machines (we are not talking about PCs, but bulky, first-generation Soviet machines) that would have transmitted a video signal from the vessel to shore video-terminals on what was happening both under the water and on the surface, the captains could have been instructed from shore on the most efficient vessel-trawl system interaction, on solutions for the vessel's production and economic tasks, and the like.

All these plans were not destined to come true. The flourishing and mighty branch and the system of the expeditionary oceanic fishery ceased their last struggle with the disintegration of the Soviet Union.

FLEET MANAGEMENT: AT SEA

In Soviet Russia, the first mention of fishing fleet management problems at sea dates back to the 1930s. It was then that the first hesitant steps were made to develop an expeditionary fishery in the Northern and Eastern basins.

During 7–10 July 1958, a meeting of the representatives of the regional Councils of National Economy from the Estonian, Latvian, and Lithuanian Republics, and those from Murmansk, Karelia, Leningrad, and Kaliningrad, was held at the Gosplan of the U.S.S.R. In conformity with the resolution of the meeting, a fishery council was established for the North Atlantic herring expeditions. Alexander Ishkov, the Minister of Fisheries, approved the regulations of the fishery council on 28 May 1960.

Prospecting for fish, a BMRT from Riga begins its search.

The fishery council was established in order "to coordinate the fishing industry fleet operation in the herring fishery and the activities of the scientific fish scouting long-term services of regional Councils of National Economy mentioned and to exercise enforcement of the regulations of joint fishery and navigation by all the vessels." It was the first serious attempt to create a mechanism for fleet operation management at sea.

Meanwhile, the picture of the Soviet oceanic fishery was literally changing before everyone's eyes. At seaports, the fishery industrial complexes were springing up all over, and the new structures were being created. The fleet filled in the new fishing areas in the ocean. Seamen from Murmansk and Kaliningrad, from the Soviet Baltic and Georgian ports, from Sevastopol and Kerch kept arriving in the Northwest, Northeast, Central Eastern, Southeast, and Southwest Atlantic areas.

At ports of registry, their vessels were part of specialized fleet bases, territorial fishing industry boards, and head offices of the basin fishing industry.

The development of many a region in the country was picking up speed due to the influx of the fleet. The prosperity of the population was increasing. But the problem of fleet management was becoming still more complicated.

The "cities" in the ocean lived their own life. For several months, crews abandoned their home ports, leaving behind their families and relatives, and their shore chiefs, notable for their tough control during the in-between trip moorage. At sea, the captains discarded their shore-borne fetters and attained immeasurably greater independence, and their actions were fraught with the elements of self-will and unpredictability.

The fortunes of the branch, of many thousands of people on shore and at sea, were dependent on the fleet. The fleet became enormous. Over half of the multimillion ruble basic production assets (i.e. ships and equipment) of the fishing industry were permanently at sea.

The necessity of directly managing the group operation of the vessels in the fishing areas, where production had been concentrated, became objectively imminent. It was there, in the ocean, that the immeasurable potential of the struggle for fulfillment and over-fulfillment of the State plans existed; it was there that the exigency in applying management forces was necessary to provide safe navigation and fishing operations, organization, and regulation of the fishery.

The coastal structures felt the growing need to slacken the burden of fleet management from shore. During the 1960s–80s, several scientific institutes of the branch were seeking and developing forms of fleet management at sea.

The State Committee of the Fishing Industry with the Council of National Economy of the U.S.S.R. issued Order No. 126 of 17 August 1963 approving the "Regulations of Flagmen and Flag Specialists in the Fleet of the Fishing Industry of the U.S.S.R." (Flagman—this was a personal military rank of the higher officers in the U.S.S.R. Navy in 1935–40. This rank was carried forward to the peaceful fishermen's "ground" and was considered to

Alongside the mothership *Rybatskaya Slava*.

be adequate to the multilevel structure of fleet management in the fishing industry). In the regulations, the duties, rights, and responsibilities were defined for the officials in charge of the work of the fleet operative units at sea.

Direct management of the activities of the vessels brought together to conduct the fishery or for passage to operative subdivisions was administered by officials named to the position of flagman. This notion applied to chiefs of the expeditions, commanders of detachments and flotillas, chiefs of groups, "columns," and other fleet subdivisions.

Most experienced ship captains or persons who had special education and vast experience in fishing fleet management at sea were appointed flagmen.

Flagmen of the expeditions (of Zapryba, for instance) or flotillas (the Kaliningrad Fishing Industry Board, for example) were nominated by head offices of the basin fishing industry by recommendation of the fishery organizations. Flagmen of other subdivisions were promoted by the chiefs of territorial fishing industry boards.

The main task of the flagman consisted of fulfilling the State fish yield plan by the fleet as a whole and by every fishing vessel in particular. It was his duty to regularly supervise all the vessels attached to the subdivision in his charge, to take measures aimed at safe navigation of the vessels, and, if necessary, to render assistance to these vessels by using all means at his disposal. The flagman saw to it that the vessels kept to the established regulations of navigation and the fishery. He controlled organizational schemes of working procedures and production discipline on board vessels. He saw to the uninterrupted functioning of communication facilities that ensured guidance of the subdivision vessels. He also governed the procedure of catch delivery from fishing vessels to motherships and receiving and transport ships.

But the responsibilities of the flagman were also high. He was responsible for fulfilling fish yield plans, fish processing, and delivery of products to the ports; for organizing the vessel's proper operation; for accident-free operation of vessels during the fishery and in passage; for observance of the rules of navigation and conduct of the fishery by the vessel captains; for political views and morale of the crew members; and for labor and production discipline on board vessels. As a whole, the rights conceded to the flagman permitted him to control the activities of the vessels under his charge, including the questions of navigation, vessel operation, and conduct of the fishery.

On 8 January 1964, about a year and a half after putting the flagmen regulations in force, the "Regulations of the Fishery Council for Marine and Oceanic Expeditions" were adopted as per Order No. 6 issued by the State Fishery Committee with the Council of National Economy of the U.S.S.R. By its functions and organizational scheme of activities, the new council differed only slightly from the fishery council for the North Atlantic expeditions adopted in 1960.

The activities aimed at improving the organization of fleet operations at sea proceeded. The "Standard Structure of Fleet Management in the Fishing Area" was worked out in 1973 at AtlantNIRO and approved by the Ministry of Fisheries. It contained information on the ways of fleet management organization, manning tables, regulations, duty regulations, and outlines of reports for chiefs of structural subdivisions and flag specialists.

And, finally, in 1986, the State Fishing Fleet Engineering Institute (Gyprorybflot) issued the "Standard Regulations of Fleet Management in the Fishing Area" adopted by the Ministry of Fisheries on 30 December 1985 (Order No. 695). This document had much in common with the standard fleet management structure issued in 1973. A certain completeness of the management organization scheme was inherent in the two documents.

The principal feature that distinguished these documents from the former ones was the introduction of the structures that markedly elevated the fleet management organization level. Approval was given for establishing headquarters of chiefs of the fishing area and the expedition (flotillas) of the territorial fishing industry board. The same was valid for the Association of the Fishing Collective Farms (Appendix Figure 27).

Representatives of the Ministry of Fisheries also participated in fleet management by area (in foreign state zones), but the chief of the fishing area who represented the central head office of the basin fishing industry (the All-Union Fishing Industry Board, AFIB, in the 1980s) had been a key figure. The chief of the fishing area was appointed by the Ministry of Fisheries. On behalf of the head office, he governed the operations of the fishing, processing, and receiving and transport fleet and the tanker, rescue, search, patrol, and other service ships via chiefs of the fishing expeditions (flotillas) of the territorial fishing industry boards, captain-flagmen of fishing detachments, or directly via the vessel captains. The chief of the fishing area headed the fishing area headquarters, and might be authorized to chair the fishery council or joint fishery council.

The RTMT *Slavsk* receiving supplies from the transport refrigerator ship *Leninskiye Gory*.

Deputy chiefs of the fishing area in charge of the fishery, safe navigation and navigation regime, and technical fleet operation were members of headquarters. The chief of the fishing area had several assistants responsible for production, radio communication, electric radio navigation and fish scouting equipment, and "protection of labor" (i.e. protection of life and health of workers). The engineer-dispatcher of the area and the interpreter were also on the headquarters staff.

Great importance was attached to the activity of the chief's assistant responsible for production. He directed and controlled the work of the assistants to the chiefs of fishing expeditions (flotillas) in charge of production, the flagman specialists of fish processing, the captains' assistants in charge of production on board vessels, the fish processing masters, and the laboratory technicians. He was also in control of fulfilling the planned product manufacturing and product quantity, quality, and assortment.

The chief's assistant was assigned to see to it that the maximal quantity of raw fish was used to manufacture human food, that freezing chambers and similar technological equipment were fully loaded with fish, that technological cycles of fish processing were observed, and that the quality of raw fish always met standard requirements. In his work, the assistant in charge of production was guided by the State standards of the U.S.S.R. and by specifications, technological instructions, and orders and directions of the Ministry of Fisheries, head offices, and other normative documents.

The quality of the fishery products was a matter of utmost importance. The fishery

products were conveyed in refrigerator cars countrywide. If the requirements of the State standard were not met, the manufacturers were accused of unsatisfactory product quality. High fines were then imposed.

The staff of the fishing expedition (flotillas) headquarters consisted of the chief, deputy chief in charge of the fishery, and assistants responsible for production, radio communication, and "protection of labor." The two lower ranks in the hierarchy of links of fleet management at sea were occupied by captain-flagmen of fishing detachments and by ship captains.

To render practical assistance to chiefs of the fishery and to the fleet placed in the fishing area, the shipowners appointed flagman specialists: captain-flagman, mechanic-flagman, electric mechanic-flagman, mechanic-flagman of freezing plants, chief trawl master-flagman, chief fish processing master-flagman, radio operator-flagman, and electric radio navigator-flagman.

In addition, in order to promote increased vessel operation efficiency in the fishing detachments, the shipowners sent specialist-instructors on the vessels: captains, mechanics, and fishery technologists.

One of the "hot lines" between chiefs of the fishing areas and chiefs of the expeditions was for securing the acceptance and transportation of fishery products from the fishing areas, distribution of refrigerated hold capacities between fishing expeditions (flotillas) and vessels, and supervision of loading and unloading operations. The distribution of fuel and water between fishing expeditions and vessels was a problem of no lesser importance.

The refrigerator fleet base consisted of five major groups of vessels differing in their functions:

1. Transport refrigerator ships (TRs);
2. Production refrigerator ships (PRs);
3. Motherships (MSs), production and transport ships inclusive;
4. Tankage fleet, sea tankers (STs) and water tankers (WTs) inclusive; and
5. Sea rescue tugs (SRTs).

Ship groups 1 and 4 were only engaged in transportation activities; groups 2 and 3—in production and transportation; and group 5—in rescue operations in the fishing areas. For lack of transport refrigerator ships, some production ships were used to transport frozen fish produced by the fishing fleet. The two main directions in the refrigerator fleet base activities can be outlined as follows:

- production and transportation (receiving raw fish and salted, semi-finished products from the fishing fleet, followed by complete or partial processing on board motherships and production refrigerator ships with subsequent delivery to port); and
- transportation (delivery of necessary material and technical supplies to fishing areas and transportation of finished or semi-finished products from fishing areas).

A scheme shown in Appendix Figure 28 gives an idea of the pattern of the joint activities of the fishing and service fleets.

The problem of unloading catches and fishery products from fishing vessels with minimal time loss did not go off the agenda, being the cause for incessant conflicts. At times there were "jammings," when unloading was incredibly slow. For example, in June 1962 on Georges Bank, nearly 180 medium fishing trawlers awaited unloading and supplies in the vicinity of their motherships. About 20 hours on average was needed to unload each vessel and transship the supplies. However, vessels frequently lay alongside motherships for 36–48 hours.

Loading and unloading operations in the open sea were always fraught with danger. It became aggravated in the Georges Bank area with frequent and dense fog in summer, gales during the fall-winter seasons, and strong tidal currents. When mooring, contact between fishing vessels and service ships were as often as not, and this and other accidents damaged the vessels and caused mutilation and loss of life.

On 4 October 4 1961, the BMRT *Almaz* disregarded a strong tidal current when maneuvering alongside the diesel-electric ship Sevastopol. The *Almaz* swept towards the *Sevastopol* when another boat was laying alongside her. The *Almaz* came in contact with the boat, and a serious accident and the loss of four seamen was the tragic outcome.

The problem of distributing the refrigerated hold capacities of the service ships between the flotillas, and establishing an order of priority for unloading fishery products and transshipment of supplies, was difficult to solve. Complaints that the chief of the fishing area on Georges Bank favored the Latvian, Lithuanian, and Estonian flotillas in terms of unloading order of priority to the detriment of the Kaliningrad flotillas kept coming in to HO Zapryba.

The scheme of fleet management by one of the head offices of the basin fishing industry was outlined above. However, large groups of vessels from the northern, southern, and Baltic regions of the country had been operated simultaneously in one and the same fishing areas, which meant that the fleet management structures of the three head offices with their own headquarters, flagman specialists, and so on, were functioning there. In such cases, the joint fishery council was represented by chiefs of the fishing areas from all head offices, chiefs of the shipowners' expeditions, captain-flagmen of the fishing detachments, and the captain-flagman of the Fish Scouting Service.

The council had been assigned to coordinate the fishery chiefs' actions, which were charged with accomplishing the tasks set for the fishery expeditions and vessel detachments: complete utilization of the fish stock potential in the fishing areas, and efficient use of the fishing, transport, and service fleets. The joint fishery council was headed by one of the chiefs of the fishing areas. Although the council did specify the above-mentioned tasks to a certain extent, as it had been expected to do, it mainly performed the functions of a consultative body.

According to the scientists, the development of diverse forms of fleet management by

headquarters directly in the fishing areas was feasible through the creation and integration of automated systems for electronic data processing on flagman ships, and the so-called automated systems for fleet management in the fishing area (ASFMFA). The latter system was supposed to use the complex of administrative, legal, economic, and mathematical methods based on maximum utilization of all available automatic devices for collecting, transmitting, and processing information. Based on ASFMFA, the leaders of the fishing area could have exercised efficient management of vessel production in conformity with the specified goal. A criterion of this system's efficiency was for the vessels to achieve the indices of planned output of the predetermined assortment of food and industrial fishery products at minimal cost.

The ASFMFA was considered to be the organizational and economic system that subsumed the problems of production management and economic activity of the vessels operating directly in the fishing areas. This system was assumed to provide an automatic solution to the tasks of promoting decision-making within the framework of the following subsystems: the search for commercial fish concentrations; the analysis of fishing conditions; short-term forecasts; the yield of fish and the output of fishery products; and the services administered to the fishing fleet by the receiving, transport, and service ships.

The so-called "headquarters" vessel equipped with up-to-date communication facilities, devices, and the ship modification of the electronic data processing machine was supposed to be the basis for the ASFMFA material-technical base.

Certain trends that emerged from the development of the first ASFMFA projects at scientific-research institutes and engineering organizations were indicative of the fact that further development of the ASFMFA might have followed three different lines:

- local (at the level of one head office or one FIB in one fishing area);
- integrated (for the vessels of all head offices or FIB in one fishing area); and
- integrated, of international character (for management of the vessels of different nations in one fishing area).

Events that occurred in the U.S.S.R. and in the countries of the socialist camp prevented the intentions of the scientists and design engineers from being implementated, although those had been quite impressive, especially the development of the integrated type of ASFMFA of international character.

The structures and forms of fleet activity management in the fishing areas were discussed above. However, there existed other mechanisms as well that served to accelerate and stabilize, but also hold back, the rotation of management gearwheels to a certain extent.

The branch was persistent in providing the officers of the vessels and expeditions with all available documents and in imparting knowledge of the issues of statutory and legal regulations of navigation and fishing in the waters of the world's oceans. Also imparted

were documents and knowledge of safe navigation and fishing operations, organization of communication, and the navigational and hydrometeorological welfare of the vessels.

Collections of documents concerning the rules and regulations of navigation and the fishery were issued in volumes. They contained the basic acting documents related to matters such as international conventions, agreements, and treaties; legislative and "bylaw" acts of the U.S.S.R.; and statutory directives of the Ministry of Fisheries, the Ministry of the Merchant Marine, the Hydrographic Board of the Ministry of Defense, and others.

The international "Regulations for Preventing Collisions of Ships at Sea" was one of the most important international statutory acts in everyday use on fishing vessels. These regulations were Addendum B in the final Act of the International Conference on Protection of Human Life at Sea, 1960, and came into force on 1 September 1965.

For regulation of the fishery conducted by numerous vessels of different classes working side by side with different types of fishing gear, special normative directions had to be developed. Thus, the "Rules of Joint Navigation and Fishery for the Vessels of the U.S.S.R. Fishing Fleet" saw the light (put in force in compliance with Order No.173 of the Ministry of Fisheries of 1 June 1966).

Later, on 25 September 1970, the "Instruction on the Rules of Navigation and Conduct of the Fishery by the Vessels of the U.S.S.R. Fishing Fleet" was approved by the Ministry of Fisheries. The rules of navigation and conduct of the fishery in high-seas areas, in territorial waters, and in fishing zones of foreign states were given considerable prominence in the directive. One of its sections dealt with the duties and responsibilities of the heads of the fishery organizations and flagmen.

Everything that could be scheduled, assigned, provided for, directed, or regulated took the shape of regulations, instructions, and rules.

The Central State Inspection of Safe Navigation and Harbor Supervision for the fleet of the Ministry of Fisheries (Glavgosrybflotinspektsiya) was established in accordance with Resolution No. 819 of 23 October 1965 passed by the Council of Ministers of the U.S.S.R. It was an independent structural subdivision at the Ministry, functioning as the head office. In accordance with the regulations of the Glavgosrybflotinspektsiya, it "… will direct its activity at preventing accidents and breaches of the order established for the fleet so that not a single ton of fish is yielded, unloaded, and delivered to port with infringement upon the requirements securing safe navigation, shipping, safety of human life at sea and in inland waters or with trespassing the frontiers of the foreign zones of coastal state jurisdiction."

The Central State Inspection executed its tasks via the State Basin Inspections of Safe Navigation and Harbor Supervision and their regional inspections as well as through harbormasters.

A wide scope of the Glavgosrybflotinspektsiya duties went together with definite rights. It could delay the carrying out of orders and instructions issued by officials of the basin

head offices, enterprises, and organizations of the Ministry of Fisheries. Ships' officers, fishing harbormasters, and chiefs of the fishing fleet units realized that direct jeopardy to safe navigation and the fishery caused by their negligence could entail severe penalties, even dismissals.

However, the fleet was too large, with too many captains, and there were those among them who did not faithfully follow the rules and regulations. The number of infringements was higher in areas with complicated sailing and fishing conditions.

Georges Bank was one such area. The number of foggy days begins to increase in March–April, reaching nearly 50% of the time in June–July. Like a thick cover, the fog frequently falls on the sea surface reducing visibility to just several meters. Fogs were especially dangerous for the fleet when a small area (sometimes 10–50 mi^2) where herring were concentrated was flooded with dozens or hundreds of vessels of different types. Some of them proceeded with their fishing operations. On such occasions, the number of vessel collisions became more frequent.

Tidal currents of a regular semi-diurnal cycle are rotary in nature, and are notable for high velocities of up to 1.5–2.5 kn.

In May 1963, the SRTR-9003 collided with the BMRT *Kazan.* In July of the same year, this misfortune was followed by a series of collisions between the RTM *Tsefey* and the BMRT-355, the SRT-4152 and the SRT-369, the SRTR-9018 and the SRT-23, and the SRT-4357 and the SRT-1148.

Quite disagreeable situations also occurred during fishing operations.

In July 1962, the area of herring concentrations was reduced to 10–12 mi^2. The fleet was fishing under congested conditions. Sometimes up to 50–60 vessels with their drift net lines filled this small area. Because of this congestion, and adding the strong tidal currents, a mass of drift net lines became entangled, some 30–45 of them at the same time. The loss of fishing gear was enormous: 7,000 nets, 130,000 m of rope, and 19,000 buoys were lost between 18 July and 28 July. Concurrent work of the trawlers and drifters made fishing more complicated. Frequent fog aggravated the situation. Neither proper fishery organization nor integrated management existed in 1962 on Georges Bank.

The question of accident-free sailing and fishery operations on Georges Bank was extremely critical. There was no refuge, nothing but the open sea all around. Even an insignificant breakdown, such as a propeller fouled with nets, became a problem. The seamen used to recall the Norwegian Sea with its sheltered Fugle Fjord on the Faroes, where minor repair and diving operations, could be made.

The Glavgosrybflotinspektsiya constantly demanded that vessel captains had a thorough knowledge of the sailing and fishery conditions on Georges Bank and took every possible precaution against accidents.

A good communication system was essential in the organization of the expeditionary fishery with large groups of vessels. The "Rules of Radio Communication for the Marine

Mobile Service of the U.S.S.R.," issued by the Minister of the Merchant Marine and the Minister of Fisheries, were approved and enforced by Order No. 118/272 of 20/22 August 1986. They stated:

> "Radio communication for the marine mobile service of the U.S.S.R. is one of the most important means to secure safe navigation as well as for operational and dispatching guidance of the activities of the fleet and its enterprises … The principal task of the marine mobile service radio communication is to ensure:
> a) safe navigation and protection of human life at sea;
> b) operational and dispatching guidance of the activities of the fleet, ports, control of the fleet, steamship lines, onshore enterprises, expeditions, and other organizations and departments that exploit the marine fleet."

Attached to the "Rules of Radio Communication," were the "Regulations of Organization of Radio Communication for the Fleet of the Ministry of Fisheries of the U.S.S.R." According to the regulations, a uniform radio communication scheme was to be used in the Ministry of Fisheries. It had to be based on a general principle of management of the activities of the fleet, onshore organizations, and enterprises, and comply with the structural schemes described above.

The schedule of radio communication was presumed to be uniform for all coastal and ship radio stations of the fishery organizations operating within the limits of their own basin (for example: the Western Basin, Northern Basin). According to the schedule, vessels had to be provided with radio communication both within the range of their basin radio center and via radio centers of other zones when operating there. Intrafishery radio communication (see a scheme in Appendix Figure 29) was scheduled for the flotillas of each fishing industry board and for the head office of the expedition as a whole. When a joint expedition represented by vessels of different head offices was fishing in the same area, a common schedule of intrafishery radio communication was drawn up for that area. Coastal and ship radio stations of the fishing industry functioned at frequencies as assigned by the State Electric Communication Inspection with the Ministry of Communication. Table 22 shows the daily schedule of intrafishery communication that were imperative for the flotillas and expeditions.

Consulting flagman specialists and consulting on matters of medical assistance took place once a day if necessary, except for urgent cases, i.e. emergencies preceded by "Pan-Pan," "Medical Assistance," and "Distress" signals.

As evident from the daily schedule of intrafishery communication, volumes of information transmitted by radio communication channels detail the state of the fish stocks in the area, their utilization, and the organization of the fishery.

Like fleet management activity, radio communication was developed for the same purpose—fulfillment of the State fish yield and fish processing plans.

Table 22. Daily intrafishery communications for flotillas and expeditions.

Communication	Frequency
Collecting fishery radio reports from detachments, flotillas, and expeditions	Once
Reports by fishing vessels on the availability of fish based on the first catch of the day (drift nets, trawls, etc.)	Once
Communication between fishing vessels and the receiving and transport fleet regarding delivery of fishery products	Once
Fishery council of detachments (10–15 ships) on the organization of fishing operations	Once
Fishery council of flotilla chiefs	Once
Exchange of information among flagmen in detachments	Once
Exchange of information among flagmen for flotilla chiefs	Once
Circular time (communication of directions, notifications, and instructions from shore) for expedition chief (fishing area chief) to relay fish search results and directions for fleet allocation	Twice
Circular time for the council of flotilla chiefs to relay fish search results to detachments and directions for fleet allocation	Twice

Coded radio-telegrams, the so-called fishery radio reports, contained detailed information on fishing results of every vessel and were transmitted at a strictly fixed time. Time intervals between successive summaries of fishing operations in flotillas were short so the captain of any vessel could obtain information on fishing results by all the vessels belonging to his head office. The same scheme of radio communication in the fishing area was employed by groups of vessels belonging to other head offices.

For a long time, no common forms for final fishery reports existed in the fishing industry. They differed considerably by head office.

In June 1972, the HO Zapryba Commission approved an automatic system for fishery data collecting and processing with the use of the electronic data processing machine "Minsk-22." This huge machine, as big as a house, accumulated and processed data on the activity of the Western Basin fleet.

Communication between vessels of the expeditions, flotillas, detachments, or groups (the group in transit inclusive) and coastal radio centers was done, as a rule, via the radio stations of expedition chiefs (chiefs of fishing areas), flotilla chiefs, and flagmen of detachments and groups, as well as via the radio stations of motherships, and production and transport ships working in the fishing area. The latter were equipped with more powerful means of radio communication and provided transit of traffic between the fishing vessels and coastal radio centers. They were permanent intermediaries—transit radio stations securing stable communication between the vessels of the expeditions (flotillas and detachments) and coastal radio stations—even during transit between the port and the fishing area (Appendix Figure 30).

Prior to the beginning of the Soviet fishery off Nova Scotia and the United States, the air waves over vast sea areas were silent and quiet, this tranquility being occasionally disturbed by radio communication between local fishermen and by words of command during exercises of the U.S. Navy.

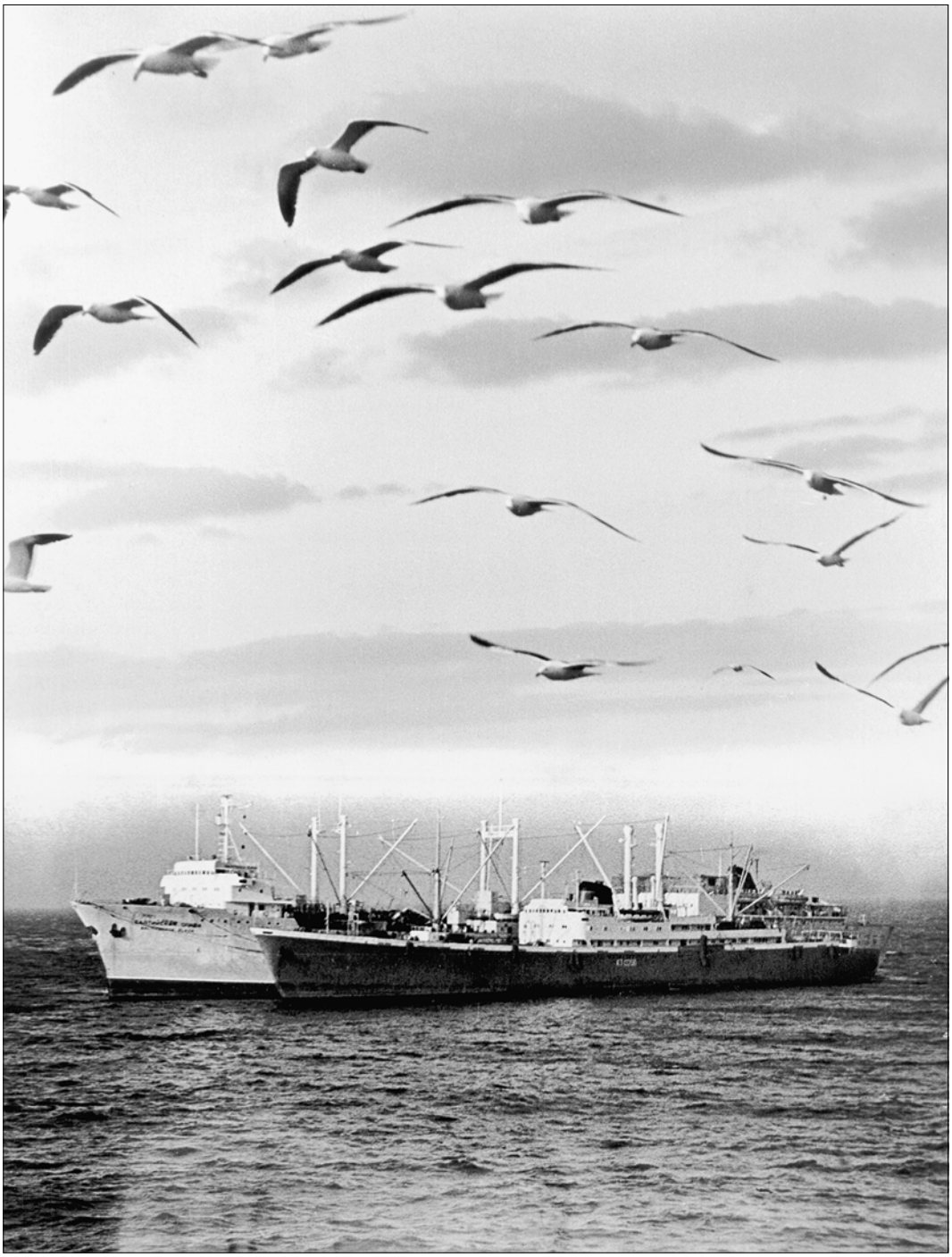
With the appearance of dozens to hundreds of vessels from the land of the Soviets, the air became full and animated. There seemed to be no end to discussions, conferences, councils, and just ordinary chat between sailors. Only late at night was a respite granted, but everything came alive again at the crack of dawn. The captains of the vessels used to jest, calling themselves "the Republic of Councils on Georges Bank."

Back home, on shore, the Soviets of People's Deputies, the image of the uniform system, reigned. The country and village Soviets were their lower links, with the superior body, the Supreme Soviet of the U.S.S.R., on top.

In the areas where the fishery was conducted by the Soviet fleet, there existed a different authority, fishermen's power, although the fleet had been managed according to the principles of the Soviet system through fishery councils of different levels.

Daredevil captains, who had the courage to listen to and participate in every daily council, went to bed with a bad headache. There seemed to be not a single silent frequency in the air.

Now, the vessels have gone, and the air over George's Bank has again been tranquil and silent for many years.



A mothership and a receiving-transport refrigerator ship exchanging cargo.

PART IV

SCIENTIFIC SEARCH: AT SEA AND ON SHORE

The first steps of the Soviet distant water fishery development were indeed "a leap in the dark." Like a desert, the enormous Atlantic spread before the fishermen, with its hidden resources and innumerable blank spots. A total, unrestricted freedom of fishing and freedom of choice reigned at that time. But the fishermen were in the dark about what they could expect at distant strange shores and wondered if they could take their fisherman's luck off Africa or South America.

Already the plans for constructing a huge fleet had been foreordained. Large groups of newly-built vessels had already been arriving. The problem of providing this fleet with fish to catch, and the search for these fish, had never been so acute. Immediate answers were required for many difficult questions:

- Where to go, and where to search for fish?
- How to arrange the search in the best possible way?
- How to estimate the potential and the size of the resources found?
- How many fishing vessels and of what type can be placed there?
- What kind of products can be brought home?

Explorers were wanted. The branch responded rapidly to the demand.

The activity of regional fishery research institutes already established in the north, west, south, and east of the country was switched over to investigations in the open ocean. But a large fleet, supported by the framework capable of operating and managing it, was required to solve the task of searching for fish resources over vast ocean expanses.

That was how the basin oceanic fish scouting services (including the one in the Far East) came into being. And shortly, the ships of the fish scouting services—the Zaprybpromrazvedka, the Yugrybpromrazvedka, and the Sevrybpromrazvedka—of the three basin head-offices could be seen at any latitude in the Atlantic and the Indian Oceans.

Although the basin fish scouting service was an independent, self-supporting enterprise, it was subordinate to the basin joint fishing industrial organization and to the basin scientific-research institute of marine fisheries and oceanography (NIRO) in respect of methodical feasibility.

By the nature of its activity, the fleet scientific and production organizations, with their structures, departments, and services, were all engaged in the scouting fleet operation and financial and economical activities. The marine expedition service, whose task was to organize and guide fish reconnaissance efforts and build up the information system, was also part of the fish scouting service.

The fleet's duty of solving the problems of continually providing its fishing ships with enough fish to fulfill the State plans for fishery product output had been assigned to the fish scouting service.

The funds assigned by the basin fishing industry, and the money raised from the sale of the fish caught by its own vessels, were the financial sources for the fish scouting service. The staff of the fish scouting service consisted of sea-going personnel of the scientific searching fleet, and production, office, and management personnel.

All-PENETRATING FISH RECONNAISSANCE

The origin of the fish scouting services was a product of collective reasoning. Their foundation was preceded by conferences of the fishery managers and scientists held at different levels, by numerous proposals, scientific grounds, fishery experience, and so on. The cost of the fish scouting services was high—about US$50 million per year, which equaled nearly 1% of the U.S.S.R. total catch value. However, the calculations made by the economists had always shown a positive economic effect generated by these organizations.

The functions of the fish scouting services encompassed fish reconnaissance and the search for new fishing areas; revealing underutilized resources in already established fishing areas; operative (active) searching in the fleet operation areas; and allocation of fishing vessels to the grounds with the most dense fish aggregations. In addition, the fish scouting ships were used by scientists from the scientific-research institutes for extensive studies of the fish resources.

Consistent with their principal functions, the fish scouting service ships were subdivided into three "detachments": long-term scouting ships, operative (active) scouting ships, and research vessels.

As of 1 January 1972, the number of ships in all the fish scouting services of the U.S.S.R. totaled 248, of which the research and long-term scouting ships numbered 143 and the operative scouting ships 105. Out of the total number of ships, 42 (17%) were large trawlers. The total number of the sea-going personnel was 9,575, including 537 in the engineering and technical staff.

In 1971, the fish scouting long-term and operative services of the country accomplished 690 cruises, including 201 to the Atlantic Ocean, 21 to the Indian Ocean, and 144 to the Pacific. During 1958–90, Zaprybpromrazvedka alone arranged 1,482 scientific scouting expeditions to the Atlantic Ocean and the Pacific, of which 191 were made to the Northwest Atlantic.

The fleet of the fish scouting services had good qualities of seaworthiness and was supplied with necessary scientific equipment, communication facilities, and fish finding aids.

Results obtained during the complex fishery and oceanographic investigations by the scientific organizations of the Ministry of Fisheries and other departments turned the development of the Soviet fishing industry in the right direction. Its attention was now focused on developing the oceanic biological resources. Combined with a powerful fishing fleet which was put into operation, it proceeded to develop vast ocean areas in a short space of time, to rapidly increase the total catch, and to appreciably improve the supply of fishery products to the population.

The fleet of the fish scouting services was also contributing its might to meet this task. In 1971, the catch taken by the searching fleet amounted to 86,000 t, and the sale of the fishery products brought 32 million rubles. Among other objectives, an increase in revenue to cover the expenses of the fish scouting services was also important. However, the increase in the catch and in the fishery product output by the searching ships was not the major purpose of the fish scouting services. Their principal task consisted of providing the fishing fleet with sustainable fish resources. But against the background of the catches taken by its own searching ships were the problems faced by the economic efficiency of the fishing vessels and the acknowledgement of recommendations given to the fishing fleet by its own catches.

Prominent persons stood at the cradle of the fish scouting services. Thus, Yury Marti, an outstanding Soviet scientist, initiated creation of the joint scientific-fishery long-term scouting service of the North Atlantic herring expedition. He also became the first scientific leader of the first Soviet oceanic fish scouting service in 1954.

Life itself suggested the form of the fish scouting service structural organization. A balance was required between the structures at sea and on shore. That was why the marine expedition services became part of the fish scouting services. Step by step, they were developed and improved until they turned into a set of structures. The main functions of the searching operation management were concentrated in zonal operational departments and sectors. An extensive oceanic zone—a fishing area—was assigned to each of these structures. In the Zaprybpromrazvedka, there existed the sectors of the Northeast Atlantic, Northwest Atlantic, Southeast Atlantic, and Central Eastern Atlantic, open sea, Antarctic, and so on. There, the cruise targets and programs for the scouting ship operations were developed, annual plans drawn up, and the fishing fleet activity analysed. Preparation and conduct of the scientific searching expeditions was one of the most responsible functions of zonal sectors. The scientific searching fleet of the fish scouting service was allocated in such a way as to gain an idea of the fishing potential in all the areas of the Atlantic Ocean at the earliest possible date and in a certain sequence.

Thus, the first flow of information came in from the scientific scouting expeditions, and the first efforts to provide the fleet with the location of fish was made by the same. Some of the expeditions were detached to unexplored or insufficiently explored oceanic areas. Frequently, those were entirely autonomous cruises. In essence, the vessels were “peaceable

raiders," which sailed thousands of miles away from their native shores. They explored the underwater mounts of the Mid-Atlantic and Walvis Ridges, the Nasca and other ridges, and "smoothed out" the high-seas areas. Most often than not they were the ships of medium tonnage.

Sometimes, the scientific scouting expeditions took on a grand scale. In 1977, following the universal introduction of the zones of extended jurisdiction, a decrease in available fish stocks, and a decline in catches, the problem of finding new fishing grounds became urgent. In March 1978, the head office of the fishing industry of the Western Basin "Zapryba" decided to arrange a reconnaisance and fishing expedition to the eastern part of the Pacific. It included five ships of large tonnage. The expedition was preceded by a wide scope of preparatory work. According to foreign sources, the peculiarities of the fish resources in the shelf zones of the coastal states of North and South America, the changes in biological productivity of the waters with increasing distance from shore, and the structures of the currents, water masses, and underwater rises and ridges had all been studied. The most promising areas for fish scouting operations were selected based on the analysis of these data.

The scope of organizational measures relevant to preparation for the expedition included the installation of hydrological winches and other oceanographic equipment on board fishing vessels, rigging the vessels with the optimal fishing gear, and establishing procedures and programs for scientific scouting work. Special consideration was given to selecting the expedition leaders and scientific groups, and providing theoretical training of this contingent and the captains of the vessels. Plans for the scientific scouting work were drawn up ashore, prior to departure of the vessels. The main requirement regarding the organization of the network was to ensure its integrated nature. Accordingly, continuous echo surveys and background oceanographic surveys, observations of sound diffusing layers, and the like were planned. To maximize the probability of discovering a fish resource base, it was decided to extend the activities over a spacious oceanic area from 56°N to 30°S. Each vessel was assigned a certain area of operation. The Zaprybpromrazvedka assumed control over the work.

In the Northeast Pacific, two vessels were engaged in fish reconnaissance in waters outside the economic zones of Mexico, the United States, and Canada. The western frontier of the area ran at a distance of 300–350 miles from the zones. Twenty-three thousand miles were traversed searching for fish, and a total area of 700,000 mi^2 was investigated.

In the Southeast Pacific, the coastal area off Peru and Chile was explored, and it was there that the fish scouts' efforts were crowned with success. Jack mackerel concentrations were found over a huge area. The expedition vessels caught 9,500 t of fish, and the fishing vessels, which arrived in the area, augmented the catch to 28,000 t. The results of the expedition remunerated the large expenses incurred for its arrangement. This and other discoveries made by the fish scouting services in the 1970s provided the fleet with a sizeable

source of fish stocks and prevented the branch from disbanding after the introduction of exclusive economic zones by the coastal nations.

Above, we cited an example of a scientific scouting expedition to a new unexplored fishing area. In areas with an existing fishery, the scientific scouting expeditions pursued different objectives: revealing additional fish resources, tracing the increase or decline in stock sizes caused by recruitment of strong or weak year-classes, and detection of probable areas of fish aggregations. This activity was complemented with background hydrological surveys, searching with echo sounders, and regulated trawling.

In the areas off Nova Scotia and the United States, the fish scouts very soon gained an understanding of the water structure and currents, determined the regularities of fish distribution and behavior relative to hydrophysical structures, and could always choose reference points for an efficient search for fish aggregations.

Another highly efficient means was used to arrange the operation at sea and to render assistance to fishing flotillas. In zonal sectors, shift groups of marine guidance had been formed in the fish scouting service. Their functions included the year-round management of the operative scouting service vessel detachments in major fishing areas and the control and coordination of fulfillment of the scientific scouting and exploratory programs by all the vessels in a given area. Usually, such a marine group consisted of two to five persons represented by the head (captain-flagman), hydrology engineers or ichthyologists, a radio operator, and a cartographer. In their work, these marine groups made wide use of facsimile maps, biological materials, and hydrological data. All this, combined with the analysis of fishing conditions, made it possible to predict the variations in the latter.

Marine groups provided the fishing fleet and the shore organizations with regular information on current and anticipated fishing conditions (up to 1 month in advance). Captain-flagmen came back from sea with detailed reports on events that had taken place in the fishing areas and on the state of the fish resources.

The fish scouting services were the bases for the exploratory fleet, and provided the research vessels with complete material and technical support. During the cruises, the scientific personnel of the basin institute both directed and participated in the research. The research vessels were being detached to autonomous cruises under the programs developed in the institute laboratories.

The sea was the main domain where the fish scouting services exercised their activity. However, a great deal was done ashore as well. As a rule, the specialists in the fish scouting service who stayed ashore between trips prepared the materials formerly requested, compiled the information on a different-interval basis, and developed fishery guidelines for the captains and the fleet shore-based organizations. In regional sectors, the catch statistics for all vessel types were efficiently processed. Year after year, the annual fishery atlases were issued with monthly maps of the fisheries distribution and descriptions of their distinctive features. The circulation numbered 200–300 copies, which were distributed among all fish-

ery enterprises of the Western Basin. Extremely valuable information was accumulated, and the captains of the fishing vessels obtained the summarized data enabling them to efficiently select the optimum searching and fishing areas.

The sectors prepared forecasts of fishing conditions half a month and a month in advance that were distributed among all fishery organizations of the Western Basin and sent to fish scouting services in other basins.

The fish scouting service functions and activity at sea and ashore were much more diversified than described above. The research was also notable for its variety. Essentially, the scientific personnel with the scope of their activity were a group competent enough to be regarded as another basin institute. Specialists in multiple disciplines (oceanographers, hydrographers, biologists, fishery engineers, etc.) constituted 10–14% of the total personnel in the fish scouting service.

On having graduated from the most prestigious institutes of the U.S.S.R., the Moscow and Leningrad Universities, and higher navigation colleges, they came young and full of energy and desire to bind their lives with the sea. During the 1950s–70s, they enlarged the ranks of the sea workers. They were distinguished by great learning, enterprise, and the ability to grasp any sea-related problem and perform the most complicated scientific search. As the saying goes, they "were breaking their necks" at sea, mastered allied marine professions, and advanced in the opinion of all. At the age of 24–26, they were fully developed specialists who headed the marine groups and scientific searching expeditions.

In general, the sea scouts differed markedly from the scientists working in the institutes. The scouts were more relaxed and venturesome. "No problem," they used to say. The sea dominated their lives. They were able to work on medium fishing trawlers with no air conditioners both in the Gulf of Guinea and off Labrador for 6 months at a time. During their endless marine "Odysseys," they perceived the mechanisms of fish distribution and behavior, and knew all about where and when the fish aggregations and schools were being formed and disintegrated. And the fishery managers trusted them, their information, and their recommendations.

They used diversified methods of fish reconnaissance, and their search often resulted in an unexpected outcome. While keeping the native fishing vessels within eyeshot, they were also able to focus their attention on the foreign vessels. For example, on having arrived in the West Greenland area yet unknown to them and being ignorant of cod and redfish behavior, they watched the operation and movements of the foreign trawlers in the area between Frederikshaab and Store Hellefiske Banks. This allowed them not only to understand the search pattern applied by the foreigners, but also revealed the regularities and periodicity of the formation and disintegration of cod and redfish aggregations on different banks. They resorted to the same tactics in the North Sea, listening to fishery councils held by Polish trawlers during the herring fishery or in the Southwest Atlantic during the squid fishery. These are illustrative examples of the sea scouts' professionalism.

In due course, they defended theses, wrote books, were appointed directors of the institutes and representatives of the Ministry of Fisheries abroad and in international organizations. And that was quite natural. Their great marine experience, knowledge of life, and realistic stand were rated highly by the branch leaders. Governmental awards such as the Order of Labor Red Banner, Honor Decorations, medals, and Governmental Prizes were frequently given to sea scouts.

Some people distinguish themselves as men of vision. This was a feature inherent in many sea scouts. In their aspiration "to conquer" the ocean, they issued challenges, more complicated every time, and met them. In about the mid-1960s, after having reconnoitered the living sea resources within practically the entire shelf zone of the Atlantic Ocean (Appendix Figure 31), the fish scouting service and the institutes initiated the development of the fish resources on the continental slope and in the epipelagic zone of the Atlantic Ocean. Most active investigations were carried out in 1972–76.

A search for fish resources in separate parts of the continental slope (to 1,000–1,500 m, sometimes to 2,000 m depths) was made in the following areas of the Atlantic:

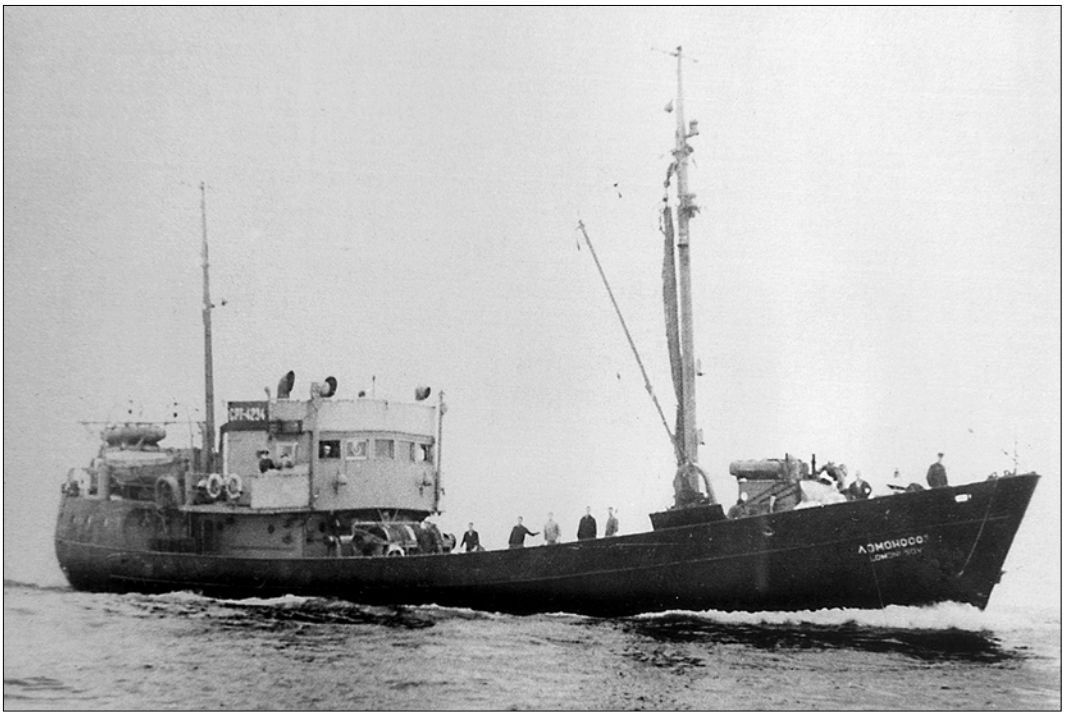
- westward of the British Isles (stocks of Baird's smoothhead, grenadier, shark, ling, and argentine were detected);
- in the Canadian-Greenland barrier area off Baffin Island, Labrador, Nova Scotia, and on Georges Bank (grenadier, halibut, witch flounder);
- off South America (grenadier);
- off Northwest Africa (smoothhead, coster dory, and grenadier); and
- off Southwest Africa (coster dory, orange roughy).

Discovery of Atlantic saury stocks in the epipelagic zone (in the Northwest, Northeast, and Southwest Atlantic) and revealing blue whiting migration routes in the Northeast Atlantic and their stocks in the Southwest Atlantic proved to be a considerable success. Discovery and commercial development of large krill stocks, outside the 200-mile zones of the South Georgia and South Orkney Islands in particular, was very important.

Substantial catches of sablefish, horse mackerel, and mackerel were taken by the Soviet fishermen far beyond the Central Eastern Atlantic shelf—on the underwater mountains of the Azore-Gibraltar zone (Hyeres, Erving, Amper) and the Canary Archipelago (Concepcion, Seine). During 1973–76, over 150,000 t of fish were caught there.

Detection of the rock grenadier stock in the Mid-Atlantic Ridge region in 1973–74 should be considered a great scientific discovery. The catch taken there in 1973–76 exceeded 30,000 t. The fish distribution pattern in this area is unusual: their aggregations extend over and around the underwater mountains. According to echo survey data, the commercial stock of grenadier on an individual mountain constituted about 15,000 t on average, with the total stock having been estimated at about 1.0–1.5 million t.

Discoveries in the ocean followed one after another, and the scientific search continued.



Scientific searching: the SRT-4234 *Lomonosov* of the Western Fish Scouting Service was a frequent visitor to the waters off U.S. coasts.

Having analyzed results of explorations accomplished by fundamental science in the world's oceans, the sea scouts concluded that fish reconnaissance had good prospects in some areas: the continental slope all along its length and down to 3,000 m depths; the large accumulative formations of bottom relief such as the Newfoundland "ridge"—a huge bar up to 250 m wide and of 1.0 to 1.5 km relative height extending northwest to southeast for nearly 500 km; the Mid-Atlantic Ridge, with its crest and peripheral parts up to the edge of the rise; clustered underwater mountains similar to those in the Azore-Gibraltar tectonic zone; the Bermudan-New England arch of underwater mountains; and underwater mountains of the Iberian Depression. It was assumed that "clots" of fish resources could be available in those areas. The program of small pelagic plankton fish species research was begun.

Implementation of these ideas required the solution of some technical problems associated with further increase in the ships' power installations and mechanism capacities, development of fundamentally new fishing techniques and gear, deep-sea appliances for fish searching and fishing gear control, and development of new technological methods to produce food stuffs for human consumption and for industrial purposes from "inconvenient" fish species.

However, all these projects failed to be realized. The country and the fish branch had been reduced to beggary, and Perestroyka put an end to ambitious plans.

FROM MIAMI TO SYDNEY

On February 14, 1961 the Fisheries Minister Alexander Ishkov gave a report to the All-Union scientific-technical conference of the Soviet fishermen. Speaking about the progress made by the fishermen during the first 2 years of the 7-year plan, he said "The Northwest Atlantic will become the central area for the Soviet fishery during the years of the 7-year plan to follow. It is the most productive area of the Atlantic Ocean, where a large-scale international fishery is being concentrated to fish mainly for demersal fish species. According to the data of the International Commission for the Northwest Atlantic Fisheries (ICNAF), 13 countries of Europe and America yield about 2 million t of fish in this area, while currently, our catch level there is hardly reaching 280,000 t." He was already aware of the results of the first expeditions to the Georges Bank area. Now, this success had to be developed, and the leaders of the branch took further expansion of fish reconnaissance under their control. A trend towards an increase in the fish scouting effort in the West Atlantic during 1959–67, and the expansion of the areas explored by the scientific searching vessels, is shown in Table 23.

The development of scientific scouting operations in all large areas of the Atlantic Ocean followed a similar scenario. In the beginning, fish reconnaissance was carried out with restricted facilities of one or two expeditions. The first results provided a possibility to specify more clearly the search reference points and targets.

At the same time, a preliminary "reserve" out of the fish stocks was made available for the pioneer group of fishing vessels. Then, the fish scouting effort began to build-up rapidly. Search operations covered the entire area and all depths and inhabitants of the shelf. Everything was subjected to a single purpose—to reveal the potential of biological resources in the area to the maximum and in the shortest possible time with reference to the fishing fleet structure and number. Discovery and exploitation of new resources was followed by the detailed study of the biology of commercial fishery species and their environment. The

Table 23. Area explored by scouting vessels compared to area covered by the fishing fleet.

1959	1960	1961	1962	1963	1964	1965	1966	1967
–	90	155	275	310	200	305	96	98
	–	21	36	18	20	24	23	28

Note: Upper value is the area (in thousand square miles) explored by the scientific scouting vessels; lower value is the area covered by the fishing fleet.

The Atlantic Scientific Research Institute of Marine Fisheries and Oceanography, Kaliningrad. The name of the Institute exactly corresponded to the subject matter, scope, and geography of its activity in the ocean.

fishing fleet was informed of the fish distribution and behavior pattern, which allowed the fleet to increase the productivity of the fishery.

At this stage, monitoring resources was also included in the scientific scouting ships' activity: changes in fish abundance, appearance of new year-classes, variations in species distribution and behavior pattern in their habitat were noted.

The sequence of events in the scientific search in the oceanic area resembled the process of constructing a large apartment building: preparatory work, laying the foundation, erecting the walls, adding the roof, furnishing the interior, "turnkey," and occupancy by the dwellers. The only difference was that the ocean "dwellers" were on the construction site as early as the initial stages of laying the foundation.

The product of the builders' efforts—a new building—can be compared to a sustainable fish resource base created for the fishing industry. It was for this purpose that versatile efforts were made by the scientists of the fishery research institutes and by the fish scouting services in the Atlantic. Such "buildings" were constructed in a whole series of ocean areas, which provided solutions to the problem of allocating the large fleet, overcoming the

seasonal character of the fishery, and, in the long run, providing a sustainable source of fish for the fishermen. The immense plans for the fish yield were being fulfilled.

The Ministry of Fisheries specified operating zones for the basin institutes and fish scouting services. Both organizations were fully responsible for a qualified study of the fishery resources in their respective zones, for the quality of long- and short-term fishery predictions, and for high-quality operative service rendered to the fishing fleet allocated in these zones.

AtlantNIRO and Zaprybpromrazvedka worked in the North Sea, off Nova Scotia and the United States, and in the Central and South Atlantic. The oceanic area assigned to them amounted to 56 million km^2. Conducting scientific scouting operations over such an expanse, often in several areas simultaneously, required a large number of vessels. According to the standards developed by the "Gyprorybflot" Institute from year-round studies and for an area this size, the number of scientific scouting vessels with sufficient sea endurance recommended for AtlantNIRO and Zaprybpromrazvedka was 62 units.

Commercial development of the areas off Nova Scotia, New England, and Norfolk could have dragged on for a long time, unless preceded with and accompanied by extended scouting and exploratory work. Table 24 shows how the fish reconnaissance effort was increased in this vast area from 1960 to 1980, how the search took new zones and fish species, and how new goals and operation trends were brought into focus.

During 1961–65, about 5–7 scientific searching expeditions were carried out in this area every year, their number increasing later up to 8–13. Prior to 1966, the cruises were made on medium trawlers, but afterwards large trawlers (three to five units) were also used for scouting activities. Altogether, 160 scientific searching trips, 39 trips by ships of large tonnage inclusive, were made during the observation period. In 1962 through 1978, all three subareas were investigated on a yearly basis.

The first scientific scouting expeditions chose the central part of the area—Georges Bank—as the main ground for fish scouting operations. Following the first "target" discovery, the search zone was extended to the northeast, southwest, and south. The expeditions sailing in southwestern and southern directions had to explore a zone from 40°N to the latitude of Miami, Florida. In 1962–64, fish scouting operations were carried out there during eight trips of ships of medium tonnage.

The Kaliningrad Sovnarkhoz (Regional Council of National Economy) set very important tasks for the expedition that had to be conducted on SRTR-9086. During the expedition, commercial concentrations of menhaden in the area between 40 and 32°N, concentrations of tuna and eel off the Bahamas and in the Sargasso Sea, and groundfish concentrations in the area from Georges Bank to 26°N were to be found. SRTR-9086 investigated this area in June to early August 1962 in conjunction with two fish scouting vessels from Murmansk. More thorough fish reconnaissance operations were performed in waters adjacent to Chesapeake and Delaware Bays.

Table 24. Scouting and research effort, operation areas, and the purposes and objects of scouting by AtlantNIRO and Zaprybpromrazvedka off Nova Scotia and the United States during 1960–80.

Year	Number of cruises			Operation area	Purposes and objects of scouting operations
	Ships of medium tonnage	Ships of large tonnage	Total		
1960	1	–	1	New England	Search for herring
1961	5	–	5	Nova Scotia, New England	Search for herring; render services to fishing fleet
1962	7	–	7	Nova Scotia, New England, Norfolk	Search for clupeids, haddock, butterfish, tuna; hydrological and biological research; render services to fishing fleet
1963	7	–	7	Nova Scotia, New England, Norfolk, Florida	Search for clupeids, small pelagic fish, tuna, silver hake, other groundfish; trawling surveys; hydrological and biological research; render services to fishing fleet
1964	6	–	6	Nova Scotia, New England, Norfolk	Search for herring, hake, commercial concentrations of other fish species; monitoring of fishable concentrations; collect environmental and fish biology data; render services to fishing fleet
1965	7	–	7	Nova Scotia, New England, Norfolk	Search for herring, hake, argentine, saithe, other fish species; studies of their distribution and behavior; standard hydrological and ichthyoplankton surveys; micro-surveys; egg sampling on herring spawning grounds; herring and hake tagging; render services to fishing fleet
1966	7	2	9	Nova Scotia, New England, Norfolk	Monitoring of fishable concentrations; hydrological, ichthyoplankton and plankton surveys; sampling; search for additional resources; render services to fishing fleet
1967	4	1	5	Nova Scotia, New England, Norfolk	Operations under Soviet-American Program; inventory trawling and hydrological surveys; seasonal surveys; hydrographic operations; monitoring of fishable concentrations; render services to fishing fleet
1968	8	2	10	Nova Scotia, New England, Norfolk, Gulf Stream, Sargasso Sea	Soviet-American Program; search for swordfish, tuna, and saury aggregations; development of pelagic trawling for herring; render services to fishing fleet

1969	5	1	6	Nova Scotia, New England, Norfolk	Soviet-American Program; search for swordfish and tuna aggregations; saury biology studies; revealing additional resources; render services to fishing fleet
1970	8	2	10	Nova Scotia, New England, Norfolk	Soviet-American Program; ichthyoplankton and plankton surveys of herring, hake, red hake spawning grounds; search for swordfish,tuna, saury; render services to fishing fleet
1971	6	2	8	Nova Scotia, New England, Norfolk	Search for saury, round herring, black seabass, snapper, other fish species; ichthyoplankton and plankton surveys, surveys of herring spawning grounds; render services to fishing fleet
1972	9	4	13	Nova Scotia, New England, Norfolk, high-seas areas	Soviet-American Program; trawling surveys; search for round herring, black seabass, sparids; reveal possibilities for mackerel trawling and purse-seining; render services to fishing fleet; deep-sea operations
1973	8	5	13	Nova Scotia, New England, Norfolk	Search for mackerel, squid; Soviet-American Program; stock assessment; monitoring of fishable concentrations; render services to fishing fleet
1974	6	4	10	Nova Scotia, New England, Norfolk	Soviet-American Program; environmental and fish biology research; monitoring of fishable concentrations; render services to fishing fleet
1975	7	3	10	Nova Scotia, New England, Norfolk	Soviet-American Program; collect materials on fish habitat and biology; search for squid; monitoring of fishable concentrations; render services to fishing fleet
1976	5	3	8	Nova Scotia, New England,Norfolk, New England Sea-mounts, Corner Seamounts	Soviet-American Program; search for deep-sea fish aggregations; trawling ecological surveys; render services to fishing fleet
1977	8	4	12	Nova Scotia, New England, Norfolk, New England Seamounts, Corner Seamounts	Soviet-American Program; ecological surveys; inventory trawling surveys under Soviet-Canadian Program; render services to fishing fleet
1978	2	3	5	Nova Scotia, New England,Norfolk	Soviet-American Program; Soviet-Canadian Program
1979	2	2	4	Nova Scotia, New England	Soviet-Canadian Program; Soviet-American Program
1980	3	1	4	Nova Scotia, New England	Soviet-American Program; Soviet-Canadian Program
Total	121	39	160		

Not a single menhaden was found over the whole area combed with trawls and drift nets. Neither were commercial concentrations of groundfish detected in the area between Cape Hatteras and Florida. Eel long-lines were set in the Sargasso Sea in hopes of catching eels. It was the first and last attempt to catch eels in that exotic sea.

However, good luck was awaiting the expedition in the area between 40°N and Cape Hatteras, where concentrations of butterfish, shad, and squid were detected. Butterfish occurred all over the area and their catches constituted about 1.5 t per trawling hour. Round herring aggregations were scattered in small patches. Discovery of Atlantic sea herring concentrations gave rise to a hypothesis that Georges Bank herring migrated in winter not to the Gulf of Maine or Nova Scotia, but southwestwards, to the Norfolk and Chesapeake area.

Subsequent expeditions revealed distinctions in the ichthyofauna composition and their habitat in the area from 40°N to Florida. The Florida peninsula area, from the port of Savannah to Cape Hatteras, and from Cape Hatteras to 40°N, differed considerably.

In the first area, the investigations were reiterated in December 1962 and April 1963. In winter, small concentrations of Atlantic thread herring and trevally as well as spot fish and snapper were found. Sometimes, the catches were as large as 1.5 t per trawling hour. The concentrations were not significant, with undersized fish of low nutritive value predominating. However, by mutual agreement between the United States and the U.S.S.R. in early September 1963, Soviet fleet operations in this area were limited to no closer than 30 miles from shore, thus putting an end to any research activity in this area.

The area from Savannah to Cape Hatteras was explored in summer 1962, in winter and spring 1963, and in spring 1964. However, it was not before the winter of 1963 that commercial catches of scup (up to 1.5 t per trawling hour) were taken there.

The area from Cape Hatteras to 40°N proved to be prospective. In addition to discoveries made by SRTR-9086 in summer 1962, concentrations of sea herring and scup, mixed aggregations of alewife and herring, alewife and mackerel, Atlantic searobin, spiny dogfish, and squid were detected by the crew of SRTR-9074 in February and March 1963.

The depths of formation of various species concentrations and the most productive grounds in the southern and northern parts of the region (36–37° and 40–40°25′N) were determined. Control catches taken by fish scouting vessels made it possible to conclude that considerable resources of mackerel, alewife, scup, and red hake were available there. Fishing vessels of the SRTR type based in Havana, Cuba, were dispatched to that region to harvest mackerel, where they caught 3,360 t in March–June 1963. The monthly mean catch per ship-day fished varied between 6 and 11 t. The representative of the Ministry in Havana, who supervised the scientific scouting work, congratulated the crew for discovering a new mackerel fishing ground.

In spring 1964, the scientific scouting work continued by SRTR-9029 and SRT-4170 confirmed the presence of commercial concentrations of mackerel, alewife, Atlantic her-

ring, scup, red hake, and silver hake, which had been fished by medium and large trawlers. Sixteen BMRTs harvested scup in this area in March.

Thus, during 1962–64, the resources in the area from 40 to 25°N were explored and the places with commercial concentrations identified. A new fishing ground for the Soviet fishery—the Norfolk area—was established off the U.S. coast. In a short while, it became one of the major fishing grounds for the newly built RTMs of the *Tropik* and *Atlantik* type. Winter and spring became their fishing season there, pelagic trawl fishing—their main fishing technique, and mackerel and herring—their target.

Rapid saturation of the area with the fishing fleet, expansion of fishing areas, and involvement of still new fish species in the fishery took place following the first expeditions of research vessels to Georges Bank. Thus, in March 1962, the vessels of the SRT, SRTR, and BMRT types began the silver hake fishery on Georges Bank. In November–December of that same year, BMRTs from Murmansk fished for silver hake off Sable Island and on Middle Ground. In October–December, ships of medium and large tonnage harvested mixed aggregations of herring, haddock, silver hake, and other fish species on Nantucket Shoals and in the Gulf of Maine.

In October 1963, BMRTs commenced the fishery for argentine on the shelf edge from Browns Bank to Sable Island. In different months of that same year, the Soviet fishery encompassed 10 fishing grounds in the area between Cabot Strait and Cape Hatteras. In 1964, the number of fishing grounds increased to 15.

The leaders of the branch and fishery managers showed a growing interest in this area. They demanded expansion of the scientific scouting and research work and support for the fishing fleet by an active search for fish.

Out of 147 expeditions made by AtlantNIRO and Zaprybpromrazvedka over the 1960–77 period, it was only in 32 expeditions that scientific research was carried out under AtlantNIRO programs. The rest of the 115 expeditions used programs developed by the fish scouting service; this included the 61st trip, during which the fleet was provided with an active search for fish. Biological samples of fish and their habitat were taken on all fish scouting cruises.

Herring and silver hake were always the focus of attention of the fishery managers, sea scouts, and scientists; therefore, herring concentrations were searched for and studied more or less on 75 cruises, and silver hake and other groundfish on 48 cruises. Over the 1962–70 period, seven cruises aimed at seeking the potential of fishing for tuna, swordfish, and marlin.

Since 1968, saury, round herring, and other fish species were studied on 13 cruises as potential species for light fishing. Since 1973, a search for squid aggregations was carried out on four cruises.

Though the fishing fleet was rapidly exploring the vast shelf area between 46 and 35°N, the vessels of Zaprybpromrazvedka continued the search for more fish resources, revealed new possibilities for the fishery, and collected scientific data. It was not easy to come to

know the particulars of the commercial ichthyofauna distribution within a large area, to figure out the locations and periods of aggregation formation, and to study their structure and behavior patterns.

The scientific and commercial information was collected methodically. Years were required to gain knowledge of the fishery potential in areas as large as these: Cabot Strait; the systems of Artimon-Misaine-Banquereau Banks and Middle Ground-Sable Island-Emerald Banks; Emerald Basin; LaHave-Roseway-Browns Banks; the Nova Scotian Shelf edge from 57 to 67°W; the Gulf of Maine; the shoals off Nantucket Island and Long Island; the U.S. shelf from 40°N to Cape Hatteras; and the zone from Corsair to Norfolk Canyons.

Fishery manuals, reports on fishery progress, and recommendations were delivered to fishermen on monthly and annual bases. In addition, very important summaries such as "Commercial Description of the Trawl, Drift-Net and Purse-Seine Fishing in U.S. and Canada Atlantic Coast Areas" (1971) and "Atlas of Hydrometeorological and Fishery Data, East Coast of North America" (1975) were also published. They were prepared by AtlantNIRO, VNIRO, and Zaprybpromrazvedka scientists and scientists in a number of other scientific institutions of the U.S.S.R. and were issued by the Hydrographic Board of the Ministry of Defense. Such books as "Herrings of the Northwest Atlantic and their Fishery" (Chuksin and Vyalov, 1963) and "Commercial Fishes of the Shelf Waters from Cape Hatteras to Cabot Strait" (Karasiov et al., 1975) were also intended for the fishermen.

In their annual recommendations to the fishermen, the sea scouts suggested the scheme of prospective fishing grounds and periods, the data on probable variations in the fish stocks, anticipated catches by various types of vessels and fishing gear, and diverse fishing techniques. Practically all commercial species were within the fish scouting service's "eyesight," so they had to answer numerous and most unexpected questions asked by fishery managers every day.

Usually one to two expeditions, sometimes three to five, worked every year off North America under the AtlantNIRO programs. The scope of the investigations fitted the name of the Institute exactly—Marine Fisheries and Oceanography.

The State planning for fish yield sizes and fishery product output presumed possession of reliable scientific knowledge of the state of the fish and non-fish resources in all the areas of the Soviet fishery in the Atlantic. By 1965, the major fishing areas were the Northeastern Atlantic, Northwestern Atlantic, Central Eastern Atlantic, Southeastern Atlantic, Southwestern Atlantic, and later the high-seas areas as well.

Such a geographical scope predetermined the Institute structure. As of 1 January 1976, the total number of Institute employees was 827, including 438 scientists. One hundred ninety scientists were involved in biological research projects for the above-mentioned areas within the precincts of six laboratories. Forty-two persons were on the staff in the Laboratory of the Northwest Atlantic. Out of 19 expeditions arranged by AtlantNIRO in 1975 for the Atlantic Ocean, two expeditions worked off North America. As in other bio-

logical subdivisions, the main goals pursued by the Laboratory were determination of stock units, gaining versatile and reliable information on biological parameters and the state of fish populations, and investigation of stock reproduction and formation conditions and abundance dynamics. The results of the research were converted into predictions of fish resource potential for $^1/_2$ year in advance, 1 year in advance, and for 5 years or more in advance. They were intended for a broad utilization by fleet organizations, various scientific and design institutions, regional fishery administrations, and the leaders of the branch. In 1975, predictions were passed on to 80 organizations in the country.

At sea, the scientists performed a wide spectrum of work. These included, but were not limited to, trawling and hydroacoustic surveys, plankton and ichthyoplankton surveys, surveys of spawning grounds, and fish tagging. Complex oceanographic surveys made by the Institute's Laboratory of Fishery Oceanography should also be mentioned. The data collected during these surveys enabled the scientists to study the spatial-temporal variability of the habitat: water masses, water circulation, fronts, eddies, and biological productivity of the waters. These studies made it possible to reveal the mechanisms that governed adaptation of the fish to the environment, to clarify the many factors causing spatial-temporal heterogeneity observed in commercial ichthyofauna distribution as well as intra-specific differentiation of predominant commercial species.

Atlantic herring and silver hake in the first half of the 1960s, and red hake after 1965, were the principal fish species studied by the Institute in the Northwest Atlantic. Knowledge of the biology of these species occurring in the high-seas areas from Cabot Strait to Cape Hatteras was poor. Evidence of their population structure and length-age composition in different parts of this vast area was badly needed in order to attempt stock assessment and prediction of probable catches 1–2 years in advance.

By 1967, the scientists already knew that Georges Bank was inhabited by a relatively isolated herring population. The results of investigation of its spawning peculiarities by means of estimating the amount of eggs laid allowed an assessment of the herring spawning biomass in 1964–66.

It was proved that silver hake in the Georges Bank and Sable Island areas occurred as separate, non-mixed populations. Scientists concluded that a long-term prediction of stock status and probable catches could be made on the basis of recruitment estimates obtained from controlled fishing of recruit aggregations. This approach appeared to be a prototype of the present trawl surveys of juvenile hake on the Nova Scotian Shelf.

The results of the red hake study confirmed an inference made earlier of the existence of three red hake populations which inhabited the Nova Scotian Shelf and the northwest and southwest slopes of Georges Bank. The supplementary data obtained were indicative of the existence of a fourth, a local red hake group in the Hudson Canyon area.

After having studied the length-age structure of these three fish species, scientists made the first attempts to estimate their probable catches. However, according to Vladimir Rikhter,

a Russian scientist, the level of knowledge of herring, silver hake, and red hake in 1961–66 was inadequate to make a valid enough quantitative estimate of their stock size and probable catches. This was the time when creation of the scientific base required for appropriate quantitative analyses was still underway.

The period of the late 1960s to the first half of the 1970s, in addition to further intensification of the Soviet fishery in the waters off Nova Scotia and the United States, was marked by fruitful cooperation between U.S.S.R. and U.S. scientists in marine investigations of biological resources in these areas. The methodical level of marine operations sharply increased, in particular that of the groundfish trawl surveys. Complex fishery investigations acquired a systematic character.

As before, herring and silver hake remained major research objects for AtlantNIRO scientists. Egg surveys on Georges Bank were made annually in 1968 through 1971. The last survey recorded a collapse of the herring stock in that area, and its spawning grounds there ceased to exist. Herring were also studied on the Nova Scotian Shelf, where appreciable differences were discovered between the groups inhabiting Banquereau and Emerald Banks.

Silver hake investigations actually covered the entire distribution area of the species from Nova Scotia to Norfolk. Off Nova Scotia, a depression in the stock in 1967 changed into a recovery phase, which resulted in the appearance of a series of strong silver hake year-classes in 1967–72. On the grounds of the investigation results, and the good state of the stocks, favorable fishing conditions were predicted for 1969–74. In 1976, the scientists began to apply a new method—virtual population analysis (VPA)—for fish stock assessment. Investigation of the hake population structure with the use of biochemical and serological analyses was in progress.

In the first half of the 1970s, a qualitative leap forward was made in red hake research attributed to the appearance of a number of publications of a theoretical and methodological nature. The availability of two isolated red hake populations on the Nova Scotian Shelf and on Georges Bank was confirmed. Evidence of the existence of local groups in the south and southwest parts of Georges Bank and in the area west of the Bank (5Zw+6) was obtained. The scientists agreed that natural factors had played a key role in red hake recruitment formation. The problem of optimal fish withdrawal was given great consideration. Based on simulation results, the optimal rate of exploitation was estimated at 40–50%.

The scientific basis was generated for a more objective estimate of stock size and the annual quota (total allowable catch) to comply with the optimal rate of exploitation at a given quantity of the biomass fished. By 1974, data from the Soviet-American surveys were a reliable source for predicting the allowable red hake catch 1–2 years in advance.

Since 1967, the Atlantic mackerel resource was involved in the Soviet fisheries scope. Atlantic mackerel had not been an important commercial object in anyone's fishery before. Intensive investigations of Atlantic mackerel almost immediately followed the commence-

The search for fish. An SRT in operative reconnaissance.

ment of its fishery. As usual, the first stage of the investigations consisted of length-age sampling, age reading, and the analysis of mackerel age composition in the catches. The parameters of analytical methods to be applied to stock assessment were determined and revised.

Before 1977, a small-scale directed fishery for argentine was conducted by ships of large tonnage. Investigations were needed, and AtlantNIRO gave consideration to the problems related to the argentine stock study. Reliable distinctions were established between the groups of Browns-Sambro and Banquereau Banks. Estimation of the optimal exploitation rate, commercial biomass, and of the total allowable catch of argentine in Division 4X was a logical conclusion of the stock research.

Fishing vessels of the SRTR type based in Havana, Cuba, were dispatched to that region to harvest mackerel, where they caught 3,360 t in March–June 1963. The monthly mean catch per ship-day fished varied between 6 and 11 t. The representative of the Ministry in Havana, who supervised the scientific scouting work, congratulated the crew for discovering a new mackerel fishing ground.

In the late 1960s, fishery managers showed interest in the possibility of a fishery for yellowtail flounder in the New England and Norfolk areas. Research on this species was begun by instructions from the "top men." Having examined the data of the Soviet-American trawl surveys, the scientists ascertained that the size of the Georges Bank population was reduced by almost 40%, and that of the southern New England (Mid-Atlantic Bight) population—by 60%.

Some work was done in the Institute to investigate river herring, saury, and squid.

It should be noted that in its research activities, AtlantNIRO focused on just a few species dominating the catches, while numerous species, "milled" by the Soviet fleet throughout its years of the fishery, were left out of scientific attention. There existed the data for some species collected at sea; however, no analysis and summaries were made.

The Institute was entrusted with the difficult mission of providing the fleet with forecasts of the state of the fish resources in enormous areas of the Atlantic. Naturally, it was

The SRTM-1288 *Yubileinyi* was frequently engaged in an operative scientific search for fish concentrations for the fishing fleet.

beyond its powers to accomodate all commercial species from each area in its research program.

However, remarkable progress in the knowledge of the biological resources and the environment in insufficiently explored high-seas areas off Nova Scotia, New England, and Norfolk was made by joint efforts of AtlantNIRO and Zaprybpromrazvedka scientists. Their American colleagues from the Northeast Fisheries Science Center (NEFSC) in Woods Hole began contributing to this success in 1967.

OPERATIVE FISH SCOUTING

The term "fish scouting" has several semantic meanings. It implies, in particular, the processes of search, discovery, and quantitative and qualitative assessment of fish aggregations. In the above sense, all fishermen in the world are engaged in fish scouting. In the Soviet fishery, the term "fish scouting" was attached an applied aspect meaning organizational subdivisions of the fishing industry that rendered their services to the fishermen, providing them with a search for fish.

This rather specific activity dates back to the 1920s, when the first fish scouting operations were undertaken for the purpose of finding prospective aggregations for the fleet. In 1926, seal concentrations were "spotted" from airplanes in the White Sea, and since then aircraft observations of their distribution were made over many years. In the Barents Sea, the fish scouting service began work in 1932, and by 1939, 15 fish searching vessels were operating.

Formation of the first boards of the fish scouting operative services was accomplished in all large maritime regions of the country in 1951–52. Their main task was to render services to the fishing fleet in developed fishing areas by making use of the ships which had been passed on to them.

The term "operative" had the meaning of immediate action, quick response to changing conditions, and opportune solutions to day-to-day problems. Several reasons existed for the origin of the operative scouting services in the Soviet fishery: impetuous development of the fish branch and expeditionary fishery in the North Atlantic, rapid growth of the fishing fleet, and State plans for high fish yields being of paramount importance.

Saturation of the North Atlantic with the fleet was picking up speed, and soon hundreds of vessels were engaged in the herring fishery. However, the fish often "vanished," as the fishermen used to say. The fish concentrations scattered or quickly moved around and had to be found again. Quite often, the fleet had poor catches while losing precious time. Meanwhile, the State plan "counter" was totaling the lost tons of catch.

Naturally, the heads of the enterprises were constantly looking for ways to reduce the time lost when not actively fishing. According to calculations, 15–17% of vessel time was wasted searching for fish. Reduction of time spent searching would allow vessels more time for fishing. This was feasible due to the efficient operation of the ships of the special branch service—the fish scouting operative service. Timely found fish concentrations were "handed over" to the fishing fleet. In the mid-1950s, almost all flotillas or detachments of fishing vessels of different fishery enterprises undertook to allot vessels for permanent use in operative search mode. The accepted ratio was one searching vessel (of the SRT type) per 15–20 fishing vessels.

It took time to find a way to stimulate the activity of the operative scouting vessels to make them search for fish "day and night." One could not but admit the eccentricity of the first solution of this problem. Regulations were developed according to which the vessel crews, in addition to guaranteed wages, could reckon on some extra money for fish shoals found. The amount payable depended on the fish shoal size: small, medium, or large. It was not easy to get that money. Confirmations were required from the chiefs of the fishery at sea that the fish shoals of so-and-so size had been found, "handed over" to the fishing fleet, and harvested by that fleet. When ashore, the captains of the operative scouting vessels had to haunt "bureaucratic thresholds" for a long time, pressing for payment of the "shoal" money.

During the first years, two organizational forms of fish scouting operations were practiced at sea:

- all fish scouting vessels were brought together into one detachment under the guidance of the captain-flagman, who was subordinate to the chief of the flotilla or to the chief of the expedition detached by the head office of the basin (regional) fishing industry; and
- each fish scouting ship was assigned to the detachment of fishing vessels and was under the command of the captain-flagman of the detachment.

In the late 1950s, with the establishment of the basin boards of exploratory fish scouting long-term services, a new organizational scheme of scouting ship operation was introduced.

A consolidated fish scouting detachment, designed to render services to the whole Soviet fleet in the fishing area, was assembled from the operative scouting ships owned by different flotillas and by the exploratory fish scouting long-term service. The head of the marine guidance group from the fish scouting long-term service was appointed chief of the detachment and was, in turn, subordinate to the chief of the fishing area—the chairman of the fishery council.

Such an organizational scheme was found to be expedient for it provided single centralized guidance of fish searching operations and continuous control over the entire area and adjacent sectors. The routine technical scouting executed by the operative vessels of the fleet organizations was be enriched due to hydrological and biological data submitted by the scientific searching vessels.

The fishing fleet received comprehensive and precise search information, while the chiefs of flotillas and captain-flagmen of detachments were able to maneuver their fishing vessels with higher efficiency. The risk of a sudden loss of fish concentrations was reduced, and the fish searching process assumed an ever-growing scientific nature.

Operative scouting was under the permanent control both of the fishery authorities and the captains of the fishing vessels. A careless captain of a scouting vessel could find himself in the "firing line" of severe criticism from fishery managers. Special emphasis was placed on appointing qualified captains.

The tasks of operative scouting were far from simple. The picture of the distribution and behavior of fish aggregations had to be reconstructed continuously, day by day, and the fleet directed at aggregations large enough to provide maximum catches.

The changes occurring in the fish habitat worked two ways: they could promote an increase in catches, or they could threaten catch failure to many a vessel. The fishermen were eager to know the fishery prospects for the nearest days. Short-term predictions of fishing conditions were required. In case the fleet "lost" the fish, the fish scouts' task was to detect fish aggregations in the shortest possible time and direct the fishermen to them. The practices of the above solutions were suggested by actual operations.

The search for fish aggregations provided the basis for a forecast of fish distribution and any necessary adjustment with regard for hydrological and stock abundance predictions. Such a preliminary forecast was derived from data on fish distribution in previous years.

The background survey and disclosure of areas favorable for the formation of commercial fish aggregations were the fundamentals of the preliminary search. The background survey of the area represented a combination of oceanographic and fish reconnaissance work. Its program included hydrological, hydrobiological, and visual observations, and sometimes control fishing. The distance between tacks (oblique-angled, parallel, or combined) depended on the fish aggregation type and structure. For example, in searching for wintering aggregations, when the fish formed large concentrated schools over a restricted area, the distance between tacks did not exceed 25–30 miles. In searching for feeding aggregations, often dispersed over larger areas, the tacks could be separated by 80–100 miles.

The background survey was followed by a detailed search. Detailed searches were arranged so that they had a high probability of detecting fish aggregations close to a fishing fleet. Distances between tacks were figured out depending on the season, biological conditions, and distribution pattern of the target species, anticipated sizes of commercial aggregations, and some other factors. A detailed search consisted of performing comprehensive hydroacoustic, fishery, and visual observations, execution of control catches within a dense grid of stations, and incidental hydrological and hydrobiological observations.

In addition to the above work, an operative search for commercial fish aggregations was aimed at contouring the detected aggregations and observations of their movements, including their qualitative and quantitative assessment. To contour a fish aggregation, it was traversed with a series of tacks.

The quantitative assessment involved estimating the total weight of the fish found, the weight of the probable catch size, and the weight of the catch per cycle of the fishing gear. The species and size composition, the fish behavior during fishing, the stability of the aggregation, and a short-term prediction of the fishing conditions were elements of the qualitative characteristic.

Short-term fishery predictions covered periods of several hours to several weeks. For short-term predictions, it was important to know the peculiarities of the fish species' annual life cycles, their behavior during fishing operations, their response to environmental conditions, the conditions affecting formation and disintegration of the aggregations, and other factors.

During 1961–77, Zaprybpromrazvedka vessels made 61 operative search cruises off Nova Scotia and the U.S. east coast. These amounted to about 40% of the total effort contributed by the vessels of this organization to the above area. In the second half of the 1960s and in the first half of the 1970s, four to six cruises were conducted there annually, their number increasing to nine in 1973.

According to some estimates that took account of peculiarities in the commercial ich-

thyofauna distribution by area over a 1-year period, the joint activities of a group of operative scouting vessels numbering 7–10 units were required to provide an efficient fishing fleet operation. The fleet organizations refused to allot their vessels for operative scouting, so Zaprybpromrazvedka undertook to fulfill these tasks.

As an example, a brief report is cited on the events that took place in the second half of 1968. The mode of the fish scouting operations was routine—typical of the area. All scouting vessels (both operative and long-term scouting) were assembled to form one detachment under the guidance of the chief of the scouting service in the area. Occasionally, however, the industry also provided the vessels for scouting operations. The scouting vessels were allocated in the area with regard for the environmental conditions, the biological condition of the fish, and the trends in the development of the fishing conditions. Information on the operation of the vessels from Poland, East Germany, West Germany, Canada, and the United States was also used.

The analysis of environmental conditions enabled the vessels to reveal the most favorable areas for the formation of fish aggregations, which had to be verified. The biological condition of the fish was responsible for movements of the aggregations and for their distribution and behavior patterns. The time for the herring migration to Georges Bank spawning grounds was estimated with a high degree of certainty. The forecast was made 45 days in advance and worked well to within 1 day. The prediction of the aggregation's withdrawal from the spawning grounds was also proven accurate to within 2 days.

These predictions were based on the estimates of water temperature. If the year under consideration was warmer than the previous ones, this caused accelerated development of herring gonads; hence the earlier dates of their appearance on the spawning grounds and post-spawning migration.

Like before, hydrological cross-sections of the Labrador water wedge were made. Sections comprising four to six stations completed at night made it possible to determine the probable location of the aggregations (frontal zones) and their relative density (based on the frontal zone size). For predictions of how the fishing conditions would develop, long-term forecasts of air pressure were used, and the general transport of air masses was taken into account.

On the Nova Scotian Shelf, facsimile maps of water temperature distribution at the sea surface were a great help. Their analysis made it possible to predict the locations and the time of formation and disintegration of silver hake and argentine aggregations.

The areas were saturated by the fishing fleet for most of the year. Vessels were moving continuously. Often dozens of vessels accumulated in small-sized fishing locations. Other times the fleet dispersed over a wide space. Vessels could operate in groups or in detachments; however, the captains of some vessels preferred to work independently or with fellow-captains. A large fleet in the area was a huge source of information.

Therefore, it was imperative that the Zaprybpromrazvedka group of marine guidance be

able to specify a number of fishery indices. Fishing grounds defined to within one fishable square (with sides 20′ in latitude and 30′ in longitude) were mainly determined based on data obtained at the fishery councils and from the fishery reports. The data on catch species composition were also collected from fishery council information. Fishery map-schemes were drawn up on a daily basis, with indications of optimal trawling courses and fishing depths. Ten-day and monthly maps of fleet operation were plotted.

Catch per effort by vessel type, area, and fish species was calculated based on the evening radio reports made by all flotillas. If several fish species were fished in the same fishing ground and were not intermixed in the catches, calculations were made separately by species. If the catches were a mix of different species, then the proportion of each species in the total catch was found.

These materials as well as the album of hydrological surveys and a set of standard section plots were enclosed with the report on the work of the group of marine guidance.

Guidance of the scouting vessel operation and exchange of information with the fishing vessels and the shore by radio were performed. Every day, scouting vessel councils were held at 7:00 a.m. and 6:00 p.m. local time, and search-related tasks were updated for the vessels, depending on changes in the progress of the fishery. The results were reported and discussed at the detachment and all-fleet councils where decisions concerning further operation of the scouting vessels were taken.

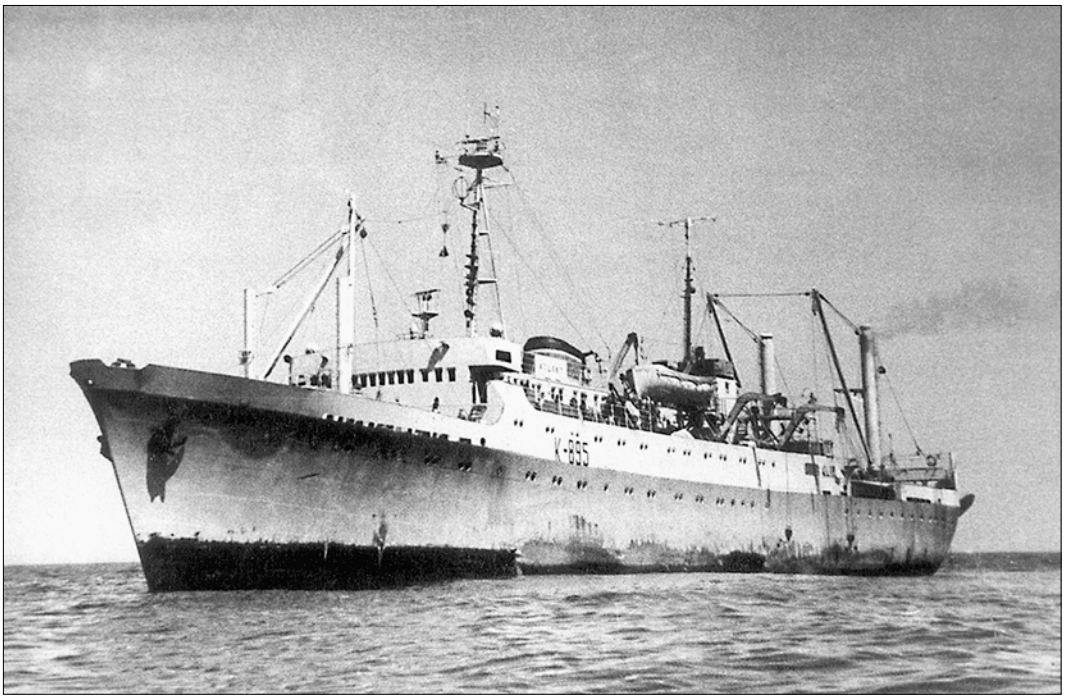
Onboard all fish scouting vessels, the radio watch functioned round-the-clock at the 2,575 kHz frequency, and the fishing vessels could obtain information on fish search results at any time. In addition, the radio watch at 2,315 kHz was operative on a scouting vessel on duty. There, fishery managers could get recommendations on matters of interest to them. Usually 10–15 inquiries were made daily about the fishing conditions, selection of the fishing area, maneuvers, and fishing gear adjustment and rigging.

Every 10 days, the group of marine guidance provided fishermen with the analysis of the fishing and scouting operations for the past period and predictions of the fishing conditions for the next 10 days. Such information was broadcast through a microphone or as radiograms. Similar information was submitted to the fishermen at monthly intervals.

Daily, 10-day, and monthly reviews of the progress of the fishery, predictions of its development, and reports on the scouting vessel operations already completed and scheduled were sent to shore fleet organizations and to head offices of the basin fishing industry. This success was due to a perfectly operated radio communication system.

In the conclusion of his report on the work performed in the second half of 1968, the head of the group of marine guidance mentioned that total control over the fish resources in the waters off Nova Scotia and the U.S. east coast could have been attained if three vessels of the BMRT type and four vessels of the SRT type were used for operative searching.

From the Soviet fishery practice in these waters, it followed that 80–100 large and up to 100 medium trawlers could fish there simultaneously. Consequently, the losses owing to



The crew of the scientific searching BMRT *Atlant* was well acquainted with Georges Bank fogs. The vessel was usually engaged in searching for fish for the fishing fleet.

the detachment of a number of vessels to perform searching activities which, as it had been stated "produced no material values," would not have been very large. However, in the chase for "live" catches, the industry did not consider it feasible to excuse even a number that small from fulfillment of the State plans.

In the sea scouts' opinion, the tasks of short-term prediction to provide the fleet with operative fish scouting were of a biological and oceanographic nature that had to be done by specialists having a good knowledge both of biology and oceanography.

The scientific personnel of Zaprybpromrazvedka included both ichthyologists and hydrologists. In a short space of time, the hydrologists became proficient in basic fish biology. Being perfectly trained at their educational institutions and possessing a set of methods to study the ocean, the hydrologists rapidly gained insight to intricacies of the water regime, peculiarities of the water mass interaction in different areas, water circulation, and so on.

It took the sea scouts only 1 or 2 years of operating off Nova Scotia and New England to find out that herring in those areas were adapted to the coastal and Labrador water masses and avoided the Gulf Stream waters and their ocean-origin modifications.

The degree of isolation of individual herring populations determined by application of the ecological criterion (characteristic properties of water circulation, the existence of stable gyrals) framed clear-cut fishery tactics for two large areas, one including Norfolk and Georges Bank and the other—the Nova Scotian banks.

It was found that the populations of redfish, silver hake, and argentine were also isolated, which implied separate harvesting with the use of special-purpose fishing gear and particular fleet maneuvering.

Also, notice was taken of the regularities in seasonal changes in the physiological state of the fish relative to environmental changes, and seasonal variations in the biological activity of the fish and in the population density as a consequence and reflection of physiological rhythms were revealed.

During the fish scouting operations, attention was always paid to the response of the fish to one or another temperature zones formed in phylogenesis; i.e. if they showed aversion to or preference for a certain water body. So, it was found that herring aggregations good for purse-seining appeared on the Banquereau, Middle, and Emerald Banks after the frontal zone of the coastal and Labrador water masses with a temperature of 2–4°C had been formed. Data on water temperature seasonal variations were used as a guideline to fix the dates of the beginning (late February) and termination (May) of the purse-seine fishing season.

Considerable attention was given to the investigation of short-term variations in fish distribution and behavior. Similar to seasonal rhythmics, these variations were stipulated by water circulation in many respects. In the area under consideration, like in other areas of the world's ocean, a general regularity could be traced: fish shoaling and consolidation of fish aggregations occurred in water inflows, gradient zones, meanders, "pockets," and small eddies formed in the gradient zones with relatively low current velocities. Frequently, such water formations owed their origin to atmospheric circulation. Their diffusion caused temporal dispersal of the fish aggregations.

Some regularities in atmospheric circulation and wind impact on fish behavior were established. For example, a direct relationship between wind direction and mackerel distribution existed on the western slopes of Georges Bank. With the winds of a southern rhumb, their aggregations kept to the northwest slopes, and with the northern winds—to the southwest slopes. These fishing spots were located at a distance of 60–80 miles one from the other, and the fleet maneuvered between them.

The importance of data on sea surface temperature in the area from Newfoundland to Florida for operative fish scouting could hardly be overestimated. The sea scouts had these data available owing to facsimile maps transmitted by the Navy oceanographic services of Canada and the United States (from Halifax and Washington). These maps were received several times a day. By the closeness of the isotherms, the location of water flows of different origins, and the meanders, the areas with a high probability of fish aggregations occur-

ring could be singled out. This afforded the opportunity to arrange a directed search within restricted local grounds, keeping vast "unproductive" areas out of the scope of the scouting activity. Time losses of the vessels for extensive oceanographic surveys were considerably reduced. One survey of the shelf and the continental slope from Banquereau Bank to 36°N with a distance of 20 miles between tacks could be made by a single vessel in 29 days (696 hours) or by 29 vessels in 24 hours.

With few exceptions, the maps could be used to predict the locations of almost all commercial fish aggregations in the area.

In the Sable Island area, the maps were used in December–February and July–September for the silver hake fishery; in the New England and Norfolk areas—in December–August for the silver and red hake fishery, and in March–October for the herring and mackerel fishery.

Potential fishing spots plotted on the maps were verified by the use of hydroacoustic equipment on the scouting (and fishing) vessels, the fishing gear, and by means of hydrological investigation. Seasonal hydrological surveys of small-size areas were made to determine water regime variations during the observation season and year.

We have attempted to display the nature of the activity aimed at providing the fleet with operative fish scouting and the methods applied to that end in a fragmentary way. In fact, there are so many more methods on hand that a separate book could have been written to describe them all in detail.

A long time has passed since the Soviet fishery epic terminated in the waters from Cabot Strait to Cape Hatteras. It is only in the memories of the fishermen and sea scouts that the hot days of the fishery, filled with the incessant hunt for fish and an everlasting search for fisherman's luck, come to life.

However, the passage of time has not left behind the need for forecasts, and the operative scouting service is alive today. But now it is guided by the achievements of modern science and engineering. Dr. Mitchell A. Roffer was the first to launch a bold experiment in this area: in 1976, he decided to set up an oceanic fishery forecasting service. At present, his company, ROFFS, in Miami, Florida, is able to render services related to fishery prediction all over the world 24 hours a day. The company carries out its activity in several interrelated directions such as tactical and strategic prediction of the fishery, fishery research and consulting, satellite remote tracking, and data communication. The basic product of the company is oceanographic analyses for commercial fishing that provide information on probable locations of fish concentrations and their accessibility for fishing. These analyses are based on data on water temperature and color, local current directions, ocean front strength and orientation, plankton, and the like. They represent a package of fishery maps and the forecast in writing and are updated several times a day as new data are received from satellites and from the fishery.

The oceanographic data come from U.S. (NOAA GOES), Russian, and European satel-

lites. The information on fishing conditions is provided by fishermen. The ROFFS' analyses are made available by telefax and e-mail. Fishing vessels subscribe to the company's services and receive its product every day. A similar service is also functioning in the University of Santiago de Compostela in Spain. It provides data to the vessels of various associations in Spain as well as in Mexico and Peru.

Recently in Dallas, Texas, a company called Sea Star Fishing Service has been established whose activity is mainly oriented at providing tuna seiners with versatile satellite oceanographic information plotted on maps. The information is received from NOAA satellites and a private satellite, Orb View-2. The maps are in color and are transmitted to the fishing vessels every day, and the captains have noted a high degree of correspondence between the predicted sea areas with tuna aggregations and those actually fished. The cost of the company's satellite program has been estimated at US$60 million and the price of an annual subscription to the company's services for a large tuna seiner—at US$80,000.

Quite recently, such companies have also been established in Russia. One of these is located in Murmansk, the other—in Vladivostok.

The operative scouting service is going through its second heyday.

SOVIET-AMERICAN SCIENTIFIC COOPERATION

In the morning hours of 11 September 1967, the port of the small seaside town of Woods Hole, Massachusetts, was uncommonly crowded. Almost 200 people had gathered there the moment a small ship appeared far off. She entered Great Harbor, and despite a strong wind carefully moored with her starboard alongside the American research vessel *Albatross IV*. For the first time in the history of Woods Hole, a Soviet ship had entered Great Harbor. Her name was the *Albatros*, and she arrived there from the Baltic, from distant Kaliningrad. With her arrival, the first page of Soviet-American cooperation in fishery research in the Atlantic Ocean was written.

On 18 September 1967, the *Albatross IV*, a vessel of the Woods Hole Laboratory of the Bureau of Commercial Fisheries (BCF), departed from Great Harbor and the AtlantNIRO vessel *Albatros* left Little Harbor. Walter E. Beatty and Lev Berezkin, the captains of the vessels, had agreed on a rendezvous in Vineyard Sound.

From there, they started their first joint research cruise under the program given the symbolic name of "Albatross." There were four Americans on board the Soviet *Albatros* and four Russian scientists on board the American *Albatross IV*.

The events that took place were most unusual for that time. The "cold war" pointer was going off the scale. Trade and economic relations and business contacts between the two countries were held to a minimum. Meanwhile, the economy of the Soviet Union was developing at a brisk pace. The level of Soviet scientific expertise and potential allowed the

September 1967. The first Soviet vessel in Woods Hole harbor. The arrival of the Soviet vessel *Albatros* marked the beginning of joint U.S.-U.S.S.R. fishery research.

country to solve almost any scientific and engineering problem. In the United States, the process of reappraising the approach to economic cooperation with the U.S.S.R. was gaining strength. Since 1964–65, the problems of adjusting Soviet-American economic relations were always on the agenda in influential organizations of American business and in the U.S. Congress.

One of the most important achievements of the U.S.S.R. was the creation of the scientific-technological and industrial basis to gain access to the world's oceans. It took only a few years for the country to become the proprietor of large fleets of fishing, merchant, exploratory, and naval vessels and to occupy a fitting place among the leading maritime states of the world. A great number of Soviet vessels bound for different destinations ploughed the ocean expanses. One day, large flotillas of Soviet fishing trawlers appeared in the waters off the U.S. coasts. Soon the Soviet fishery was running there on a grand scale.

The natural response of the United States was to consolidate its position in the struggle for food resources development, and to increase control over the activities of the nations, the U.S.S.R. in particular, engaged in the expeditionary fishery in the high-seas areas off the U.S. coasts. The Americans were especially concerned about the operation of extensive groups of the Soviet ships of large tonnage.

A solution was sought at various levels in order to resolve the emerging problem. In 1966, the U.S. Congress passed a law, P.L. 89-658, extending jurisdiction over all fishing in the coastal zone to 12 miles off shore. However, unilateral restrictions were not sufficiently drastic to radically change the situation at that time. In reports by U.S. President Johnson, the necessity of international and regional cooperation aimed at conservation of productivity of the fish resources was repeatedly emphasized. This led to the signing of Soviet-American agreements on fishery regulation in the Pacific and Atlantic Oceans. In February 1965, the Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics Relating to Fishing for King Crab was concluded. According to the agreement, the citizens and vessels of the U.S.S.R. were allowed to carry out commercial fishing for crab on the U.S. Continental Shelf in the Bering Sea over a 2-year period. In one of the provisions of the agreement, the governments of the two countries undertook to continue and extend their research of the king crab resource and exchange the results of this research annually, including, as far as possible, data on the maximum sustainable yield assessment. The exchange of scientists engaged in king crab stock research was also provided for.

This agreement contained one of the practical solutions of the fishery regulation problem; namely, that expanded research of the resources was to be executed by both countries and aimed at coordination of the maximum sustainable yield estimates. Such an approach was developed in the U.S. State Department where, at that time, Donald L. McKernan, former Director of the Bureau of Commercial Fisheries, was Coordinator of Ocean Affairs and Special Assistant to the Secretary for Fisheries and Wildlife with the rank of Ambassador. Dr. Robert L. Edwards was McKernan's adviser. It was these two men who made a great contribution in conceiving the idea of international cooperation in the joint utilization of the marine biological resources off the U.S. coasts. They were engaged in preparing and reaching agreements with many countries, including the U.S.S.R. Their views on the problems of utilization of the biological resources had much in common. In particular, they were convinced that the countries that intensively exploited the marine resources off the U.S. coasts and committed overfishing there were obliged to contribute to cover the expenses for fisheries regulation.

In the 1960s, the Soviet fishing effort kept increasing year by year. The first indications of certain fish stocks diminishing became obvious. The necessity of finding a way to agree on fisheries regulation was pressing.

In summer 1966, Dr. Robert Edwards arrived in Moscow where he met Alexander

Bogdanov, the Director of VNIRO, Pyotr Moiseev, an outstanding Soviet scientist, and other scientists. The problems of the Soviet fishery and fishery investigations were discussed in detail. The finale of Dr. Edwards' stay in Moscow was his meeting with Vladimir Kamentsev, Deputy Minister of Fisheries. The leaders of the U.S.S.R. fishery branch regarded the American party proposals to conclude intergovernmental fishery agreements with understanding.The Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics on Certain Fishery Problems in the Northeastern Part of the Pacific Ocean off the Coast of the United States of America was concluded in February 1967, and the Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics on Certain Fishery Problems on the High Seas in the Western Areas of the Middle Atlantic Ocean in November 1967.

It is significant that the first clauses in these two agreements contained arrangements for the expansion of scientific research on fish species of interest to the parties concerned—for each nation individually and in the form of coordinated research under the agreed-upon programs. The parties committed themselves to ensure the exchange of scientific and statistical data and fishery investigation results, and to arrange meetings of the scientists as well as their participation in the research carried out on the research vessels of the other party.

In the bilateral agreement on the fisheries in the Northwest Atlantic, both parties considered it necessary to conduct the fisheries with regard for the state of the fish resources based on research results in order to maintain harvests at the maximum sustainable yield level. The agreements that were reached made it possible to open broad opportunities built into the Soviet-American cooperation.

In September 1967, Dr. Edwards, who awaited the arrival of the Soviet *Albatros*, was Deputy Director of the Woods Hole Laboratory of the Bureau of Commercial Fisheries. The development and maintenance of the scientific and technical cooperation between the two countries, and bringing this to the highest level of efficiency, was one of his cardinal missions.

The first words addressed by Dr. Edwards to the Soviet scientists on board the *Albatros* were: "It's hard to express our pleasure—the Soviet colleagues are our guests! We have done our best to speed up the time so that we could work together. Now we'll be looking forward to the time when our cooperation becomes a tradition."

For the next 14 years, until 1981, when the cooperative program concluded, Dr. Edwards was a guardian of this thin thread of Soviet-American relations. In Moscow, this cooperation was also protected. The leaders of the U.S.S.R. fishery branch always attached great importance to joint fishery investigations.

Nowadays, when reading the materials and reports from the joint research by U.S.S.R and U.S. scientists, one is astonished at their scope, intensity, and firmness of purpose. The

Early pioneers in 1967: the first team of participants in U.S.-U.S.S.R. joint research in front of the *Albatross IV*.

scientists of both countries were aware of the necessity to determine the impact of increasing fishery pressure on the fish stocks and to estimate the maximum allowable catch compatible with the productive capacities of these stocks. To attain these objectives, the partners required more accurate estimates of fish abundance and a clearer idea of the impact of fishing and natural factors on fish productivity. Realizing the importance of these objectives, they tried to develop necessary management measures as promptly and efficiently as possible. The creation of a single database to be used by all the scientists in their analysis was a top priority. It was required to eliminate the primary source of probable differences.

The bottom trawl surveys become the major component of the joint research program. The survey system was developed in the Woods Hole Laboratory and began in 1963. The main purpose of these surveys was to assess the distribution, relative abundance, and structure of demersal finfish populations in the Northwest Atlantic. In a unique way, this survey system integrated stratified random sampling and the multispecies approach.

The survey area was subdivided into smaller areas called "strata." Their size and shape was based on geographic and oceanographic factors affecting fish distribution. During each

survey, the trawl station positions were randomly selected for each stratum. In the open sea, one station was occupied within the area of about 1,000 km^2 (300 $n.mi.^2$), and in the coastal waters—within an area of 500 km^2 (150 $n.mi.^2$). This method ensured representative sampling at all depths and a relatively uniform distribution of the stations over all the survey area. The actual catches of all species represented in the trawl series (in pounds) per standard tow as plotted on the diagram maps characterized their population density.

The unique features of the survey method provided statistically unbiased estimates of relative abundance of all species accessible to the trawl, and at the same time gave a geographical picture of density distribution and a total structure of each species stock (including fry).

The *Albatross IV* and the *Albatros* conducted the first joint surveys and comparative tests of trawl catchability in October 1967 in the areas from Cape Cod to Cape Hatteras and southward of Hudson Canyon. Irrespective of differences both in trawl design and size and in vessel class, similar patterns of species composition, distribution, and relative abundance of demersal finfish populations were obtained.

The next year, the survey was extended to cover Georges Bank and the Nova Scotian Shelf, and later the area from Cape Hatteras to Georges Bank was mainly surveyed.

A distinct declining trend in abundance indices for the demersal finfish biomass as a whole was revealed by the joint surveys by the early 1970s. This trend appeared to be one of the critical scientific reasons for the appropriate restrictions on the total catch of these fish species in Subarea 5 and Statistical Area 6 imposed by the International Commission for the Northwest Atlantic Fisheries (ICNAF) in 1974.

The joint research by the U.S.S.R. and the U.S. scientists was used by ICNAF as a model for the development of its program of coordinated surveys. In May 1971, in Halifax, Nova Scotia, the ICNAF Working Group on Coordinated Groundfish Surveys launched a multilateral survey program, and after 1972, the U.S.S.R.-U.S. bilateral trawl surveys became part of this large-scale program.

Interpretation of the results of the joint bottom trawl survey was one of the first problems faced by the Soviet and American scientists. Since the surveys were made by vessels of various types using unlike trawls and trawling techniques, the catch levels of different fish species, ages, and sizes differed markedly. The scientists were unable to convert the data on catch per trawl to absolute species abundance or total biomass values. Therefore, the investigations of catchability of different trawls was the key element in the joint program for a decade. Comparative tests of eight basic trawls—two Soviet and six American trawls—were made during that period. The trawls were tested, and comparative investigations carried out on board six vessels—four Soviet (*Albatros*, *Belogorsk*, *Blesk*, and *Quant*) and two American (*Albatross IV* and *Delaware II*). During the first years of the program, the partners studied differences between comparative catchability of the Soviet and American trawls. After 1973, the program focused exclusively on comparison of the American

Friendship for years, but ... without politics. Lev Berezkin, captain of the *Albatros*, who time and again navigated his vessels to Woods Hole, and Robert Edwards, coordinator of the U.S.-U.S.S.R. joint research program.

Yankee-36 and Yankee-41 trawls. The Soviet scientists on the *Belogorsk* and the *Blesk* were assigned the "key role" of obtaining data pertinent to the subject. As a result of these experiments, a modified Yankee-41 trawl was acknowledged to be the most optimal gear for utilization in the new standard trawl surveys scheduled for ICNAF Subarea 5 and Statistical Area 6.

Plankton surveys under the ICNAF program, joined later by vessels of many other countries, were one of the most important lines of cooperative studies.

The joint investigation program kept expanding. After 1968, fish egg and larval investigations were initiated on the *Albatros*, the *Blesk*, and the Canadian vessel *Teta*. At the initial stages, as in the case of the zooplankton studies, the experiments were aimed at specifying

standard gear, sampling techniques, and methods. In autumn 1969, the vessels *Albatross IV*, *Ekliptika*, and *Aliot* investigated the herring spawning grounds and egg density on the northern slope of Georges Bank. In autumn 1970, this work was continued by the *Albatross IV*, the *Alferas*, and by the Canadian submersible *Pisces*.

In 1971, the United States, U.S.S.R., and some other ICNAF member countries carried out the joint herring larval survey on Georges Bank and in the Gulf of Maine. The ICNAF programs of herring and mackerel larva surveys were underway until 1976. The U.S. vessels *Albatross IV* and *Delaware II*, the Soviet vessels *Belogorsk*, *Prognoz*, and *Vyandra*, the French ship *Cryos*, the Polish *Wieczno*, and the West German *Walter Hervig* (later renamed *Anton Dorn*) were also participants in these programs.

In autumn 1976, U.S. and U.S.S.R. scientists executed the ICNAF program of tagging spawning Atlantic herring on the *Belogorsk*. The number of specimens tagged amounted to 30,000.

In the second half of the 1970s, scientists on board vessels of the two countries performed intensive surveys of the Marine Resources Monitoring Assessment and Prediction (MARMAP) program.

Political relations between the U.S.S.R. and the United States began to change for the better in the early 1970s. Relaxation of the tension between the two countries stimulated scientific cooperation. The Agreement between the Government of the Union of Soviet Socialist Republics and the Government of the United States of America on Cooperation in the Investigation of the World Ocean, effected on 19 June 1973 in Washington, D.C., was one of the most important in the series of Soviet-American agreements.

According to the Agreement, joint investigations were supposed to cover six priority scientific branches and directions. The study of biological production and investigations in the field of biochemistry of individual organism functioning and of the biological community in the marine environment was one of the research lines.

According to the Soviet-American cooperation program scheduled for 1975–80, VNIRO, AlantNIRO, Moscow State University, the U.S. National Marine Fisheries Service, the Woods Hole Laboratory, and the National Oceanic and Atmospheric Administration (NOAA) were charged with investigations on the subject of "biological production systems of the Northwest Atlantic."

Application of hydroacoustic methods and devices for fish stock assessment was anticipated. The scientists of the two countries, however, made arrangements for joint activities much earlier, in 1973, at the International Council for the Exploration of the Sea (ICES) symposium on "Hydro-acoustics in Fisheries Research" held in Bergen, Norway.

Joint studies aimed at the development of a single method for assessing commercial fish abundance with the use of hydroacoustic devices were initiated in 1974. Investigations were carried out on the *Delaware II* and the *Chronometer*. In 1975, the *Delaware II* and the *Poisk* conducted an acoustic survey of pelagic fish schools, which were identified with the

Soviet scientists visiting Boston in 1967. Olga Krylova, Florensa Motuzko, and Arkady Noskov with Senator Edward Kennedy.

use of midwater trawls operated from the Polish vessel *Wieczno* and the GDR vessel *Ernst Haeckel*. At the end of 1975, a conference on hydroacoustic investigations was held in Woods Hole. The joint report made later by the scientists of the two countries at an ICNAF session was based on the investigation materials presented at that conference. In 1976, aboard the *Chronometer*, scientists carried out joint research on fish aggregation density and composition in the central part of the Atlantic Ocean. In June 1979, a Soviet-American symposium on "Hydroacoustic Methods for the Estimation of Marine Fish Populations" was held in the United States. Scientists and engineers from 14 countries and the Food and Agriculture Organization of the United Nations (FAO) participated. The symposium resulted in publication of a two-volume guidebook on quantitative assessment of fish stocks using hydroacoustic methods.

The third regular meeting of Soviet and American scientists on the problem of joint fishery research within the economic zone of the Northeast Atlantic coast of the United States was held 19–23 February 1979 in Moscow. At that time, investigations of the life

cycle and stock sizes of major commercial fish species (silver hake, red hake, mackerel, herring, and squid) as well as marine fishery ecosystem studies were the main objectives of the cooperation. At the meeting, the results of the research performed in 1978 were summarized. Three Soviet research vessels—the *Argus*, the *Aliot*, and the *Belogorsk*—took part in the work. Twenty-three scientists from AtlantNIRO and 84 from the United States were involved in the implementation of the marine part of the research program. Five Soviet scientists were trained in various U.S. laboratories. At the meeting, both parties emphasized that scientific cooperation had become a tradition and had acquired a creative quality, and that the research activity had reached an extraordinarily high level. All this gave more possibilities for the extension and intensification of the research.

Time and circumstances, however, decreed otherwise. After the introduction of the 200-mile fishing zone by the United States in 1976, the Soviet fishing fleets were compelled to leave the waters off the U.S. coast. The Ministry of Fisheries had regarded Soviet-American cooperation in the field of fishery research as the prime condition granting the U.S.S.R. the possibility of maintaining a large-scale fishery in the U.S. high-seas waters and later in the fishing zone of that country. However, the fishery had to be curtailed.

The Ministry of Fisheries saw no point in supporting further scientific cooperation between AtlantNIRO and the Northeast Fisheries Science Center for investigations of U.S. biological resources. Hard times were coming. Money was allotted for the discovery of new fishing areas and their exploration. Soviet research vessels were no longer to be mooring at Woods Hole berths.

The years of Soviet-American cooperation have rushed by. Today it is just an episode in the history of U.S.S.R.-U.S. relations, bright and meaningful though. The scope of the joint work was impressive. Two U.S. and 15 U.S.S.R. vessels were engaged in the research work. Over 70 cruises were made in which 350 American and 140 Soviet scientists took part.

The importance of the joint program can be measured by its contribution to science. The level of basic knowledge on the distribution, biomass, and dynamics of fish populations in the Northwest Atlantic has significantly increased. This credible knowledge was of utmost importance for solving resource management problems. Owing to the joint efforts of the scientists, population dynamics parameters such as recruitment, growth, and mortality of the major commercial fish species (cod, silver hake, red hake, and yellowtail flounder) were estimated.

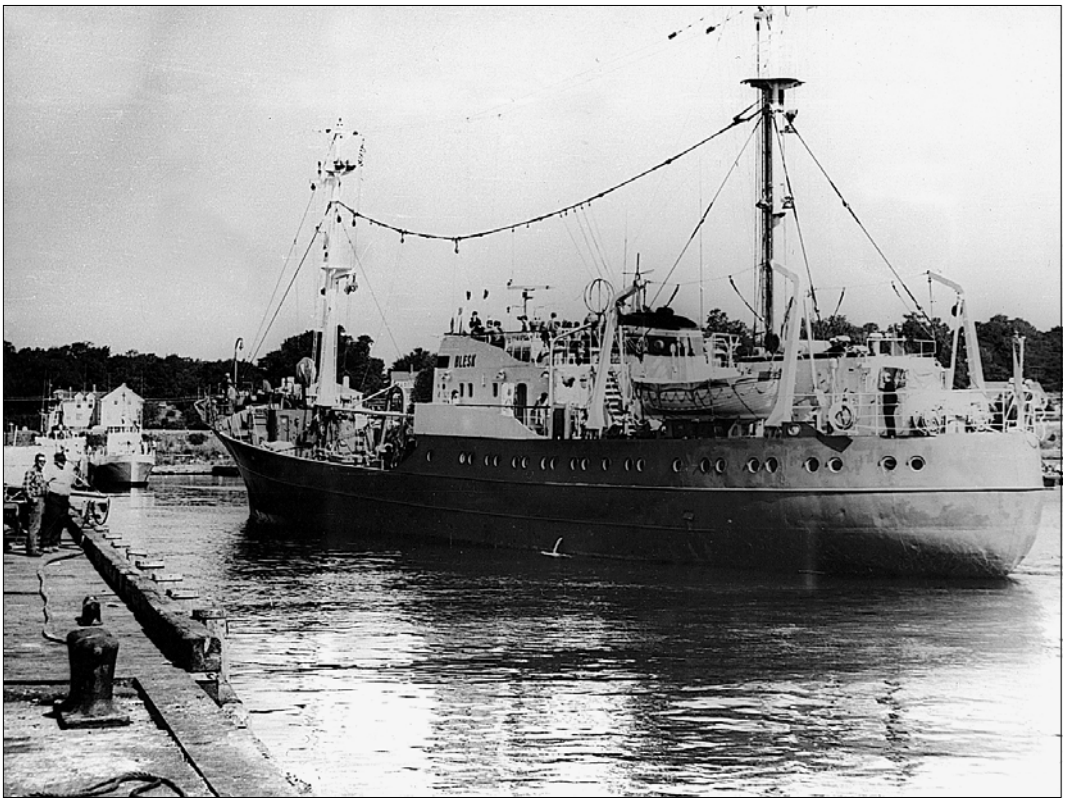
The introduction of new equipment and research methods, numerous publications, a broadened scope of scientific knowledge, and eventually a contribution to the development of ICNAF and world fishery science can be placed among the advantages and benefits of the cooperation.

The cooperation was fruitful. Exalted aim, common interests, and working as a team brought the scientists together. American scientists such as Robert Edwards, Marvin

A strong handshake between scientists, September 1967. Arkady Noskov, Laboratory Chief, Valentin Briantsev, AtlantNIRO oceanographer, and Herbert Graham, Director of the Woods Hole Laboratory. The Soviet scientists were invited to Woods Hole to launch the joint U.S.-U.S.S.R. fishery research program.

Grosslein, Richard Hennemuth, and Kenneth Sherman remained as friendly to Yury Vyalov, Arkady Noskov, Vladimir Rikhter, Valentin Bryantsev, and many other Soviet scientists as before.

Excellent relations were also established between the American scientists and the Soviet vessel crews. At the first press conference held in September 1967 on the occasion of the arrival of the Soviet vessel *Albatros*, Dr. Robert Edwards addressed the American journalists with a request to skip the questions concerning the events that were taking place in the world arena: "Please, no questions about Vietnam." Following his example, the American scientists and the Soviet seamen made it an unwritten rule not to stir up discussions on



The research vessel SRTM-815 *Blesk* in Woods Hole harbor. The *Blesk* particpated in joint surveys in 1968 and 1972.

political subjects. That allowed them to avoid needless excesses and emotions aboard the vessels during the periods of quite frequent crisis that were occurring in the political relations between the two Great Powers. The behavior of the Soviet seamen was invariably admired by the American scientists. "They are extraordinarily hospitable, friendly, open-handed, always ready to help. I get great pleasure from meeting them," Dr. Donna Turgeon wrote. A friendly atmosphere always reigned aboard the Soviet vessels.

As it turned out, a friendly spirit accompanied the relations between the Soviet seamen and the locals as well, whose interest in the Soviet vessels was tremendous. The vessels and crews exchanged personnel with one another, departed, and returned; but the people willing to visit the vessel and meet the Soviet seamen kept queuing up alongside the vessel on the "open house" days.

One thousand five hundred Americans visited the *Albatros* in September 1967. The *Belogorsk* received more than 3,000 visitors in October 1974, 6,000 in September 1975, and 5,000 in October 1976.

Plankton sampling on board the U.S. vessel *Albatross IV* during the first cruise of a long series of joint research cruises. Pictured are planktonologists Ruth Stoddard from Woods Hole and Olga Krylova from Kaliningrad.

In October 1976, Lev Berezkin was captain of the *Belogorsk*. Soviet-American cooperation was in its 10th year. Berezkin, full of initiative, took the lead to celebrate the anniversary. He addressed "Our Cape Cod friends" with a welcoming letter in the *Cape Cod Standard Times* newspaper on 1 October, and arranged an "open house" day on board the vessel on 5 October.

On 6 October, an article titled "5,000 literally get taste of Russian hospitality" was published in the Cape Cod Standard Times. The reporter described the reception aboard the *Belogorsk* as follows: "Nearly 5,000 American visitors literally got a 'taste' of Russian hospitality Sunday as they sampled 1,100 pounds of Russian bread, 80 gallons of borscht, and 265 gallons of a fruit punch [compote].... The first visitors were greeted with the traditional Russian welcoming gifts of bread and salt for peace and good health.... The ship's guest book showed comments from visitors hailing from 22 different states by the time the day was winding to an end."

The Soviet seamen were the center of attention, and their leisure-time was taken care of

The hospitable *Belogorsk*. This research vessel, navigated by captains Lev Berezkin and Alexey Zentsov, arrived at Woods Hole every year from 1973 to 1978. American and Soviet scientists used to work in peace and quiet on board the vessel. Thousands of Americans, residents of New England seaside towns, remembered the cordiality of her crew during port calls that the *Belogorsk* made in between cruises.

during the stays of the vessels at Woods Hole. Trips to Boston and Falmouth, visits to schools and museums were arranged for them. They were invited to evening parties in the MBL Club and were asked by the locals to be their guests.

The visits of the Soviet vessels at Woods Hole always had a broad local press. The tone of the news coverage was exceptionally friendly and benevolent. The issues of peaceful co-existence of the two Great Powers, community of purpose in joint investigations of the resources by the scientists, and contacts between the Soviet sailors and Americans never disappeared from the news pages. Today, looking through the newspapers of that time, one pays attention to numerous touching details associated with these contacts.

In the *Cape Cod Standard Times* of 13 September 1967, a curious fact imparted by Dr. Robert Edwards was mentioned in a report on the arrival of the *Albatros*—a local woman came with a basket of fresh cucumbers to treat the Russians.

The *Sunday Cape Cod Standard Times* of 26 August 1973 wrote about an exceptionally warm meeting of the *Belogorsk* sailors with the troupers of Falmouth's College Light Opera Company who gave a performance of "Paint Your Wagon" for the sailors. After the performance, an impromptu evening event was arranged for the Soviet seamen, with refreshments and songs. Quite a lot of vodka was drunk. Barby Robinson, a student from Florida State University, wrote about that meeting: "They're really extremely nice people and very friendly." Bill Mackey, a member of the show's vocal company from Plainfield, Indiana, said, "The Russians seemed to want to get to know you. There was a lot of unity, and it seemed like it was a step toward fellowship. It was magnificent."

The Americans' cordial welcome entailed reciprocal feelings. On leaving Woods Hole, Aleksey Zentsov, the captain of the *Belogorsk*, sent an open letter of thanks to the Woods Hole and Falmouth residents—"To our American friends"—published on 18 November 1974 in the *Cape Cod Standard Times*:

> "We have now completed seven successful years of joint U.S.S.R.-U.S. fishery research.... During our calls in Woods Hole, members of our crew had contacts with many citizens of the United States. They visited Boston, toured and visited around Falmouth, and were guests of families living in Woods Hole and Falmouth. More than 3,000 visitors have been aboard our ship. Today, leaving American shores, we heartily thank the inhabitants of Woods Hole and Falmouth for their cordiality and hospitality.... Do Svedanya."

The many manifestations of the keen interest, warmth, and goodwill by Cape Cod residents in the Soviet seamen and vessels make one automatically reflect on the nature of these phenomena. One possible explanation seems to be a historically predestined mutual attraction of the two great nations and a deep feeling of mutual respect. These very qualities in peoples' souls surmounted the curtains and estrangement of the "Cold War," billows of propaganda, and political and military crises.

On both sides, people were governed by a desire to get to know each other, to understand what makes them draw together and what makes them part. It turned out that their souls were open to each other, that ideological blinders can be removed. People realized that contact brings a feeling of joy, and that meeting other people is permeated with a festive mood.

PART V

PANORAMA OF THE SOVIET FISHERY IN 1961–77

In Part II, this book depicted a generalized picture of fishery development in the Region by Soviet fishermen. In that picture, the large-scale features of the fishery were emphasized: the year-to-year changes in catch size and structure, the fishing effort by ships of large and medium tonnage, and the contribution of groups of these ships to the development of the fisheries in three areas and in the Region as a whole.

In this section, the other profile of events in the history of the Soviet fishery is scrutinized: intra-year variations in the distribution of fishing effort, catch per effort, and commercial ichthyofauna. This is feasible due to the availability of annual commercial fishery atlases that were compiled by the Western Fish Scouting Service for the entire period under review. Groups of technicians permanently processed daily radio reports received from different Atlantic areas, the Northwest Atlantic in particular. Plotted on the fishing schemes were the places where particular fish species were caught by each vessel, with the fishing sites outlined based on geographic signs and catch composition. Ultimately, monthly maps of fishery distribution were laid out with associated tabulated statistical data on the fishery conducted by vessels of different class and type with the use of different fishing techniques in the outlined fishing grounds. These data comprised the number of ship-days fished, daily mean catches, daily average output of frozen products, and species composition of the catches. All these operations were done manually, as no personal computers existed in the country at that time.

Looking through the atlases, one can identify a series of regularities in the fishery distribution both of an intra-year and year-to-year nature. The availability of several fishing grounds can be distinguished: the canyon zones from Norfolk to Corsair, the shallow waters from Long Island to Cape Hatteras, and the oceanic slopes of the Nova Scotian Shelf.

The analysis of the data from the atlases by season and fishing period within the limits of the above-mentioned areas made it possible to complete a brief description of the fishery peculiarities for each year and to obtain insight into the levels of fishing effort and catch sizes.

With few exceptions, we present data on the average number of ships that were fishing. Catch sizes are monthly mean catch per ship-day fished. The data on the range of catches, apart from changes by month, also reflect irregularities in the catches caused both by specific features of particular parts of the fishing area and by the varying productivity of the fishery by large trawlers of different class and type.

During the first years, the fishery in the Region was conducted by BMRTs. The first RTMTs appeared in 1963, followed in 1968 by RTMAs constructed in East Germany. In

the 1970s, large trawlers of new generations with increased productivity were involved in the fishery.

Everywhere in the Region, the fishery was based on mixed fish aggregations. In all cases where data on catch composition are given, the commercial species are listed in the order of their predominance. The nonfood bycatch normally includes goosefish, Atlantic searobin, skate, spiny dogfish, a number of other species, and undersized fish.

Annual catch sizes of different fish species were adopted from the official ICNAF statistics. These and the other ICNAF data relevant to the fishery in the Region can be found in Appendix Tables 1–9.

1961. Mention of the first year of the Soviet fishery in the Region was already made above. This section dwells on just on a few of its characteristic features. Throughout the fishing period from May to December, herring concentrations were fished in a narrow belt along the north and northwest slopes of Georges Bank. Only in October and November did the fishery also encompass the parts eastward of Cape Cod and Nantucket Island. All fishing effort was concentrated within this limited area. Herring were the focus of attention. However, they occurred in mixed aggregations along with other fish species, and the captains of the BMRTs, in their operative reports beginning in July, told of bycatch of haddock (up to 5–40%), silver hake (up to 5%), cod (5–25%), flounder, and redfish (up to 10%).

On having detected dense herring concentrations in the water column, the captains of the BMRTs attempted to harvest them with primitive 31-m midwater trawls of the PINRO design. To provide successful fishing for pelagic fish concentrations, the trawl had to be well calibrated: the towing depth was determined by the length of the wires paid out and the trawling speed. Irrespective of a small trawl opening, some ships adjusted themselves to fishing dense herring shoals at night as well as at dawn and dusk. In August–September, on some nights, the BMRTs *Yantar* and *Zhemchug* were catching up to 20–30 t of herring.

1962. This year the fishery began as early as February. As against the previous year, the total catch increased almost 4 times, with herring accounting for up to 70%. The species composition of the catches became more diversified due to the availability of cod, haddock, redfish, silver hake, flounder, and other commercial species. But as before, herring and drift-net fishing were the gamble. One hundred sixty drifters arrived at Georges Bank in May, with their number growing to 200 in July. However, the herring resource in 1962 turned out to be inadequate for efficient drift-net fishing by such a large number of vessels.

Besides, herring behavior did not meet the requirements of drift-net fishing. From February to June, their behavior was identical to that in the same months of 1961 (no dense concentrations, just small, separate mobile schools), but it changed later. In July–August, herring formed a dense concentration within a small area, kept to the bottom for most of the day, and were passive. From March to June, the north, east, southeast, and west slopes of the Bank and its central shallow part were fished. In July–December, the aggregations formed along the north and northwest Bank slopes, on Browns Bank, in the Gulf of Maine, and

eastward of Cape Cod and Nantucket Island. A considerable number of drifters could not find aggregations on which to set their drift nets. In some months, "empty" drifts made up 30–50%. In March–August and October–December, a monthly mean catch per net varied between 24 and 112 kg, and only in September did it constitute 200 kg. For the most part, the catch per drift did not exceed 3–5 t.

After 19 April, the fleet began to move to Banquereau Bank, where the number of vessels reached 125 units. Herring aggregations were also detected on Saint Pierre Bank. Favorable fishing conditions did not last long, and by late April–early May, the vessels went to Georges Bank.

In March, the SRTs and SRTRs commenced trawl fishing for herring, and in July—for groundfish as well. Herring catches were 5–6 t in May–October and 9 t in September. In other words, the productivity of trawl fishing for herring surpassed that of drift-net fishing. Deficiencies in the receiving-transport fleet retarded vessel operations. A lot of fishing time was lost waiting for discharge and supplies. The resultant lost catch of herring was estimated at 10,000–15,000 t.

The fishery for silver hake, red hake, haddock, and herring conducted by medium trawlers in July–September in the sectors between Lydonia and Corsair Canyons brought catches of 8–10 t.

All fishing ships of large tonnage were the same, the BMRT type. They harvested herring in the same areas as the ships of medium tonnage. On Georges Bank, there were nine BMRTs fishing in February, three in March, and one in April. Their mean catches were 21, 14, and 20 t, respectively. During July–October, 7, 12, 11, and 8 BMRTs were engaged in the fishery, yielding 25, 29, 44, and 26 t, respectively. In November, mean catches of 13 t were taken by three vessels, and 8 t by one BMRT in December. Over the entire period, the bycatch was represented by haddock, with cod added in February–July.

Thirteen BMRTs in October and 6 in November harvested mixed aggregations of silver hake, herring, red hake, haddock, and pollock on the north slopes of Georges Bank yielding 22 and 13 t, respectively.

Higher results were shown by the BMRTs involved in the fishery in the Lydonia-Corsair Canyon zone in April–September. One BMRT operated there in April–May, 8 in June, 10 in July–August, and 6 in September. In April–July, their mean catches were 42–57 t, in August—23 t, and in September—37 t. Silver hake were predominant; haddock and herring occurred in the bycatch, with red hake added in July.

Off Nova Scotia, the BMRTs fished two areas: parts of the oceanic slope of the shelf from Emerald Bank to Sable Island and Emerald Basin. In the first area, one to three BMRTs worked in March–May. Their catches ranged from 26 to 48 t and consisted mainly of silver hake, haddock, cod, herring, and argentine. In the second area, seven and nine BMRTs operated in November and December. Their catches of silver hake, redfish, haddock, cod, and flounder were 33 and 26 t, respectively.

The total catch taken off Nova Scotia was not large, just 30,000 t; however, the first results were encouraging. In addition to 9,000 t of silver hake, 9,000 t of cod, haddock, and redfish were caught. The ships of medium tonnage captured 9,000 t of herring.

Off New England, despite all kinds of fishery-related problems, the catch of herring constituted 150,000 t, with 106,000 t contributed by medium trawlers. The BMRTs captured about 100,000 t of silver hake, herring, and cod.

By the results of this year, herring and silver hake were anticipated to take the lead in prospective catches.

1963. The catch in the Region increased by 165,000 t. The herring resources deteriorated, which caused a drop in their catch by 60,000 t. The reduced catch, however, was compensated for by a fivefold rise in hake catches compared to the previous year. Silver hake and herring accounted for 83% of the annual catch. An additional 14% was made of cod, haddock, redfish, red hake, scup, and argentine.

Attempts to start the fishery on Georges Bank were made occasionally in February–June; however, the density of herring and other fish concentrations was low, and it was not before July that the fishery expanded there. Twenty-two BMRTs were fishing in July, 42 in August, and 17 in September. The number of BMRTs decreased to 7 in October–November; in December, it increased to 11 units. The fishery covered the south, southeast, east, north, and northwest Bank slopes, and in August, also the sectors east of Cape Cod and Nantucket Island. The catches by month and by individual site fluctuated between 18 and 44 t. In some months, herring or silver hake dominated, but in general, they remained the two leading species. The bycatch included haddock, red hake, and other species.

Seventy-two, 61, and 32 SRTs and SRTRs were involved in trawl fishing for herring in July–September, respectively. Their catches varied between 3.5 and 9.0 t. In August, the drifters made 189 drifts with nets. Mean catches per drift in May–August equaled 3.6, 6.5, 4.9, and 1.5 t, with catches per net of 45, 62, 82 and 24 kg, respectively. The results of this year discouraged the fishermen from drift-net fishing once and for all.

In April–May, one to three BMRTs and several SRTs and SRTRs operated at Baltimore–Hudson–Black Canyons. The catches consisted of scup, herring, mackerel, and silver hake, and constituted 27–36 t for the BMRTs and 6 t for the SRTs and SRTRs. At Lydonia–Corsair Canyons, 18 BMRTs and 33 SRTs and SRTRs were fishing in July. The catches of silver hake, herring, and red hake were 49 and 11 t, respectively.

In July–September, the BMRTs and medium trawlers sporadically entered the waters of Nantucket Shoals; however, the fishing conditions there did not meet the captains' demand.

In October–November, on Browns Bank, four and one BMRTs, respectively, harvested argentine with bycatch of pollock, haddock, and silver hake. Their catches ranged from 24 to 28 t.

This year, several vessels of the RTMT type, the construction of which had begun in East Germany in 1962, arrived at the fishing ground.

The fishery off Nova Scotia continued year round.

On the plots of Emerald Basin, the BMRTs worked January through April and August through December. In January–March and in August, they numbered 4–7 and 11, respectively; in December—4; and in other months—1 or 2. Silver hake predominated in mixed aggregations represented also by redfish, haddock, cod, argentine, and pollock. The catches ranged from 25 to 34 t in January–September, and from 16 to 24 t in October–December. In some parts of the oceanic slope of the shelf from Emerald Bank to Sable Island, a small-scale fishery for silver hake, redfish, argentine, haddock, and cod existed in April–June and September–November. Thirteen BMRTs were fishing in May, and one to three vessels were involved in fishing activity in other months. The catches taken during the first period equaled 39–47 t, and 21–35 t during the second period. Twenty SRTs and SRTRs were catching 8 t on average in May.

In August–November, three to nine BMRTs fished for silver hake, redfish, haddock, flounder, and cod in the shallow waters of Emerald and Middle Banks and off Sable Island. The catches were 30–44 t in August–October and 22 t in November.

As can be seen, the vessels harvested mixed silver hake and other fish aggregations in all the areas off Nova Scotia. Their catch constituted 123,000 t of silver hake and 37,000 t of cod, haddock, redfish, herring, and argentine.

Off New England, silver hake and herring accounted for the lion's share of the catches (204,000 t). Cod, haddock, redfish, red hake, scup, butterfish, and argentine added just 21,000 t to the catch.

For the first time, 8,000 t of fish were taken in the Norfolk area.

1964. The growth of the catch by another 85,000 t can be attributed to an increase in silver hake and herring catches supplemented by those of haddock, red hake, and argentine. The largest fleet concentration in the Region was recorded in May–September. Up to 50 BMRTs and 145 SRTs and SRTRs were available there in at least one of these months.

The average number of BMRTs fishing increased from 2 and 6 in January and February to 10 and 19 in March and April, respectively, and up to 36 in May–July. Thirty-three and 30 vessels operated in August and September, respectively, 15 in October–November, and 1 in December. Such tactics of fleet allocation were applied to cover the optimal period of formation of dense aggregations of silver hake and pre-spawning and spawning herring.

Off New England, the fishery on the north and northwest slopes of Georges Bank started in January and lasted until February. Two BMRTs in January and six BMRTs in February on average harvested mixed silver hake and herring, as well as haddock, cod, and red hake aggregations, taking catches of 37–40 t. The BMRTs resumed the fishery in July. From 6 and 10 units in July and August, respectively, their number reached 28 in September. Fifteen BMRTs operated there in October, and 7 BMRTs in November. In July–August, they harvested silver hake, haddock, and herring aggregations; in September—herring; and in October–November—silver hake, herring, haddock, red hake, cod, redfish, and mackerel; the catches taken during these three periods were 35–36, 45, and 20–30 t, respectively.

The SRTs and SRTRs began working in this area in June. From 10 vessels in June and 6 in July, the group increased to 21 in August and 43 in September. During the first period, they fished for silver hake, haddock, and herring, making catches of 4–5 t, and during the second period—mainly for herring, yielding 7–10 t. In August, nine SRTs and SRTRs were involved in pair trawling for herring, with the number dropping to six vessels in September. Their catches were 9 and 6 t per vessel, respectively.

In May–August, the major herring fishery area for medium trawlers was located in shallow water on the southwest, south, southeast, and east parts of Georges Bank. During each of these months, groups of 46, 87, 57, and 37 trawlers, respectively, were fishing there. Catches ranged from 4.4 to 6.0 t. Twenty-three vessels were engaged in pair trawling in July and 20 in August, yielding 6.5 and 8 t per vessel, respectively. Notwithstanding a reduced stock size, the distribution of herring was favorable for medium trawlers, as it met their fishing capacities. However, the density of herring concentrations was utterly inadequate for the BMRTs. This was how localization between the fishing areas took place.

On Georges Bank, the catches taken by medium trawlers were especially high in September—the peak of the season. Herring concentrations were large enough for all the ships. The mean catch of 47 vessels was 10 t. According to the captains of the fishing vessels, 300–400 medium trawlers could have successfully operated in September. However, the lack of receiving-transport ships at that time adversely affected fishing vessel operations. The vessels were laid up waiting for their catches to be unloaded and their holds discharged. The herring dispersed by mid-October, and the fishery ceased.

The canyon zone was one of the fishing areas for BMRTs in March–July. Three BMRTs worked in March on the grounds located from 36°20′N to Baltimore Canyon. Their catches of scup, mackerel, alewife, and herring constituted 40 t. Three more BMRTs fished for silver hake, herring, and red hake in the sectors between Veatch and Corsair Canyons. They captured 52 t. In April, the number of fishing places between Block and Corsair Canyons, where 19 BMRTs harvested 48 t of silver hake, red hake, and herring, was 10. In May, June, and July, groups of 11, 33, and 13 BMRTs, respectively, were fishing for silver hake, haddock, herring, and red hake between Veatch and Corsair Canyons in the beginning of the period, and between Lydonia and Corsair Canyons in July. Catches ranged from 37 to 38 t. Two to six SRTs and SRTRs conducted the fishery in April–July in the same areas as the BMRTs. Their catches varied between 10–11 t in April–May and 5 t in July.

The fishery at the canyons was resumed in December. One BMRT yielded 40 t of scup at Norfolk Canyon, and seven BMRTs captured 30–40 t of red and silver hake at Hudson-Hydrographer Canyons.

Six SRTs and SRTRs operated in April–May in the shallow waters from 40°30′N to Cape Hatteras. They harvested scup and mackerel in the southern part of the area and herring, alewife, and mackerel in the north. Catches ranged from 4 to 9 t.

The fishery on Nantucket Shoals existed only in July–August, when three to five SRTs

An elevator for fishermen. Flights in a net. Quite a safe way to get to the mothership.

and SRTRs harvested mixed alewife, silver hake, red hake, herring, butterfish, and mackerel aggregations. Their catch constituted 5.5 t.

Off Nova Scotia, the fishery existed in four areas. In February–March and June–December, BMRTs fished for argentine, silver hake, pollock, haddock, cod, and redfish on the Browns Bank slopes. The number of vessels ranged from one in March and two in November–December to four in July, seven in August, and four in October. The fishery in February–September was of a sporadic character. Catches varied between 20 t in March, 32–37 t in June–August, 26 t in October, 33 t in November, and 28 t in December.

One to two BMRTs worked on the slopes of Emerald Basin in February–March, 13 vessels worked there in July, and 5 vessels in August. The catches of silver hake, redfish, cod, argentine, and haddock fluctuated between 37 and 42 t.

The fishery for silver hake, argentine, pollock, haddock, and redfish on the oceanic slope of the shelf between 61–65°W continued for 3 months. It was only in May that 24 BMRTs involved in the fishery brought in a catch of 40 t. In June, three BMRTs were fishing, and five in November, yielding 32 and 20 t, respectively.

Eleven BMRTs in August and 1–2 BMRTs in September–November fished for silver hake, haddock, cod, redfish, and flounder in the shallow waters of Middle Bank, off Sable

Island, and on Emerald Bank. The catches ranged from 54 t in August, to 48 and 44 t in September and October, respectively, and to 23 t in November.

Due to the transient character of the fishery in the areas off Nova Scotia, a relatively small number of BMRTs fished there for most of the year, and "motley" catches were indicative of a decline in the resources of silver hake, the dominate commercial species. The silver hake catch declined by 40,000 t, and the total catch turned out to be only one-third as large as that taken off New England where, to the contrary, an increase in the silver hake resource was obvious. Silver hake and herring accounted for almost 90% of the total catch in the latter area.

The catch from the Norfolk area increased due to silver and red hake.

1965. The catch increased by 200,000 t. A major part of the catch was obtained off New England, where silver hake, haddock, and red hake contributed to the increase. The catch of these species (550,000 t) more than compensated for the losses suffered in the herring fishery. The resources of these fish species were the best ever in the history of the Soviet fishery in this area. Employment of the ships of medium tonnage in the fishery for Norwegian herring, and a self-imposed ban on fishing for herring on Georges Bank because of a slack market for herring, were responsible for almost a fourfold decline in the herring catch.

The most intensive fishery was carried on in the canyon zone and in the southwest, south, southeast, and east shallow portions of Georges Bank.

The fishery that commenced at Veatch Canyon in January was continued in the areas between Hudson and Hydrographer Canyons in February–March, between Veatch and Corsair Canyons in March–May, between Block and Corsair Canyons in June, and between Welker and Corsair Canyons in July. Seven BMRTs were fishing in this zone in January, 17 in February, 19 in March, 27 in April, 17 in May, 36 in June, and 18 in July. Silver and red hake prevailed in the catches throughout this period. Red hake predominated in some places, but silver hake were second to none on the majority of fishing grounds. A substantial bycatch of haddock was taken in April, and of herring and mackerel in May. Fishing conditions were stable. Monthly mean catches by the BMRTs varied between 47 and 53 t in January–May, and between 35 and 40 t in June and July, respectively. Beginning in April, the fishery was conducted by small groups of SRTs and SRTRs; in May–June, their number increased to 13 and 53 units. Their catches were within the range of 6–9 t.

In April–May, a small-scale fishery was carried on at the canyons, between 36°20′N and Wilmington Canyon. Two to six SRTs and SRTRs, and occasionally one BMRT, were fishing there for scup, butterfish, black seabass, herring, and mackerel, yielding 3–7 t and 31 t, respectively.

The opening of a new fishing season at the canyons took place in December, when five BMRTs were harvesting silver and red hake at Block and Veatch Canyons. Their catch constituted 40 t.

A prolonged and stable fishery in the shallow waters of southwest, south, and east Georges

Bank rested upon the entry of unusually strong haddock year-classes into the fishery. Four BMRTs and 22 SRTs and SRTRs fished for herring in June, with catches of 34 and 6 t, respectively. One BMRT and three SRTs and SRTRs harvested haddock; their catches were 42 and 4.4 t, respectively. In July, the fishery was of an occasional character. Ten BMRTs were fishing in August, 16 in September, 9 in October–November, and 16 in December. Haddock occurred in mixed aggregations with herring, and silver and red hake, but predominated in the catches. Their concentration density, as opposed to that of silver and red hake in the canyons, was relatively low, and the ships were busy trawling for 17 hours a day on average. Catches varied between 30 and 37 t in August and September, constituted 28 t in October, and reached 37 t in November–December. In July–October, 2 to 20 SRTs and SRTRs, together with the BMRTs, fished for haddock. Their catches fluctuated between 6 and 12 t.

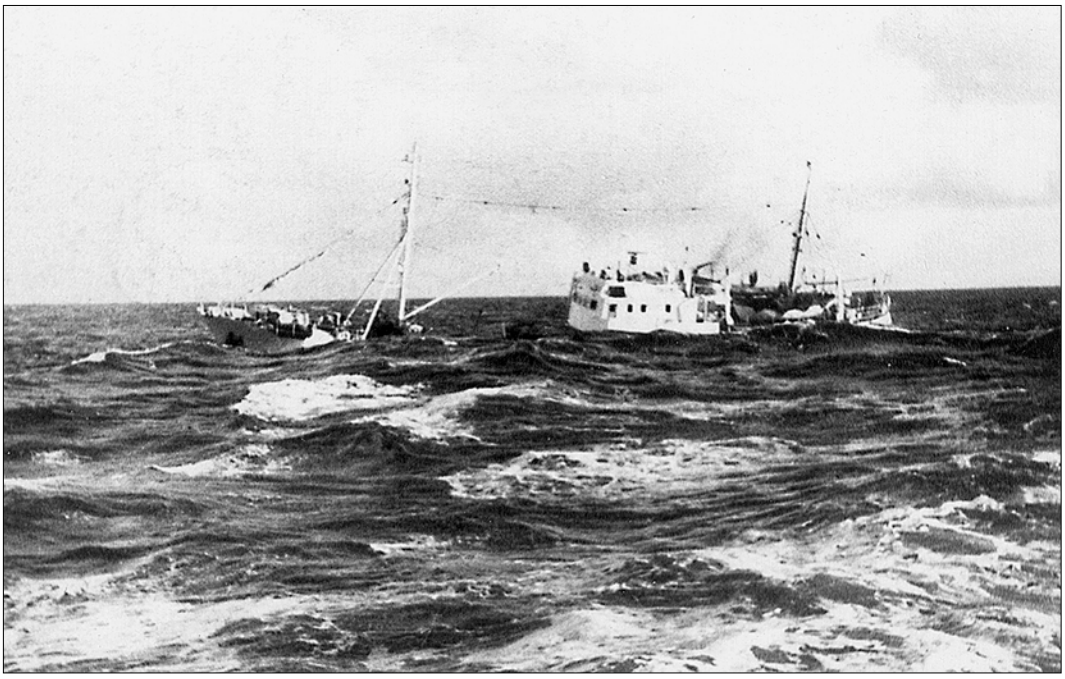
In April–November, the vessels harvested herring with haddock, silver hake, red hake, and cod as the bycatch on the northwest slope of Georges Bank. In April–July and December, the fishery was of an occasional character, but four, nine, and six BMRTs were fishing in August, September, and October, respectively. Their catches were 34, 42, and 32 t, respectively. Four to seven SRTs and SRTRs were also engaged in the fishery, yielding 9–12 t.

This year, a downward trend in silver hake resources off Nova Scotia became still more apparent. No dense aggregations occurred on the oceanic slope of the shelf or in the fishing places of Emerald Basin. In May–December, just 1–2 BMRTs operated in the first of the above-mentioned areas. Silver hake made up a considerable part of the catches only in May and June, with argentine predominant though. The bycatch included haddock, pollock, redfish, and flounder. Catches fluctuated between 37 and 47 t. The catch taken by 13 SRTs in May constituted 7 t. Two BMRTs conducted the silver hake and redfish fishery in Emerald Basin only in July. The catch amounted to 47 t.

In July–December, a small-scale fishery for argentine, with haddock, pollock, and silver hake as the bycatch, existed on the slopes of Browns Bank. One BMRT worked there in July–August and in December, four units in September–October, and two in November. Catches varied between 25 and 34 t.

This year, the major commercial effort was concentrated in the shallow waters of Sable Island and Middle and Emerald Banks. Eighteen BMRTs were fishing there for haddock, cod, silver hake, and flounder in July, 15 in August, 6 in September, and 9 in October, and six BMRTs harvested flounder, haddock, cod, and silver hake in November, as did two in December. In July–September, the catches were at the level of 46–50 t, and ranged from 32 to 37 t in October–December. Groups of 21, 29, and 4 SRTs and SRTRs worked there in July, August, and September, respectively, taking catches of 4–6 t.

The unfavorable situation caused by a decline in the Nova Scotian silver hake resource steeply decreased the commercial fishery potential of the area. Practically no other customary fish species objectives of high enough commercial abundance were left to warrant a



The roads taken at sea are driven in all kinds of weather.

successful fishery. The "outburst" of haddock abundance took the strain off the troubled waters and gave rise to a 6-month-long fishery in the shallow water areas that made up for the low catch of silver hake. Catches of haddock and silver hake constituted 45,000 and 50,000 t, respectively. Incidental cod catches and increased catches of red hake, flounder, and herring were a "make-weight" to the catch.

Switching medium trawlers to the groundfish fishery contributed to the increase in the catch in the Region by 20,000 t of haddock and 69,000 t of silver hake. The herring catch amounted to just 7,000 t. Another 37,000 t were taken by the BMRTs.

1966. By the ultimate results—the total catch and the catches of several fish species—this year could have been placed among the most successful years of the Soviet fishery in the Region. The total catch even exceeded the outcome recorded in 1965. The only distinction was a slightly smaller catch from the major fishing area off New England. But it was also the year when negative tendencies clearly manifested themselves. Degradation of the fishing area off Nova Scotia and deterioration of the silver hake and haddock resources off New England became obvious. The availability of substantial biomasses of herring and red hake allowed the fleet to compensate for the reduced catch of the above-mentioned species.

Large groups of BMRTs came to New England in the very beginning of the year. On average, the number of ships fishing were 21 in January, 29 in February, 45 in March, 42 in

April, 31 in May, 39 in June, and 33 in July. Later, their numbers varied between 12 and 21 in August and September, and 14 and 1 in October and November. The maximum number of ships fishing in the Region was in May, June, and July—50, 54, and 51, respectively.

The canyon zone from 36°N to Corsair Canyon was the main fishing ground off the U.S. coast. In January–April, BMRT groups of 18, 26, 33, and 22 vessels, respectively, conducted the fishery in several sites between Hudson–Block–Veatch–Hydrographer–Corsair Canyons. The bulk of the catch was red and silver hake, with red hake prevailing in one site, and silver hake in the others. Fishing conditions were favorable, and large catches were taken due to dense concentrations of fish. The catch sizes could have been higher if it were not for restricted fish processing facilities. The monthly average productivity of the fishery fluctuated between 40 and 52 t. In May–July, silver hake and red hake aggregations formed in the Hydrographer-Lydonia Canyon zone. Their density diminished; the intervals between shoal dispersal became shorter; and the productivity of the fishery dropped to 36 t. Eight, 20 and 9 BMRTs were involved in the fishery in these three months, respectively.

As distinct from previous years, changes took place in silver hake distribution. In March–May, their concentrations formed in the canyon zone between 36°00′ and 39°15′N. Nine, 16, and 17 BMRTs operated there in March, April, and May, respectively. Catches constituted 52 t in March, 51 t in April, and 35 t in May.

In March–July, the SRT and SRTR groups worked in different parts between Hudson–Block–Lydonia Canyons. In March–April, the number of the ships ranged from 14 to 21, in May–June from 28 to 55, and totaled 24 in July. Catches were at a level of 5–12 t.

Having explored the Norfolk area during the winter-spring period, searching ships detected considerable biomasses of herring. In May, herring aggregations were observed to enter the southwest and south parts of Georges Bank. The peculiarities of herring distribution favored the trawl fishery.

The fishery in the shallow parts of southwest, south, southeast, and east Georges Bank lasted from January to September. Three BMRTs on average were fishing there in January–March, 1 in April, 6 in May, 17 in June, 22 in July, 8 in August, and 1 in September. In January–April, the vessels were harvesting haddock, with herring, silver hake, red hake, and cod as bycatch. Catches varied between 27 t in January and 43–59 t in February–April. Beginning in May, herring became the major object for the fishery. Bycatch consisted of ocean pout, haddock, and silver hake, and catches ranged within 35–43 t.

The SRTs and SRTRs were fishing herring concentrations since May. In May, a group of 24 SRTs and SRTRs took 6–10 t. Nine, 16, and 4 units involved in the fishery in June–August caught 10 to 14 t.

The herring fishery in the northwest part of the Bank started in June. One to two BMRTs worked there in June–July and November, and 4, 8, and 13 units in August, September, and October, respectively. In June, July, and November, catches varied between 27 and 35 t. The density of aggregations was high in August–September. The vessels used bottom and

midwater trawls and were yielding 40–52 t. The bycatch consisted of silver hake, red hake, haddock, cod, and mackerel.

A small-scale fishery on Nantucket Shoals existed in August–October. During these three months, 21, 10, and 5 SRTs and SRTRs operated there, respectively, being joined by 2 BMRTs in September and 1 in October. The catches of alewife, silver and red hake, herring, and butterfish were 10–14 t and 25–36 t, respectively.

Off Nova Scotia, the major fishing effort was applied to the oceanic slopes of the shelf from Browns Bank to Sable Island. The first ship appeared in this area in April, and 16 BMRTs on average were fishing there in May. In June and July, their number decreased to 10 and 6 units, respectively. Fifteen vessels operated there in August, and 3, 10, and 8 BMRTs in September, October, and November, respectively. Silver hake predominated only in the catches taken in May, while argentine made up the bulk of the catches in other months. The bycatch in the western part of the area consisted of silver hake, pollock, cod, and haddock, and in the eastern part—redfish, haddock, and flounder. The average level of catch varied between 31 and 35 t. Fishing for argentine has always caused problems for the Soviet fishery in the Region. This species is notable for special life habits and permanent transformation of schools and concentrations. Some parts of the shelf edge and the continental slope are distinguished by complicated, broken-down bottom relief, with the bedrock frequently cropped out. This caused a high accident rate when trawling and a drastic drop in the productivity of the fishery.

In Emerald Basin, the fishery was only conducted in May and June. Three BMRTs were fishing for herring, redfish, and cod in May, with a mean catch of 33 t. In June, five BMRTs captured 29 t of pollock, herring, redfish, and haddock.

During July, August, September, and October, 12, 6, 2, and 1 BMRTs, respectively, harvested flounder, haddock, and cod in the shallow waters of Middle and Emerald Banks and Sable Island. The catches varied between 35 t in July–August and 25 and 28 t in September–October. Approximately 40–50% of the catch was the nonfood bycatch of skate, goosefish, and other non-marketable species.

The fishery off Nova Scotia in 1966 resulted in a total change in the catch structure, which proved to be 40,000 t less than in the previous year. The haddock catch of 21,000 t and silver hake catch of 10,000 t were 2 times and 5 times lower as against the previous year. The proportion of silver hake made up just 10%, the major part of the catch being represented by "background" fish such as cod, haddock, redfish, pollock, flounder, and argentine. This boded ill for the next year.

The catch off Norfolk showed a fourfold increase. Silver hake (92,000 t) and red hake (26,000 t) accounted for 90% of the catch. As it turned out later, 1966 was a record year in the fishery in this area, and catches of silver and red hake had reached a peak.

1967. The catch in the Region was reduced by 360,000 t, by more than half, due to a more than threefold downturn in fishing effort by the BMRTs. The results of 1966 were

indicative of a decline in the main fish species resources. The problems related to marketing of lean frozen herring became another troublesome factor. Restrictions on the herring catch were coming into effect. By May, it became evident that silver hake stocks were weakened and would not be able to facilitate the success of the fishery.

One BMRT was fishing in January, 16 in February, and 23 in April. Their numbers decreased to 15 in May and to 4 in June. Eight BMRTs were involved in the fishery in July and September, and two to three in November–December. The vessels were being dispatched to other areas of the Atlantic Ocean.

The zone from Hudson to Lydonia Canyons was the major fishing ground for the BMRTs in January–April. Fifteen, 11, and 15 vessels operated there in February, March, and April, respectively. Silver and red hake were the main commercial species. Fishing conditions turned out to be favorable, with mean catches holding to a level of 41 t. Fishing conditions deteriorated in May, and the ships left for port. On average, three BMRTs were actively fishing, bringing in catches of 36 t.

In April–May, one to three vessels worked in the areas between Baltimore–Wilmington–Hudson Canyons fishing for mixed mackerel, scup, butterfish, herring, and alewife aggregations. Their catches were at a level of 42 t.

Groups of SRTs and SRTRs were engaged in the fishery in the areas between Hudson–Lydonia Canyons in March–July. The number of ships varied: 14 in March, 9 in April, 10 in May, 25 in June, and 16 in July. Silver hake, red hake, and herring catches ranged from 11 t during the first months of the fishing period to 7–9 t by its termination.

The mackerel and alewife fishery existed in the shallow waters off Norfolk between 36°10′ and 37°40′N in February–March. One BMRT worked there for several days in February, and four BMRTs in March. The catch constituted 52 t.

The operation of the vessels at the canyons and in the shallow waters was indicative of increased mackerel abundance. However, the mackerel fishery failed to be developed in 1967 because of restrictions imposed by the shipowners on fishing for this species in April–May.

In March–June, the BMRTs and the ships of medium tonnage worked in the shallow waters from 39°N to Long Island–Nantucket–southwest Georges Bank. Two BMRTs were fishing in March, six in April and May, and one in June. Catches taken off Long Island and Nantucket consisted of herring, mackerel, alewife, butterfish, flounder, silver hake, and red hake, while the catches on southwest Georges Bank were represented by herring, haddock, silver hake, red hake, and mackerel. The BMRT catches varied between 47 t in March, 31 and 36 t in April–May, and 42 t in June.

A group of SRTs and SRTRs numbering 7 ships in March increased to 41 in April, 77 in May, and then was reduced to 7 units in June. Their catches fluctuated between 17 t in March, 11 t in April, and 9 t in May–June.

In June–September, the ships of medium tonnage fished for herring, which occurred in

mixed aggregations with silver and red hake on the south, southeast, and east parts of Georges Bank. In June and July, their numbers ran to 66 and 81 units, respectively. Later, the group decreased to 40 ships in August and 3 in September. Their monthly mean catches varied between 7.6 and 12.0 t. The BMRTs worked there occasionally in April, June, and August.

The BMRTs were involved in the fishery on the north and northwest slopes of Georges Bank only in September and October—7 and 5 units, respectively. They caught herring, with silver hake, red hake, mackerel, cod, flounder, and haddock as bycatch. The catches were 40 t in September and 45 t in October. Twenty-three SRTs and SRTMs worked there in July, with their numbers dwindling to 13 by September. They caught 8–10 t of herring and other fish.

From July to October, the BMRTs worked on Nantucket Shoals. Their number varied between eight and four in July and August, respectively, and one in September–October. The catches consisted of several fish species—alewife, silver hake, flounder, red hake, mackerel, herring, and butterfish—and ranged from 38 to 44 t.

In November and December, two and three BMRTs, respectively, conducted the fishery for the same species, but with flounder and herring predominating, on the shoals off Long Island and Nantucket. The catches constituted 47 and 50 t per month, respectively. The Nantucket Shoals area was one of the "awkward" places for the fishery. The catches taken there were remarkable in containing a wide range of species, which required large labor inputs for fish sorting and processing. Nonfood fish species such as skate, spiny dogfish, undersized silver hake, etc., accounted for about 40–60% of the catches. The frozen product output was low compared to catch sizes. So, in November, the mean catch taken by the BMRTs was 47 t, while the frozen product output made up just 24 t.

This year, the fishery off Nova Scotia was actually nonexistent. One to three BMRTs attempted to fish for argentine on the oceanic slope of the shelf in April–May, respectively. Their catches were low—26 and 35 t. Argentine, pollock, silver hake, and haddock concentrations appeared to be dispersed. The proportion of the nonfood bycatch was high. These circumstances did not encourage the fishermen to continue the fishery. Another attempt to arrange a fishery for groundfish—haddock, flounder, cod, and other fish species—on Emerald and Middle Banks in June also turned out to be a failure. The total catch in the area did not exceed 11,000 t.

Off New England, 87% of the catch consisted of silver hake, red hake, and herring. The catches of these species were 70,000; 37,000; and 124,000 t, respectively. Another 7% was made up by mackerel and alewife (12,000 and 6,000 t). The yield off Norfolk declined by almost 3 times.

Practical results of this year and the information on the state of the fish resources aroused anxiety about the fate of the fish yield plan next year.

1968. According to the data from the inventory surveys made by AtlantNIRO, the silver hake, red hake, and herring abundance kept declining in the Region and in its detached

"Free admission for sea dwellers!" The *Atlantik* stern. Trawl doors show that the vessel is prepared to rapidly change its bottom trawl for a pelagic one and vice versa.

areas. Fishing effort by BMRTs, after having been drastically reduced in the previous year, showed but an insignificant increase, while a tendency towards a growing effort by medium trawlers was becoming still more pronounced. The total catch in the Region increased somewhat in comparison with the previous year. An extra 75,000 t were obtained due to a rise in the catches of cod, flounder, ocean pout, herring, mackerel, and alewife (by 106,000 t) as well as other fish species in mixed multispecies aggregations (by 41,000 t). Silver hake and red hake catches dropped by 28,000 and 39,000 t, respectively.

Like in 1967, medium trawlers provided most of the herring catches. They also contributed almost half of the mackerel catch and most of the alewife catch. The BMRTs "gathered in the harvest" of groundfish—cod, silver hake, red hake, flounder, and ocean pout.

The average number of BMRTs fishing off New England and Norfolk varied between 9 in January, 11 in February, 13 in March, 17 in April, and 10 in May. No BMRTs were involved in the fishery in June and July. However, their numbers ran to 9 in August and 20

in September, respectively, and then decreased to 7 in October, 6 in November, and 4 in December.

The major effort by the ships of medium tonnage was applied to the waters off New England. The average number of SRTs and SRTRs, joined by several SRTMs, increased from 5 in February to 75 and 116 in March and April, respectively, reaching 139 units in May. Ninety-one to 106 units were involved in the fishery there in June–August, 63 to 25 in September–October, 10 in November, and 4 in December.

The zone from Norfolk to Oceanographer Canyons served as the fishing ground for the BMRTs in January through May. Silver hake predominated in the catches taken there. The bycatch harvested at Norfolk–Wilmington Canyons in February–March consisted of scup, red hake, herring, squid, butterfish, and Atlantic searobin. To the north of Wilmington Canyon, catches taken during the fishing period consisted of silver hake, red hake, herring, and butterfish. Seven to 10 BMRTs were fishing in January–April, and 1 vessel in May. Fishing conditions were steady until mid-April; catches varied between 41 t in January and 45–48 t in February–April. In mid-April, silver hake concentrations began to disperse, and the catch taken in May amounted to 25 t. The fishery was over.

The other area of BMRT activity in February–May was in the shallow waters from 36°20′N to Long Island (February–March), and from 37°N to Nantucket and the southeast parts of Georges Bank (April–May). Four to nine BMRTs were fishing. Herring predominated the catches in February–March, as did mackerel, herring, and scup in April–May south of Long Island, and herring and mackerel in the Nantucket-southeast Georges Bank parts. Catches ranged from 40 to 50 t.

Five medium trawlers were involved in the fishery in the shallow waters of the same area in February. In March, April, and May, their number increased to 75, 116, and 139 units, respectively. Eighty-five SRTs, SRTRs, and SRTMs operated in June in the area from Long Island to eastern Georges Bank. Predominately herring and mackerel were harvested. The catches varied between 7–8 t in March–April and 5–6 t in May–June.

In July–August, 73 and 59 medium trawlers, respectively, fished for herring, alewife, and mackerel in the southern, southeastern, and eastern parts of Georges Bank. Catches were not high—5.5 t on average. The BMRTs worked there occasionally for a few days in August and September.

In 1968, new midwater trawls were tested and pelagic fishing for herring was first attempted from the BMRT Gizhiga (owned by the Western Fish Scouting Service). The other BMRTs also switched over to this new fishing technique in August and September.

The first BMRTs appeared on the northwest and west Georges Bank in August. In September and October, 14 and 3 vessels, respectively, were fishing there. In September, the vessels brought in 41 t of herring with bottom and pelagic trawls. In October and November, three and one BMRTs, respectively, harvested mixed silver hake, herring, mackerel, and alewife aggregations yielding catches of 41 and 31 t. Groups of medium trawlers oper-

ated in this area from July until October. Three vessels were engaged in bottom fishing in June, 18 in July–August, and 54 and 18 in September–October, respectively. Herring catches, with bycatch of mackerel and cod, fluctuated between 3.8 and 8.0 t. Six, 12, and 9 vessels conducted pair fishing for herring in July, August, and September, respectively, yielding catches of 6.0 to 12.6 t.

In July–December, the fishery covered Nantucket Shoals, having been extended in October–December to include shoals off Long Island. Four BMRTs were fishing there in August, and seven in December. Alewife predominated in the catches in August–September, red hake in October, mackerel in November, and flounder in December (the bycatch consisted of silver hake, herring, ocean pout, haddock, butterfish, and other species). In August–October, catches ranged from 40 to 44 t; and in November–December from 37 to 38 t. Small groups of medium trawlers numbering 3 to 10 units worked there in July–December conducting selective fishing for alewife, mackerel, herring, and butterfish. Catches were not large and fluctuated between 4.2 and 6.0 t.

This year, purse seiners first appeared in the Region. The fishery lasted from March to June. Five vessels were fishing in May. Sometimes up to 100 t of herring were taken per set. But on average, 7 to 22 t per ship-day fished were captured during these months.

Off Nova Scotia, the fishery existed in only one area—in the shallow waters of Emerald, Sable Island, Middle, and Bankereau Banks. Attempts to develop the fishery on the oceanic slope of the shelf were of no effect. In March, the vessels came to the area sporadically. Three BMRTs were fishing in May catching 30 t of argentine, with bycatch of silver hake, herring, pollock, cod, flounder, and nonfood species. Control fishing in the shallow waters in April–May showed that concentrations of flounder had formed in some places. Catches of flounder and other species reached 40–50 t. Four vessels operated in June, and nine and five vessels in July and August, respectively. In August–September, the vessels moved to Georges Bank on the assumption that they would catch herring there. The fishery in the shallow waters was developed in October, November, and December when 5, 15, and 12 BMRTs, respectively, were fishing. The species composition of the catches (38–40 t) was represented by flounder, cod, haddock, mackerel, herring, silver hake, pollock, redfish, etc. The nonfood fish bycatch made up 20–50% of the catches.

The results of the year showed that mackerel, flounder, and alewife played an important role in the fishery. The success of the fishery, however, was dependent on the state of the silver hake, herring, and red hake stocks. Unfortunately, those kept declining. The prospects for the fishery in the coming year were obscure.

1969. This year was notable for a substantial growth in fishing effort. The catch increased by one third. Purse-seine fishing for herring was conducted on a broad scale, and the catch of herring reached a peak level. As before, New England remained a key area. Catches of silver and red hake, flounder, ocean pout, and butterfish taken there increased.

In January–May, the ships of medium tonnage concentrated their activity in the shallow

Minor repairs before casting the trawl.

waters from Long Island to Cape Hatteras. The monthly average number of SRTs and SR-TRs fishing varied between 23 in January, 58 in February, 115 in March, 53 in April, and 44 in May. Their catches consisted of herring, mackerel, and alewife and ranged from 6.0 to 8.5 t per ship-day fished. Three to four SRTMs were involved in the fishery in January–February. Five ships of large tonnage operated there only in April. Catches of herring, mackerel, scup, silver hake, and butterfish constituted 40–42 t.

The largest recorded concentration of ships of large tonnage was on Nantucket Shoals, where the multispecies fishery was conducted throughout the year. Mixed aggregations included at least 12 commercial fish species and squid. Among the fish species were red hake, silver hake, ocean pout, flounder, mackerel, herring, alewife, scup, butterfish, haddock, cod, and pollock. Their importance varied from catch to catch, but red hake, silver hake, flounder, herring, mackerel, and ocean pout predominated. Ocean pout occurred in the catches in large quantities during the first 6 months. Their proportion reached 20–50% in some months. Flounder accounted for 10–30% of the catches the year round. Thirty to 45% of the catches were nonfood species used for reduction to fish meal. The number of

large trawlers fishing varied between 5 and 11 in January–May, ran to 21 in June, 26–28 in July–September, 21 in October, 9 in November, and 4 in December. Their catches averaged 41–51 t in January–August, and 30–43 t in September–December. The fishery was notable for its high stability. There occurred some changes in the species composition of the aggregations, but their density remained invariably high. After May–June, Nantucket Shoals became the fishing area for the ships of medium tonnage as well. In July, they numbered 30; in August, 50; and in September–December, 22–26 to 12 units (at the end of the season). The SRTs and SRTRs fished mainly for herring, mackerel, alewife, and butterfish bringing in catches of 5.0–7.5 t.

Four to eight ships of large tonnage operated in the fishery in the canyon zone north of 36°N, fishing from Baltimore to Hydrographer Canyons (in January–May) and from Lydonia to Corsair Canyons (in April). Mixed mackerel, butterfish, scup, herring, and silver hake aggregations were fished in the southern part of the zone, and red hake, silver hake, herring, mackerel, and other species—north and east of the zone. Catches fluctuated between 30 and 60 t, of which the nonfood species constituted up to 30%.

The herring fishery on Georges Bank began in May and continued until October. The herring resources had declined, which showed in the absence of sizeable dense concentrations, frequent dispersal of those available, and mobility of the fish. Herring were distributed on the southeast and northwest slopes of Georges Bank in mixed aggregations with mackerel or silver hake. Small isolated shoals moving very fast and keeping mostly to the pelagic zone was a typical distribution pattern. The ships of large tonnage could not find a concentration that would enable them to fulfill their daily plans. All the troubles about the herring fishery were shifted to medium trawlers, which switched over to trawl fishing for herring in view of the poor opportunities for a domestic outlet for mackerel. Since May, they were in an incessant search, using momentary improvements in the fishing conditions, constantly adapting themselves to herring behavior, increasing the number of trawling tows. Twenty-five SRTs and SRTRs were fishing in May–June, and 54, 62, and 76 in July, August, and September, respectively. The productivity of the trawl fishery varied between 4 and 7 t. Vessels unloaded herring, mackerel, and alewife to factory ships and left the area in October.

In the second half of May, the group of ships of medium tonnage engaged in trawl fishing was joined by purse seiners that had left the Banquereau Bank area for Georges Bank. Twenty-three ships operated in June. Fish behavior did not favor the fishery. The daily mean catch of herring fluctuated between 4 and 17 t. The fishery was over in October.

In September–November, three to five large trawlers worked on the north and west slopes of Georges Bank. Small concentrations of pre-spawning and spawning herring formed in September. A large group of foreign vessels (nearly 80 units) conducted an intensive fishery with bottom trawls. Small fishing areas were congested with a host of ships. The majority of herring spawned by 28 September, and small concentrations of spawning fish were

observed in the northern part of the Bank until 7 October. Catches by the Soviet ships in September–early October consisted of herring, silver hake, mackerel, flounder, and red hake, and later, of the same species, excluding herring. Catches were at a level of 28–44 t.

An increase in silver hake and herring resources was observed off Nova Scotia. Ships of large tonnage fished for silver hake in two spacious areas: on the parts of the oceanic slope of the shelf from Emerald Bank to Sable Island and adjacent shallow water areas from January to June, and in the shallow waters from Emerald Bank and Sable Island to Middle Bank, and in Emerald Basin in July–November.

In the first area, the ships worked occasionally in January–February. Three ships were fishing in March, 11 in April–May, and 1 in June. Apart from silver hake, a whole array of species were represented in the catches—argentine, mackerel, flounder, pollock, redfish, cod, haddock, and herring. The nonfood species made up 20–30% of the catches, which fluctuated between 30 and 50 t. In the second area, 7 ships operated in July, 12–13 in August–October, and 4 in November. The same broad spectrum of species was available there, with silver hake predominating; herring appeared in numbers in October–November. Catches varied between 45–60 t in July–August and 26–39 t in September–November.

In January–May, herring concentrations were still available on Banquereau Bank. Thirty SRTs and SRTRs equipped with pair trawls, 7–9 ships with purse seines, and up to 10 large trawlers with pelagic trawls worked there in March. Catches taken by pair trawls and purse seines were 4–10 t and 10–30 t, respectively, per ship-day fished. High catches were taken by the RTMAs, which operated their trawls at a speed of 5 or more knots. At slower speeds, herring avoided the trawls. Mean catches by the RTMAs were 60–70 t per ship-day fished. In May, herring concentrations migrated from Banquereau Bank to the coastal zone.

In October, the scientific scouting BMRT *Gizhiga* detected dense herring concentrations east of Cape Breton Island, which frequently migrated to the coastal areas inaccessible for the fleet. Up to 40 foreign trawlers worked there in October.

Herring, silver hake, and flounder were the principal commercial species off Nova Scotia. Irrespective of diminished herring resources in the waters off the U.S. coast, the U.S.S.R. catch off New England and Norfolk totaled 100,000 and 38,000 t, respectively, with only 28,000 t of these quantities captured by the ships of large tonnage.

Following instructions from shore, the medium trawlers purposefully sought and fished for herring the year round all over their habitat. Success rewarded their efforts—they harvested 110,000 t. In total, 363,000 t was caught by all nations in these areas.

In 1969, Soviet fishermen captured a record quantity of flounder (mainly yellowtail flounder) and ocean pout—27,000 and 20,000 t, respectively—off New England. The whole catch was taken by large trawlers mainly on Nantucket Shoals where flounders and ocean pout, mixed with other species, formed aggregations throughout the year. Some of the flounder catches were taken on Georges Bank. Mackerel gained the lead this year.

Silver hake and herring (46,000 and 65,000 t, respectively) and flounder (13,000 t) accounted for a relatively small catch taken off Nova Scotia.

1970. The fish catch in the Region was reduced by 100,000 t. The state of the fish resources off New England took a sharp turn for the worse compared to the previous year, which affected the catches of large trawlers most drastically. The absence of dense aggregations resulted in a threefold decrease in fishing effort. Effort by ships of medium tonnage also showed a downward trend. The silver hake catch was the lowest of all the years. The catch of red hake was nearly 8 times as low; of flounder, 7 times; of herring, 3 times; and of alewife, 2 times. The resultant total catch dropped by more than half.

Off Norfolk, the yield was at approximately the same level as in the previous year due to increased mackerel catches.

Unfavorable fishing conditions off New England, the major fishing area for the Soviet fishery in the Region before this year, were fraught with failure for the fishery. The situation was saved owing to the "outburst" of silver hake abundance and the growth of the herring stock off Nova Scotia. Silver hake, herring, and redfish to a lesser degree made up the bulk of the catches. Beginning this year, the waters off Nova Scotia had yielded approximately the same catches as the fishery off New England.

Under the Soviet-American Agreement, certain sectors off the continental slope in the Norfolk area were closed to the Soviet fishery in 1970.

In January–May, the shallow waters from Cape Hatteras to Oceanographer Canyon, bordering on the shelf slope, was the main fishing ground for medium trawlers. In January–March, fishing took place in the area from Cape Hatteras to 40°N; and in April–May, from 36°N to Veatch and Oceanographer Canyons. In January, 22 SRTs and SRTRs were fishing, harvesting mixed alewife, herring, and mackerel aggregations in the southern part of the area and herring, mackerel, and flounder in the northern part. The number of vessels increased to 32 in February and to 96, 117, and 92 units in March, April, and May, respectively. Mackerel, herring, and alewife were the principal commercial species. Catches ranged from 4 to 10 t on average per ship-day fished. Three to five SRTMs were also engaged in the fishery in March–May. Their catches constituted 9–14 t. Three to five large trawlers worked there from February to May. In March, their numbers increased to eight units. The species composition of their catches was similar to that of the catches taken by medium trawlers, with the catch sizes varying between 48–80 t in February, 30–45 t in March–April, and 28–30 t in May. The proportion of nonfood bycatch was as large as 40%.

The importance of Nantucket Shoals decreased markedly compared with the previous year. The fishery there lasted from March to December (from October to December on Nantucket Shoals and off Long Island). The number of ships of large tonnage fishing there varied between one and three in March–May and August–December. Only in June and July did 10 vessels work there. The species composition of the catches changed. In March–May, flounder, herring, mackerel, ocean pout, cod, haddock, red hake, and alewife occurred in

The "marine folklore club" takes a few minutes of rest after a day's work to talk about life or tell fishermens' yarns.

the catches in different ratios. After June, the quantity of silver hake, red hake, and alewife increased, while mackerel prevailed in the catches after October. However, over the entire period, catches consisted of a variety of species, with nonfood bycatch reaching 40–50%. Catches ranged from 30–38 t in March–May, 34–46 t in June–September, and 23–45 t in October–November. Two to four SRTMs were engaged in the fishery in June–December. The groups of SRTs and SRTRs operated there only in June and November–December: 14, 21, and 30 ships, respectively. In other months, their number did not exceed 3–7 units. The ships of medium tonnage gave preference to fishing for mackerel, herring, alewife, butterfish, and silver hake. The productivity of the SRTM fishery was 8–13 t and that of the SRT and SRTR fishery was 5–8 t.

This year, the fish resources of the canyon zone did not facilitate development of the fishery. Only one large trawler fished at Hudson–Veatch Canyons in January and March. Catches consisted of mackerel, red hake, silver hake, flounder, and cod. The productivity of the fishery ranged from 27 to 36 t. In April, five and three large trawlers operated at Wilmington–Block and Veatch–Lydonia Canyons, respectively, and three units in the area from

Baltimore Canyon to Lydonia Canyon in May. Silver hake, mackerel, red hake, and herring predominated in the catches, which fluctuated between 22 and 50 t. Three ships harvested silver hake, red hake, and mackerel at Veatch and Lydonia Canyons in December. Their catches averaged 37 t per ship-day fished.

Medium trawlers, mainly SRTs and SRTRs, conducted the fishery on the south, southeast, and east slopes of Georges Bank. They numbered 16 in May–June, 30 in July, 13 in August, and 2 units in October. Catches consisted of herring, mackerel, alewife, silver hake, and red hake and amounted to 4–8 t.

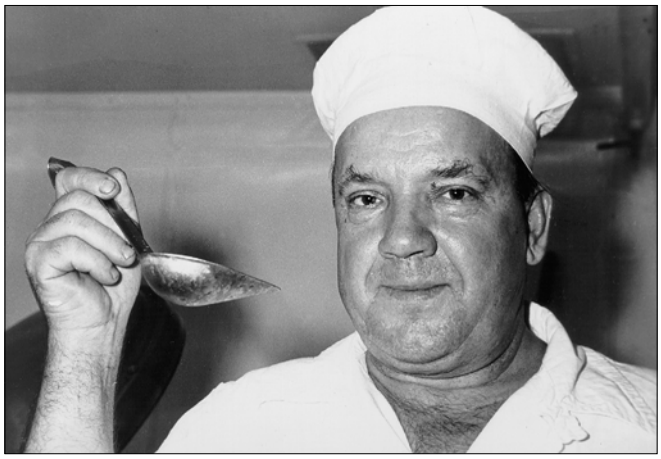
In May–October, the fishery covered the north, northwest, and west slopes of Georges Bank. Individual SRTMs and SRTs worked there in May–July, while 4, 9, and 3 large and 14, 35, and 17 medium trawlers were involved in the fishery in August, September, and October, respectively. There were five to eight SRTMs among the latter, the rest being SRTs and SRTRs. Mixed aggregations of silver hake, herring, red hake, mackerel, alewife, and other fish species were fished over the entire period. Herring and mackerel were target species for SRTs and SRTRs. Some ships of large tonnage conducted a directed herring fishery in August and September, which was quite complicated, though, because of the scores of fishing vessels in the area. In September, up to 100 units were within eyesight of each other. The catches of large trawlers varied between 27 and 48 t in August, 29 and 34 t in September, and 18 and 26 t in October. SRTM catches ranged from 5 to 12 t, and those taken by SRTs and SRTRs—from 5 to 10 t.

In May, the purse seiners came to Georges Bank from the Nova Scotian area. The daily mean catch fluctuated between 7 and 22 t. The herring shoals, however, occurred occasionally. Many purse-seine casts produced no fish at all, and many purse seines returned damaged. Most seiners left for port at the end of June.

Off Nova Scotia, three fishing areas were distinguished. A number of spots on the oceanic slope of the shelf from Browns to Banquereau Banks were fished in March–October. The fishery in the inner parts of the shelf between Sambro, Emerald, and Middle Banks, in Emerald Basin, and on the shoal off Sable Island was carried on during the same period, and the shelf slopes and the continental slope parts in the Cabot Strait were fished in June–November.

In the first area, the intensive fishery was confined to the months of April, May, and June when the average number of the ships of large tonnage fishing was 13, 17, and 16, respectively. In March and July–October, the number of ships did not exceed 1–3 units. Silver hake predominated in the catches throughout this period, the bycatch being represented by herring, flounder, argentine, cod, haddock, redfish, and mackerel in different ratios. The proportion of nonfood bycatch varied between 10 and 40%. At the peak of the fishing season in April–June, daily catches ranged from 32 to 45 t, fluctuating between 29 and 55 t in other months.

After June, fishing effort in the inner shelf area increased to 7 units. In July, August, and



Aboard ship, the cook was a very important person, with a clientele sometimes numbering 100. The crew was always pleased with tasty borsch.

September, the average number of large trawlers fishing was 14, 36, and 22, respectively. In October, their number was reduced to eight. Up to three to four vessels were engaged in the fishery in March–May and November–December. The species composition of the catches was nearly the same as in the first area. The nonfood bycatch making up 15 to 35% of the catches was reduced to fish meal. Catch size varied between 30 and 57 t on average. Though the largest catches were taken in August, the productivity of the fishery was high enough in the end of the year as well. The redfish fishery in Cabot Strait operated by SRTs and SRTRs provided a weighty addition to the catch. From 7 units in June, their number increased to 40 in August–October. The number of SRTs fishing averaged 12 in November. Catches fluctuated between 4.5 and 6.0 t. The first attempts to develop purse-seine fishing for herring were made in January. In March and April, 14 and 45 purse seiners, respectively, were engaged in the fishery in the Emerald and Banquereau Banks area. Daily mean catches were 12–20 t. Fishing conditions worsened in May. Some ships, having finished their trips, left for port, and the rest went to Georges Bank. Several vessels of large tonnage conducted a directed herring fishery in April. The success of the fishery off Nova Scotia could be attributed to two fish species, herring and silver hake, the catches of which constituted 169,000 and 72,000 t, respectively. The catch of redfish reached 13,000 t. The total catch off Nova Scotia increased nearly 2 times, amounting to 284,000 t.

1971. The catch in the Region increased by 125,000 t compared with the previous year. Nearly equal catches were taken off Nova Scotia and New England. Silver hake and mackerel catches remained at the same level. The herring catch diminished. Larger quantities of red hake, flounder, redfish, and squid were caught.

In January–May, the vessels fished for mixed mackerel, herring, alewife, and other fish aggregations in the area from Long Island to Norfolk. Two to 11 large trawlers on average were fishing. A number of fishing grounds were closed to the Soviet fishery under the

bilateral Soviet-American agreement and because of U.S. Navy exercises. This especially affected the activity of the ships of large tonnage. Daily catches varied between 29 and 55 t. Nonfood bycatch made up 27–55% of the catches. Monthly productivity of the fishery by medium trawlers (4–8 SRTMs and up to 50–60 SRTs and SRTRs in February–April) varied between 5 and 11 t for the SRTMs and between 4.5 and 8.0 t for the SRTs and SRTRs.

From January to July, the fishery was conducted on Nantucket Shoals, where the vessels harvested mixed herring, mackerel, flounder, red hake, and ocean pout aggregations. For the most part, two to five large trawlers worked there; only in July did their number increase to nine units. Daily catches ranged from 22 to 45 t. The nonfood bycatch was as large as 50–60%.

Beginning in April, the fishery for silver hake, mackerel, herring, flounder, and other species developed in the zone of Veatch–Corsair Canyons, and after May—on Georges Bank. Mixed silver hake, mackerel, herring, red hake, flounder, and squid (since August) aggregations formed in different parts of the Bank and on its slopes until November. The vessels permanently traversed the area in search of more dense fish concentrations or aggregations, where herring and mackerel would be predominant (medium trawlers). The number of ships of large tonnage fishing varied between 17, 5, and 17 in April, May, and June, 11, 20, and 14 in July, August, and September, and 10 and 2 units in October and November, respectively. Catches fluctuated between 30–43 t in April–June, 26–38 t in July–August, and 22–37 t in September–November. Fishing conditions were complicated and unstable. Frozen product output was low, as 20–60% of the catch consisted of nonfood fish. In September, a multitude of vessels from different countries thronged into the area to fish for spawning herring. Sometimes their numbers ran to 160. Ships of medium tonnage were also engaged in the fishery there. Ten SRTMs were fishing in May, 7 in July, 15 in August, 17 in September, and 2–3 in other months. The highest recorded number of SRTs and SRTRs was in May, June, August, and September—52, 14, 19, and 22, respectively. SRTM catches amounted to 7–11 t and included mackerel, herring, silver hake, and red hake. The proportion of silver hake increased in July–September. SRT and SRTR catches varied between 4 and 11 t.

In October, the fishery started on Nantucket shoals and off Long Island. Fourteen and 10 large trawlers worked there in October and November, respectively, and 23 in December. Until November, the catches consisted of silver hake, red hake, mackerel, butterfish, and flounder, and in December of mackerel, flounder, and other species. Catches ranged from 23 to 34 t in October–November and from 22 to 53 t in December. Eleven to 13 SRTMs and 7–22 SRTs and SRTRs also participated in the fishery. Their catches were 6–11 and 4–7 t, respectively.

Twelve seiners carried out purse-seine fishing in May, and nine in June. Fishing was successful, and daily mean catches constituted 17–20 t. The behavior of herring changed in July; the schools were not readily accessible for purse seines, and the fleet left for port.

The fishery off Nova Scotia started in February. The intensive fishery in the areas of the oceanic slope of the shelf from Browns Bank to Sable Island was recorded only in March–April, when 18 and 37 large trawlers were fishing there. In other months, except for May, they numbered one to five units. Catches of silver hake, flounder, mackerel, herring, cod, argentine, and squid were 30–42 t in March–April and 22–38 t in July–September. On the Browns Bank slopes, two vessels fished for pollock and argentine in February, and eight vessels fished for argentine and silver hake in May. Their catches fluctuated between 31 and 42 t.

The other major fishing area was the shelf parts between Sambro, Emerald, and Middle Banks and Emerald Basin. In searching for dense concentrations, vessels also frequented the adjacent locations of the oceanic slope of the shelf. Three to five ships of large tonnage worked there in February–April and October–November, 16 in May–June, 28 in July–August, and 20 in September. Their catches consisted of silver hake, flounder, mackerel, herring, and squid, and ranged from 30 to 55 t. In October–November, catches decreased to 29 t, with mackerel predominating. This year, the RTMAs first used pelagic trawl fishing for silver hake, which resulted in a rise in the productivity of their fishery.

A smaller scale fishery for flounder, redfish, and silver hake was conducted on Banquereau Bank in April–November. The vessels visited this area sporadically in August and October–November, but in other months, two to five vessels on average were permanently fishing there. Their catches ranged from 33 to 43 t. Like in all other areas, the proportion of nonfood bycatch was significant, reaching 20–55%. SRTs and SRTRs fished for redfish in Cabot Strait in March–December. Two ships operated in March–July, and 11 in December, and 15, 27, 30 and 19 in the months from August through November, respectively. Catches were 3.4–4.1 t on the margins of the season and 4.4–5.7 t in July–November.

Purse-seine fishing for herring off Nova Scotia was carried out on Middle and Banquereau Banks in February–March. The largest number of seiners fishing, 30 units, was recorded in April. Catch per ship-day fished varied within the range of 12–19 t. In May, with a deterioration in fishing conditions, all of the ships went to Georges Bank.

A more than twofold decline in herring catches off Nova Scotia, from 72,000 to 29,000 t, was one of the distinctive features of this fishing year. However, there was also a marked growth in the catch of valuable fish species and squid. The catches of cod increased up to 5,000 t, of redfish up to 21,000 t, of flounder up to 20,000 t, and of squid up to 7,000 t. Off New England, the catch increase was provided by silver hake, red hake, and herring. Squid catches also increased there up to 6,000 t. The bulk of the catch off Norfolk consisted of mackerel. A slight rise in silver and red hake catches made it possible to retain the total catch at the same level as in the previous year.

1972. The catch in the Region remained at the level of the previous year. The catch sizes of silver hake and mackerel were also nearly the same. The quantity of red hake caught was 2 times the amount in 1971, and that of argentine—6 times. Herring catches diminished by one third. ICNAF introduced a quota for the herring fishery.

From the analysis of the distribution of the Soviet fishery in 1972, it can be concluded that the potential of the natural resources in the area from Cabot Strait to Cape Hatteras were utilized to the maximum.

In January–July, vessels operated in the shallow waters off Long Island and further south to Cape Hatteras. In the southern part of the area, some five ships of large tonnage harvested searobin as well as scup, mackerel, and alewife in February–March. Nearly 40–60% of the searobin catch was reduced to fishmeal. Catches by these ships ranged from 30 to 60 t. In January–June, large and medium trawlers harvested mixed mackerel, red hake, silver hake, herring, alewife, and other fish species aggregations in the areas from Long Island to Baltimore Canyon. The greatest number of large and medium trawlers fishing was in January—22 and 55 units, respectively. The state of the fish resources favored fulfillment of the plans. Catches taken by ships of large tonnage ranged from 26 to 60 t, by SRTMs from 6 to 11 t, and by SRTs and SRTRs from 4 to 6 t. The SRTs and SRTRs fished mainly for mackerel and herring.

In February–June, vessels worked from Hudson Canyon to Corsair Canyon. Over 30 SRTs and SRTRs participated in the mackerel fishery in the area of Veatch–Lydonia Canyons in March–April, and about 8 ships of large tonnage in the fishery for mackerel, silver hake, and other species. In May, a group of 25 ships of large tonnage harvested mixed silver hake, mackerel, and red hake aggregations at Hydrographer–Corsair Canyons. Twenty ships of large tonnage fished for silver hake, mackerel, and squid in June in the area of Welker Canyon to the eastern slope of Georges Bank. Within the zone of all the above-mentioned canyons, the productivity of the fishery by ships of large tonnage was 27–50 t, of SRTMs—7–12, and of SRTs and SRTRs—5–7 t.

In March–April, 35 SRTs and SRTRs harvested redfish and argentine on the northern slope of Georges Bank. The catch averaged 5.5 t. In April, at 190–300 m depths, dense aggregations of pre-spawning and spawning argentine formed, which became the target for an intensive fishery conducted by 20 ships of large tonnage. Their catches constituted 46–67 t. On 18 April, there occurred an extreme decline in the catches, and most vessels went to the Nova Scotian Shelf. Ten SRTs continued fishing for argentine in May.

The fishery on Nantucket Shoals started in May. The vessels worked there until the end of the year. In June–August, 17 ships of large tonnage on average, and 1–8 units in other months, participated in the fishery. Catches ranged from 29 to 52 t. The number of medium trawlers was the highest in June–July: 20 units. In other months, they numbered nine units at most. SRT and SRTR catches varied between 4 and 8 t, and those taken by the SRTMs—between 7 and 11 t. All this time, mackerel, red hake, silver hake, and flounder occurred in mixed aggregations in varying proportions. Up to 20–40% of the nonfood bycatch was reduced to fish meal.

On Georges Bank, mixed aggregations of commercial fish species and squid formed on the northwest and southeast slopes of the Bank in July–December. The species composi-

A contact out of the ordinary: BMRTs sometimes unloaded freshly caught fish to production refrigerator ships.

tion of the aggregations in the two fishing places was identical: silver hake, red hake, mackerel, herring, flounder, and squid. The ratio of these species varied in the catches by fishing place and period; however, the first four species led in quantities. Every month, 3 to 23 large trawlers on average operated in the two places. The highest recorded number was in July and August–September: 23 and 15 units, respectively. The productivity of the fishery fluctuated between 15 and 42 t. It was low in September–October in the northern and western parts of the Bank, and in both parts in November–December. Over the entire period, 15–50% of the catch, consisting of undersized and nonfood fish, was reduced to fish meal.

In July–October, the fishery was conducted by SRTs and SRTRs ranging in number from 8–12 and 20, respectively, and by 6–9 SRTMs. The SRTs and SRTRs fished for mackerel and herring, making catches of 4–6 t. Catches of groundfish and pelagic species taken by SRTMs constituted 7–12 t. In October, the fleet began the fishery in shallow waters off Long Island. Eight ships of large tonnage and 26 SRTs and SRTRs harvested red hake and silver hake. Most vessels left this area in November–December. The specific pattern of

trawl fishing vessel distribution stated above is indicative both of the availability of a number of places with fish concentrations and of constant movement of the vessels in search of more dense and payable, in terms of cost of the final product, fish aggregations.

Purse-seine fishing on the northwest and east slopes of Georges Bank was carried out from May to September. The highest recorded number of vessels was in May, June, and July—37, 35, and 23 units, respectively. Monthly mean catches varied between 11 and 22 t per ship-day fished.

In October–December, a group of 3 to 20 SRTs fished for Atlantic saury to the east and south of Georges Bank using lights. The response of the fish to light varied sharply. Positive response to the light occurred occasionally, but did during periods of high catches. In November, the mean catch amounted to 4.6 t.

On the Nova Scotian Shelf, commercial silver hake concentrations began forming in March and kept up until October. The best fishing conditions persisted during the formation of pre-spawning and spawning silver hake concentrations—in May through September. The number of ships of large tonnage involved in the fishery varied between 9 in March, 26 in May, 37 in July, 12 in September, and 6 units in October. The productivity of the fishery was 30–45 t. Silver hake predominated in the catches, with bycatch consisting of mackerel, flounder, squid, and pollock (nonfood species amounting to nearly 30%). The fishery covered the shelf edge southward of Emerald Bank and Sable Island; Emerald, Sambro, and Middle Banks; and Emerald Basin. In March and June–October, two to three BMRTs fished for mixed flounder, cod, and redfish aggregations on Banquereau Bank yielding catches of 30–46 t.

SRTs and SRTRs fished for redfish in Cabot Strait in May and July–December. The number of vessels increased from 15 in July to 30–35 in August–October. Monthly mean catches ranged from 7.6 t in July to 6 t in August, and to 4.5 t in November. The abundance of the herring stock on Banquereau Bank decreased and, in this connection, purse seining for herring began late in March–April and continued until May. Catches were 11–20 t. With fishing conditions worsening, a group of ships went to Georges Bank.

Prime distinctions between the results of the 1972 fishery and those of the previous year are given below by area:

- off Nova Scotia: a twofold decline in redfish and flounder catches;
- off New England: a twofold increase in the red hake catch, a one-third increase in the flounder catch, a 1.7-fold increase in the mackerel catch, a 16-fold increase in the argentine catch; and a decrease in the herring catch by one-third; and
- off Norfolk: a twofold rise in red hake catch; a fourfold decrease in the herring catch, a twofold decrease in the mackerel catch; and the total catch declined by over one-third.

1973. The yield in the Region increased by nearly 200,000 t, reaching a peak, and constituted nearly 900,000 t. Such a result could be attributed to a rise in fishing effort by large

trawlers and a record high silver hake catch, twice as much as in the previous year. Catches of mackerel, squid, and herring also increased. A large-scale introduction of pelagic fishing by ships of large tonnage also facilitated the achievement of high fishery results. This fishing technique extended the potential of the fleet. Now, depending on fish behavior, captains could alternatively use bottom and pelagic trawls, catch near-bottom concentrations with pelagic trawls in places with good bottom, and besides herring and mackerel, fish for silver hake in the pelagic zone. The introduction of still more stringent regulations was a forcible factor that inhibited Soviet fishery activity. Under the bilateral Soviet-American agreement, new grounds in the shallow waters off Long Island, Nantucket Shoals, and in the western part of Georges Bank were closed down to bottom fishing from 1 July to the end of the year. This ban did not apply to SRTs and SRTRs. ICNAF had introduced quotas for the fishery for herring, silver hake, red hake, and other fish species off Nova Scotia and New England. Filling the quotas of herring and silver hake caused difficulties for fleet operations in the second half of the year, resulting in diminished catches taken by ships of large tonnage. This year, the number of large trawlers dispatched to the Region by Soviet fishery organizations was the greatest in all the years of fishing there. They numbered 22 units as early as January and 80–87 in March–July. The number of vessels engaged in the fishery decreased in August, and only 10–15 units continued to work in the Region by November–December. High fishing effort was observed in the areas off Nova Scotia. In January–October, the number of ships of large tonnage varied between 30 and 45, and that of purse seiners—between 17 and 63.

A rather restricted fishery in the Norfolk area was attributed to the state of the fish resources. Some large and medium trawlers fished for scup, mackerel, and searobin between 39 and 37°N in January–April, while in August–December, two SRTMs were involved in directed fishing for squid in the area between 39 and 36°N, yielding 3–4 t.

The long-term (January–August) availability of mixed mackerel, silver hake, red hake, and herring aggregations in the shallow waters from Long Island–Nantucket to the southern and southeastern parts of Georges Bank ranked among the specific features of this year. This zone was fished over all its area by ships of large and medium tonnage, which constantly moved about in search of more dense and stable concentrations. The importance of different fish species in the catches varied. In some months, mackerel led in quantity, while in other months red hake and silver hake gained the lead. Herring were abundant early in the year. Sometimes flounder, butterfish, alewife, and ocean pout were caught. The fishery in the shallow waters off Long Island and Nantucket continued year round. During some periods, large groups of vessels were engaged in the fishery.

Twenty-eight large trawlers, 16 SRTMs, and 10 SRTs and SRTRs worked in the Long Island–southern Georges Bank area in February. In mixed aggregations, harvested in different parts of the area, herring, mackerel, silver hake, or red hake predominated. Catches taken by large trawlers, SRTMs, and SRTs and SRTRs were 44–64, 7–9 and 5 t, respectively.

Thirty large trawlers, 20 SRTMs, and 22 SRTs and SRTRs fished for red hake, herring, mackerel, and silver hake off Long Island and Nantucket in March. Their catches constituted 37–45, 6.5, and 6.4 t, respectively.

Twenty-two large trawlers, 16 SRTMs, and 10 SRTs and SRTRs conducted the fishery in the area from Long Island to the eastern and southeastern parts of Georges Bank in May. Off Long Island–Nantucket, catches consisted of silver hake, red hake, ocean pout, herring, and mackerel, and on the Bank—of mackerel, silver hake, squid, herring, and flounder. The catches in these three areas varied between 27–44, 8–11, and 5–9 t, respectively.

Five to 20 large trawlers, 8–19 SRTMs, and 8–20 SRTs and SRTRs were engaged in the fishery all over this area in other months and in two local parts off Long Island–Nantucket and south-southeastern Georges Bank from September. Catches ranged from 30–60, to 7–13, and to 6–10 t, respectively.

For the year as a whole, 15–40% of the catches made by ships of large tonnage consisted of undersized and nonfood fish, which were reduced to fish meal.

The canyon area from Hydrographer to Corsair was of great importance for the ships of large tonnage in January–July. Fishing for silver hake, mixed with mackerel and herring, and with red hake and squid by the end of the fishing season, started early in the year. During different months, groups of 4–21 vessels (17–21 units in March–April and July) were engaged in the fishery there. Catches ranged from 33 to 60 t.

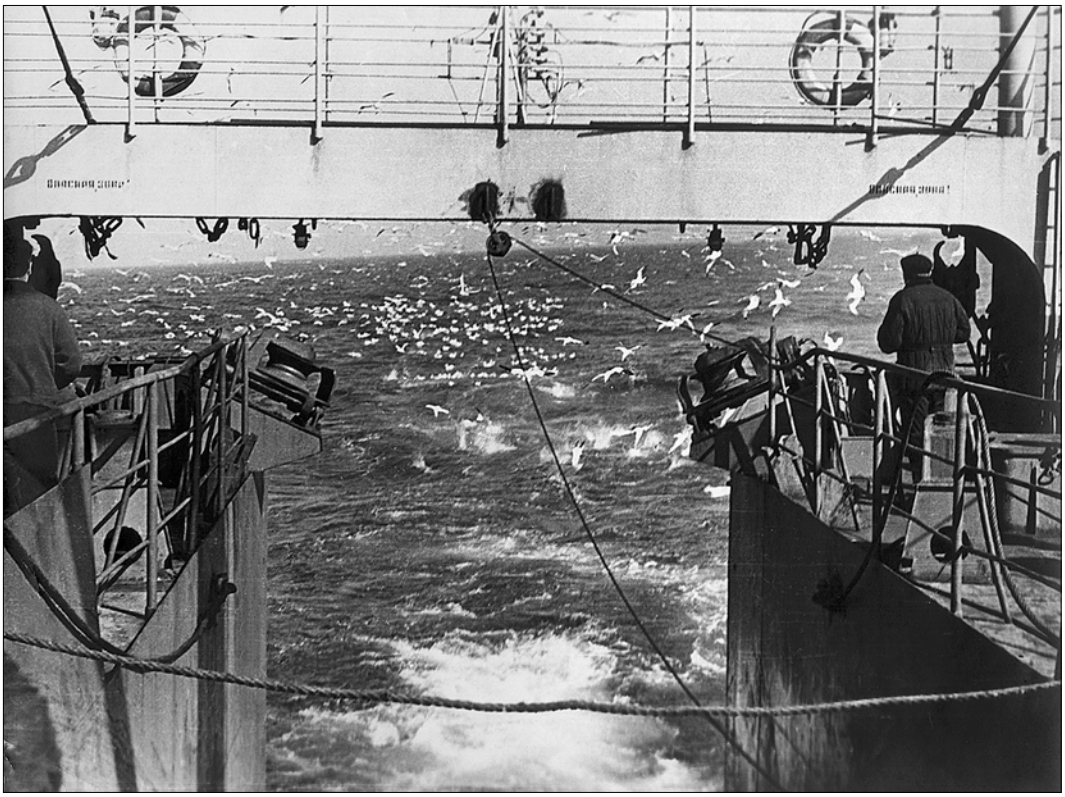
In Georges Basin, 5 to 20 large trawlers fished for silver hake and argentine in March–April at depths of 280–360 m. Catches constituted 30–50 t.

On the north and northwest slopes of Georges Bank, the fishery continued from May to the end of the year. Seven to 13 ships of large tonnage were operated there in July–September. Catches included silver hake, herring, red hake, cod, and flounder and made up 28–54 t. In November, six ships captured 22–45 t of mackerel, silver hake, and red hake. After July, a group of 7–17 SRTMs made catches of 6–10 t.

Five large trawlers fished for herring in the Gulf of Maine in August with a mean catch of 32 t.

Purse-seine fishing for herring off New England started in March and lasted until July. The fishing areas encompassed the south, southeast, east, and north slopes of Georges Bank, including Browns Bank (in June–July). The number of vessels engaged in the fishery increased from 17 units in April to 46, 63, and 43 units in May, June, and July, respectively. Monthly mean catches varied within the range of 11–20 t. This year, the total herring catch made by purse seiners reached a maximum—nearly 45,000 t, half of all the herring catch. The fishery had to be discontinued at the end of July because the quota was reached.

The fishery on the Nova Scotian Shelf started in March. Large silver hake concentrations were detected in Emerald Basin, on Emerald Bank, and its oceanic slopes. Soon large trawlers from the Newfoundland and Labrador areas came to the Nova Scotian Shelf waters, and a group of 16 units was formed. After some vessels came there from the New



As the trawl approaches the ship, the surface of Georges Bank becomes a “sea gull’s pasture.” Gulls associate themselves closely with BMRTs.

England area in April, the group increased to 38 units. The number of vessels increased further to 60 units in May. The group numbered 55 units in June, 40 in July, and 31 in August. In September, the number of vessels was reduced to 8—the peak of the fishery was past. The fishery subsided in October–November; however, up to 15 ships of large tonnage came to the shelf slope and closed the 1973 fishing season for silver hake.

Emerald Basin and the oceanic slope of the shelf from LaHave Bank to Sable Island was the major fishing area. The fishery was notable for its high stability, with catches averaging 40–55 t. Problems that arose were caused by a lack of receiving-transport ships. Large catches of undersized hake and difficulties with their marketing resulted in a ban on freezing undressed hake imposed in July by instructions from shore. Later, however, this ban was lifted for some vessels. During some periods, a large number of mackerel were caught in the silver hake fishery, which, in turn, were replaced by squid in the summer time.

Several vessels harvested mixed flounder, cod, redfish, silver hake, mackerel, and herring aggregations on Banquereau Bank and in the shallow waters off Sable Island from

May to September. A group of nine vessels fished for flounder and cod on Banquereau Bank in August. Catch sizes fluctuated between 32 and 46 t on average throughout the fishing period.

Thus, the fleet utilized the fish stocks of the Nova Scotian Shelf to the full and, in addition to an enormous catch of hake, caught a significant quantity of more valuable food species such as cod, redfish, flounder, and squid (3,000, 10,000, 17,000, and 9,000 t, respectively).

Off New England, the bulk of the catches consisted of silver hake, red hake, herring, and mackerel. Both mackerel and squid catches were record highs of 132,000 and 9,000 t, respectively.

1974. This was the year of new fishery regulations, new catch quotas, and closed fishing areas and periods. These limitations were introduced both by ICNAF and by provisions of the bilateral Soviet-American agreement. Multivessel groups of large trawlers were dispatched to the Region. Thirty-nine ships on average fished as early as January, and 60 in April. Their number dropped to 33 and 28, respectively, in May–June, increased to 58 and 48 in July–August, and 20 ships were still fishing in December. The number of medium trawlers in the Region varied between 17 in January and 38 in March–April, totaled 17–18 in June–July, 25 in August–October, and 18 in November–December. A group of purse seiners numbered 25 units in April, 48 in May, 54 in June, 35 in July, and 20 in August. Catch quotas for the herring fishery were given to the purse seiners, which limited the possibilities of large trawlers to fish for this species. The transition of large trawlers and stern trawling SRTMs to pelagic trawl fishing was gaining ground. Fishing effort by the fleet of large tonnage was distributed in such a way that the majority of vessels operated off New England in January–April (38–65 units fishing) and off Nova Scotia in the second half of the year (45 units in July–August).

Irrespective of high fishing effort, the 1974 catch declined because of a decrease in the yields of the principal species—silver hake, herring, mackerel, and red hake.

Some features of the fishery distribution are worth noting. For the first time, a year-round squid fishery was arranged. A group of two to six SRTMs worked on the shelf slope at depths of 100–320 m from Cape Hatteras to Veatch and Hydrographer Canyons. In the first half of the year, a shift of the fishery could be traced from the south to the north up to Hydrographer Canyon in June–July, and to the south, to 39–36°N from August. Catches ranged from 3 to 6 t.

In the shallow waters from 40 to 37°N, the fishery was conducted in January–April. In February, a group of 30 ships of large tonnage, 14 SRTMs and 8 SRTs and SRTRs, conducted the fishery there. Mackerel predominated in catches taken by ships of large tonnage which operated pelagic trawls. Catches constituted 37–50 t. Some ships used bottom trawls to harvest mixed red hake, silver hake, and mackerel aggregations. Catches of the SRTMs, SRTs, and SRTRs were 8, 10, and 6 t, respectively. In other months, the ships of large tonnage numbered two to five units at most.

The shallow waters of Long Island to Nantucket, and Nantucket to the southern, southeastern and eastern parts of Georges Bank, were fished in January–February and March–June, respectively. The major fishing effort was applied there in January, February, and March: 26, 16, and 52 ships of large tonnage and 9, 4, and 16 SRTMs, respectively. Mackerel predominated in the catches, which amounted to 36–56 t (ships of large tonnage) and 9–12 t (SRTMs). Thirteen SRTs and SRTRs fished in March, yielding 9 t of silver hake, red hake, and mackerel on average.

In the canyon zone, from Block to Corsair Canyons, the fishery continued from January to July. Mackerel prevailed in the catches until April; mackerel and silver hake were the principal species for bottom fishing. Two groups of large trawlers worked there: 11 in March and 40 in April. Their catches were 32–58 t per ship-day fished. Silver hake, red hake, and squid were harvested in June–July. During these two months, groups of 16 and 8 large trawlers, respectively, were engaged in the fishery yielding 30 and 48 t. Up to 7–15 SRTMs and about 11 SRTs and SRTRs also worked there, harvesting 8–13 and 8 t, respectively.

On the north and northwest slopes of Georges Bank, small groups of SRTMs and SRTs and individual ships of large tonnage fished for silver and red hake (in February and July–November) and herring and hake (in April–June and November–December).

Filling the mackerel quota caused a drastic reduction in the fleet of large trawlers off New England in April–May. The fleet proceeded to Nova Scotia.

In April–August, the purse seine fleet was engaged in fishing on the south, southeast, east, north, and northwest slopes of Georges Bank, on Browns Bank, and in the Gulf of Maine. Catches averaged to 11–20 t. In August, after the herring quota was filled, the fishery terminated.

Off Nova Scotia, silver hake concentrations formed the year round. The fishery was conducted on the parts of the oceanic slope of the shelf from Browns Bank to Sable Island, in Emerald Basin, and, occasionally, on Sambro, Middle, and Banquereau Banks. A full range of fishing activity began in March. The number of vessels fishing increased to 17 units in April and to 45 in July–August. Later, the number of vessels rapidly decreased to 6 units in November, but in December fishing effort increased again to 20 units. The productivity of the fishery varied between 39–52 t in March, 30–40 t in April–May, 40–43 t in June, 32–45 t in July–September, and 28–42 t in October–December. Silver hake led the catches, and bycatch in different months consisted of mackerel, herring, flounder, argentine, squid, and cod. Up to 15–40% of the catch was reduced to fish meal. The yield of silver hake diminished by 200,000 t, which corresponded approximately to the total decrease in the catch. A drop in the catches of other species, namely, redfish, flounder, herring, and squid, also took place. Off New England, the catches of nearly all the principal commercial fish species was reduced, except for silver hake. The catches taken off Norfolk were also low.

1975. This year, the total catch remained at the level of the previous year. Catches of the

principal fish species—silver hake, mackerel, herring, and red hake—did not change significantly either. However, extreme fishery regulation measures, catch quotas, and more limitations on fishing areas and seasons aggravated conditions for the Soviet fishery. Now, numerous ships of large tonnage were dispatched to the fishery as early in the year as possible in order to fill the quota of mackerel in U.S. waters. The distribution of the catches during the year underwent radical changes. The largest catches were taken in January–April. Then fishing effort gradually reduced, shifting to Nova Scotia. Filling the mackerel quota early prevented the fleet from harvesting mixed mackerel, silver hake, and alewife aggregations on Georges Bank in April–August. The productivity of the large trawler fishery was changed accordingly from high values in January–April to low indices during subsequent months. The changes affected the fleet of medium trawlers. Only ships equipped with freezing plants were in operation.

The fishery in U.S. waters was notable for some peculiarities. In March–August, a directed fishery for squid was conducted on the shelf slope from Cape Hatteras to Hudson Canyon depths of 120–420 m. Fishing was performed by SRTMs numbering two to three units in March–June and six to nine units in July–August. Squid catches, with bycatch of silver hake, butterfish, and red hake, fluctuated between 6 and 10 t on average. One RTMT also worked there in June and July. Her catches taken during these months averaged 26 and 22 t, respectively. Having filled the quota, the vessels ceased the fishery in August.

Long Island–Nantucket Shoals and southwest Georges Bank was the major fishing area for ships of large tonnage in January–April. The number of ships fishing there averaged 38 units in January–March and 8 in April. The ships were engaged in pelagic fishing for mackerel, taking bycatches of silver hake, alewife, and butterfish. Catches fluctuated between 30 and 80 t depending on the ship class. Twenty to 45% of the catch was undersized and nonfood fish, which were reduced to fish meal. One to five SRTMs also operated there taking catches of 8–11 t.

Nineteen large trawlers in January and five in February conducted the fishery in the shallow waters from 40 to 38°N . Catches (36–80 t) consisted of mackerel, silver hake, and small nonfood fish (20–25%). One to eight SRTMs were involved in the fishery in January–April. In February–April, their catches (silver hake, red hake, herring, and squid) constituted 9–11 t.

The zone of canyons from Veatch to Corsair was one of the fishing grounds in January through October. The number of large trawlers increased there from 2 in January to 17 in February and 37 in March. Mackerel was the predominant species in the catches. The size of the catches varied between 30 and 80 t. After the mackerel quota was filled, the number of vessels declined to 7–9 in April–May and to 2–5 in June–August. Mixed silver hake, red hake, and squid aggregations were fished. Catches ranged from 28 to 52 t. Like in other areas, 10 to 60% of the raw fish was reduced to fish meal. At the canyons, two to eight SRTMs on average were fishing every month from January through October. They pro-

duced 5 to 15 t of frozen silver hake, red hake, and squid in different proportions. Frozen red hake, silver hake, and herring were produced at the end of the fishing period.

The north, northwest, and west slopes of Georges Bank were fished in August–December. Both in August and December, ships of large tonnage fishing on the Bank averaged 15–13 units. Herring and silver hake and silver hake and squid were fished in August, while silver hake and argentine were fished in December; catches were 28–40 and 25–45 t, respectively.

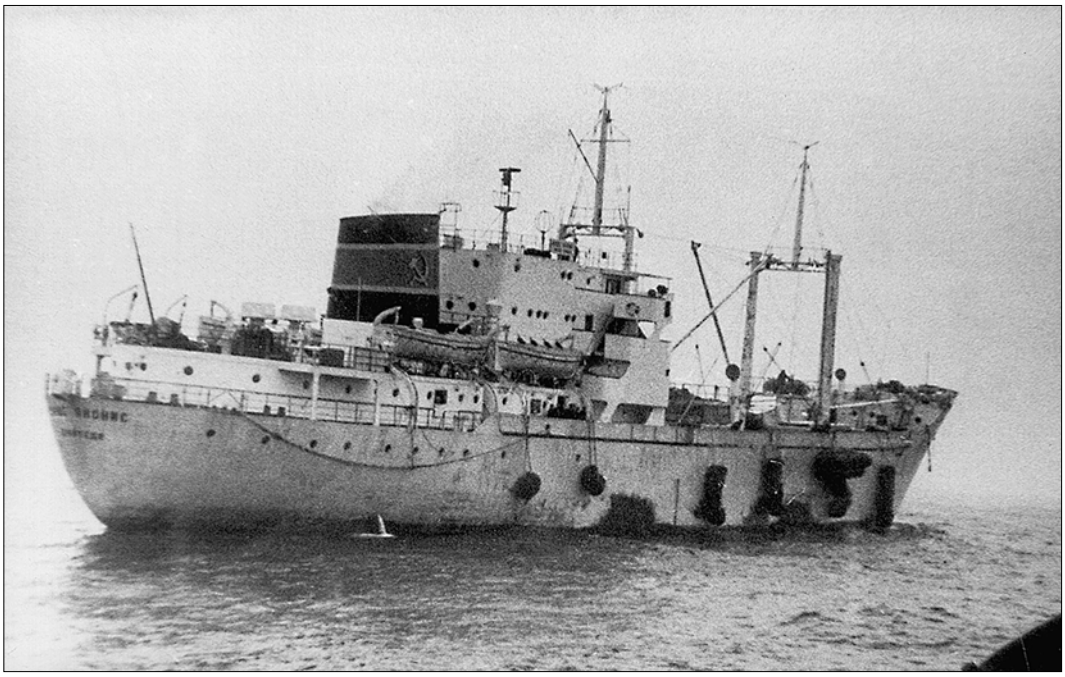
In December, the fishery was conducted in the areas adjacent to northern Georges Bank and southwest Browns Bank. In other months, large trawlers numbering one to three units at most fished for silver hake, red hake, and herring. In October, up to 80 foreign vessels were engaged in the herring fishery. The average number of SRTMs fishing ranged from 5 to 12. The daily rate of silver hake and red hake freezing was 6–11 t.

In addition to the above-mentioned areas, the shallow water parts of south and southeast Georges Bank were fished occasionally by individual vessels in June–July.

This year the purse seiners, more numerous than ever before, joined the fishery. The fishery lasted from March to August, covering different slopes of Georges Bank, Browns Bank, and the Gulf of Maine off Yarmouth. Fishing conditions were fairly complicated and unstable. One could hardly imagine a greater congestion of vessels. The whole fleet of seiners (about 80 units) was concentrated in a small fishing area on the north and northwest slopes of Georges Bank in June. Herring shoals occurred there from time to time, and half of the vessels had slim chances to cast their seines. More herring shoals, which formed denser concentrations, were available there in August–September, but most of the vessels left the area by that time. The fishery was over early in September.

Off Nova Scotia, the fishery continued throughout the year in three main areas: on the oceanic slope of the shelf from Browns Bank to Sable Island, with the highest recurrence on the fishing grounds from LaHave Bank to Sable Island (in January–August), in Emerald Basin from Sambro Bank to Middle Ground (in January–September), and in the shallow waters off Sable Island including Middle and Banquereau Banks (in July–December). The average number of ships of large tonnage fishing increased from 6 in January–February to 8 in March, to 22 in April, and to 25 in May. This group of ships decreased to 14 units in June, and then increased: 56 in July and 36 in August. The average number of ships fishing was 17 in September and 2, 5, and 4 in October, November, and December, respectively.

The number of vessels on the oceanic slope of the shelf increased from 4 units in January to 12 in June, and then from 37 units in July down to 20 in August. Silver hake was the principal commercial species, and the bycatch included cod, mackerel, redfish, flounder, and squid. Like in the other two areas, the major part of the catch (6–60%) was nonfood bycatch used for reduction to fish meal. Monthly mean catches ranged from 25 to 44 t. Unsteady fishing conditions was a distinctive feature both in this and other areas. Fish aggregations of relatively low density tended to scatter.



The production refrigerator ship *Julius Janonis* from Klaipeda awaiting the arrival of fishing vessels.

In the Emerald Basin area, the largest number of vessels operated in April–May and August–September—15 units during each period. Along with silver hake, the major commercial species, the trawls brought in herring, flounder, redfish, cod, and squid. Catch sizes in January–September varied between 25 and 44 t. Having filled the quota, the vessels ceased the silver hake fishery in September.

In the shallow waters of Sable Island and on Banquereau and Middle Banks, two to eight vessels harvested mixed flounder, cod, redfish, mackerel, and other fish species aggregations in July–December. Catches fluctuated between 24 and 43 t. The vessels operated bottom trawls, and the nonfood bycatch was especially high there, reaching 39–58%.

Silver hake accounted for nearly half of the total catch taken off Nova Scotia. The other half was a "collection" of less abundant species such as cod, redfish, flounder, herring, argentine, other fish species, and squid. Off New England, silver hake, red hake, herring, and mackerel made up 85% of the catch, and mackerel—38%. A small catch from the Norfolk area consisted of silver hake, red hake, mackerel, and squid.

1976. Fishery regulation measures became still more stringent, with ensuing cuts in quotas, fishery regulations for different fishing gear, and an increased number of fishing areas under a ban. A ban on the bottom fishery in the Norfolk area ruled out any opportuni-

ty to fish for squid. After quotas on the major species were imposed, the peculiarities of the overall ichthyofauna distribution (in mixed aggregations) became an extra limiting factor for the fishery. Taking the quota for one species made the fleet face gloomy prospects, since it then had to seek either aggregations in which this species was not available or abandon the idea of having it frozen (i.e. discard it). One would not want to be in the place of the captains of the vessels who had found themselves in the midst of all kinds of bans that "fenced them in." The annual catch suffered a one-third decrease. A drastic downturn in fishing effort, especially for ships of medium tonnage, was observed. Like in previous years, a group of numerous large trawlers entered the New England and Norfolk area early in the year. For them, taking the mackerel quota was the task of top priority.

In the shallow waters from Long Island to 38°30′N, and those of Nantucket and at Block Canyon, 40 ships of large tonnage on average fished in January. Mackerel catches ranged from 42 to 130 t. In February, March, and April, fishing effort declined there to eight, six, and one unit, respectively. Mackerel continued to be the main commercial species in February, while in March–April, the remaining vessels fished for mixed red hake, silver hake, and other species aggregations. Catches varied between 28 and 75 t. Like in other areas mentioned below, 15–60% of the catches consisted of nonfood bycatch.

In conjunction with large trawlers, one to six SRTMs fished in the area in January–April. Their catches (9–12 t) consisted of red hake, silver hake, squid, and mackerel at different ratios.

In January–March, mackerel was harvested in the zone of Veatch to Corsair Canyons (in January) and Veatch to Oceanographer Canyons (in February–March). The number of ships fishing varied from 2 in January to 30 in February and 9 in March. Catches constituted 32–60 t. Having filled the quota, fishing for mackerel ceased in mid-March.

In February–May, the ships of large tonnage fished for silver hake, red hake, and squid at Oceanographer–Corsair Canyons. Their number ranged from 10 in February to 18 in March, 20 in April, and 1 in May. Catches fluctuated between 38 and 60 t.

Not until October did large trawlers reappear in the canyon zone (Lydonia). This time, five vessels fished for red hake, with bycatch of squid and butterfish. Catches were at a level of 39 t.

During January–November, two to five SRTMs worked in the canyon zone (Veatch to Corsair Canyons in January–May and off Lydonia after May). Catches were 6–13 t.

In August–December, red hake, silver hake, and squid aggregations on the northwest slopes of Georges Bank were fished occasionally by individual SRTMs. In September, a group of nine large trawlers fished for herring, with a squid bycatch. In the pelagic zone, catches varied between 44 and 65 t. The group reduced to three units in October, and herring catches decreased to 20–27 t.

The purse seiners arrived on Georges and Browns Banks in May; however, high water temperatures made herring concentrations migrate to coastal waters. The vessels had a run

of bad luck, being constantly short of catch, and after having failed to take their quota of herring left the area at the end of June.

Pre-spawning herring concentrations migrated from the coastal waters to the area west of Cape Cod late in August. Large trawlers took advantage of the occasion and filled the quota.

One of the fishing areas off Nova Scotia was the oceanic slope of the shelf from LaHave Bank to Sable Island. The number of large trawlers fishing there grew from 1–2 in January–February to 4–8 in March–April, and up to 15 in May. Nine, 11, and 14 vessels on average were fishing in June, July, and August, respectively, and 1 in September–October. In January–April, catches consisted of silver hake and nonfood bycatch (10–38%). Fishing conditions were unsteady; catches ranged from 29 to 43 t. A considerable quantity of squid was captured in May; in June, their proportion in the catches fluctuated between 20 and 80% and reached 60–80% in July–August. Catches ranged from 29 to 46 t. Six SRTMs in July and four in August also fished for squid and silver hake in the same area. Their catches were 11–12 t. In August, the squid quota was caught, and the vessels had to discontinue the harvest of mixed squid and silver hake aggregations.

The Emerald Basin area between Emerald and Middle Banks was another fishing ground in March–December. Eighteen, nine, and seven ships of large tonnage operated there in March, April, and May, respectively, their number having been reduced to one to five units in the following months. In March–April, catches consisted of silver hake, alewife, and nonfood bycatch (10–47%), and in May–August consisted of squid and silver hake. During these periods, catches varied between 24–33 and 33–61 t, respectively. In September–December, one to three vessels fished for mixed silver hake, mackerel, argentine, and alewife aggregations with catches of 18–42 t.

This next-to-last year of the fishery, half of the total catch taken off Nova Scotia consisted of silver hake, the rest being represented by flounder, mackerel, argentine, and squid. The "outburst" in squid abundance that occurred in 1975 resulted in a high catch in 1976 (16,000 t). Off New England, silver hake, red hake, herring, mackerel, and squid accounted for most of the catches. On account of a threefold decrease, the herring catch totaled just 13,000 t. Because of the mackerel fishery, the low previous year level of catches off Norfolk was matched.

1977. The Fishery Conservation and Management Act (FCMA) was passed in the United States in April 1976. The fishery within the U.S. 200-mile zone was prohibited for foreign fishermen as of 1 March 1977.

On 26 November 1976, the Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics Concerning Fisheries off the Coasts of the United States was signed. Effective 28 February 1977, in accordance with the Agreement, the Soviet fishery in the fishery conservation zone of the United States was conducted in stringent conformity with the rules regulating foreign fishing in U.S. waters. Fishing sectors and seasons for directed fisheries were strictly defined.

Heavy smokers on deck waiting for the next trawl to return.
These deck hands are enjoying their short rest.

The same applied to the 200-mile zone of Canada under the Act of the Territorial Sea and the Fishing Zone approved in November 1976.

Furthermore, the fishery in the U.S. and Canadian zones was regulated by rules governing Soviet fishing vessels in the ICNAF zone as well as by quotas imposed on the yield of practically all commercial species. These quotas were considerably reduced as compared to the previous years. In September, after all the quotas had been filled, the Soviet fishery was terminated.

In January–February, Soviet vessels were still operating in the shallow waters from Nantucket and Long Island to Norfolk. Twenty-one ships of large tonnage were fishing there in January. The fishery was directed at mackerel. Catches ranged from 35 to 67 t with nonfood bycatch of 23 to 50%. On 7 February, after having caught the quota of mackerel, the Soviet vessels abandoned the area.

In January–March, silver hake and red hake were fished at Hudson–Block–Veatch and Welker–Lydonia–Corsair Canyons. During these 3 months, 12, 23, and 12 large trawlers, respectively, and 3 SRTMs were involved in the fishery. Catches varied between 31–52 and

10–13 t. In April, May, June, and July, 6, 9, 14, and 2 large trawlers and 5, 4, 5, and 2 SRTMs, respectively, operated on a small plot at Lydonia Canyon open for the fishery and free from lobster traps. Mean catches of 20–50 and 9–11 t were taken. Silver hake and red hake were fished until June, as the fishery for these species on the U.S. shelf was prohibited starting in July. The vessels continued their activity by harvesting squid.

Five ships of large tonnage fished for squid off Wilmington Canyon in July, and two in August. Their catches constituted 26–39 t. On 8 August, the quota was filled and the ships left for Nova Scotia.

In this area, the parts of the oceanic slope of the shelf between LaHave Bank and Sable Island were the major fishing ground in March–August. In different months, the number of vessels fishing varied between 7 and 11 units. Only in July did the group of vessels increase to 18 units. Until May, silver hake was the main commercial item. Squid predominated in the catches in June–August. Catches constituted 24–35 t in March–May and 35–45 t in June–July. The squid quota was taken in August. The vessels searched for places with silver hake concentrations, but squid prevailed in the catches everywhere. Silver hake concentrations were scattered, which resulted in a drop in catches. The fishery had to be discontinued.

The 1977 catch declined to 160,000 t. Small catches taken off Nova Scotia and New England consisted of silver hake and squid, and those taken off Norfolk were represented by the same species plus mackerel.

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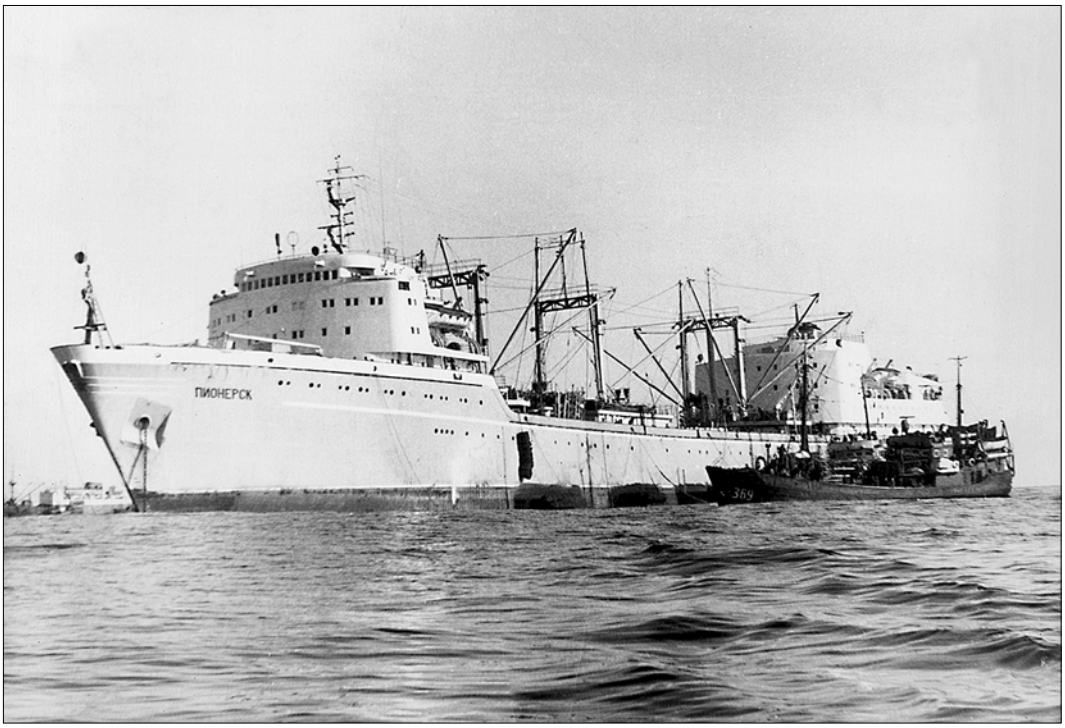
The information from the annual atlases that was used to give an overview of the years 1961–77 enabled us to determine the fishing periods in particular areas, the species composition of the catches (or mixed aggregations), and the predominance of one or another species.

Canyon zone from Cape Hatteras to Corsair Canyon. The fishing period: December–May from Cape Hatteras to Wilmington Canyon and the year round from Hudson Canyon to Corsair Canyon. The catch species composition: scup, mackerel, alewife, herring, butterfish, black seabass, Atlantic searobin, spiny dogfish, and squid in the southern part of the zone; silver hake, red hake, herring, mackerel, flounder, cod, butterfish, spiny dogfish, and squid from Hudson Canyon to Corsair Canyon. Predominant species in the catches: scup, mackerel, and squid in the south and silver hake, red hake, mackerel, and squid in the north and in the east. Recurrence of the fishery in the canyon zone—16 years.

Georges Bank. Different parts of the Bank were fished from May to December. The catch species composition: herring, silver hake, haddock, red hake, cod, mackerel, alewife, flounder, and squid. Predominant species in the catches: silver hake, herring, red hake, and mackerel. Recurrence of the fishery—15 years.



Business relations. SRTs alongside the mothership *Pionersk*.

Nantucket Shoals. A year-round fishery was possible. The catch species composition: alewife, silver hake, red hake, mackerel, herring, flounder, butterfish, ocean pout, haddock, pollock, scup, cod, and squid. Predominant species: alewife, silver hake, red hake, flounder, herring, and mackerel. Recurrence of the fishery—9 years.

Shallow waters from Long Island to Cape Hatteras. The fishery was of a seasonal character: January–June. The catch species composition: Atlantic searobin, scup, mackerel, alewife, herring, butterfish, spiny dogfish, and squid in the south; herring, alewife, mackerel, butterfish, flounder, silver hake, red hake, scup, and spiny dogfish in the north. Recurrence of the fishery—12 years.

Shallow waters from Long Island–Nantucket to southwest and southeast Georges Bank. In particular years, mixed species aggregations formed during January–June and were fished throughout these shallow waters. The catch species composition: herring, mackerel, alewife, butterfish, flounder, silver hake, red hake, scup, ocean pout, and spiny dogfish off Long Island–Nantucket; herring, haddock, silver hake, red hake, mackerel, alewife, and butterfish to the southwest of Georges Bank and in the southeastern part of the Bank. Recurrence of the fishery—8 years.

Oceanic slope of the shelf off Nova Scotia. In years of increased silver hake abun-

dance, the fishery was conducted year round. The catch species composition: silver hake, argentine, cod, pollock, flounder, haddock, mackerel, herring, redfish, red hake, skate, and squid. Predominant species: silver hake, argentine, and squid. Recurrence of the fishery—14 years.

Emerald Basin. In the years of increased silver hake abundance, the fishery was conducted year-round. The catch species composition: silver hake, redfish, red hake, flounder, cod, herring, mackerel, argentine, haddock, pollock, alewife, and squid. Predominant species: silver hake. Recurrence of the fishery—9 years.

Shallow waters of Emerald–Middle–Sable Island–Banquereau Banks. In some years, the fishery was conducted in February through December, in other years—in May through November. The catch species composition: silver hake, flounder, cod, haddock, redfish, mackerel, herring, pollock, argentine, and squid. Predominant species: silver hake and flounder. Recurrence of the fishery—12 years.

The Soviet fishery harvested mixed species aggregations all over the Region. The information derived from the annual atlases made it possible to judge the role of the most abundant species in one or another area and their impact on the productivity of the fishery.

Silver hake was a region-wide component of the fish resources. It is hard to imagine the fishery in the canyon zone without this species. It dominated the catches taken there in 1962–68, 1971, 1973, and 1977. The only exceptions were the 1969 catches when red hake predominated, and those of 1970 and 1974–76 when mackerel led in quantity. On Georges Bank, silver hake's importance increased in 1964, 1967, and 1970–75. In the other three areas of New England and Norfolk, silver hake was item two and three in the fishery. This species formed the basis of the fisheries' potential in the Nova Scotian areas. The areas of the oceanic slope of the shelf and of Emerald Basin could "work" for the fleet only in years of high silver hake abundance (1962–64, 1969–77 and 1962–65, 1973–76, respectively).

During years of low silver hake abundance, it was due to argentine that the fishery existed in the first area to a certain extent (1965–66), while no fishery at all was conducted in the areas of Emerald Basin in 1966–72. In the shallow waters of the Nova Scotian Shelf, silver hake predominated in 1963–64, 1969, and 1971–72.

Georges Bank and the shallow waters from Long Island to Cape Hatteras were basic herring habitats. Herring prevailed there in 1962–63, 1968–69 and 1964, 1968–70, respectively. Their importance in the Nantucket Shoals area increased in 1971, and in the shallow waters from Long Island to southeast Georges Bank—in 1967.

The importance of mackerel increased after 1967. That year, as well as in 1971–72 and 1974–77, they predominated in the shallow waters from Long Island to Cape Hatteras, in 1968 and 1973–77 in the shallow waters from Long Island to southeast Georges Bank, and in 1970 and 1974–76 in the canyon zone. On Nantucket Shoals, mackerel occurred in large quantities in 1972. In this area, alewife predominated in 1963–64 and 1966–68, red hake in 1969, and flounder in 1970.

Flounder also took a leading stand in the shallow waters of Nova Scotia in 1966, 1968, and 1973–75.

Scup predominated in the catches taken in the southern canyon zone in 1963–65, and in the shallow waters of Long Island–Cape Hatteras in 1964.

The abundance of squid increased sharply in 1976–77, and they predominated in the catches yielded on the oceanic slope of the Nova Scotian Shelf.

Thus, as early as the first years of the Soviet fishery, eight areas were defined with fish stocks permitting the fisheries to be conducted with considerable numbers of ships of large and medium tonnage. Given a satisfactory state of the major stocks, the fishery in five of these areas was able to be performed on a year-round basis. In two other areas, the fishing season was timed to the first half of the year, and on Georges Bank—to the second. All eight areas were the arena for large trawler activity. They provided an opportunity for broad maneuvering of vessels by fishing area and season. The canyon zone (in January–July), Georges Bank (in July–October), the oceanic slope of the Nova Scotian Shelf (year-round), and Emerald Basin (during the year) met the fishery requirements in the best possible way. Vessels also constantly maneuvered between areas during protracted periods of fish concentration dispersal. Captains were very well aware of the fishing areas and conditions and knew exactly when and to where the course of their ships should be laid. Besides, the searching vessels were striving to keep the "pulse" of fishing conditions in various areas under their permanent control. When dispatching their large trawlers to the Region, shipowners relied on the silver hake fishery in the canyon zone and on the oceanic slope of the Nova Scotian Shelf as well as on optimal conditions for the mackerel fishery in January–April. Fishery managers always kept in mind that most dense herring concentrations good for bottom and pelagic fishing formed on Georges Bank in August and September. Captains retained in their memory a number of auxiliary areas where aggregations of argentine, herring, redfish, cod, etc., had formed from time to time. Occasionally, they raided those areas and, if lucky, used their chance to the maximum.

The shallow water areas of New England and Norfolk were more preferable for the trawlers of medium tonnage. But SRTs and SRTRs happened to harvest redfish in Cabot Strait, and SRTMs occasionally entered the canyon zone and the waters of the oceanic slope of the Nova Scotian Shelf. Compared with the other areas of the Atlantic Ocean, the Region was recognized as the most optimal area for SRTMs employing side and stern trawling. Their freezing chambers were always used to their fullest capacity.

Monthly maps of long-term fishery distribution in the Region are shown in Appendix Figures 32–43. These were based on data derived from the annual atlases, and the duration of the fishery at 1–3, 4–7, 8–12, and 13–16 year intervals was chosen as a way to illustrate them.

In total, the maps present an overall and reliable picture of the development of the Soviet fishery in the Region. However, they are not illustrative of just the geography of the

Soviet fishery. Considering the scale, mass character, and steadiness of the fishery, the maps make it possible to show the frequency of "attendance" at different sites by the groups of fishing vessels. The places notable for the highest duration of the fishery are, at the same time, the zones of formation of more stable and dense fish aggregations and, consequently, of higher fish productivity. White spots on the maps are indicative of the areas where no efficient fishery could be expected because of the absence of the required fish stocks.

Thus, the maps contain information on the places in which the desired result of the fishery was achieved to a lesser or greater degree of probability. Evidence of the seasonal changes and transformations and of the mobility of the fishery is also quite important. It serves as an indirect indication of stock movements and seasonal processes in the formation and disintegration of fish concentrations.

EPILOGUE

The year of 1977 became an evil omen for the Soviet expeditionary fishery. The huge fishermen's "shallop" of the Soviet Union was profoundly staved.

In a flash, the branch was deprived of the vast, productive, and economically optimal nearby areas in the North Atlantic and North Pacific. The introduction of 200-mile fishing zones by the United States, Canada, and the European Economic Community nations created huge problems. From that moment on, the clock of the Soviet fishery began the countdown "towards the decline"—"the mirror cracked."

But the State was still strong; the "petrodollars" kept flowing. The fishing branch, which had been developing in keeping with natural economic principles, proceeded to fortify the bastions of the unified economic complex.

The steps taken in order to avert the crisis, adapt to new conditions, offset losses, and retain the scope of the oceanic fishery were Herculean indeed.

Great attention was paid to the problems of organizing the fishery in shelf waters still remaining "free" off Mauritania, Namibia, and other West African countries. Some 30–40 ships of large tonnage fished off Namibia annually, yielding nearly 18 million t from 1972 through 1991. Off Namibia, the catch in 1976–90 exceeded 12 million t.

Owing to continual international activity of the Ministry, access to fishery resources of a number of developing coastal states was secured based on bilateral intergovernmental agreements.

There also existed the third, radical way of enlarging the fishery sources that had already become traditional—searching for new areas in the open sea. The efforts of fishery research institutes, and of fish scouting services more particularly, unprecedented in their scale, were subjected to this goal.

Out of 910 research, scientific, and scouting expeditions carried out in 1976–80, 460 were sent to open sea areas, 109 to the Antarctic, and 141 to shelf waters. As a result of the development of the areas discovered in the open sea, the State gained 4 million t of fish during these 5 years. Over 1979–80, the catches taken in these areas amounted to 1.6 and 1.7 million t, respectively. Some findings (for example, discovery of jack mackerel resources outside the 200-mile zones of Peru and Chile, pelagic redfish in the Irminger Sea, fish stocks above underwater mountains) were regarded as outstanding geographical and scientific discoveries. In other words, the branch again commanded a large fishery potential. The fishermen sailed from their native shores farther and farther, cast their trawls ever deeper, and developed ever complicated areas for fishing.

Bridgeheads for the huge fleet were reconstructed and, it seemed, fortune would be gracious to the Soviet fishermen. Catches maintained a high level. A total of 10.5–11.3 million t of fish were harvested in the second half of the 1980s, and in 1989, the fishermen

reported a great labor victory: that year they became number one in the world after having taken the lead from Japan. But unfortunately, it happened to be the last triumphant report.

Changes followed that were unexpected and incomprehensible to the majority of the fishermen. They became aware that their "ship was sinking." In 1990, Russian fishermen yielded 7.9 million t of fish; in 1994, the national catch amounted to just 3.5 million t.

Well, what happened? What kind of trouble befell the integrated branch mechanism that had been adjusted for years? What caused the shattering of the destiny of many a fisherman?

Like any other gigantic monopoly branch, the fishing branch was the offspring of the Socialist state. It would not have existed and developed were it not akin to the centralized planning system. This system was allotting funded resources, supplying fuel at symbolic prices, and introducing special terms to form the costs and revenues. These measures were expected to provide profitability for the oceanic fishery that made use of fishery resources represented by massive amounts of mainly small pelagic fishes of low commodity value.

It worked well until the introduction of the 200-mile zones. However, the geography of the fishery was changing, and every time the fishermen developed more distant areas, it resulted in permanent escalation of costs. The right of access to stocks within the 200-mile zones also had to be paid. In line with scientific and technical cooperation and assistance, coastal states benefited by goods or services rendered; by payments made to acquire licenses for fishing; by gaining either part of the catches or fish products; and by payments for services provided to the Soviet fleet in their ports (repairs, procurement of supply, victualling, etc.).

All these expenditures pressed heavily on the State.

Three to 4 million t of small pelagic fish species of little value were caught year after year. Without purchasers, most of the catch had to be processed for industrial purposes. Financial losses were sizeable. In the long run, the fishing industry became unprofitable, and required more money to be poured in by the State.

As is known from official Soviet sources, the yearly State subsidies for the branch exceeded 3 billion rubles by the end of the 1980s. According to estimates by FAO experts, however, based on the size and species composition of the Soviet catches, the excess of expenses over income in the fishery of the Soviet Union in 1989 might have ranged between US$5 billion and 8 billion.

Anxious times set in for the fishing branch. The uneasiness was aggravated by the country's state of affairs. Emergency situations had shown up in the Soviet economy for a long time. Centralized planning made many mistakes and tended towards disproportions. During 1970–85, expenses exceeded profits, and every effort strained to "adjust" the State budget. Attempts were made to mend the flaws of the "command-and-might" system by cosmetic reforms in 1965 and 1979. By the beginning of the 1980s, the state of the U.S.S.R. economy kept deteriorating, and emergency situations were building up. Growth in production, in its efficiency, and in the living standards of the population were suspended.

Earnings from oil field operations became reduced by the mid-1980s. By that time, gross domestic product per capita was about 37% of the U.S. level. The growth rate of labor productivity approached zero. Soviet society was bogged down in a profound crisis by the spring of 1985. After that, there began a new and final phase in the history of the U.S.S.R. called Perestroika. Attempts by the State to reform, to "cure," the Soviet economy turned out to be inefficient and ended in failure.

Meanwhile, with Perestroika, the crisis of State organization was mounting, as evidenced by aggravated disintegration of the country and weakening of its territorial integrity and the bodies of the central government. The old administrative system became ever decrepit, decayed, and lacked vitality.

By the end of 1991, the State economy was "up to the spout." The external debt of US$22–25 billion in 1986 went up to more than US$60 billion in 1991. The country was shaken with a severe political crisis that eventuated in the breakdown of the U.S.S.R. and elimination of the Union government bodies.

In October 1991, Boris Yeltzin declared that radical economic reforms would be carried out in the country. The "hot-shot" reforms based mainly on liberalization of prices and privatization launched the market mechanism. The country was seized with an extreme economic and social crisis. Reforms were accompanied by a catastrophic decline in production in many branches, galloping inflation, and unemployment. Hard times set in for the branches that had existed owing to State subsidies. The speeded-up transition of the larger part of the State's property to private enterprise in a short space of time destroyed and dismantled the mechanism of centralized control of the economy. Redefinition of the economy, with the absence of capable institutes of power, entailed disintegration of its components.

This brief enumeration of events and phenomena that preceded the disintegration of the Soviet Union and those that followed makes it possible to imagine what kind of destiny was foreordained to the branch and its phenomenal oceanic expeditionary fishery. Hyperachievements or noted victories were no more. The dreadful catastrophe that overtook the State, and disruption of the social and property structure of society, transferred the fishermen to a new road—that of losses and defeats.

After Latvia, Lithuania, and Estonia ceased to be parts of the U.S.S.R., large fishing industry complexes in Riga, Klaipeda, and Tallinn were gone.

As a result of all-embracing privatization, most fishing and processing enterprises, seaports, ship-repair plants, fishing and transport vessels, and transportation and trade in fish products ended up as private or community property.

At the beginning of 2000, such Russian-managed enterprises had increased to 3,200 (2.3 times as many as in 1992). The non-State sector contained 93% of the enterprises, which provided 97% of the total production output.

Redistribution of property has progressed, taking apart the appurtenances of the branch, and spreading them around. The fishing fleet is decreasing in number, and, so too, at an

ever quickening pace, the number of ships in the processing, transport, auxiliary, and scouting fleets. The number of ships decommissioned during the last few years approximates a thousand units.

In 2000, 70% of the ships were in service for over 10 years, and 1,700 more units will be reduced to scrap metal in the years to come. In 1990, the U.S.S.R. had 1,018 units in the fishing fleet of large tonnage. With the formation of the Russian Federation, their numbers were reduced to approximately 640. As of 1 January 1995, 181 ships of the 1970–90s design of the *Gorizont*, *Moonzund*, *Pulkovsky Meridian*, *Ivan Bochkov*, and *Prometey* types were still available, of which 168 units could operate in the open areas of the world oceans according to normative service life.

These five types of vessels were purposely designed for the development of the fishery in open areas and were regarded as the "youngest" generation, having more advanced technical and technological equipment. Their length varied between 85 and 107 m, the main engine capacity—between 3,500 and 5,200 hp, and daily output of the freezing equipment—between 50 and 60 t.

Large changes took place in the allocation of the Russian fishery by 1993–94. The fleet left the productive Southeast Pacific area and distant waters of the coastal states in the Atlantic and redeployed to the waters of the economic zone of Russia and to the closest areas of the Northeast Atlantic. The possibility of reviving the large-scale fisheries in the open areas of the world's oceans and in the Pacific in particular was considered in 1994. However, calculations showed that the losses would far exceed the profits, and the idea of revival was rejected. The ships of the above five types were designed and built reckoning on wardship and patronage from the State, but ended up having no prospects for being used in distant areas of the open sea. Their production rate was absolutely insufficient for a break-even profitable fishery of small pelagic fish species of low value. Dutch shipowners used a simple way to solve the problem of fishing for these species. In the 1990s, the new super trawler designs were developed. They were built to carry out lucrative fishing for sardinella and sardine off West Africa. The last of such gigantic pelagic stern trawlers, the *Maartje Theadora*, was built in Vigo, resembles a dry-cargo ship in outward appearance, is capable of freezing 330 t of fish per day, and has capacious holds. Its length is 140.8 m, and the width is 18.68 m.

According to calculations, the annual catch of a Russian trawler in the open sea areas would have constituted 6,300 to 11,000 t depending on the ship type. Given a favorable fishing situation, the Dutch super trawlers need 20–30 days to produce the same volume of frozen fish. The majority of the operational Russian "mastodons" have superflous fishing capacities. They are unprofitable in distant areas; and in the economic zone of Russia, no adequate fishery resources exist. These are ships with no future before them. Outdated both morally and physically, they are subject to utilization according to the norms of the developed capitalist countries.

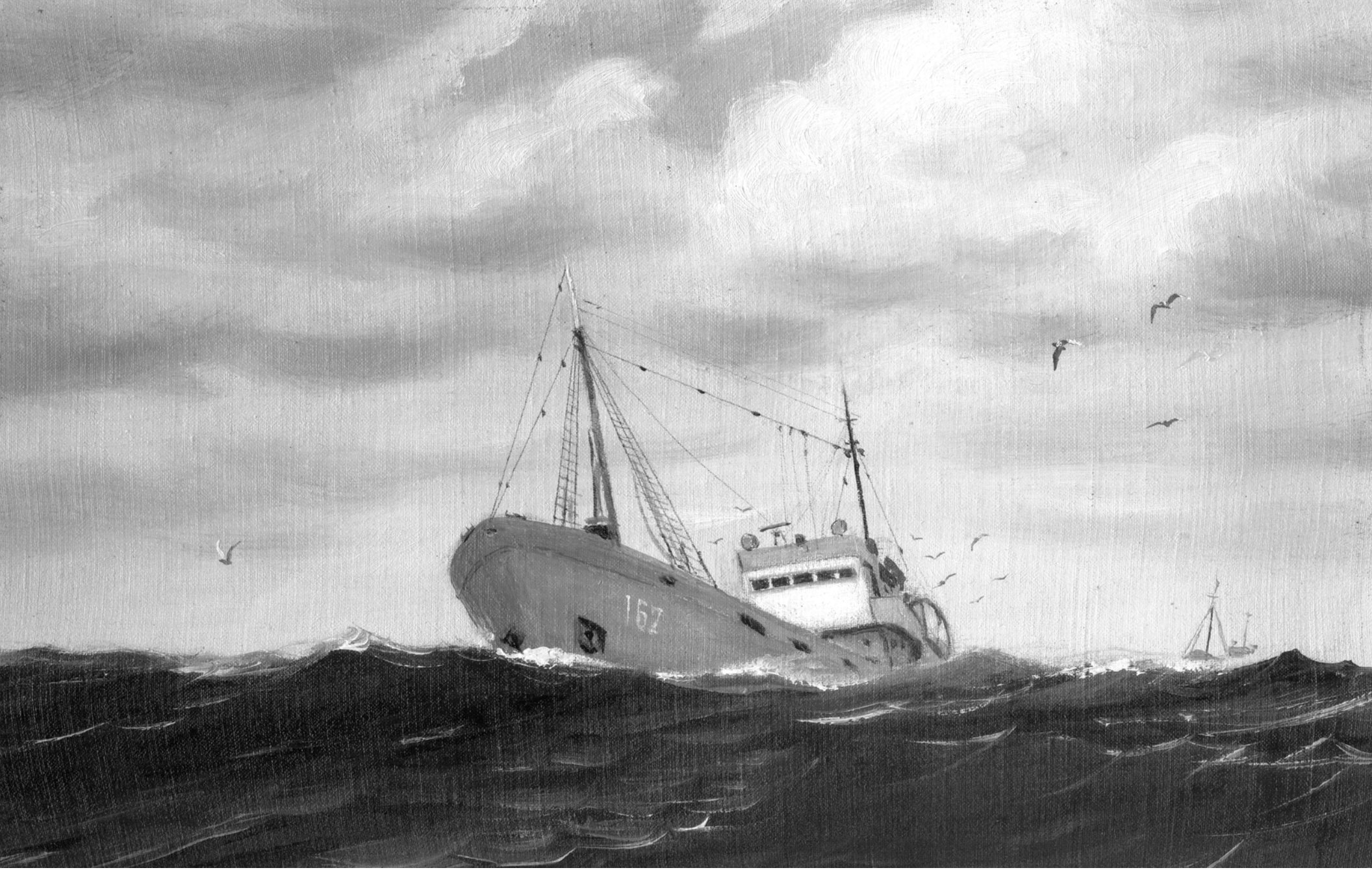
The Russian oceanic fishery entered the third millennium in the grip of a deep crisis. It had already been in a period of retreat for 10 years, yielding the positions taken once with such difficulty.

The Norwegian Sea became the launching ground for the Soviet expeditionary fishery in the Atlantic Ocean. Later, huge shelf and open sea areas were developed. The fishermen's routes became ever shorter in recent years. Fishing areas shrank fast like shagreen leather, and everything fell back into its original place. The cycle has now been closed in the nearest circle—the North Atlantic.

In the Pacific, the fishermen went back to native shores, to their economic zone. Events that are moving there aggravate the state of the fishery. The stocks of Alaska pollock, the most important resource in the Far East waters, are decreasing. The living sea resources are being plundered by thousands of poachers. The high-value resources of the Russian zone attract external attention, and expansion of foreign firms to Russian waters is taking place.

The future of the Russian fishery is vague. According to calculations, nearly 1,120 new fishing vessels of different classes must be brought into operation in order to take a 5.5 million t catch in 2015. This will require US$20 billion capital costs, or US$1.3 billion annually. The fishing companies have no such means available. Granting State subsidies was discontinued in 1995. Hopes for large-scale State financing at the expense of tax proceeds and for foreign investment are unfounded.

It can be seen that the picture of the Russian fishery is grievous. Though, seemingly, it could not be any other. The break-up of the Great Power has not spared its economy and the integral parts of the latter—the branches. The unified fishery complex of the State that was the kernel of the branch mechanism perfected year after year, with its commanding structures of management in the center, basin, and territorial levels, became a wreck. The expeditionary fishery remains only in the memories of the old fishermen. As though there had never existed detachments, flotillas, heads of fishing areas and expeditions, and flagman captains. But all this did exist. For 40 years, hundreds of thousands of Soviet fishermen kept the labor watch on thousands of ships everywhere in the expanses of the world's oceans. Generations of fishermen succeeded one another. There was no limit to their energy, fearlessness, and optimism. And there was an explanation for it: they were succumbing to a great source of energy—the ocean. Also, present-day generations of Russian fishermen know themselves what the magnetic force of the ocean feels like. As before, they enter marine academies and colleges, put out to sea under Russian and other nations' flags, endure hardship and troubles, get over the difficulties, and sail away again. The era of the Russian fishermen-seafarers continues. And it shows promise of revival of the Russian fishery, revival in a world of new realia, new ideas, and new solutions. However, those old and glorious times won't be forgotten. The pages of history are wont to return to life, to become the inheritance of new generations of people.



The SRT-167 searches for fish far from home in this painting by Victor Sinitzin called *In the Fishing Area*.

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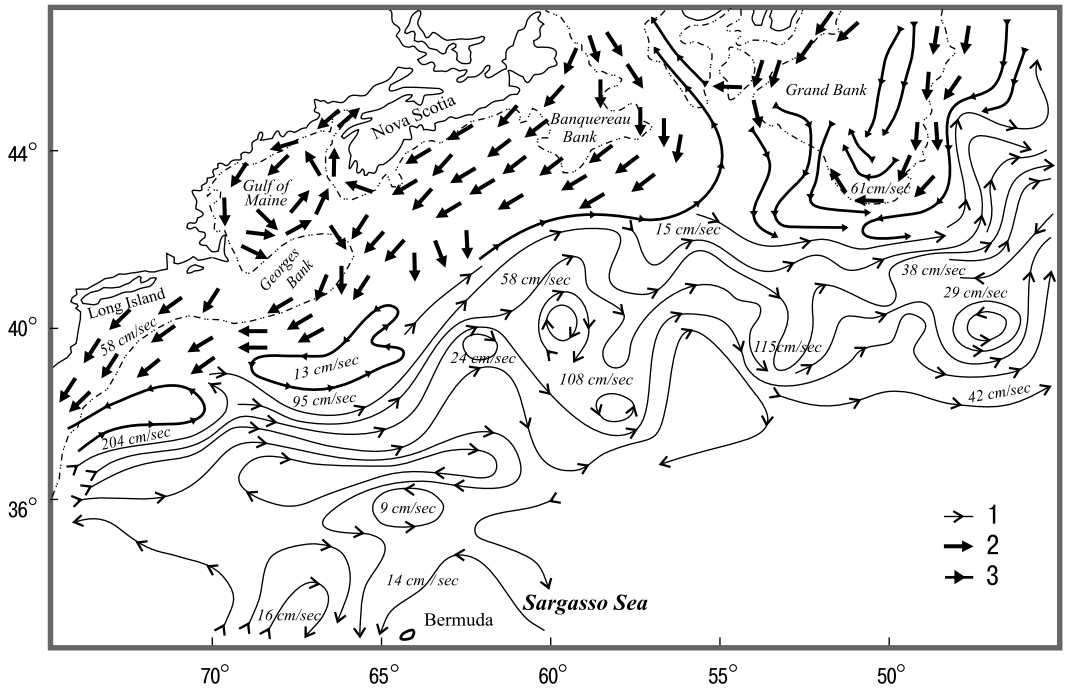
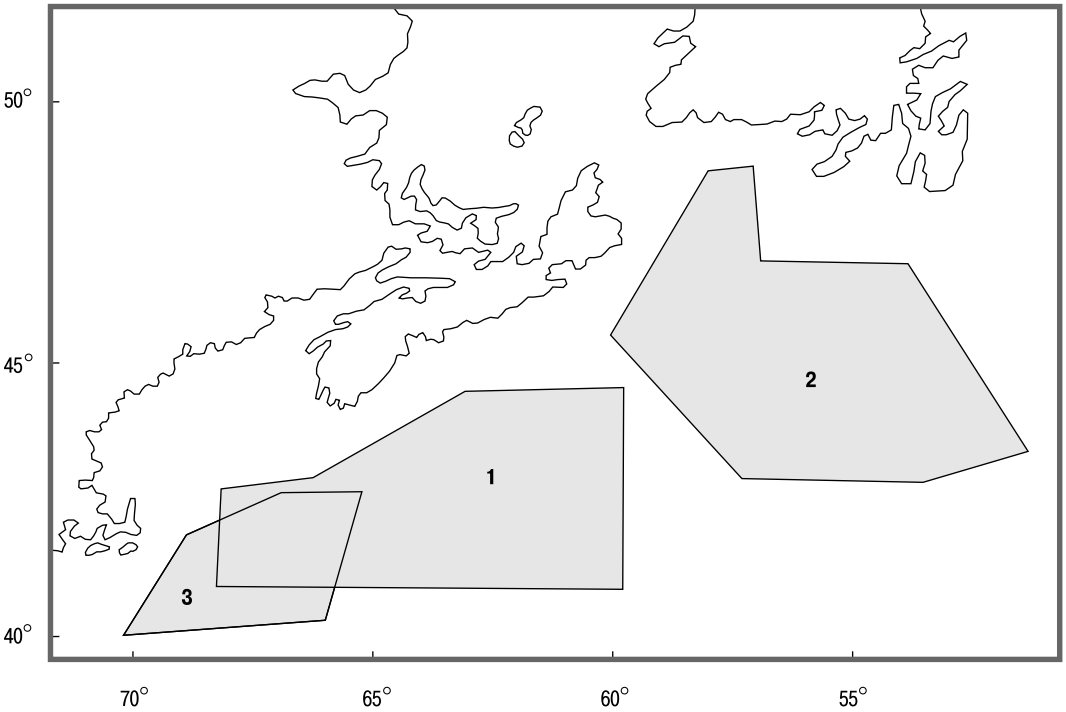
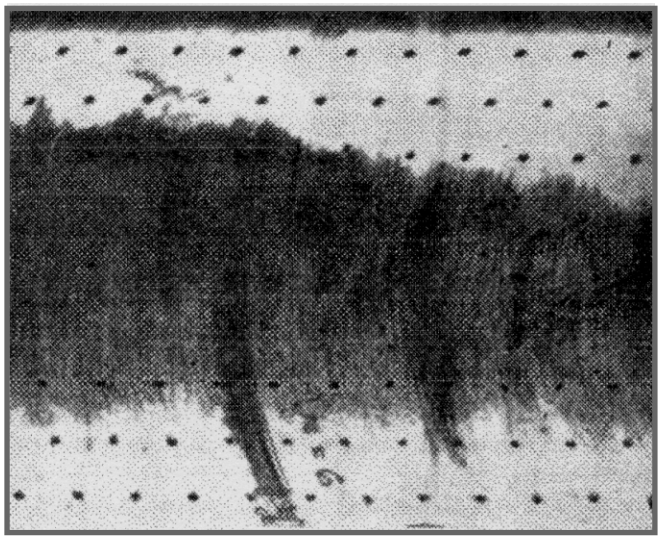
APPENDIX



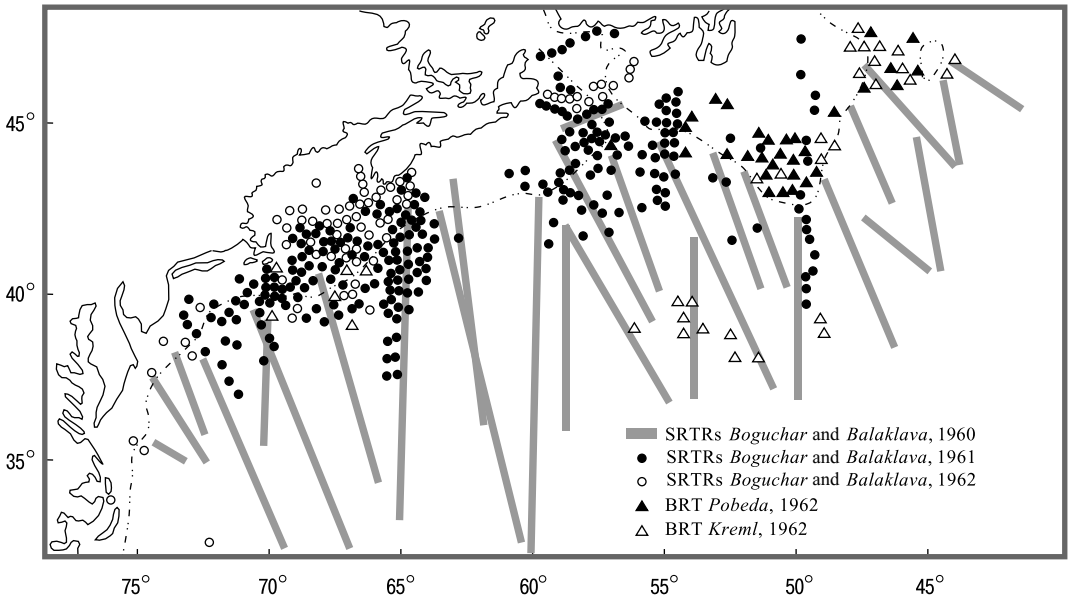
Appendix Figure 1. A scheme of constant surface currents in the Northwest Atlantic, May–August 1960: 1—Gulf Stream water; 2—cold water; 3—mixed water.



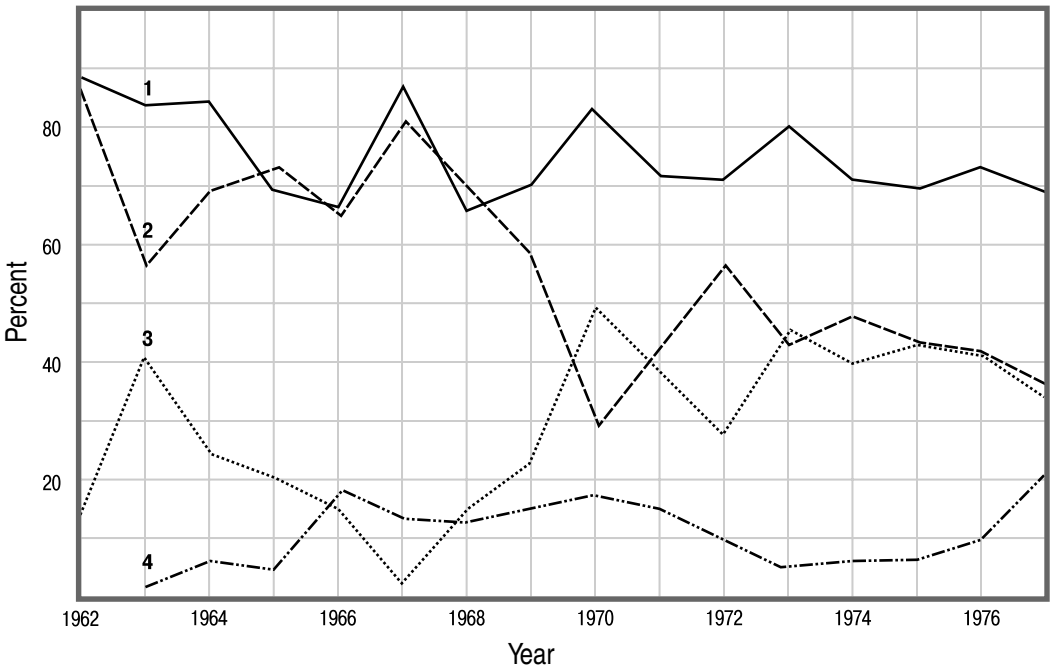
Appendix Figure 2. Areas of the AtlantNIRO second expedition operations in November 1960–March 1961.



Appendix Figure 3. Echogram of herring concentration on Banqereau Bank recorded at 6:25 pm on 4 November 1961 (echo sounder NEL-5r, 0–100 m range).

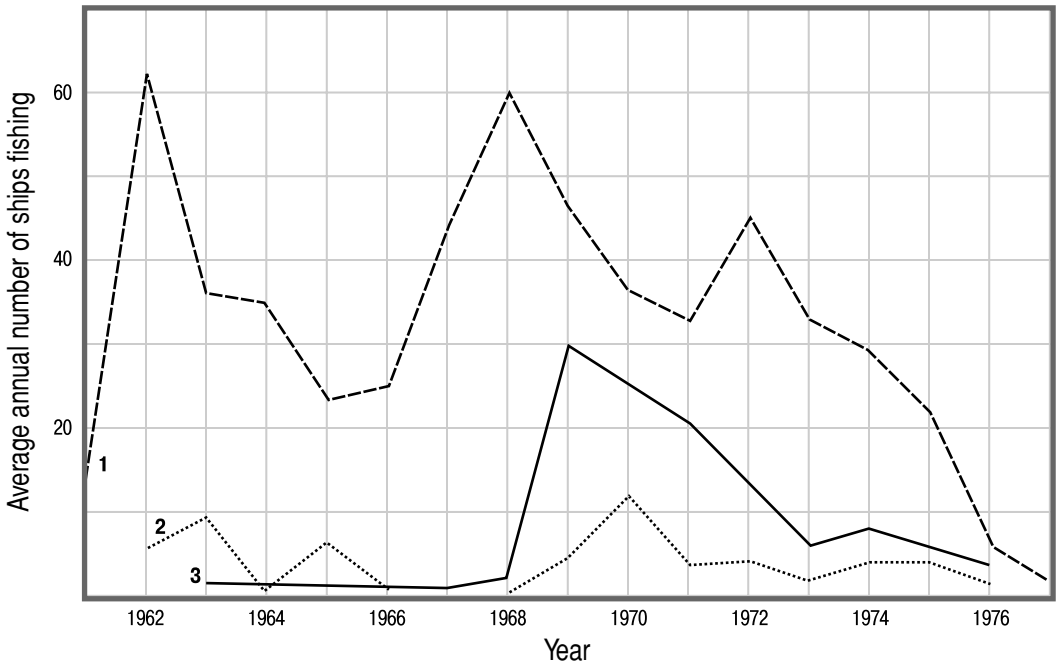


Appendix Figure 4. Hydrological sections and stations occupied by PINRO and Northern Fish Scouting Service ships in the Northwest Atlantic, 1960–62.

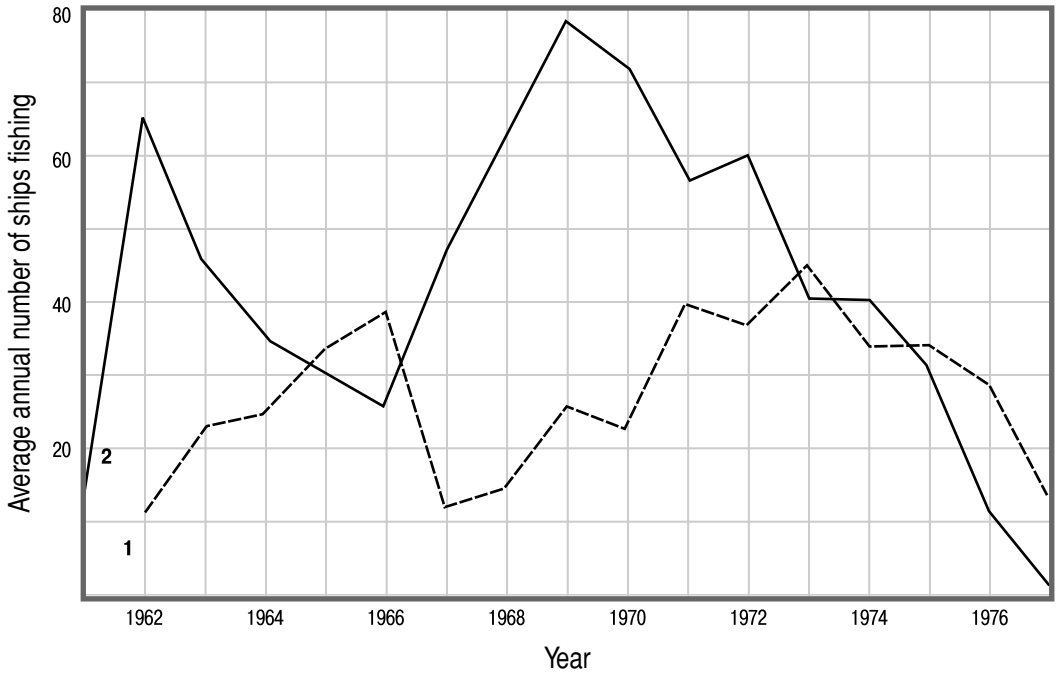


Appendix Figure 5. The combined catch of four species (silver hake, red hake, herring, and mackerel) expressed as a percentage of the total catch from the Region (1), off New England (2), off Nova Scotia (3), and off Norfolk (4), 1962–77.

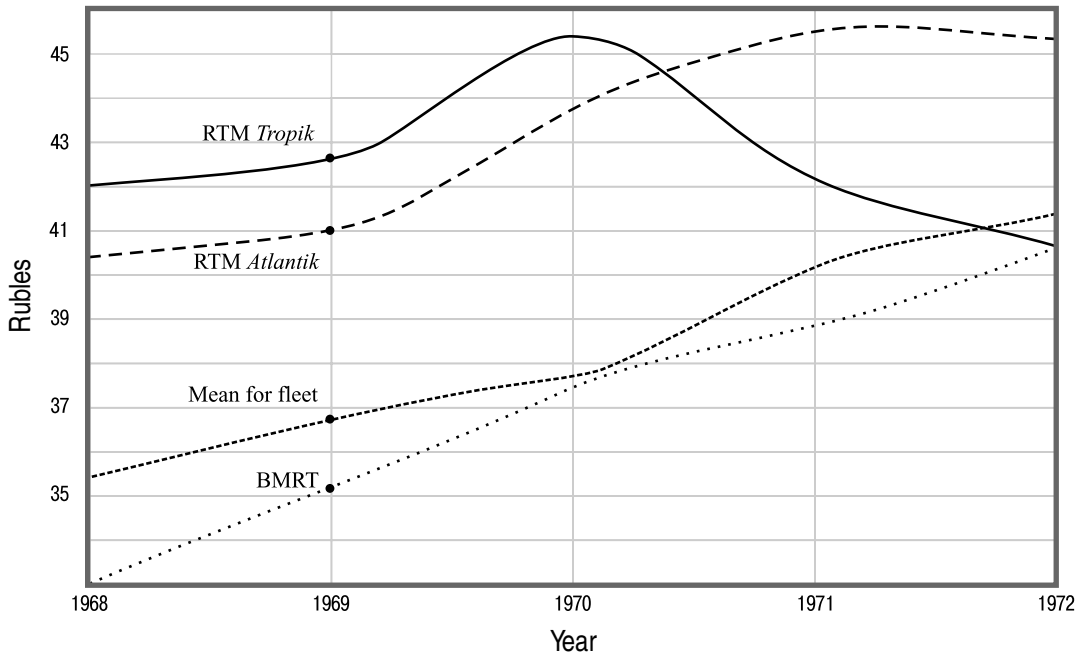
Appendix Figure 6. Variation in the average annual number of large-tonnage ships fishing in the areas of New England (1), Nova Scotia (2), and Norfolk (3), 1961–77.



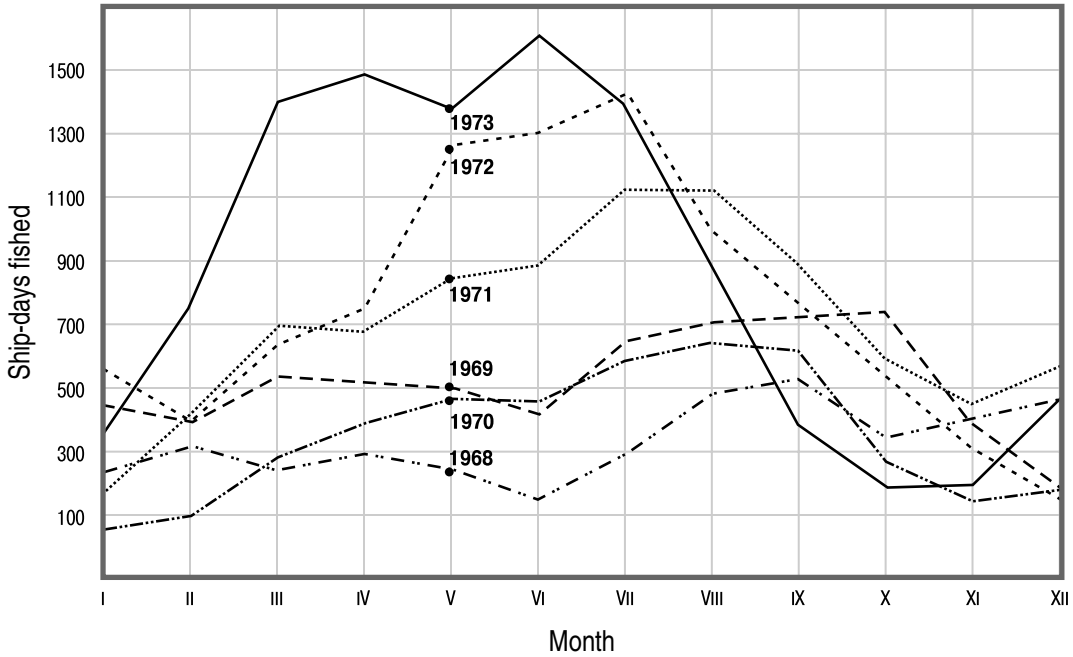
Appendix Figure 7. Variation in the average annual number of medium-tonnage ships fishing in the areas of New England (1), Nova Scotia (2), and Norfolk (3), 1961–77.



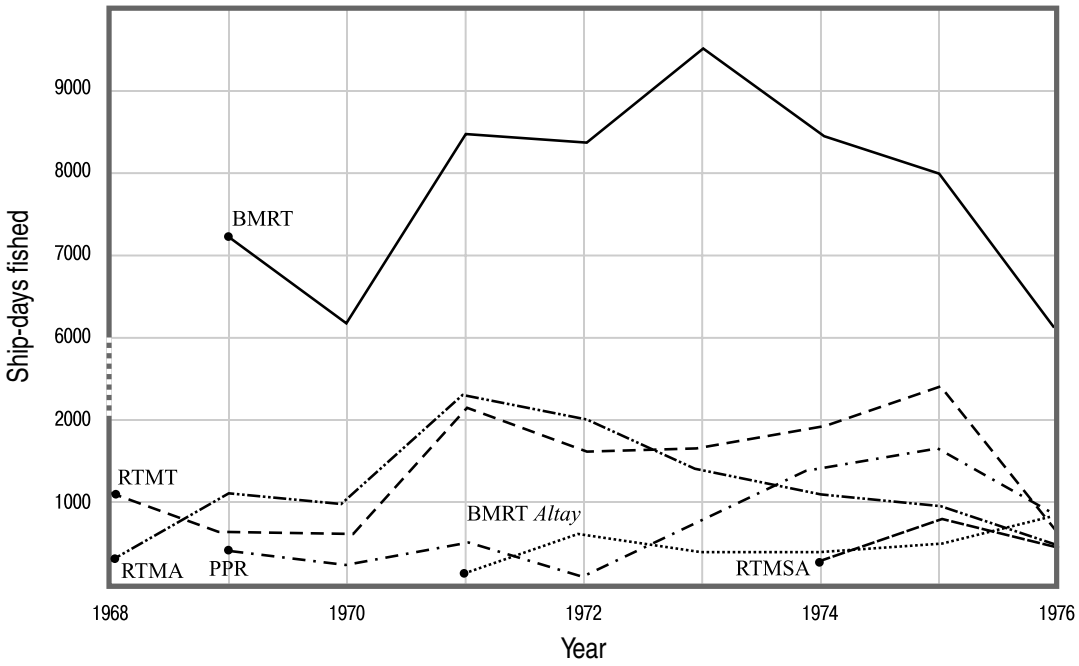
Appendix Figure 8. Variation in the average annual number of large- (1) and medium-tonnage (2) ships fishing in the Region, 1961–77.



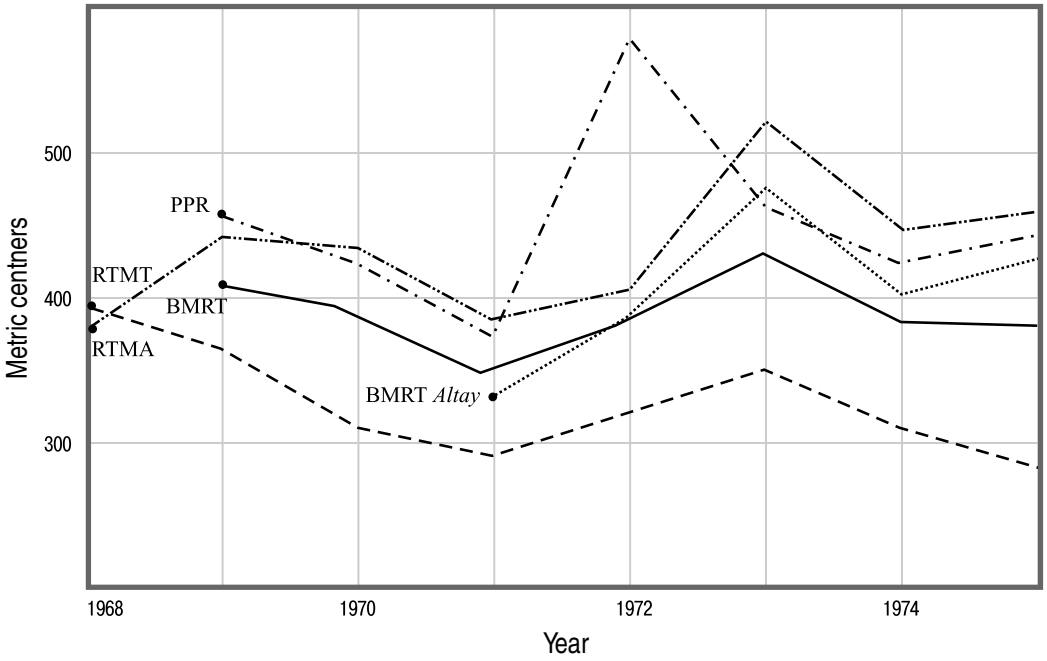
Appendix Figure 9. Variation in mean price per production unit (metric centner) for large trawlers in the Region, 1968–72.



Appendix Figure 10. Intra- and interyear variations in fishing effort (ship-days fished) for large trawlers of HO Zapryba in the Region, 1968–73.

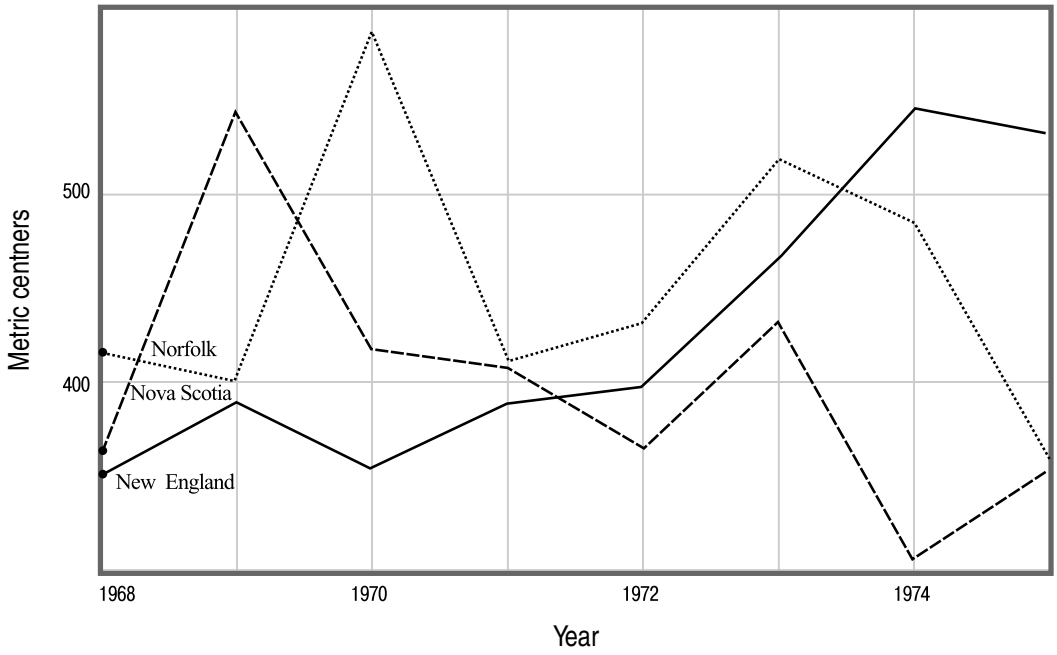


Appendix Figure 11. Interyear variations in fishing effort (ship-days fished) for U.S.S.R. large trawlers in the Region,1968–76.

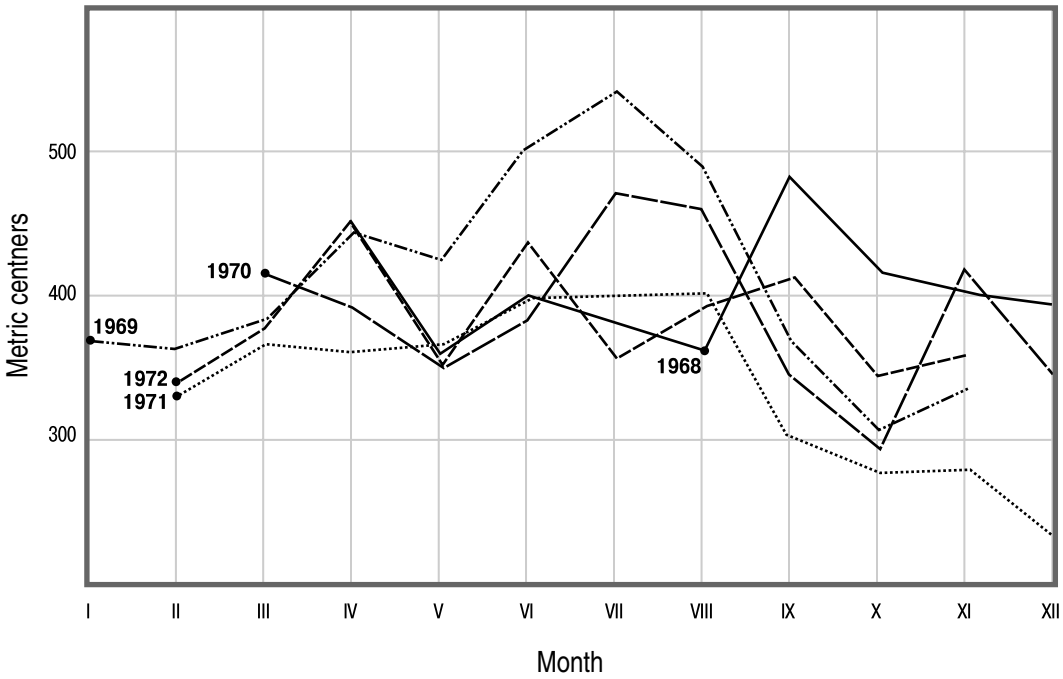


Appendix Figure 12. Interyear variations in fishing productivity (catch per ship-day fished) for U.S.S.R. large trawlers in the Region, 1968–75.

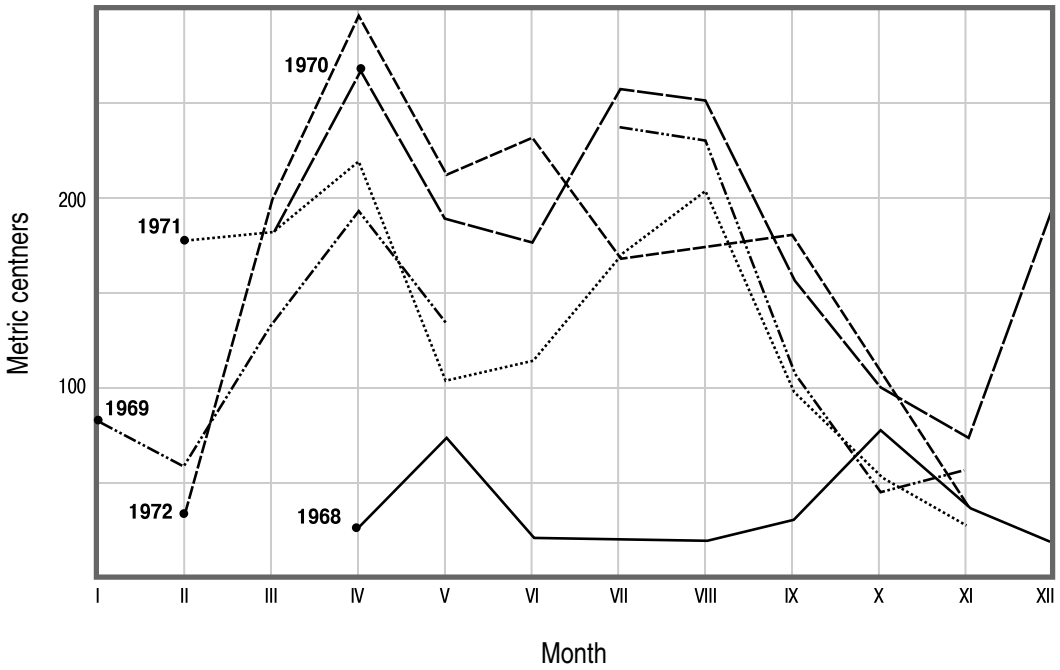
Appendix Figure 13. Interyear variations in fishing productivity (catch per ship-day fished) for BMRTs of HO Zapryba in the Region, 1968–75.



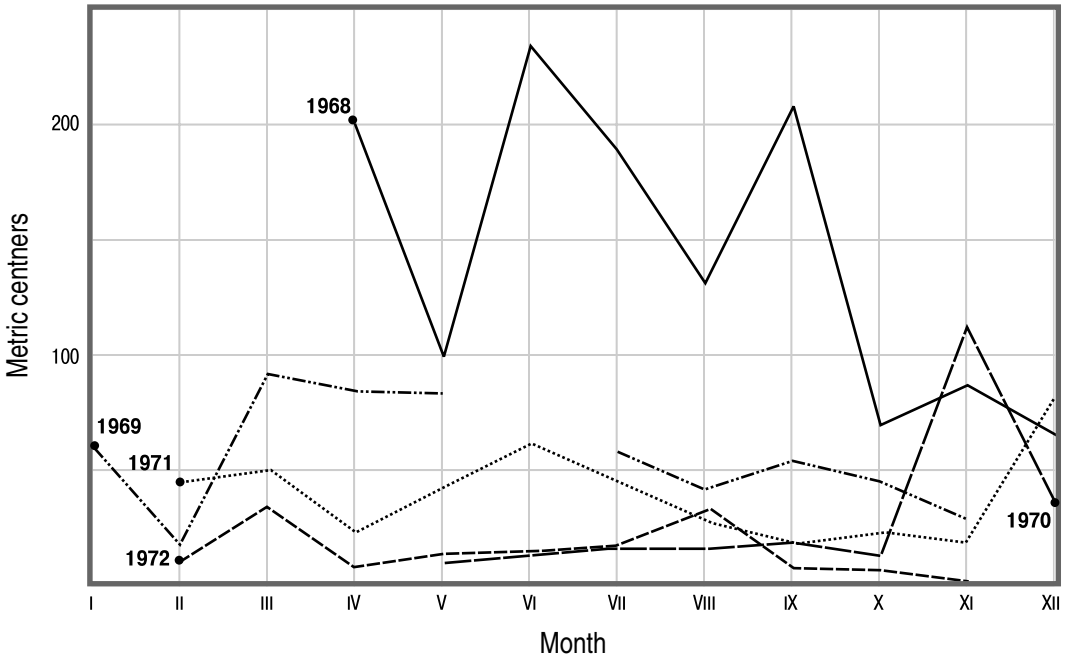
Appendix Figure 14. Interyear variations in fishing productivity (catch per ship-day fished) for RTMAs of HO Zapryba in the Region, 1968–75.



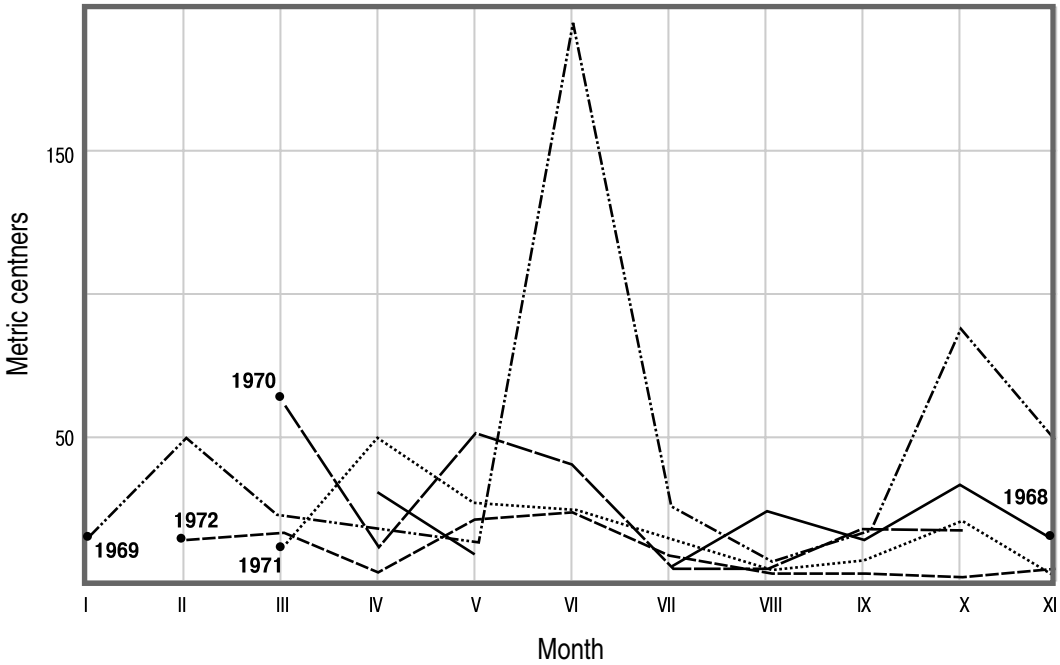
Appendix Figure 15. Intra- and interyear variations in fishing productivity (catch per ship-day fished) for BMRTs of HO Zapryba off Nova Scotia, 1968–72.



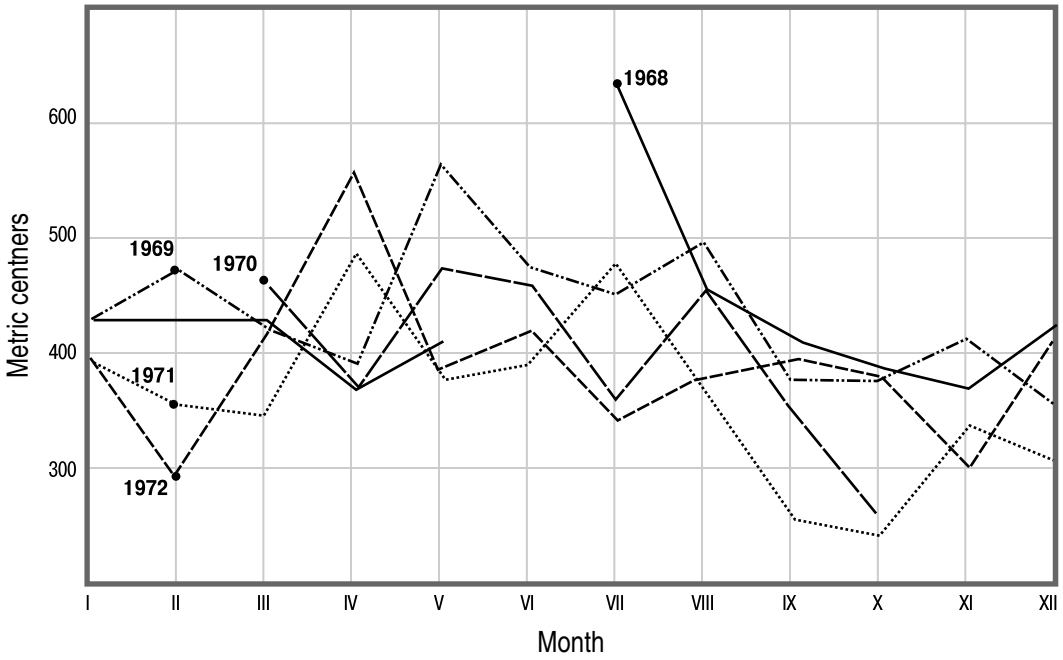
Appendix Figure 16. Intra- and interyear variations in the silver hake catch (catch per ship-day fished) by BMRTs of HO Zapryba off Nova Scotia, (1968–72).



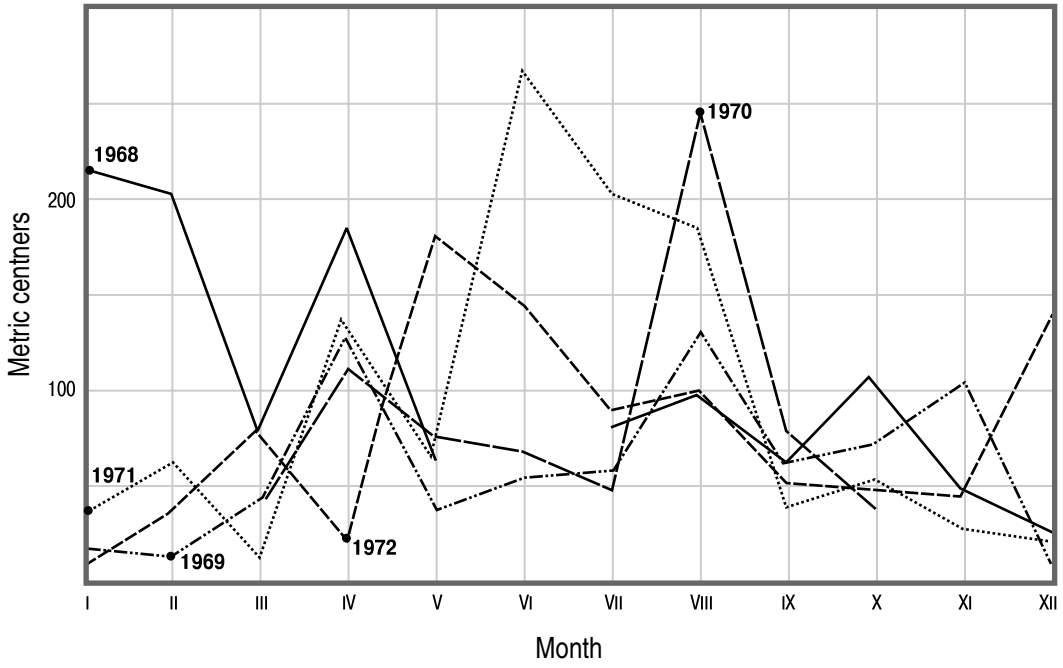
Appendix Figure 17. Intra- and interyear variations in the flounder catch (catch per ship-day fished) by BMRTs of HO Zapryba off Nova Scotia, 1968–72.



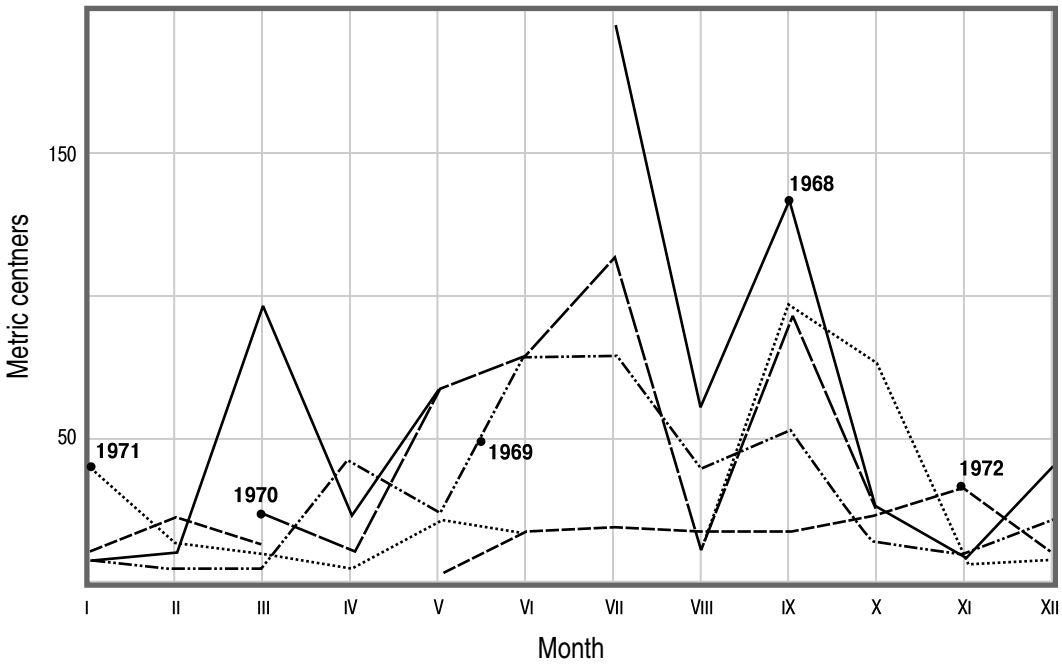
Appendix Figure 18. Intra- and interyear variations in the herring catch (catch per ship-day fished) by BMRTs of HO Zapryba off Nova Scotia, 1968–72.



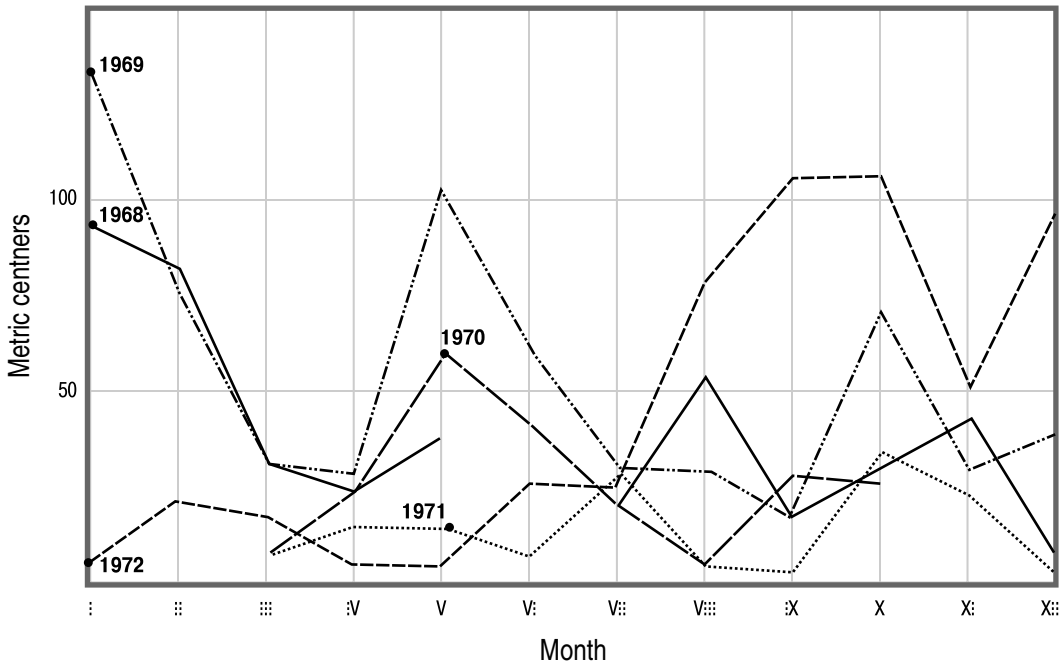
Appendix Figure 19. Intra- and interyear variations in fishing productivity (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



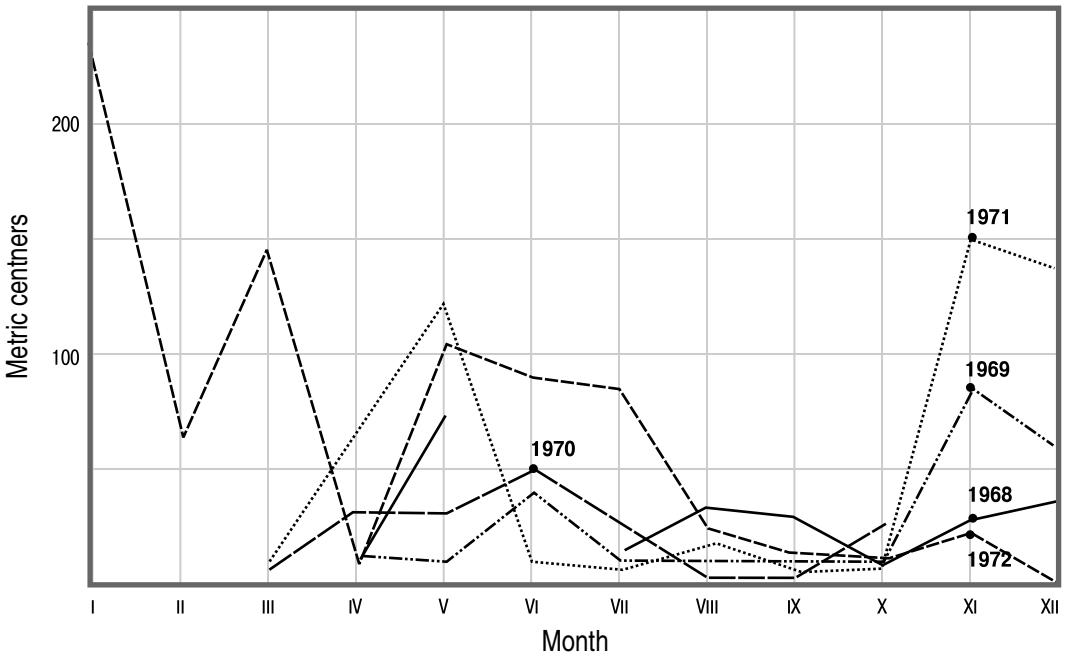
Appendix Figure 20. Intra- and interyear variations in the silver hake catch (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



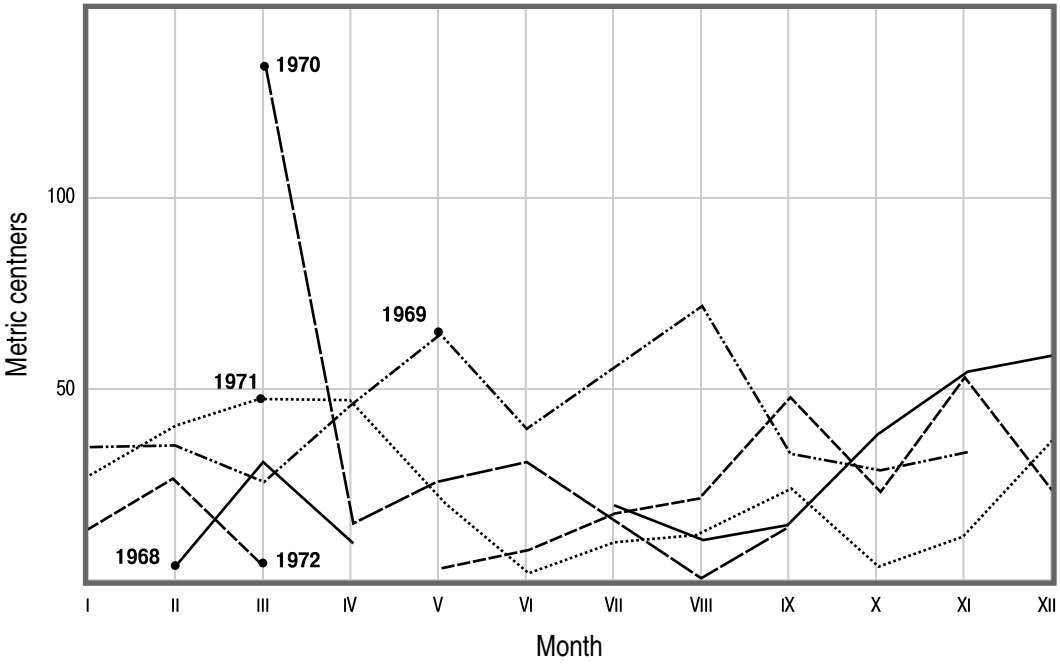
Appendix Figure 21. Intra- and interyear variations in the herring catch (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



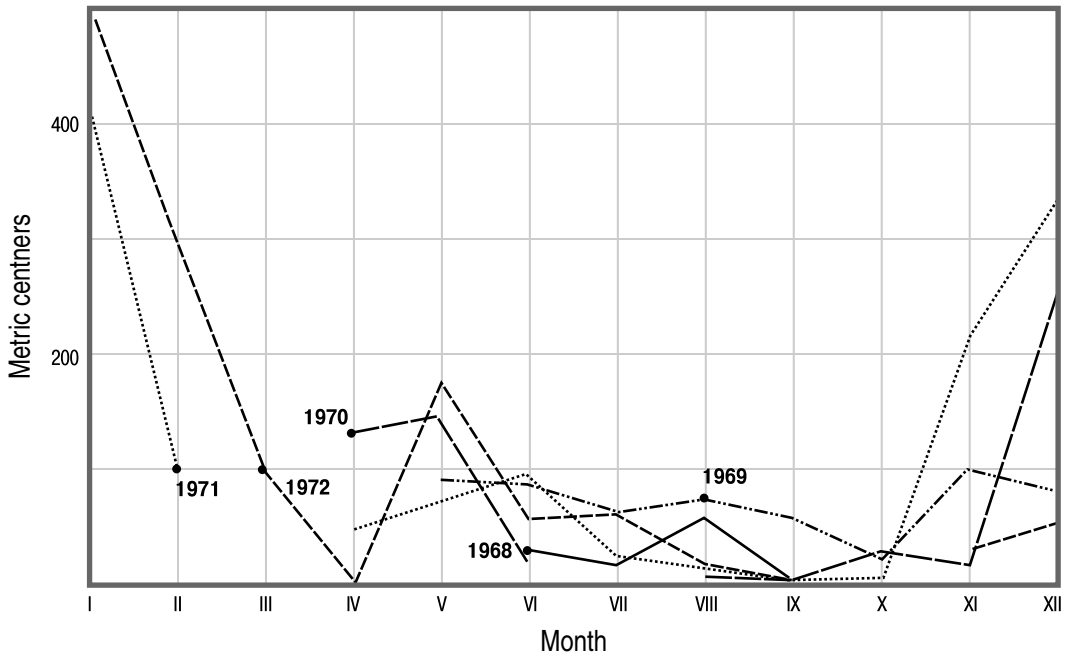
Appendix Figure 22. Intra- and interyear variations in the red hake catch (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



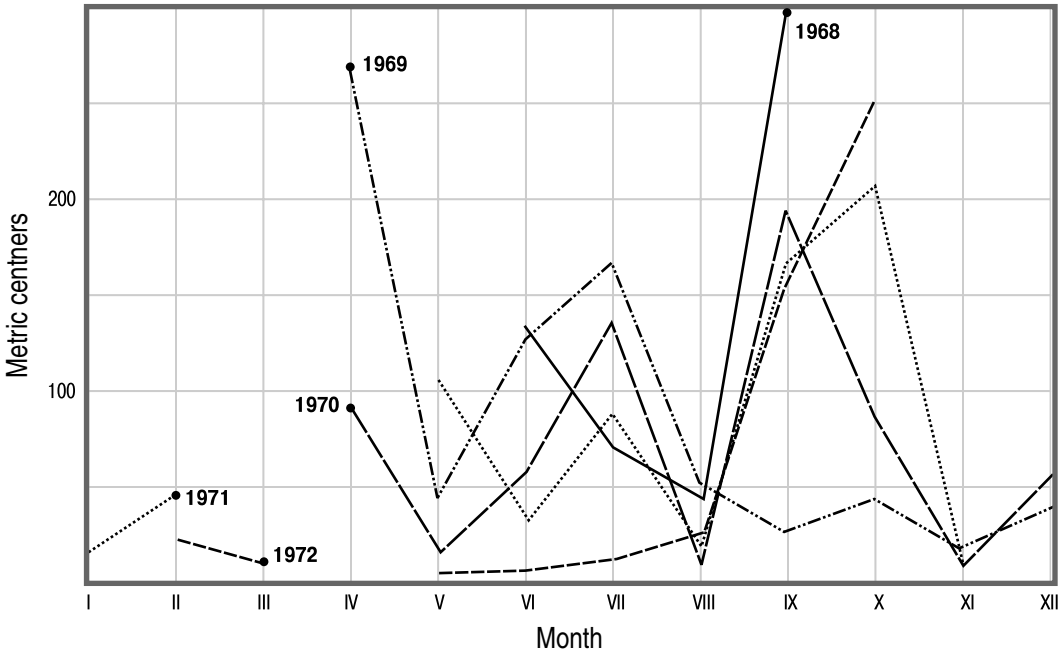
Appendix Figure 23. Intra- and interyear variations in the mackerel catch (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



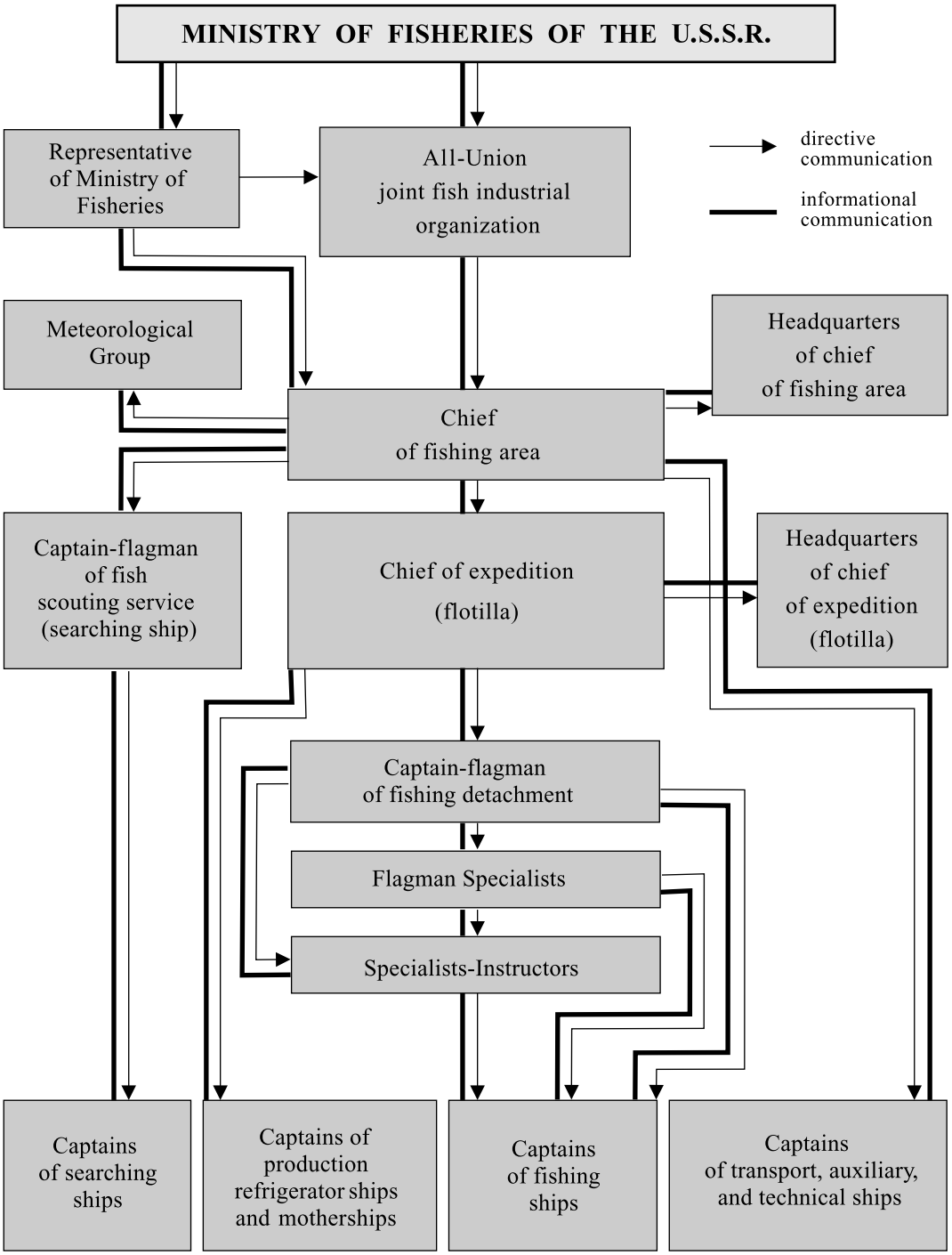
Appendix Figure 24. Intra- and interyear variations in the flounder catch (catch per ship-day fished) by BMRTs of HO Zapryba off New England, 1968–72.



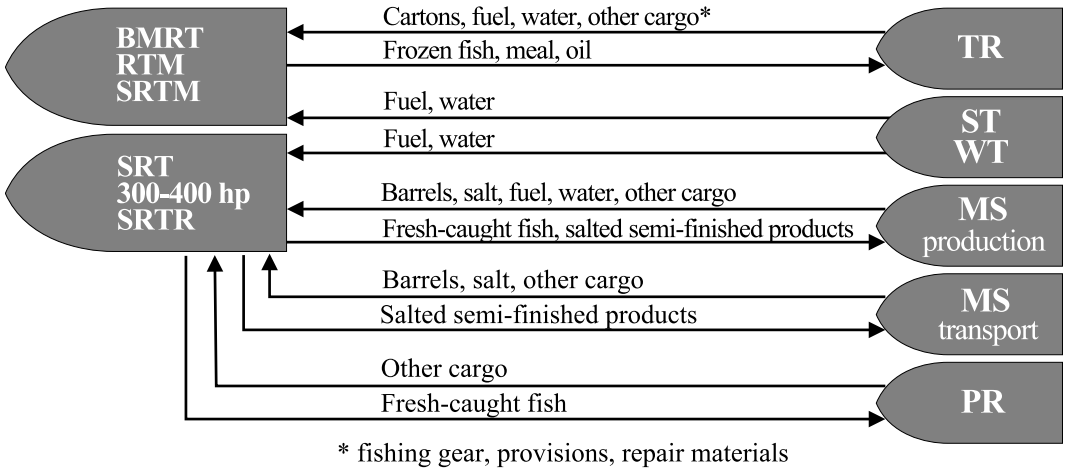
Appendix Figure 25. Intra- and interyear variations in the mackerel catch (catch per ship-day fished) by RTMAs of HO Zapryba off New England, 1968–72.



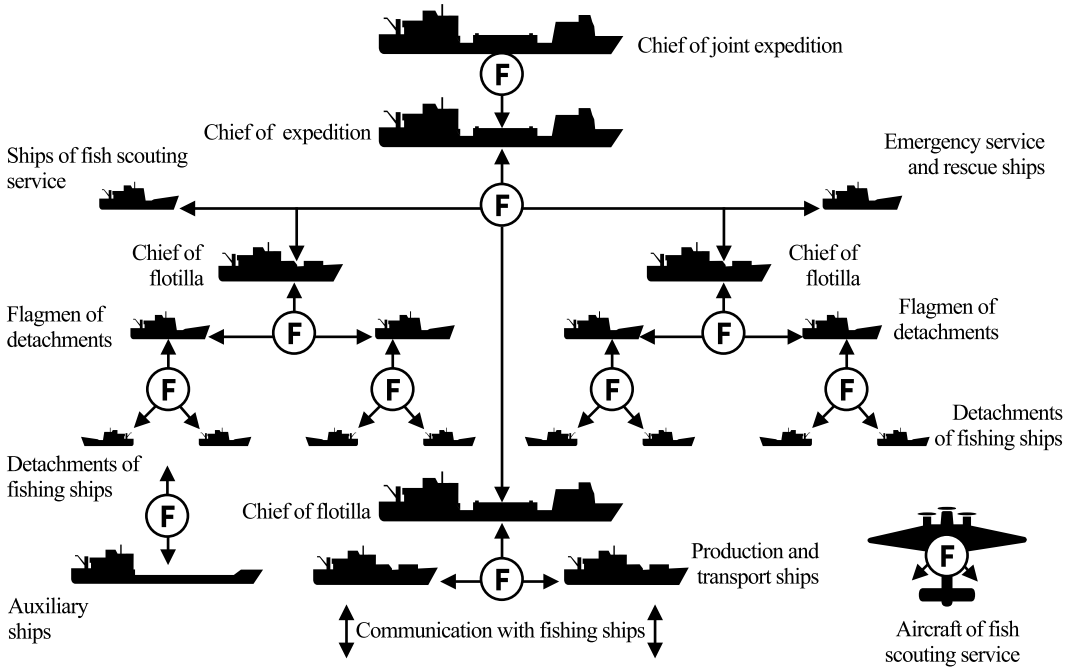
Appendix Figure 26. Intra- and interyear variations in the herring catch (catch per ship-day fished) by RTMAs of HO Zapryba off New England, 1968–72.



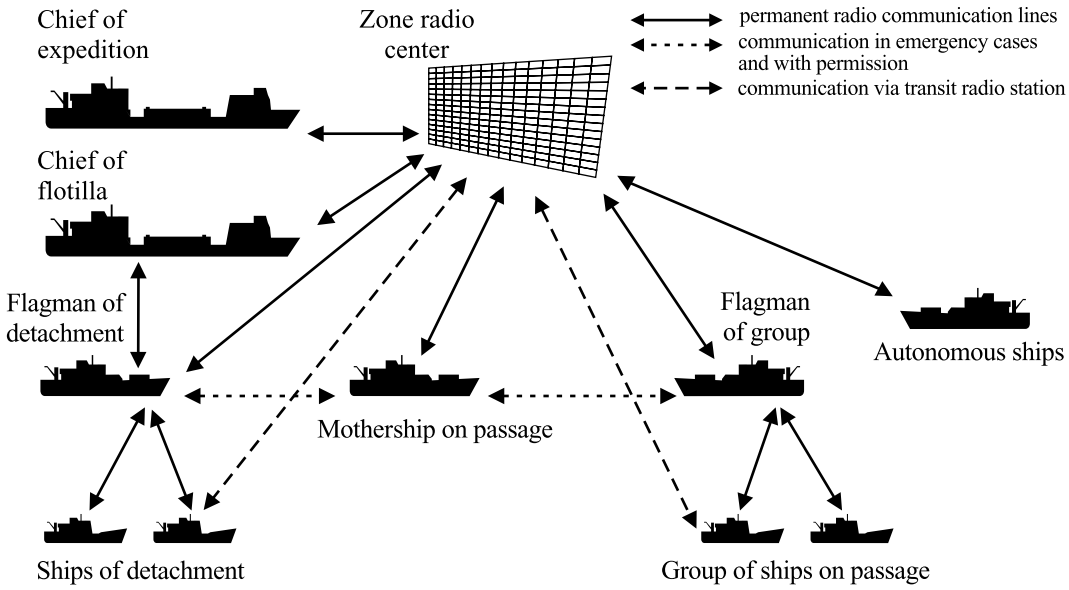
Appendix Figure 27. Standard structure of fleet management in fishing areas.



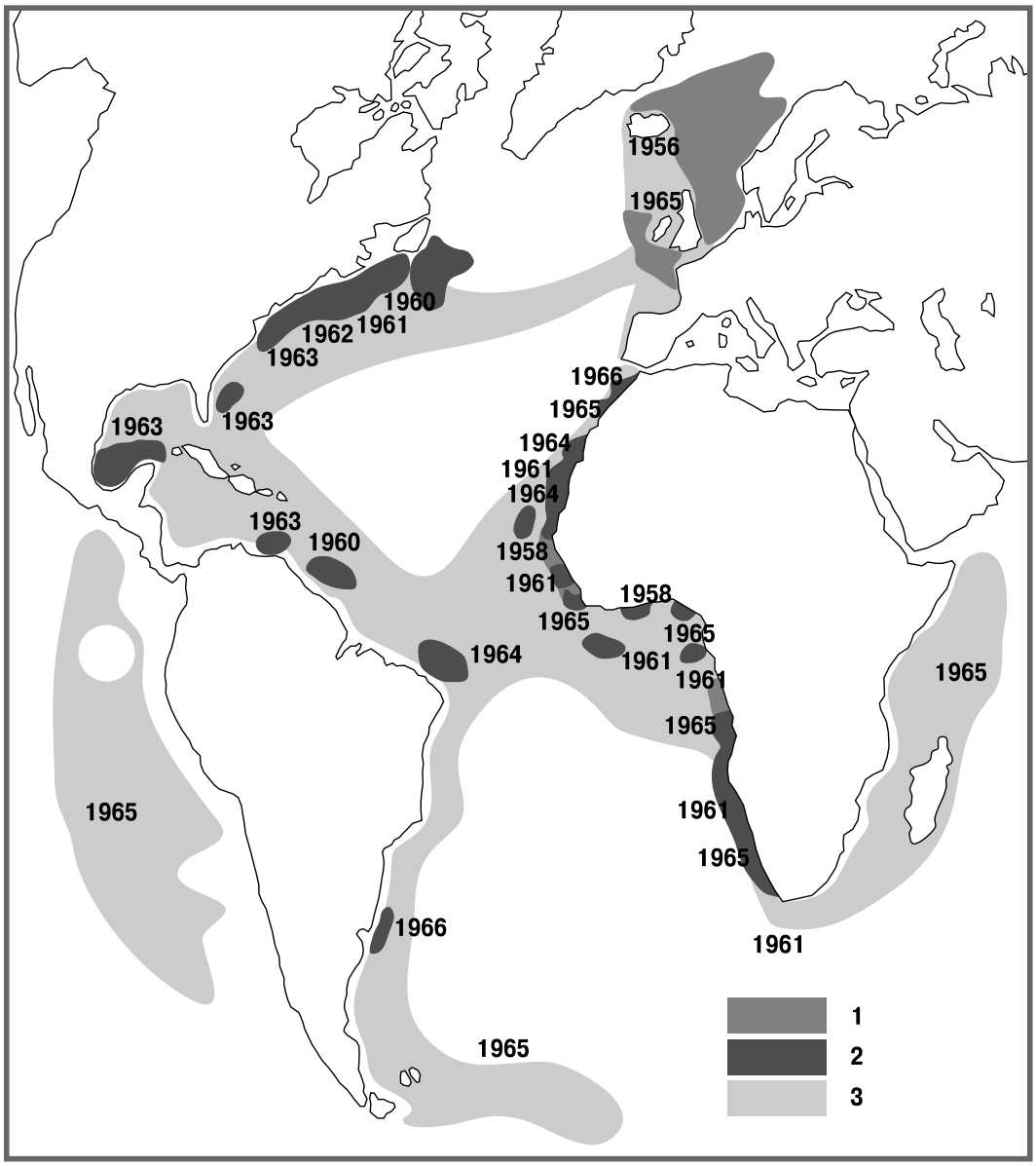
Appendix Figure 28. Scheme of interaction between fishing vessels and service ships.



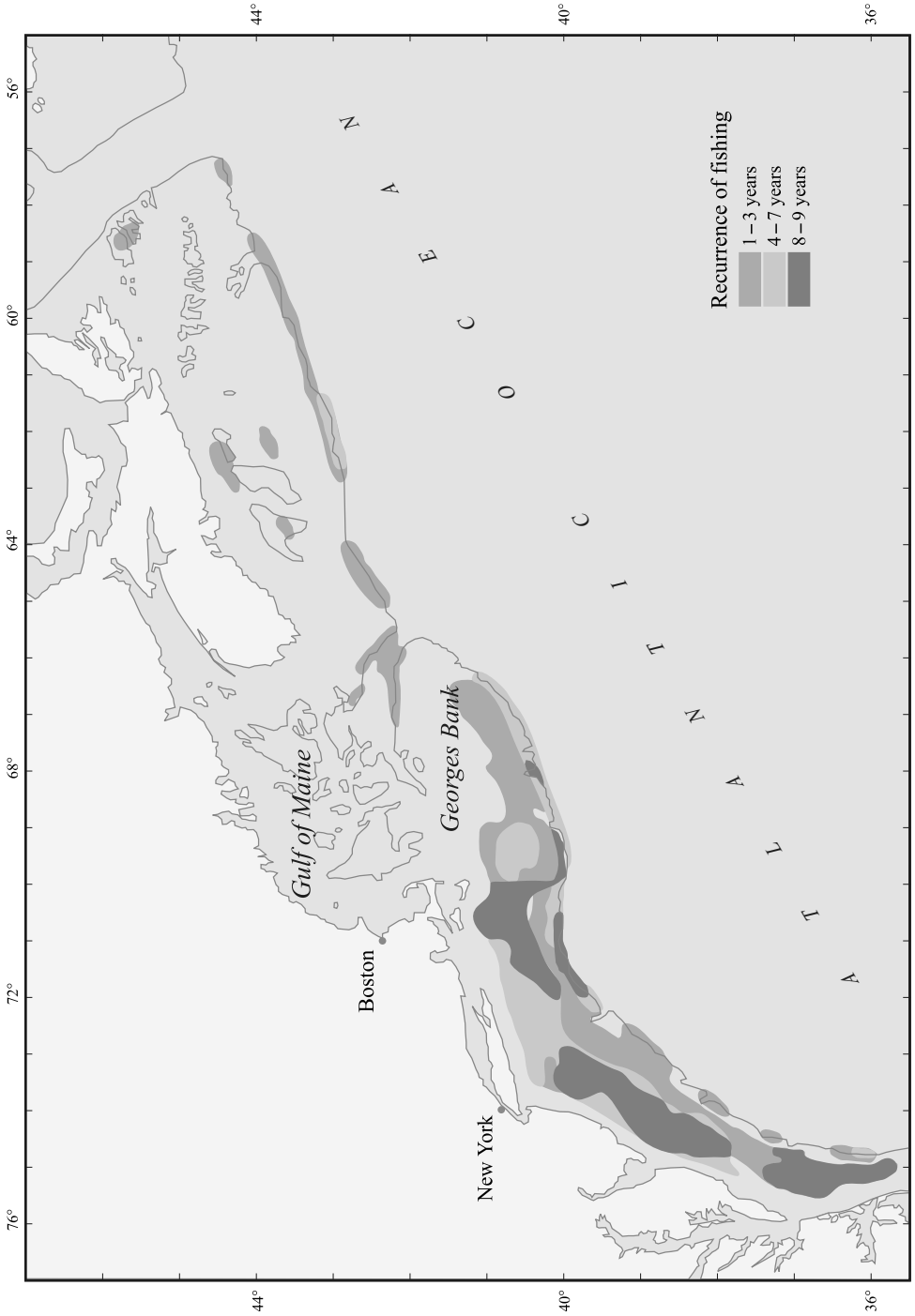
Appendix Figure 29. Scheme of internal radio communication during the joint expedition fishery.



Appendix Figure 30. Scheme of radio communication between expedition ships and land radio stations.

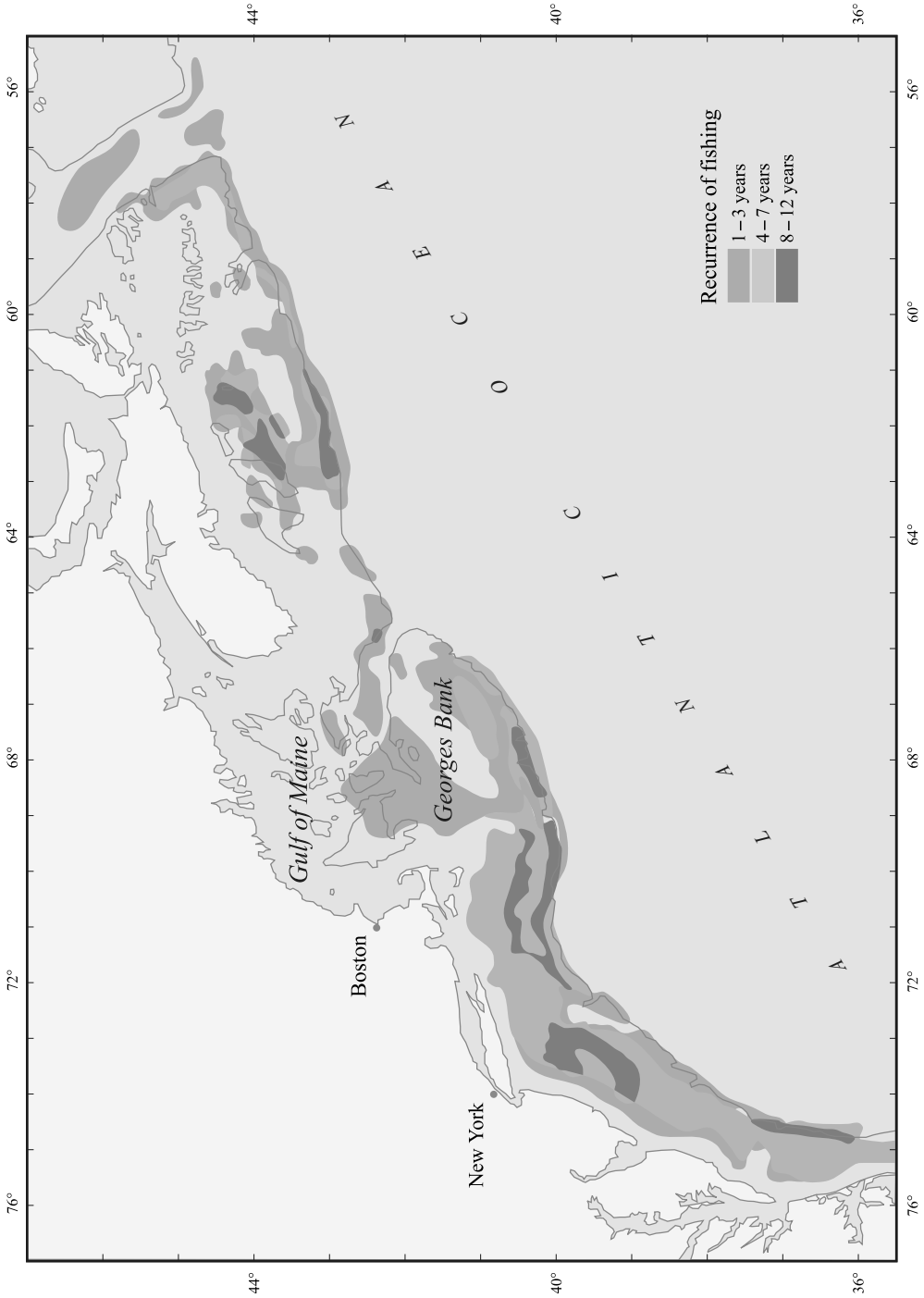


Appendix Figure 31. Areas of fishery revealed by the Atlantic Scientific Fish Prospecting Scouting Service, 1958–66: 1—fishing areas in 1958; 2—fishing areas in 1966; 3—areas investigated by 1966.

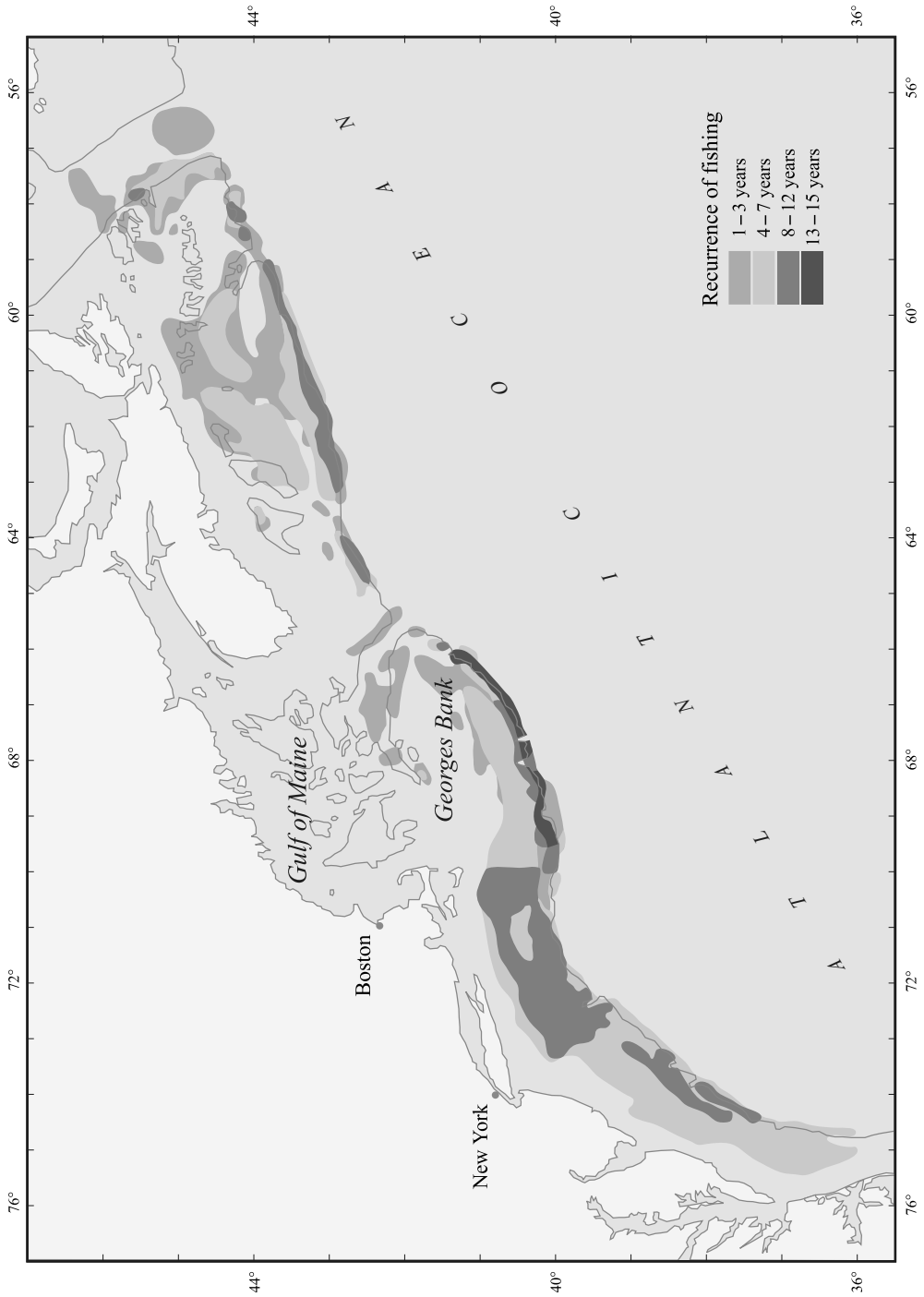


Appendix Figure 32. Long-term distribution of the fishery by Soviet vessels of all classes and types in January.

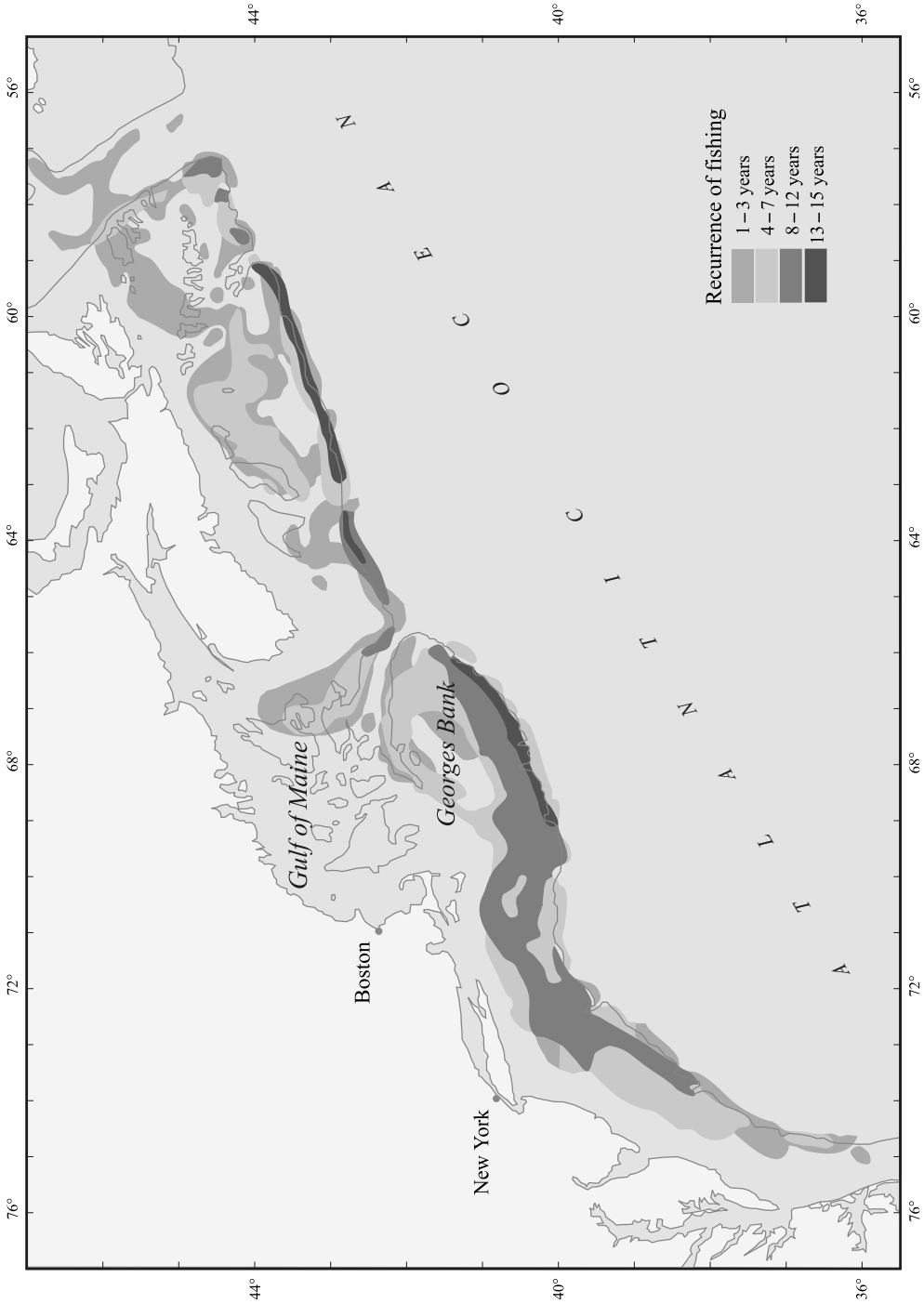
Appendix Figure 33. Long-term distribution of the fishery by Soviet vessels of all classes and types in February.



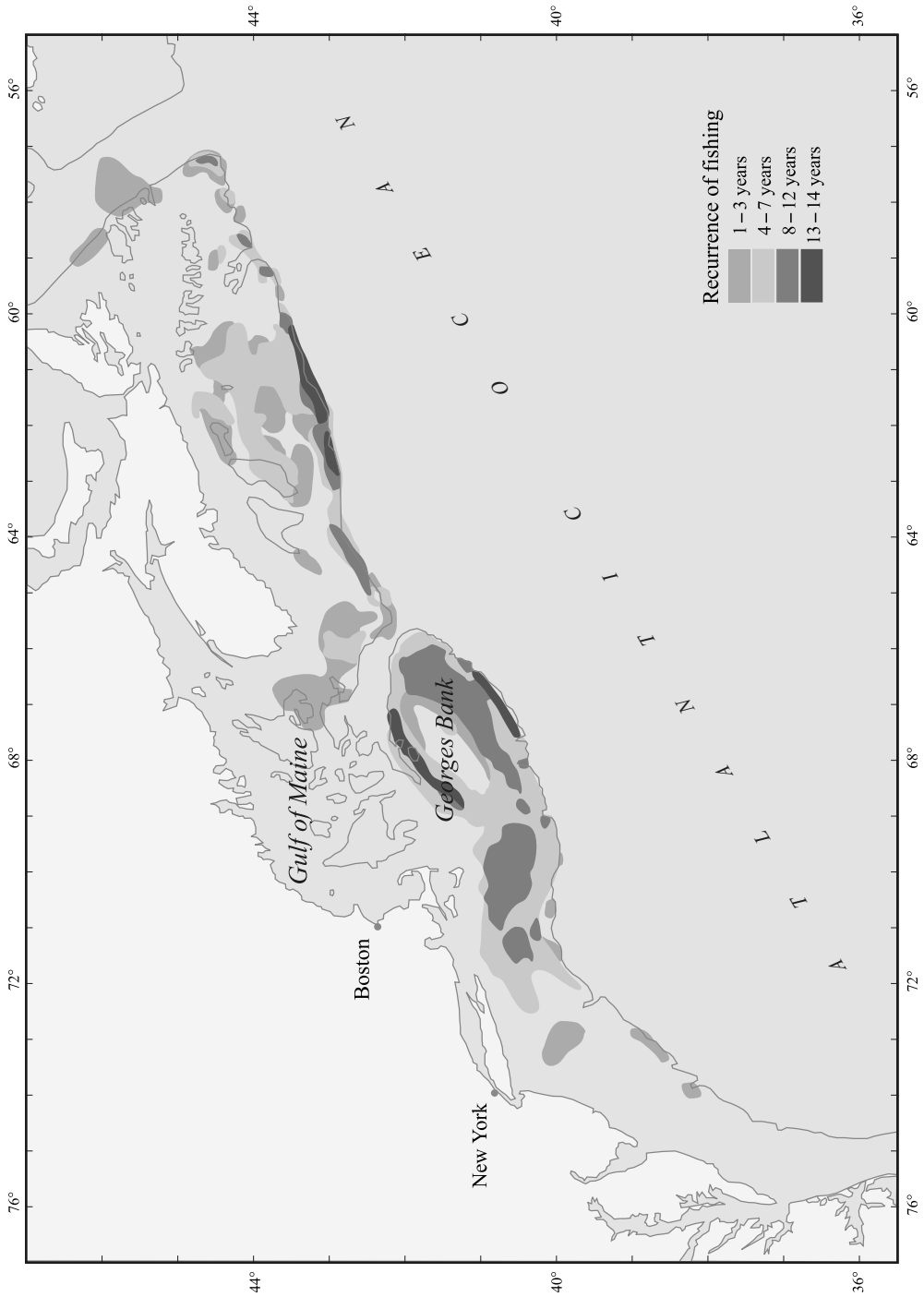
Appendix Figure 34. Long-term distribution of the fishery by Soviet vessels of all classes and types in March.



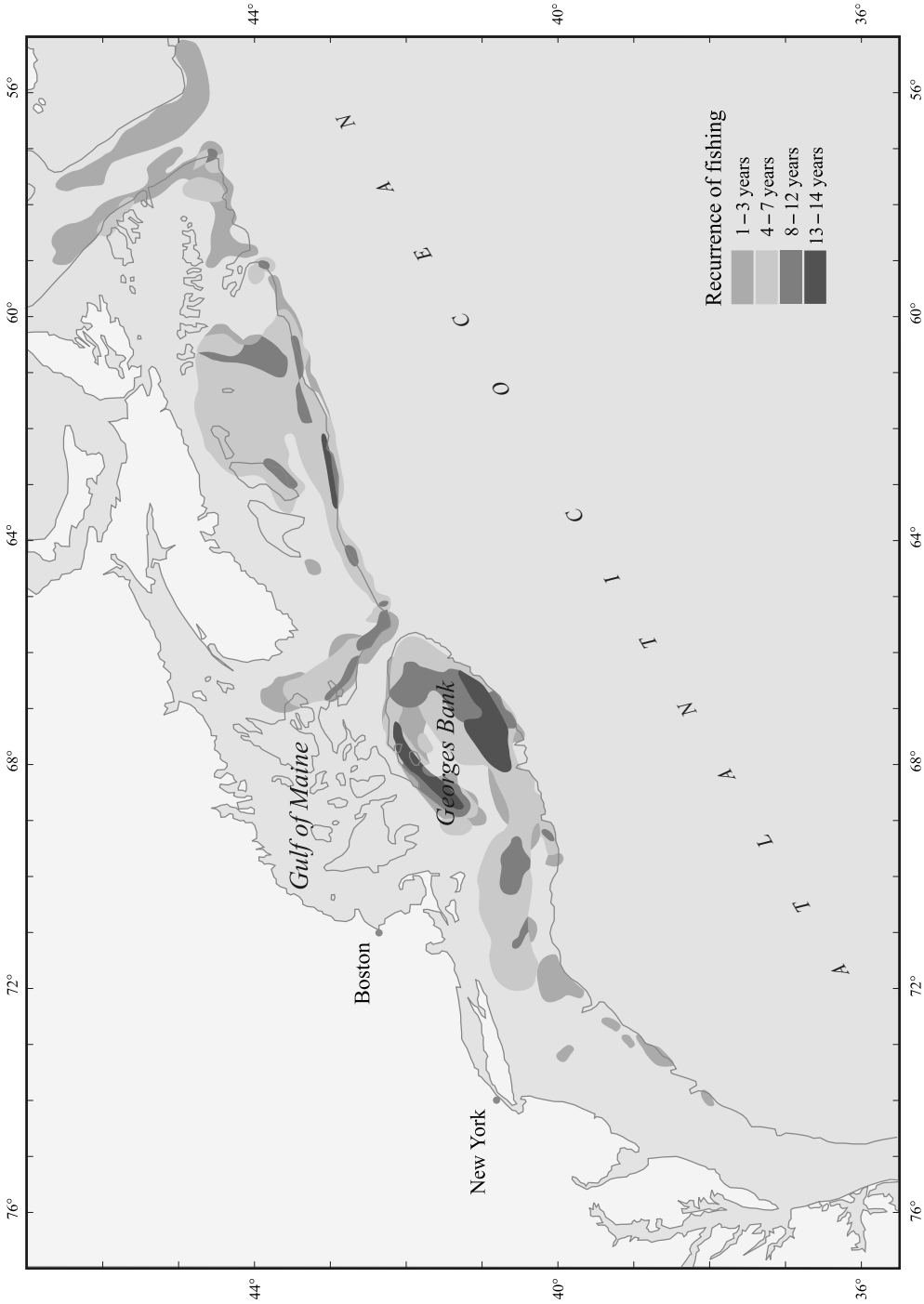
Appendix Figure 35. Long-term distribution of the fishery by Soviet vessels of all classes and types in April.



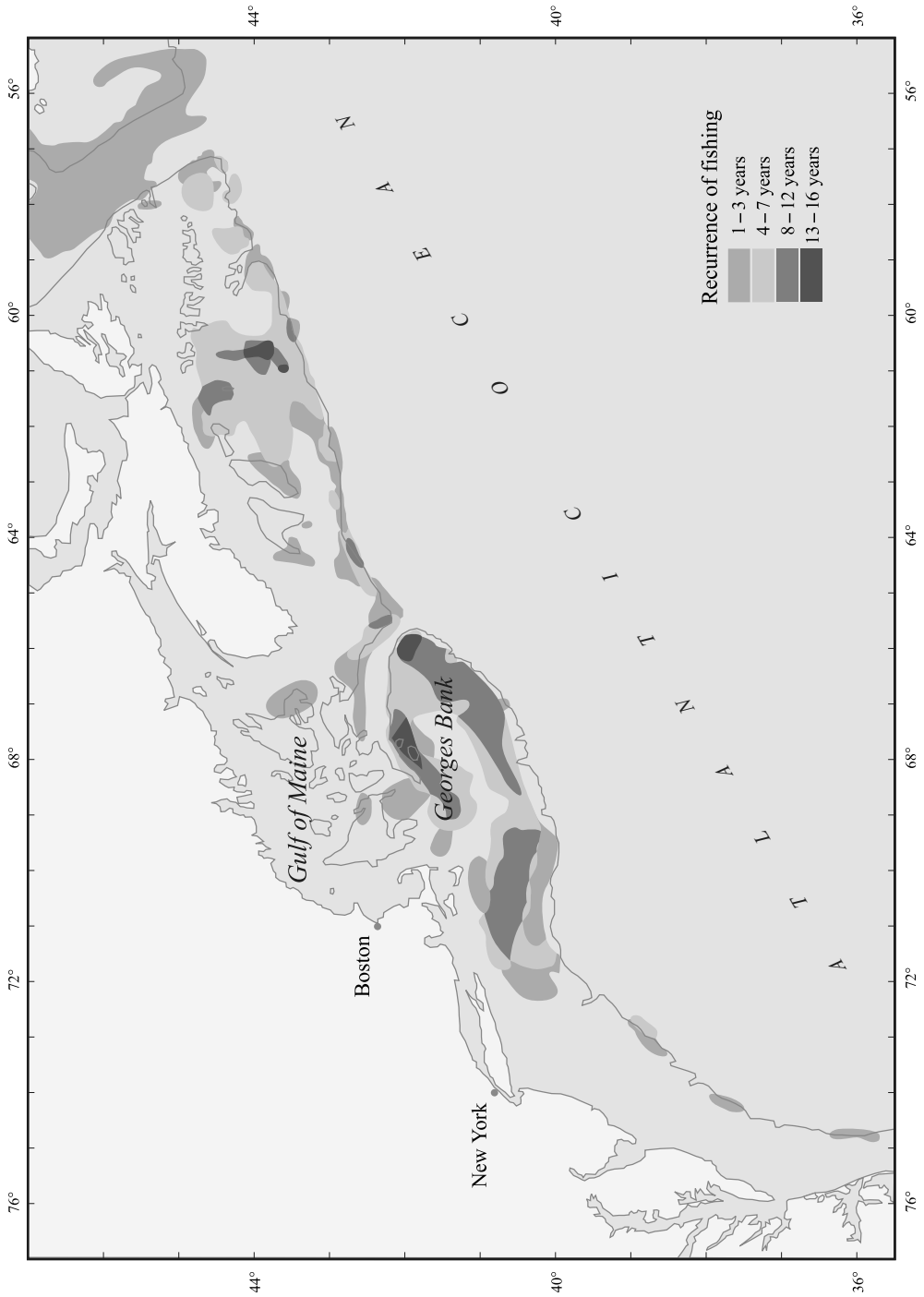
Appendix Figure 36. Long-term distribution of the fishery by Soviet vessels of all classes and types in May.



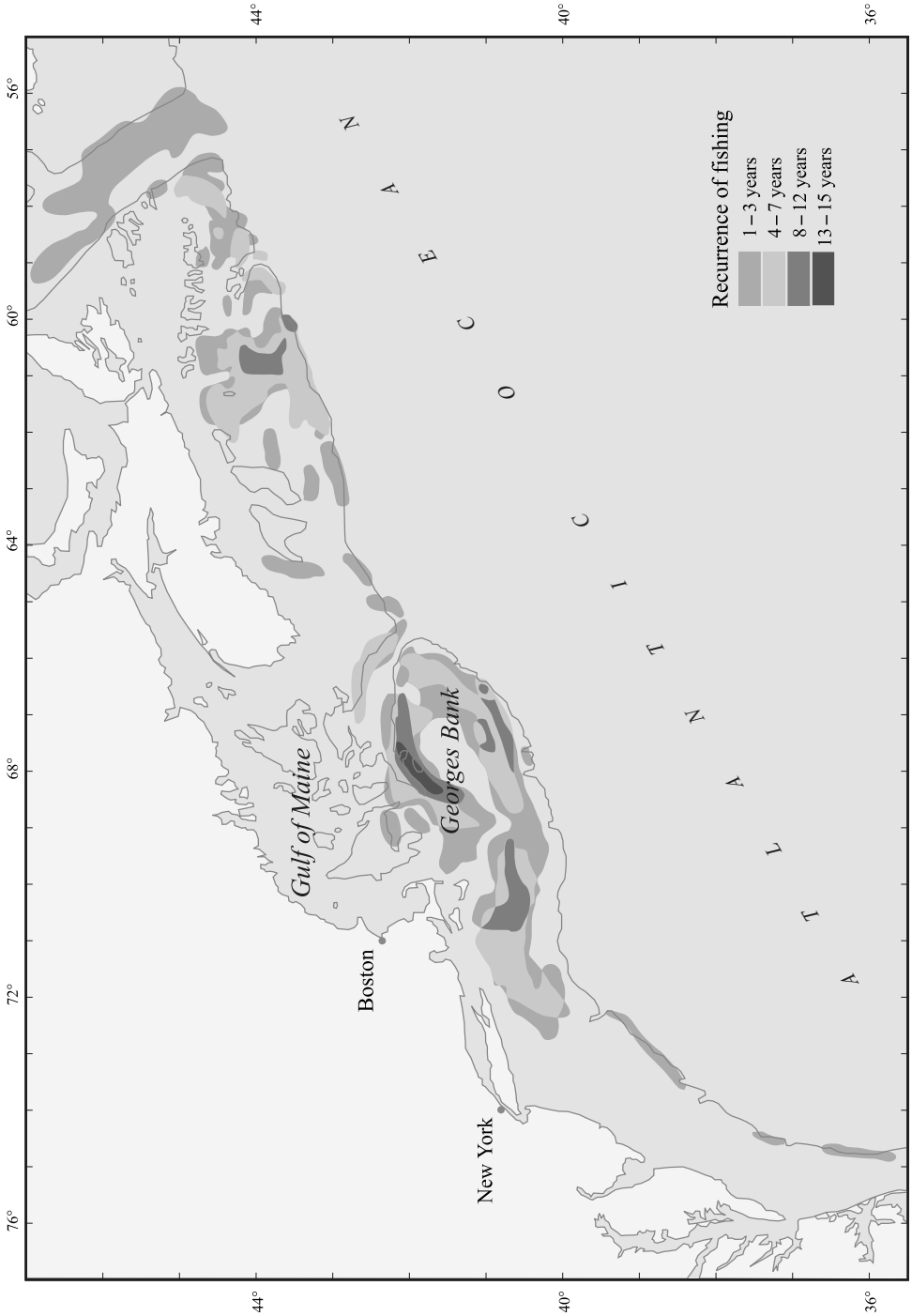
Appendix Figure 37. Long-term distribution of the fishery by Soviet vessels of all classes and types in June.



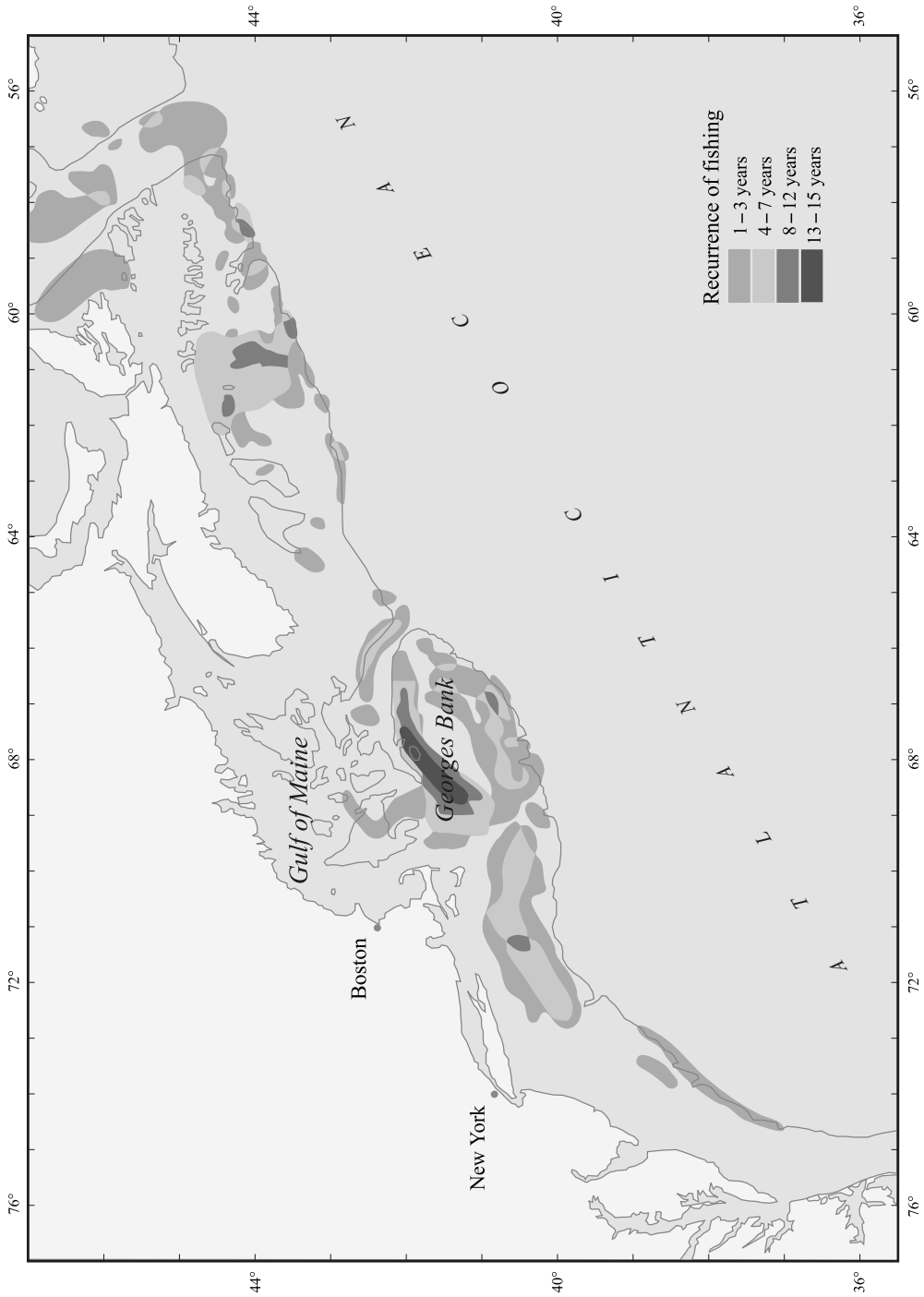
Appendix Figure 38. Long-term distribution of the fishery by Soviet vessels of all classes and types in July.



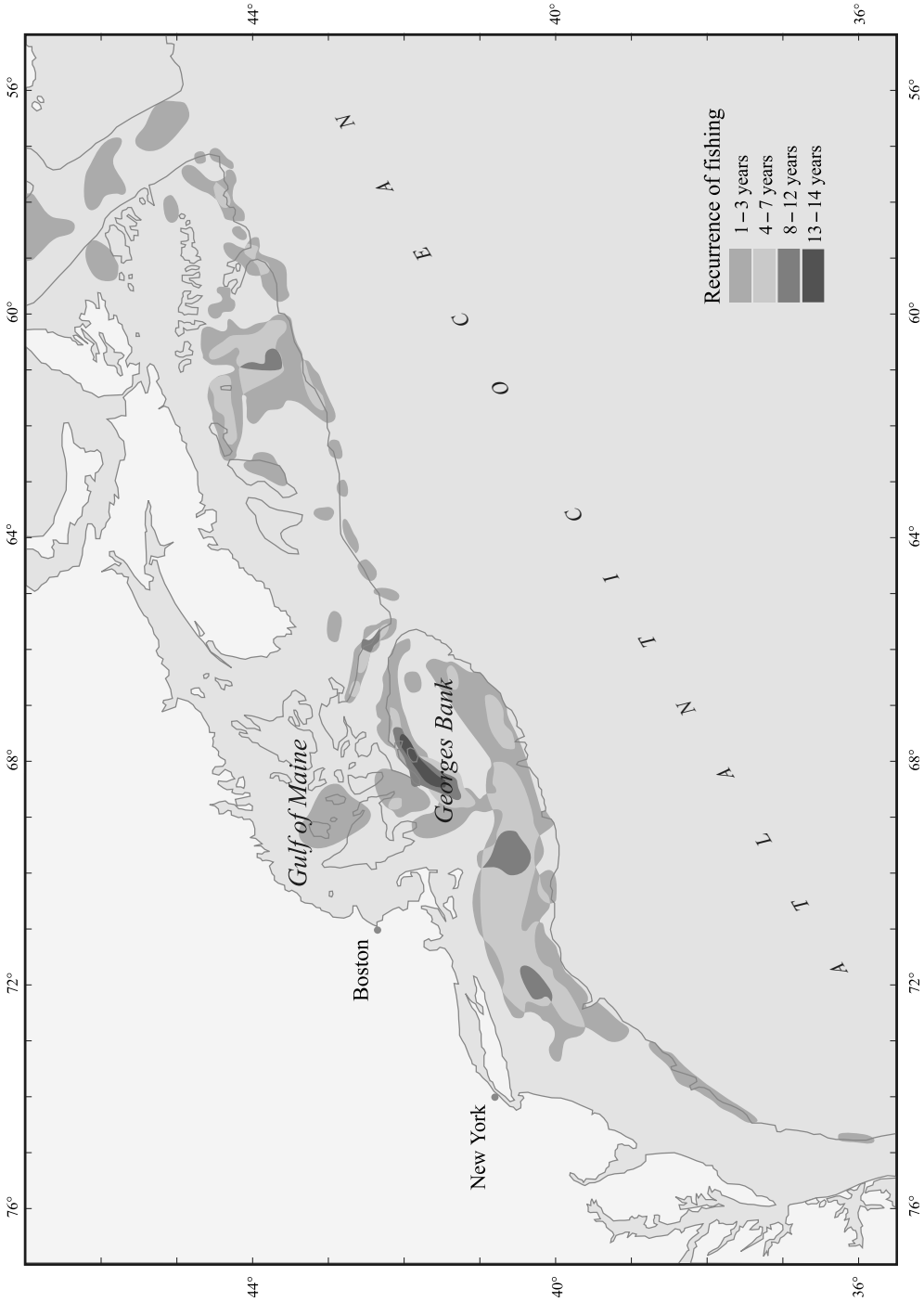
Appendix Figure 39. Long-term distribution of the fishery by Soviet vessels of all classes and types in August.



Appendix Figure 40. Long-term distribution of the fishery by Soviet vessels of all classes and types in September.



Appendix Figure 41. Long-term distribution of the fishery by Soviet vessels of all classes and types in October.



Appendix Figure 42. Long-term distribution of the fishery by Soviet vessels of all classes and types in November.

Appendix Figure 43. Long-term distribution of the fishery by Soviet vessels of all classes and types in December.

Appendix Table 1. Species composition of catches by the Soviet fleet in the Nova Scotia area, 1962–77.

Species	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Cod	2	10	10	10	10	2	6	3	2	5	5	3	3	3	1	<1
	7	6	9	7	10	18	9	2	1	2	3	1	1	1	<1	<1
Haddock	3	4	5	45	21	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1
	10	2	4	32	20	2	<1	1	<1	<1	<1	<1	<1	<1	<1	<1
Redfish	4	12	4	2	14	<1	<1	2	13	28	12	11	7	5	1	<1
	13	7	3	1	14	1	<1	1	5	8	6	3	3	2	<1	<1
Silver hake	9	123	81	50	10	2	3	46	169	129	114	299	95	112	81	33
	30	75	70	36	10	18	5	30	60	48	57	71	38	43	43	57
Red hake	–	1	2	7	2	<1	<1	<1	1	2	1	2	3	3	1	<1
		1	2	5	2	2	<1	<1	<1	1	<1	<1	1	1	<1	<1
Pollock	–	<1	3	<1	7	<1	<1	<1	<1	1	2	<1	2	2	1	<1
		<1	3	<1	7	2	<1	<1	<1	<1	1	<1	1	1	<1	<1
Flounder	<1	<1	<1	8	14	<1	30	13	8	20	10	17	13	11	8	<1
	<1	<1	<1	6	14	1	45	9	3	7	5	4	5	4	4	<1
Herring	9	3	2	6	2	<1	3	65	72	29	24	31	23	22	32	<1
	30	2	2	4	2	1	5	43	25	11	12	7	9	8	17	1
Mackerel	–	–	<1	<1	<1	<1	9	4	4	9	6	17	27	21	17	<1
			<1	<1	<1	1	14	3	1	3	3	4	11	8	9	1
Argentine	–	8	5	5	15	4	<1	4	2	4	5	1	17	15	7	<1
		5	4	4	15	36	<1	3	1	1	3	<1	7	6	4	1
Squid	–	–	–	<1	<1	–	<1	<1	1	7	2	9	<1	13	16	18
				<1	<1		<1	<1	<1	3	1	2	<1	5	8	31
Other	3	3	3	6	6	2	14	12	10	43	18	32	60	56	24	5
	10	2	3	4	6	18	21	8	4	16	9	8	24	21	13	9
Total	30	165	115	140	101	11	66	151	284	277	199	423	250	264	189	56
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Upper value in each horizontal band is catch (thousand t); lower value is the percentage of this species in the total catch in the area.

Appendix Table 2. Variations in the fishing effort of Soviet large-tonnage ships in the Nova Scotia, New England, and Norfolk areas and in the Region, 1961–77.

Area	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nova Scotia	–	696	3,994	3,227	3,029	3,016	318	1,677	2,871	5,405	6,823	4,813	9,333	6,209	6,823	5,400	1,356
		2	11	9	8	8	<1	4	8	15	18	13	26	17	17	15	4
New England	1,331	3,317	4,297	5,877	8,544	8,415	3,165	2,981	5,766	2,328	6,075	7,166	6,733	5,149	4,806	3,964	2,608
	4	9	12	16	23	23	9	8	16	6	17	20	18	14	13	11	7
Norfolk	–	–	155	195	572	2,746	1,012	928	1,044	644	1,692	1,514	897	942	980	1,198	1,023
					2	8	3	3	3	2	5	4	2	3	3	3	3
Region	1,331	4,013	8,446	9,299	12,145	14,177	4,495	5,586	9,681	8,377	14,590	13,493	16,963	12,300	12,609	10,562	4,987
	4	11	23	25	33	39	12	15	27	23	40	37	46	34	34	29	14

Note: Upper value in each horizontal band is the number of ship-days fished; lower value is the average number of ships fishing.

Appendix Table 3. Variations in the fishing effort of Soviet medium-tonnage ships in the Nova Scotia, New England, and Norfolk areas and in the Region, 1961–77.

Area	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nova Scotia	–	1,682	3,139	61	2,103	71	67	–	1,868	4,342	1,590	1,443	626	1,598	1,454	610	–
		4	9		6				5	12	4	4	2	4	4	2	
New England	4,613	22,603	13,102	12,600	8,574	9,329	16,463	21,952	16,593	12,968	11,900	16,284	11,992	10,446	8,146	2,227	712
	13	62	36	35	23	25	45	60	45	36	33	45	33	29	22	6	2
Norfolk	–	–	471	361	451	216	468	762	10,509	9,241	7,528	4,456	2,253	3,060	2,119	1,471	52
			1	1	1	1	1	2	29	25	20	12	6	8	6	4	
Region	4,613	24,285	16,712	13,022	11,128	9,616	16,998	22,714	28,970	26,551	21,018	22,183	14,871	15,104	11,719	4,308	764
	13	66	46	36	30	26	46	62	79	73	57	61	41	41	32	12	2

Note: Upper value in each horizontal band is the number of ship-days fished; lower value is the average number of ships fishing.

Appendix Table 4. Catches by Soviet large-tonnage ships in the Nova Scotia, New England, and Norfolk areas, 1961–77 (thousand t).

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nova Scotia																	
Cod	–	2	9	10	9	10	2	6	3	2	5	5	3	3	3	1	–
Haddock	–	3	4	5	39	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	–
Redfish	–	4	12	4	1	14	<1	<1	2	10	19	12	11	7	5	1	<1
Silver hake	–	9	101	81	44	10	2	3	46	168	129	114	99	93	112	81	33
Red hake	–	–	1	2	7	2	<1	<1	<1	1	2	1	2	3	3	<1	<1
Pollock	–	–	<1	3	<1	7	<1	<1	<1	<1	1	2	<1	2	2	1	–
Flounder	–	<1	<1	<1	8	14	<1	30	13	8	20	10	17	13	11	8	–
Herring	–	–	2	2	6	2	<1	3	37	15	9	6	23	5	3	2	<1
Mackerel	–	–	–	<1	<1	<1	<1	9	4	4	9	6	16	26	21	17	<1
Argentine	–	–	8	5	5	15	4	<1	4	2	4	5	1	17	15	7	<1
Squid	–	–	–	–	<1	<1	–	<1	<1	<1	7	2	9	<1	13	16	18
Other	–	3	3	3	3	6	2	14	12	10	43	18	32	59	56	21	5
Total	–	21	141	115	123	101	11	66	121	222	248	181	214	228	244	156	59
New England																	
Cod	–	5	4	4	10	13	<1	<1	<1	<1	<1	1	1	<1	2	1	<1
Haddock	–	1	2	5	67	37	1	<1	<1	<1	<1	<1	<1	<1	<1	–	–
Redfish	–	1	1	<1	<1	<1	–	–	–	–	1	1	5	1	1	<1	–
Silver hake	–	39	86	158	222	70	43	39	64	24	73	84	86	74	37	47	41
Red hake	–	–	3	3	52	55	22	11	45	6	20	41	27	5	3	17	4
Pollock	–	–	<1	2	2	3	<1	<1	<1	<1	1	1	3	<1	<1	<1	<1

Appendix Table 4 (continued).

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Flounder	–	<1	1	<1	2	1	4	5	27	4	7	11	2	<1	<1	<1	<1
Ocean pout	–	–	–	–	–	6	<1	4	20	1	4	1	3	<1	<1	–	–
Scup	–	–	4	1	1	–	<1	<1	1	<1	<1	<1	–	<1	–	–	–
Herring	36	44	47	50	29	110	32	28	23	10	24	13	9	4	6	12	1
Mackerel	–	–	<1	<1	1	5	9	12	23	12	31	57	80	81	99	57	2
Butterfish	–	–	2	1	<1	3	1	1	7	<1	<1	<1	<1	<1	<1	<1	<1
Alewife	–	–	–	–	–	–	5	5	15	8	8	3	<1	<1	<1	<1	<1
Argentine	–	–	3	13	9	29	2	1	2	1	2	28	2	17	1	<1	–
Squid	–	–	–	–	<1	<1	<1	2	1	<1	5	5	7	4	3	4	<1
Other	–	7	2	6	7	12	7	20	32	12	28	39	31	15	28	15	6
Total	36	98	155	244	403	344	126	128	260	80	206	285	258	201	181	155	56
Norfolk																	
Silver hake	–	–	2	8	14	92	18	15	7	3	6	4	8	3	11	3	6
Red hake	–	–	<1	6	10	25	15	2	4	1	3	7	11	5	5	2	<1
Herring	–	–	–	<1	2	3	3	12	5	2	4	<1	5	7	<1	<1	<1
Mackerel	–	–	–	<1	<1	1	6	6	4	22	41	20	8	12	7	29	19
Butterfish	–	–	–	–	–	–	<1	<1	2	<1	1	1	1	<1	<1	<1	<1
Alewife	–	–	–	–	–	–	1	1	<1	1	1	2	<1	<1	<1	<1	<1
Squid	–	–	–	–	–	–	<1	<1	<1	<1	<1	<1	<1	2	1	<1	7
Other	–	3	2	2	1	8	2	11	9	1	9	18	6	5	2	–	3
Total	–	3	5	16	27	129	45	47	31	30	65	52	39	34	26	34	36

Appendix Table 5. Catches by Soviet medium-tonnage ships in the Nova Scotia, New England, and Norfolk areas, 1961–77 (thousand t).

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nova Scotia																	
Cod	–	–	1	–	1	–	–	–	<1	<1	–	–	–	–	–	<1	–
Haddock	–	–	<1	–	6	–	–	–	–	<1	–	–	–	–	–	–	–
Redfish	–	–	<1	–	<1	–	–	–	<1	3	2	–	–	–	–	–	–
Silver hake	–	–	22	–	6	–	–	–	–	<1	–	–	–	2	<1	<1	–
Herring	–	9	<1	–	<1	–	–	–	28	57	20	18	8	18	19	–	–
Mackerel	–	–	–	–	<1	–	–	–	–	<1	–	–	<1	1	<1	–	–
Other	–	–	–	–	3	–	–	–	1	–	–	–	<1	1	<1	3	–
Total	–	9	24	–	17	–	–	–	30	62	22	18	9	22	20	4	–
New England																	
Cod	–	1	1	1	4	4	<1	1	<1	<1	<1	1	2	<1	<1	–	–
Haddock	–	–	<1	<1	14	12	<1	<1	<1	<1	<1	<1	<1	<1	–	–	–
Redfish	–	–	–	<1	<1	<1	–	–	–	–	2	5	<1	1	–	–	–
Silver hake	–	3	21	9	59	51	27	5	2	5	8	10	15	32	30	–	5
Red hake	–	–	<1	<1	6	28	15	<1	<1	<1	5	15	19	14	13	<1	1
Herring	31	106	50	80	7	7	92	99	77	29	40	31	33	27	34	1	31
Mackerel	–	–	<1	–	1	<1	3	22	24	44	28	46	52	15	<1	2	–
Butterfish	–	–	<1	–	<1	1	<1	<1	2	<1	<1	<1	1	<1	<1	–	–
Atlantic saury	–	–	–	–	–	–	–	–	–	<1	2	3	2	2	–	–	–

Appendix Table 5 (continued).

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Alewife	–	–	–	–	–	–	<1	16	10	5	<1	2	<1	–	–	–	–
Argentine	–	–	<1	<1	–	5	–	–	<1	–	–	5	–	3	<1	–	–
Squid	–	–	–	–	–	–	<1	<1	–	<1	<1	1	2	2	2	2	–
Other	–	1	2	–	5	3	2	9	3	–	–	2	4	–	5	–	1
Total	31	111	76	92	97	112	142	154	120	86	87	122	132	98	87	5	38
Norfolk																	
Silver hake	–	–	2	9	4	<1	<1	<1	<1	<1	1	4	4	4	10	3	1
Red hake	–	–	<1	2	2	<1	<1	<1	<1	<1	5	8	5	6	5	4	<1
Herring	–	–	<1	<1	<1	<1	<1	4	33	20	13	4	5	3	<1	<1	–
Mackerel	–	–	<1	<1	–	–	<1	1	33	46	28	10	5	<1	<1	1	<1
Alewife	–	–	–	–	–	–	–	–	9	5	1	<1	<1	–	–	–	–
Squid	–	–	–	–	–	–	–	–	–	–	–	<1	<1	1	3	2	<1
Other	–	–	–	–	–	<1	–	–	–	–	1	2	2	3	–	1	–
Total	–	–	3	12	6	2	2	6	76	72	49	29	22	18	19	11	2

Appendix Table 6. Species composition of catches by the Soviet fleet in the New England area in 1961–77.

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969
Cod	–	6	5	5	14	17	1	2	1
	–	3	2	2	3	4	<1	1	<1
Haddock	–	1	2	5	81	49	1	<1	1
	–	<1	1	2	16	11	<1	<1	<1
Redfish	–	1	1	<1	1	1	–	–	–
	–	<1	<1	<1	<1	<1	–	–	–
Silver hake	–	42	107	167	281	121	70	44	66
	–	21	46	50	56	27	26	16	18
Red hake	–	–	3	4	58	83	37	11	45
	–	–	1	1	12	18	14	4	12
Pollock	–	–	<1	2	2	3	<1	<1	<1
	–	–	<1	<1	<1	1	<1	<1	<1
Flounder	–	<1	1	<1	2	1	4	6	27
	–	<1	<1	<1	<1	<1	1	2	7
Ocean pout	–	–	–	–	–	6	<1	4	20
	–	–	–	–	–	1	<1	1	5
Scup	–	–	5	1	1	<1	<1	1	<1
	–	–	2	<1	<1	<1	<1	<1	<1
Herring	67	150	97	130	36	117	124	127	100
	100	72	42	39	8	26	47	45	26
Mackerel	–	–	1	<1	2	5	12	34	47
	–	–	<1	<1	<1	1	5	12	12
Butterfish	–	–	2	1	1	4	2	2	9
	–	–	1	<1	<1	1	1	1	3
Atlantic saury	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–
Alewife	–	–	–	–	–	–	6	21	25
	–	–	–	–	–	–	2	7	7
Argentine	–	–	3	13	9	34	2	1	2
	–	–	1	4	2	7	1	<1	1
Squid	–	–	–	–	<1	<1	<1	2	1
	–	–	–	–	<1	<1	<1	1	<1
Other	–	8	4	6	12	15	7	27	35
	–	4	2	2	3	3	3	10	9
Total	67	209	231	336	500	456	268	282	380
	100	100	100	100	100	100	100	100	100

Note: Upper value in each horizontal band is catch (thousand t); lower value is the percentage of this species in the total catch in the area.

Appendix Table 6 (continued).

Fish species	1970	1971	1972	1973	1974	1975	1976	1977
Cod	<1	1	2	3	<1	2	1	<1
	<1	<1	<1	1	<1	1	1	<1
Haddock	<1	<1	<1	1	<1	<1	<1	–
	<1	<1	<1	<1	<1	<1	<1	–
Redfish	–	3	6	5	1	1	<1	<1
	–	1	1	1	1	<1	<1	<1
Silver hake	29	81	94	101	106	67	47	46
	17	28	23	26	35	25	30	73
Red hake	6	25	56	46	19	16	17	5
	4	9	15	12	6	7	11	9
Pollock	<1	1	1	3	<1	<1	<1	<1
	<1	<1	<1	1	<1	<1	<1	<1
Flounder	4	7	11	3	1	1	<1	<1
	2	2	3	1	<1	<1	<1	<1
Ocean pout	1	4	1	3	<1	<1	–	–
	1	1	<1	1	<1	<1	–	–
Scup	1	1	<1	1	<1	–	–	–
	1	<1	<1	<1	<1	–	–	–
Herring	39	64	44	42	31	40	13	1
	23	22	11	10	11	15	8	2
Mackerel	56	59	103	132	96	99	59	3
	34	20	26	34	32	38	37	5
Butterfish	<1	<1	<1	1	1	1	–	<1
	<1	<1	<1	<1	<1	<1	–	<1
Atlantic saury	1	2	3	2	2	–	–	–
	1	1	1	1	1	–	–	–
Alewife	13	9	5	<1	<1	<1	<1	<1
	8	3	1	<1	<1	<1	<1	<1
Argentine	1	2	33	2	20	1	<1	–
	1	1	8	1	7	<1	<1	–
Squid	1	6	6	9	6	5	6	<1
	1	2	1	2	2	2	4	<1
Other	12	28	41	35	15	33	15	7
	7	10	10	9	5	12	9	11
Total	166	293	407	390	299	268	160	63
	100	100	100	100	100	100	100	100

Appendix Table 7. Species composition of catches by the Soviet fleet in the Norfolk area, 1963–77.

Species	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Silver hake	4	17	18	92	18	15	7	3	7	8	12	7	21	6	7
	50	61	55	70	39	28	7	3	6	10	20	14	46	13	18
Red hake	1	8	12	26	15	2	4	1	8	15	16	11	10	6	<1
	13	29	36	20	32	4	4	1	7	19	26	21	22	13	2
Herring	<1	<1	2	3	3	16	38	22	17	4	10	10	<1	<1	<1
	6	1	6	2	6	30	35	21	15	5	16	19	1	<1	2
Mackerel	<1	<1	<1	1	6	7	37	68	69	30	13	12	7	30	19
	6	1	<1	1	13	13	35	67	60	37	21	23	15	66	50
Butterfish	–	<1	<1	–	1	<1	2	<1	1	1	1	<1	1	<1	<1
	–	1	<1	–	2	<1	2	<1	1	1	2	1	2	<1	1
Alewife	–	–	–	–	1	1	10	6	2	2	1	<1	<1	<1	<1
	–	–	–	–	2	2	9	6	2	2	2	1	1	<1	1
Squid	–	–	–	<1	1	<1	<1	<1	<1	1	<1	3	4	2	7
	–	–	–	<1	2	<1	<1	<1	<1	1	<1	6	9	4	18
Other	2	2	1	9	2	11	9	1	10	20	8	8	2	1	3
	25	7	3	7	4	21	8	1	9	25	13	15	4	4	8
Total	8	28	33	131	47	53	107	102	114	81	61	52	45	45	38
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Upper value in each horizontal band is catch (thousand t); lower value is the percentage of this species in the total catch in the area.

Appendix Table 8. Species composition of catches by the Soviet fleet in the Region, 1961–77.

Species					
Cod	8	15	15	24	27
	3	4	3	4	4
Haddock	4	6	10	126	70
	2	2	2	19	10
Redfish	5	13	5	3	15
	2	3	1	<1	2
Silver hake	51	234	265	349	223
	21	58	56	52	33
Red hake	–	5	14	77	111
	–	1	3	11	16
Pollock	–	2	5	2	10
	–	<1	1	<1	2
Flounder	1	1	1	10	15
	<1	<1	<1	1	2
Ocean pout	–	–	–	–	6
	–	–	–	–	1
Scup	–	5	1	1	<1
	–	1	<1	<1	<1
Herring	159	100	132	44	122
	67	25	28	7	18
Mackerel	–	1	1	3	7
	–	<1	<1	<1	1
Butterfish	–	2	1	1	3
	–	<1	<1	<1	<1
Atlantic saury	–	–	–	–	–
	–	–	–	–	–
Alewife	–	–	–	–	–
	–	–	–	–	–
Argentine	–	11	18	14	49
	–	3	4	2	7
Squid	–	–	–	<1	<1
	–	–	–	<1	<1
Other	11	9	11	19	30
	5	2	2	3	4
Total	239	404	479	673	688
	100	100	100	100	100

Note: Upper value in each horizontal band is catch (thousand t); lower value is the percentage of this species in the total catch in the area.

Appendix Table 8 (continued).

Species	1967	1968	1969	1970	1971	1972
Cod	3	8	4	3	6	7
	1	2	1	<1	1	1
Haddock	1	<1	1	2	1	1
	<1	<1	<1	<1	<1	<1
Redfish	<1	<1	2	13	24	18
	<1	<1	<1	3	4	3
Silver hake	90	62	119	201	217	216
	28	15	19	37	32	31
Red hake	52	13	50	8	35	72
	16	3	8	2	5	10
Pollock	1	<1	1	1	2	3
	<1	<1	<1	<1	<1	<1
Flounder	4	36	40	12	27	21
	1	9	6	2	4	3
Ocean pout	1	4	20	1	4	1
	<1	1	3	<1	1	<1
Scup	<1	2	<1	1	1	<1
	<1	<1	<1	<1	<1	<1
Herring	127	146	203	133	110	72
	40	36	32	24	16	11
Mackerel	18	50	88	128	137	139
	6	13	14	23	20	20
Butterfish	3	2	11	1	<1	1
	1	<1	2	<1	<1	<1
Atlantic saury	–	–	–	1	2	3
	–	–	–	<1	<1	<1
Alewife	7	22	35	19	11	7
	2	6	5	4	2	1
Argentine	6	1	6	3	6	38
	2	<1	1	<1	1	6
Squid	<1	3	1	2	13	9
	<1	1	<1	<1	2	1
Other	11	52	56	23	81	79
	3	13	9	4	12	12
Total	326	401	638	552	677	687
	100	100	100	100	100	100

Appendix Table 8 (continued).

Species	1973	1974	1975	1976	1977
Cod	6	3	5	2	<1
	1	<1	1	1	<1
Haddock	1	1	1	<1	<1
	<1	<1	<1	<1	<1
Redfish	16	8	6	1	<1
	2	1	1	<1	<1
Silver hake	412	208	200	134	86
	47	35	35	37	54
Red hake	64	33	29	24	6
	7	6	5	7	4
Pollock	3	2	2	1	1
	<1	<1	<1	<1	1
Flounder	20	14	12	8	1
	2	2	2	2	1
Ocean pout	3	<1	–	<1	–
	<1	<1	–	<1	–
Scup	1	1	–	<1	–
	<1	<1	–	<1	–
Herring	83	64	62	16	2
	10	11	11	4	1
Mackerel	162	135	127	106	22
	19	23	22	29	14
Butterfish	2	1	2	<1	<1
	<1	<1	<1	<1	<1
Atlantic saury	2	2	–	–	–
	<1	<1	–	–	–
Alewife	2	1	2	<1	<1
	<1	<1	<1	<1	<1
Argentine	3	37	16	8	<1
	<1	6	3	2	<1
Squid	19	9	22	24	25
	2	2	4	7	16
Other	75	83	91	40	15
	9	14	16	11	9
Total	874	602	577	365	160
	100	100	100	100	100

Appendix Table 9. Use of different methods and fishing gear by large- and medium-tonnage ships in the Region, 1961–77 (ship-days fished, and proportion of total fishing effort by percentage).

	Large-tonnage ships			Medium-tonnage ships						
Year	Total effort (ship-days fished)	Bottom trawl (%)	Pelagic trawl (%)	Total effort (ship-days fished)	Drift nets (%)	Bottom trawl (%)	Pair trawl (%)	Pelagic trawl (%)	Purse seine (%)	Fishing with light (%)
1961	1,331	100	–	4,613	100	–	–	–	–	–
1962	4,013	100	–	24,285	85	15	–	–	–	–
1963	8,446	100	–	16,712	12	88	–	–	–	–
1964	9,299	100	–	13,022	–	97	3	–	–	–
1965	12,145	100	–	11,128	–	100	–	–	–	–
1966	14,177	100	–	9,616	–	100	–	–	–	–
1967	4,495	100	–	16,998	–	99	1	–	–	–
1968	5,586	100	–	22,714	–	98	–	–	2	–
1969	9,681	100	–	28,970	–	88	1	–	11	–
1970	8,377	100	–	26,551	–	82	–	–	16	2
1971	14,590	100	–	21,018	–	88	–	–	9	3
1972	13,493	98	2	22,183	–	79	–	–	18	3
1973	16,963	88	12	14,871	–	67	–	–	30	3
1974	12,300	77	23	15,104	–	77	–	2	16	5
1975	12,609	51	49	11,719	–	25	–	39	36	–
1976	10,562	48	52	4,308	–	54	–	41	5	–
1977	4,987	76	24	764	–	98	–	2	–	–

Appendix Table 10. Catches and species composition of frozen products per ship-day fished by BMRTs of HO Zapryba in the Region, 1968–71.

Item	Unit	1968	1969	1970	1971
Total catch	Metric centner	424	439	406	367
Total product	Metric centner	284	308	292	269
Fish meal	Metric centner	35	33	28	24
Frozen fish	Metric centner	249	275	264	245
Target species					
Herring	Metric centner	46	41	34	18
Mackerel	Metric centner	33	22	19	31
Silver hake and cod	Metric centner	71	89	174	134
Red hake	Metric centner	23	39	10	5
Flounder	Metric centner	62	46	17	31
Ocean pout	Metric centner	1	30	1	4
Bycatch					
Redfish	Metric centner	–	1	5	19
Argentine	Metric centner	3	3	2	–
Scup, butterfish	Metric centner	4	4	–	–
Other	Metric centner	6	–	2	3
Commodity output	Rubles	13,920	15,440	15,340	14,330
Mean price per metric centner	Rubles	49	50	52	52

Appendix Table 11. Number of days on ground, days fished, catches, and species composition of frozen products per ship-day fished by BMRTs of HO Zapryba in the Region, 1972–75.

Item	Unit	1972	1973	1974	1975
Number of days on ground	Days	7,919	10,582	10,030	9,549
Number of days fished	Days	6,464	8,194	8,105	7,164
Total catch	Metric centner	392	428	387	390
Total product	Metric centner	294	312	289	282
Fish meal	Metric centner	25	29	24	26
Frozen fish	Metric centner	269	283	265	256
Target species					
Herring	Metric centner	14	34	7	7
Mackerel	Metric centner	41	38	94	80
Silver hake and cod	Metric centner	142	169	154	147
Red hake	Metric centner	23	13	2	3
Flounder	Metric centner	19	13	2	6
Bycatch	Metric centner	30	16	6	13
Commodity output	Rubles	15,630	16,640	16,630	16,350
Use of time on ground	%	82	77	81	75
Use of time in trip	%	60	57	59	55

Appendix Table 12. Seasonal and interyear variations in productivity of the fishery by BMRTs of HO Zapryba (metric centner per ship-day fished) in the Region by month, 1968–72.

Item	Month												Mean
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1968	433	455	432	470	391	402	420	437	430	407	404	411	424
1969	408	467	434	429	537	482	500	503	380	355	406	373	440
1970	288	450	439	410	363	413	442	470	357	293	429	397	396
1971	394	352	364	411	368	400	407	403	308	268	316	329	360
1972	377	341	398	508	362	435	343	385	414	390	263	435	388
Average catch	380	413	413	446	404	426	422	440	378	343	364	389	402
Deviation	145	126	75	98	175	82	157	118	122	139	166	106	80
Percentage of deviation from mean catch	38	31	18	22	43	19	37	27	32	41	46	27	20

Appendix Table 13. Catches and species composition of frozen products per ship-day fished by RTMAs of HO Zapryba in the Region, 1968–71.

Item	Unit	1968	1969	1970	1971
Total catch	Metric centner	371	441	432	403
Total product	Metric centner	276	356	335	320
Fish meal	Metric centner	22	20	23	17
Frozen fish	Metric centner	254	336	312	303
Target species					
Herring	Metric centner	122	173	49	44
Mackerel	Metric centner	45	42	118	123
Silver hake and cod	Metric centner	28	58	129	113
Red hake	Metric centner	11	26	4	14
Flounder	Metric centner	35	19	3	2
Ocean pout	Metric centner	9	2	–	–
Bycatch					
Redfish	Metric centner	–	–	1	1
Argentine	Metric centner	–	–	3	–
Scup, butterfish	Metric centner	1	14	1	–
Other	Metric centner	3	2	4	6
Commodity output	Rubles	15,040	18,120	19,060	18,460
Mean price per metric centner	Rubles	54	51	57	56

Appendix Table 14. Number of days on ground and days fished, catches, and species composition of frozen products per ship-day fished by RTMAs of HO Zapryba in the Region, 1972–75.

Item	Unit	1972	1973	1974	1975
Number of days on ground	Days	1,691	1,686	921	694
Number of days fished	Days	1,331	1,115	727	474
Total catch	Metric centner	398	535	456	481
Total product	Metric centner	322	428	360	355
Fish meal	Metric centner	19	25	23	29
Frozen fish	Metric centner	303	403	337	326
Target species					
Herring	Metric centner	34	54	1	3
Mackerel	Metric centner	98	134	261	227
Silver hake and cod	Metric centner	122	146	70	89
Red hake	Metric centner	18	15	2	–
Flounder	Metric centner	4	1	–	–
Bycatch	Metric centner	27	53	3	7
Commodity output	Rubles	17,410	22,610	22,180	21,930
Use of time on ground	%	79	66	79	68
Use of time in trip	%	62	52	63	54

Appendix Table 15. Catches and species composition of frozen products per ship-day fished by RTMTs of HO Zapryba in the Region, 1968–71.

Item	Unit	1968	1969	1970	1971
Total catch	Metric centner	389	365	309	308
Total product	Metric centner	305	284	235	236
Fish meal	Metric centner	32	19	18	17
Frozen fish	Metric centner	273	265	217	219
Target species					
Herring	Metric centner	94	33	33	22
Mackerel	Metric centner	46	38	70	77
Silver hake and cod	Metric centner	64	41	90	71
Red hake	Metric centner	14	85	11	26
Flounder	Metric centner	24	13	5	7
Ocean pout	Metric centner	2	18	2	4
Bycatch					
Redfish	Metric centner	–	–	1	–
Argentine	Metric centner	–	–	2	3
Scup, butterfish	Metric centner	14	34	1	1
Other	Metric centner	15	3	2	8
Commodity output	Rubles	16,360	15,600	14,140	13,070
Mean price per metric centner	Rubles	56	55	60	55

Appendix Table 16. Number of days on ground and days fished, catches and species composition of frozen products per ship-day fished by RTMTs of HO Zapryba in the Region, 1972–75.

Item	Unit	1972	1973	1974	1975
Number of days on ground	Days	1,554	1,431	1,162	1,244
Number of days fished	Days	1,167	967	833	959
Total catch	Metric centner	330	366	305	273
Total product	Metric centner	243	284	229	212
Fish meal	Metric centner	20	20	18	14
Frozen fish	Metric centner	223	264	211	198
Target species					
Herring	Metric centner	7	31	8	8
Mackerel	Metric centner	67	78	45	76
Silver hake and cod	Metric centner	72	68	145	85
Red hake	Metric centner	23	43	6	4
Flounder	Metric centner	15	1	1	3
Bycatch	Metric centner	39	43	6	22
Commodity output	Rubles	13,050	14,930	12,710	12,590
Use of time on ground	%	75	68	72	77
Use of time in trip	%	58	52	56	60

Appendix Table 17. Number of days fished, catches and species composition of frozen products per ship-day fished by BMRTs, RTMAs, and RTMTs of HO Zapryba off Nova Scotia, 1968–71.

Item	Unit	1968			1969		1970			1971		
		BMRT	RTMA	RTMT	BMRT	RTMA	BMRT	RTMA	RTMT	BMRT	RTMA	RTMT
Number of days fished	Days	1,126	21	107	1,512	312	1,746	290	108	4,784	132	113
Percentage of total number of days fished in the Region	%	43	10	11	34	31	72	31	20	83	14	10
Period of operation	Months	IV–XII	VI–VIII	VI–VIII	I–XI	I–V X–XI	III–XII	III–IX	VI–VIII	II–X	VII–XI	V–VIII
Total catch	Metric centners	404	361	321	419	551	407	422	346	375	343	280
Fish meal	Metric centners	34	15	23	30	20	28	14	18	26	11	14
Frozen product	Metric centners	233	285	211	271	444	269	314	252	252	285	203
Target species												
Herring	Metric centners	13	126	–	36	394	22	14	3	17	5	6
Mackerel	Metric centners	50	2	–	15	6	6	6	4	13	3	21
Silver hake, cod	Metric centners	38	19	26	152	34	215	282	224	157	256	139
Red hake	Metric centners	3	–	–	3	1	2	1	–	2	1	3
Flounder	Metric centners	121	137	176	53	7	16	6	7	35	2	17
Other	Metric centners	8	1	9	12	2	8	5	14	28	18	17
Commodity output	Rubles	13,040	13,080	10,620	15,520	22,580	15,930	18,010	14,930	14,520	16,530	12,110

Appendix Table 18. Number of days on ground and days fished, catches, and species composition of frozen products per ship-day fished by BMRTs of HO Zapryba off Nova Scotia, 1972–76.

Item	Unit	1972	1973	1974	1975	1976
Number of days on ground	Days	3,871	6,991	5,078	5,105	3,191
Number of days fished	Days	3,207	5,477	4,154	3,925	2,634
Total catch	Metric centner	380	435	380	394	384
Total product	Metric centner	288	301	286	288	299
Fish meal	Metric centner	22	29	23	26	21
Frozen product	Metric centner	266	272	263	262	278
Target species						
Herring	Metric centner	12	21	12	6	7
Mackerel	Metric centner	11	17	15	9	4
Silver hake and cod	Metric centner	205	199	222	219	180
Red hake	Metric centner	2	2	1	3	2
Flounder	Metric centner	20	18	5	11	1
Bycatch						
Redfish	Metric centner	9	4	2	6	3
Argentine	Metric centner	4	1	1	2	1
Squid	Metric centner	3	7	5	5	79
Other	Metric centner	–	3	–	1	1
Commodity output	Rubles	14,030	16,220	15,350	16,060	17,170
Use of time on ground	%	83	78	81	77	82
Use of time in trip	%	61	56	60	56	60

Appendix Table 19. Number of days fished, catches, and species composition of frozen products per day fished by BMRTs, RTMAs, and RTMTs of HO Zapryba off New England, 1968–71.

Item	Unit	1968			1969			1970			1971		
		BMRT	RTMA	RTMT	BMRT	RTMA	RTMT	BMRT	RTMA	RTMT	BMRT	RTMA	RTMT
Number of days fished	Days	1,327	127	312	2,217	590	294	611	425	351	979	439	741
Percentage of total number of days fished in the Region	%	50	63	31	50	58	48	25	46	63	17	45	68
Period of operation	Months	I–III, VII–XII	VI–XI	I–III, VIII–X	III–XII	V–XII	III–X	III–XII	III–XII	IV–X	I–X	V–X	II–X
Total catch	Metric centner	433	355	352	440	395	346	397	369	276	366	356	282
Total product	Metric centner	295	266	278	303	310	262	271	285	204	266	292	218
Fish meal	Metric centner	35	22	19	34	20	20	31	20	18	24	16	21
Frozen fish	Metric centner	260	244	259	269	290	242	240	265	186	242	276	197
Target species													
Herring	Metric centner	68	157	137	40	78	42	67	81	43	31	102	35
Mackerel	Metric centner	20	32	15	26	68	32	28	69	45	36	35	32
Silver hake, cod	Metric centner	102	36	62	66	68	66	72	83	69	111	95	77
Red hake	Metric centner	42	10	21	48	39	38	35	8	14	14	29	24
Flounders	Metric centner	20	6	15	48	22	27	21	12	5	20	2	6
Ocean pout	Metric centner	4	–	–	32	4	24	5	5	3	19	–	7
Other	Metric centner	4	3	9	9	11	13	12	7	7	11	13	16
Commodity output	Rubles	14,910	13,280	14,050	15,130	16,350	13,780	13,690	15,550	11,190	14,090	15,440	11,740

Appendix Table 20. Number of days fished, catches, and species composition of frozen products per day fished by BMRTs, RTMAs, and RTMTs of HO Zapryba off Norfolk, 1968–71.

Item	Unit	1968			1969			1970			1971	
		BMRT	RTMA	RTMT	BMRT	RTMA	RTMT	BMRT	RTMA	RTMT	RTMA	RTMT
Number of days fished	Days	183	53	588	664	111	316	61	216	96	409	236
Percentage of total number of days fished in the Region	%	7	26	58	15	11	52	2	23	17	42	22
Period of operation	Months	II–V	V–XII	II–V, X–XII	I–IV	III–V	I–IV	III–V	II–IV	III–IV	I–V	III–V
Total catch	Metric centner	483	415	422	447	405	383	458	580	388	436	381
Total product	Metric centner	288	293	321	319	339	304	354	429	303	343	270
Fish meal	Metric centner	25	30	25	32	17	18	26	36	20	22	21
Frozen product	Metric centner	263	263	296	287	322	286	328	393	283	321	249
Target species												
Herring	Metric centner	85	39	88	27	146	17	47	30	25	56	5
Mackerel	Metric centner	19	93	71	15	97	44	161	352	223	258	200
Silver hake, cod	Metric centner	50	10	72	18	1	16	108	5	17	3	35
Red hake	Metric centner	4	16	12	85	–	130	5	–	15	–	3
Flounder	Metric centner	5	64	4	34	–	3	7	–	2	–	1
Ocean pout	Metric centner	73	33	3	91	–	14	–	–	–	–	–
Other	Metric centner	27	8	46	17	78	62	–	6	1	4	5
Commodity output	Rubles	15,010	15,790	17,590	15,930	19,010	15,430	17,910	25,980	17,770	20,320	17,450

Appendix Table 21. Number of days on ground and days fished, catches, and species composition of frozen products per day fished by BMRTs of HO Zapryba off New England and Norfolk, 1972–76.

Item	Unit	1972	1973	1974	1975	1976
Number of days on ground	Days	4,048	3,370	4,940	4,438	3,840
Number of days fished	Days	3,257	2,570	3,948	3,238	2,831
Total catch	Metric centner	412	441	394	385	437
Total product	Metric centner	302	325	292	275	323
Fish meal	Metric centner	28	28	26	27	29
Frozen product	Metric centner	274	297	266	248	294
Target species						
Herring	Metric centner	17	61	2	9	25
Mackerel	Metric centner	63	85	177	165	152
Silver hake and cod	Metric centner	80	96	81	59	90
Red hake	Metric centner	52	35	3	4	24
Flounder	Metric centner	19	2	–	–	–
Bycatch						
Redfish	Metric centner	1	1	–	–	–
Argentine	Metric centner	36	7	–	1	–
Scup, butterfish	Metric centner	2	4	–	1	–
Other	Metric centner	4	6	3	9	3
Commodity output	Rubles	15,620	18,540	16,300	16,600	19,140
Use of time on ground	%	80	76	80	73	74
Use of time in trip	%	57	54	57	52	52

Appendix Table 22. Number of days on ground and days fished, catches, and structure of frozen products per day fished by RTMAs of HO Zapryba off New England and Norfolk, 1972–76.

Item	Unit	1972	1973	1974	1975	1976
Number of days on ground	Days	1,446	1,202	828	571	323
Number of days fished	Days	1,124	782	641	397	195
Total catch	Metric centner	410	537	471	513	482
Total product	Metric centner	325	425	372	366	376
Fish meal	Metric centner	20	28	23	32	25
Frozen fish	Metric centner	305	397	349	334	351
Target species						
Herring	Metric centner	39	73	2	4	–
Mackerel	Metric centner	109	183	296	269	274
Silver hake and cod	Metric centner	105	108	47	51	77
Red hake	Metric centner	21	22	2	–	–
Flounder	Metric centner	4	2	–	–	–
Other	Metric centner	13	–	2	10	–
Bycatch						
Argentine	Metric centner	13	4	–	–	–
Scup, butterfish	Metric centner	1	5	–	–	–
Commodity output	Rubles	17,380	21,260	22,420	22,820	23,410
Use of time on ground	%	78	65	77	70	60
Use of time in trip	%	62	52	61	55	48

Appendix Table 23. Number of days on ground and days fished during purse seine fishing, catches, and species composition per day fished by SRTRs of HO Zapryba in the Region, 1972–75.

Item	Unit	1972	1973	1974	1975
Number of days on ground	Days	3,738	1,933	1,772	2,906
Number of days fished	Days	1,999	1,381	1,295	1,352
Work indices per day fished					
Fish catch	Metric centner	128	167	179	141
Herring	Metric centner	102	163	176	140
Mackerel	Metric centner	25	4	2	–
Other	Metric centner	1	–	1	1
Commodity output	Rubles	6,080	7,800	8,420	6,420
Use of time on ground	%	54	71	74	46
Use of time in trip	%	36	48	50	32
Indices per day of operation					
Fish catch	Metric centner	50	81	91	45
Commodity output	Rubles	2,220	3,730	4,240	2,040
Production expenses	Rubles	720	950	1,020	690
Economic efficiency	Rubles	1,500	2,780	3,220	1,350
Mean price per metric centner	Rubles	45	47	47	46

Appendix Table 24. Technical and operational characteristics of the existing and projected long-term fishing fleet (March 1973).

Characteristic	Unit	Existing fleet				Projected fleet					
		BMRT	RTM (*Tropik* type)	RTM (*Atlantik* type)	SRTM	BMRT (394A design)	BMRT (1,288 design, *Meridian* type)	BMRT (super 1,386)	RTM (*Atlantik* super)	SRTM	Seiner-trawler (503 design)
Main engine power	hp	1 × 2,000	2 × 670	2 × 1,160	1 × 800	1 × 2,000	2 × 3,000	2 × 3,500	1 × 3,880	1 × 1,000	1 × 1,320
Trawl winch power	t	12	12	2 × 6.3	6	12	2 × 10	2 × 10	2 × 10	6.3	10
Trawl retrieval speed	m/min	72	60	100	45	72	120–140	120–140	85–90	60	100
Trawling speed	m/min	–	–	–	–	120–150	180–200	180–200	180–200		
Fishing gear		Trawl	Trawls (bottom, pelagic)	Trawls (bottom, pelagic)	Trawl	Trawl	Trawls (bottom, pelagic)	Trawls (bottom, pelagic)	Trawls (bottom, pelagic)	Trawl, purse seine	Trawl, purse seine
Fishing scheme		One trawl	One trawl	One trawl	One trawl	One trawl	Double	Double	Double	–	–
Running speed	kn	12.5	10.7	12.5	12.0	12.5	14.5	15.0	14.0	–	13.0
Carrying capacity											
Frozen fish	t	630	435	500	168	600	1,130	2,156	947	168	–
Canned fish	t	50	–	–	–	–	24	40	19	–	–
Fish meal	t	98	48	98	–	110	160	250	165	–	–
Fuel stock	t	716	549	674	141	776	1,273	1,877	1,290	–	167
Sea endurance	Days	60	60	60	30	70	60	100	70	–	25
Crew number	Persons	112	80	81	31	97	94	100	90	–	26
Refrigerator plant capacity (raw material)	t/day	30	30	45	12	44	52	52	64	10–12	–
Technological equipment capacity											
Filleting line (raw material)	t/day	–	–	–	–	–	30	30	30	–	–
Minced fish line (finished product)	t/day	–	–	–	–	–	4	4	4	–	–
Frozen round fish (finished product)	t/day	–	–	–	–	–	55	48	48	–	–
Fish meal plant (raw material)	t/day	20	20	35	–	30	30–35	60–70	50–60	–	–
Canning room	cans/h	–	–	–	–	–	272	83	100	–	–

Appendix Table 25. Long-term forecast of productivity of fishing by different type vessels off Nova Scotia, New England, and Norfolk.

Ship type	Time of fishing per year (days)	Catch per day fished (metric centners)	Annual catch (thousand metric centners)	Yield factor of finished products (%)	Output (thousand metric centners)
BMRT 394	162	400	64.8	75	48.6
BMRT 394A	183	400	73.2	75	54.9
	173	400	69.2	75	51.9
	162	400	64.8	75	48.6
RTM (*Tropik* type)	125	380	47.5	76	36.1
RTM (*Atlantik* type)	151	450	67.9	80	54.3
	139	450	62.5	80	50.0
BMRT (*Meridian* type)	204	450	91.8	75	68.8
	192	450	86.4	75	64.8
	180	450	81.0	75	60.7
RTM (super *Atlantik* type)	201	525	105.5	80	84.4
	184	525	96.6	80	77.3
	172	525	90.3	80	72.2
BMRT (Super)	213	525	111.8	75	83.8
	201	525	105.5	75	79.1
	188	525	98.7	75	74.0
SRTM (800 hp)	138	100	13.8	95	13.1
SRTM (1,000 hp 502E)	181	110	19.9	90	17.9
	149	100	16.4	90	14.8
Seiner-trawler (503)	183	110	20.1	98	19.7
	151	110	16.6	98	16.3

Appendix Table 26. Forecast of percentage species composition of catches in the Region up to 1990 (made in 1973).

Species	1971	1972	1980	1985	1990
Flounder	4.9	3.6	5.1	4.6	4.4
Red hake	3.9	9.9	3.4	3.1	3.0
Silver hake	24.9	30.7	21.4	19.5	18.4
Herring	19.0	11.9	11.7	10.6	10.0
Alewife	1.6	0.8	4.8	4.4	4.1
Atlantic saury	–	0.2	–	–	–
Butterfish	0.1	0.3	4.0	3.6	3.4
Mackerel	22.7	20.0	13.7	12.5	11.8
Redfish	3.6	2.5	5.5	5.0	4.7
Sculpin	0.3	1.0	–	–	–
Scup	0.1	0.1	–	–	–
Ocean pout	0.7	0.2	2.7	2.5	2.4
Goosefish	3.3	1.3	–	–	–
Spiny dogfish	2.4	3.2	1.0	10.0	9.4
Skate	4.3	1.9	–	–	4.9
Squid	2.5	1.4	–	–	–
Round herring	–	–	4.1	3.7	3.5
Argentine	0.6	5.7	4.1	3.7	3.5
Cod	1.4	1.5	2.7	2.5	2.4
Atlantic searobin	0.1	0.6	2.6	2.3	2.2
Other	3.6	3.2	13.2	12.0	11.9
Total	100.0	100.0	100.0	100.0	100.0

Appendix Table 27. Forecast of fish and non-fish species catches (thousand metric centers) by large- and medium-tonnage ships of Western Basin up to 1990 (made in March 1974).

Fishing area	1980			1985			1990		
	Large-tonnage fleet	Medium-tonnage fleet	Total	Large-tonnage fleet	Medium-tonnage fleet	Total	Large-tonnage fleet	Medium-tonnage fleet	Total
Northeast Atlantic	3,625	3,520	7,145	3,625	4,425	8,050	3,625	4,420	8,045
Northwest Atlantic	6,959	700	7,659	7,424	700	8,124	7,719	700	8,419
Grand Bank, Labrador	2,900	100	3,000	2,900	100	3,000	2,900	100	3,000
West Greenland, Nova Scotia, New England, Norfolk	4,059	600	4,659	4,524	600	5,124	4,819	600	5,419
Central Eastern Atlantic	2,000	800	2,800	2,000	800	2,800	2,000	1,000	3,000
Southeast Atlantic	2,400	–	2,400	2,400	–	2,400	3,000	–	3,000
Southwest Atlantic	1,080	–	1,080	1,080	–	1,080	1,100	–	1,100
Open part of Atlantic Ocean (tuna species fishing area)	365	300	665	365	300	665	365	300	665
Invertebrate fishing area	400	30	430	400	30	430	400	30	430
Baltic Sea	–	2,291	2,291	–	2,291	2,291	–	2,291	2,291
Total	16,829	7,641	24,470	17,294	8,546	25,840	18,209	8,741	26,950

Appendix Table 28. Significance (expressed as percentage) of Western Basin fishing areas (1967–72) and forecast up to 1990.

Area of fishery	1967	1968	1969	1970	1971	1972	1980	1985	1990
Northeast Atlantic	29.4	27.5	29.2	36.7	20.5	19.1	38.6	40.0	38.4
Northwest Atlantic	23.9	39.7	45.1	30.9	43.8	43.4	31.3	31.4	31.2
Grand Bank, Labrador	8.8	19.7	15.1	10.6	14.5	12.9	12.3	11.6	11.1
West Greenland, Nova Scotia, New England, Norfolk	15.1	20.0	30.0	20.3	29.3	30.5	19.0	19.8	20.1
Central Eastern Atlantic	11.2	14.7	15.7	18.0	28.3	24.9	11.4	10.8	11.1
Southeast Atlantic	13.8	13.2	9.1	8.9	6.6	11.1	9.8	9.3	11.1
Southwest Atlantic	21.7	4.9	0.9	5.5	0.8	1.5	4.4	4.2	4.1
Other areas	–	–	–	–	–	–	4.5	4.3	4.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LIST OF SPECIES

Alaska (walleye) pollock	*Theragra chalcogramma*
Alewife (river herring)	*Alosa pseudoharengus*
Amphipod	*Themisto* sp.
Argentine	*Argentina silus*
Argentine (Patagonian) hake (merluza)	*Merluccius hubbsi*
Butterfish	*Peprilus triacanthus*
Atlantic cod	*Gadus morhua*
Atlantic cutlassfish	*Trichiurus lepturus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic redfish	*Sebastes* sp.
Atlantic saury	*Scomberesox saurus*
Atlantic searobin	*Prionotus* spp.
Atlantic thread herring	*Opisthonema oglinum*
Marlin	Istiophoridae
Baird's smoothhead	*Alepocephalus bairdii*
Black seabass	*Centropristis striata*
Blue whiting	*Micromesistius poutassou*
Bream	Sparidae
Cape hake (merluza)	*Merluccius capensis*
Capelin	*Mallotus villosus*
Copepod	*Calanus finmarchicus*
Caspian blackback shad	*Alosa kessleri kessleri*
Caspian roach	*Rutilus rutilus caspicus*
Chastikovye	Mostly cyprinids and percids in the Caspian and Volga region
Dory	Zeidae
Eel	*Anguilla anguilla*
Euphausiid (krill)	Euphausiacea

Flounder	Pleuronectidae
Garfish (Atlantic needlefish)	*Strongylura marina*
Grenadier	Macrouridae
Goosefish	*Lophius americanus*
Hake	Gadidae
Halibut	
Atlantic halibut	*Hippoglossus hippoglossus*
Greenland halibut	*Reinhardtius hippoglossoides*
Haddock	*Melanogrammus aeglefinus*
Horse mackerel	*Trachurus trachurus*
Jack	Carangidae
Jack mackerel	*Trachurus symmetricus murphyi*
King crab	*Paralithodes* spp.
Ling	*Molva molva*
Ocean pout	*Macrozoarces americanus*
Orange roughy	*Hoplostethus atlanticus*
Pollock (saithe)	*Pollachius virens*
Red hake	*Urophycis chuss*
Rock grenadier	*Coryphaenoides rupestris*
Round herring	*Etrumeus teres*
Sardine (pilchard)	*Sardina pilchardus*
Sardinella	*Sardinella* spp.
Sculpin	Cottidae
Scup (porgy)	*Stenotomus chrysops*
Silver hake (merluza)	*Merluccius bilinearis*
Shad	*Alosa sapidissima*
Shark	Lamniformes
Skate	Rajidae
Smoothhead	Alepocephalidae
Snapper	Lutjanidae
South African pilchard	*Sardinops sagax*
Spiny dogfish	*Squalus acanthias*

Spot fish	*Leiostomus xanthurus*
Squid	
long-finned squid	*Loligo pealei*
short-finned squid	*Illex illecebrosus*
Sturgeon	Acipenseridae
Swordfish	*Xiphias gladius*
Tuna	*Thunnus* spp.
Trevally	*Caranx* sp.
Witch flounder	*Glyptocephalus cynoglossus*
Yellowtail flounder	*Pleuronectes ferrugineus*