UNITED NATIONS

GENERAL ASSEMBLY

Distr.
LIMITED

A/AC.138/SC.II/L.20
2 April 1973

ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL USES OF THE SEA-BED AND THE OCEAN FLOOR BEYOND THE LIMITS OF NATIONAL JURISDICTION
SUB-COMMITTEE II

SPECIAL CONSIDERATIONS REGARDING THE MANAGEMENT OF ANADROMOUS FISHES AND HIGHLY MIGRATORY OCEANIC FISHES

Working paper submitted by the United States of America

The biological characteristics of fish species are critical in determining how they can most effectively be managed and economically exploited. The technical and economic characteristics of a fishery developed under the influence of the biological nature of the fish in turn are important determinants of the best system for managing the fishery for conservation purposes and for regulating it for economic objectives.

For example, relatively sedentary or localized fish populations, which for the most part inhabit comparatively shallow waters near coasts, can be exploited by small vessels of limited range based on the nearby coast and can be managed by the adjacent coastal State.

Some anadromous species, such as the salmon, have quite different biological characteristics which tend to determine different patterns of exploitation and different systems of conservation of the resources and regulation of the fisheries.

There are other valuable species which live out their lives in the open ocean, migrating long distances and associating themselves only temporarily, if at all, with coastal features. The classic example of this type of fishery resource is the tunas.

This working paper describes the special characteristics of anadromous and highly migratory fishes which, in the judgement of the United States, require that they be dealt with in special ways.

Part I. Special considerations regarding the management of anadromous fishes

The term "anadromous", derived from the Greek ana - "upward" - and dromein - "to run", retains in the fishery context its literal meaning: to run upward, or ascend from the sea. More completely, anadromous fishes are those which require a fresh-water environment for their spawning, egg incubation, and, in most cases, the rearing of juveniles - and upon the marine environment for the majority of their growth and maturation. This group of unique aquatic resources includes not only the Pacific and Atlantic salmons, which produced a catch of some 400,000 metric tons in 1970, but also such widely distributed forms as the trouts, shads, striped bass, smelts and sturgeons which together accounted for a commercial harvest of over 600,000 metric tons, spread over some 25 countries. One genus of the shad family, Hilsa, is especially important throughout southern and south-eastern Asia where it contributes significantly to the local catches from the Suez to the Yangtze River.

All of these animals share a high degree of dependence upon the maintenance by their "host" state of a suitable environment for a key portion of their life history.

The Pacific salmons (genus Oncorhynchus) are prime examples of this group, for together they comprise the world's largest anadromous fishery resource; have a wide natural distribution; have been transplanted, with mixed results, into the Atlantic, Arctic and South Pacific Oceans, as well as land-locked lakes; and are highly desirable for both commercial and recreational use.

Distribution and life history

With regard to their natural distribution, one or more species of Pacific salmon spawn in the fresh waters of the western United States from central California north, in the Province of British Columbia and the Yukon Territory of Canada, throughout the coastal areas of Alaska from its south-east tip into the Arctic Ocean and along the length of the Aleutian Island chain; along the Siberian Coast of the USSR; and in Japan and Korea.

Although members of the same genus, the six species of Pacific salmon exhibit quite different biological characteristics and life histories. For example, the pink salmon is short-lived (two years) and rarely exceeds three kilograms in weight. On the other hand, the chinook or king salmon often lives to an age of seven years and commonly attains a weight in excess of 20 kilograms (occasionally to over 40 kilograms).

Responsibilities of the host State

As diverse as these species are, they share both a wide-ranging marine existence and the unique and precise homing characteristics that cause them to return not only to the river system of their origin, but to the particular tributary of their birth.

This dependence upon the freshwater environment for the survival not only of individuals but stocks and indeed entire species poses survival hazards not faced by purely marine species: natural obstacles to their upstream spawning migration, such as landslides and log jams; man-made obstacles, such as hydroelectric and flood control dams; the diversion of water for irrigation or industrial use, which if it occurs during the period of downstream migration of the juvenile fish can lead millions of those "smolts" out of the main stream of the river into blind-end irrigation systems, thermal pollution, caused either by the use of river water for cooling industrial equipment or by the impoundment of river water behind dams, which tends to lower resistance to disease and favours populations of predators; silting of spawning gravel; oxygen deficits caused by sewage and other biodegradable wastes; etc.

All of these mortality factors can be overcome or prevented, but to do so involves a great deal of expense. This expense can take the form of direct outlays of money and manpower in the construction of fishways around natural or man-made obstructions, the physical clearing of land slides or log and brush jams and the construction and maintenance of fish hatcheries and artificial spawning channels for supplementing natural production when adverse conditions cannot be otherwise overcome.

Indirect expenses can be even more significant for they entail a purposeful decision to maintain the physical and chemical characteristics of the river necessary for continued salmon reproduction in the face of increasing demands for alternative uses of the rivers and watersheds. The decision to forgo other uses of freshwater in order to maintain salmon production is not an easy one in such areas as Siberia, western Canada, and Alaska where settlement and industrialization are in their early stages and local demands for using the river systems for commerce, for the generation of electric power, for waste disposal and for industrial purposes are not easy to overcome. Nevertheless, in many cases, these pressures have been resisted and healthy salmon runs have been maintained or rebuilt.

The people and the Governments of the countries which support Pacific salmon runs have often chosen to bear these expenses - whether direct or indirect - even when the annual costs exceeded the annual monetary return from the salmon harvest primarily because the long-term economic and social benefits promised to at least balance these outlays. In other words, the host States involved have invested heavily - and will have to continue investing - to not only maintain a viable commercial resource but, indeed, to assure the very survival of these species. Obviously, few Governments or their constituents could justify this continued expense unless they had some assurance of the imposition of limitations on ocean harvesting necessary to ensure that the measures they undertake in internal waters are not rendered ineffective.

Management considerations

This, then, brings us to the question of the times and places to which ocean harvesting should be limited. In the case of Pacific salmon there are two characteristics of the fishes which argue for strict limitation on the time and location of the ocean harvest. First, after many years of co-operative international investigations on the high seas, it has been determined that during much of their life at sea salmon stocks from various host countries intermingle in wide areas of the North Pacific Ocean. Therefore, over most of this broad expanse it would be virtually impossible to conduct a fishery for only those stocks which originated in any particular country. Furthermore, each stock of salmon - i.e., those fish from a particular lake or tributary - represent a unique genetic pool from which the maximum production will be achieved only if it is managed in accordance with its individual and annual requirements for optimum escapement of spawners. On the high seas, even relatively close to the mouths of the spawning rivers, the various racial stocks are intermingled and, therefore, cannot be managed optimally. This problem can be illustrated by considering two hypothetical but typical stocks of the same species of salmon which originate in geographically close but hydrologically and liminologically different rivers. These stocks would have, in the course of their evolution, developed a genetic pool which best allows them to cope with the particular conditions of their natal streams. In a given year, the population from one stream may be very healthy and capable of supporting a large harvest while fish from the adjacent river, because of some natural phenomenon such as low water levels during the egg incubation period which resulted in the freezing of a high proportion of those eggs, may be in such low abundance when the mature fish return to the streams as to require virtually the entire run to escape to the spawning area if that parent-progeny cycle is to be restored to maximum production. Therefore, management criteria for each of these hypothetical populations are quite different - one is healthy and, for both biological and economic reasons, should be harvested - the other is weak and most returning fish should be allowed to spawn. However, these two stocks may be intermingled throughout most of their oceanic migration and should they be subjected to a high seas fishery it would be virtually impossible to crop only fish from the healthy stock. The likely result of such a fishery would be an underexploitation of the healthy stock and an overexploitation, perhaps even extinction, of the stock which that year had no surplus available for harvest. Therefore, conservation can be fulfilled and management achieved only if these runs are harvested well inshore after they have segregated themselves into the appropriate stock units upon which individual management decisions can be applied.

The second characteristic is the relation between the rates of growth and natural mortality which leads to the conclusion that the greatest yield can be achieved by harvesting the salmon just before it re-enters fresh water. The growth of individual fish while they are still in the freshwater phase of their life is relatively slow; even those fish which spend up to three years in fresh water rarely attain weights of more than 300 grammes before they migrate to the sea. Following their adaptation to the marine environment, however, growth is rapid - often startlingly so - right up until the time that feeding ceases shortly before their entry into fresh water. In some cases, the weight of an individual salmon can double, sometimes triple and even occasionally quadruple during its last few months in the ocean. On the other hand, while death due to natural causes is quite high during the freshwater phase of their life, and during the very early portion of the marine existence, as the fish grow and move beyond the inshore areas which tend to be higher in predators natural mortality decreases substantially.

Scientific evidence indicates that during most of its marine life, and certainly during the last few months of its life in the ocean, the total increase in a salmon stock due to the growth of its individuals exceeds the total loss to the stock caused by natural mortality factors. Therefore, in the absence of high seas fishing during this period, the net change in the population is an increase in total biomass and, in turn, an increase in potential yield.

Bearing in mind these two considerations - the need for independent management of individual genetic units which are intermingled during most of their marine existence and the net increase in biomass during at least the latter part of the marine existence - a high seas fishery for salmon is unsound both in terms of the economics of the fisheries and the biology of the animals.

Relation to other high seas fishes

Finally, one might argue that the maintenance of high populations of salmon for the exclusive use of the host State might reduce, through competition or predation, the available stocks of other fish of the high seas which are being sought by other nations. However, scientific investigations of the feeding habits and the distribution of Pacific salmon during their marine phase indicate that, first, salmon are predominantly found in the epipelagic (i.e., uppermost) zone of the open ocean where they are rarely in geographic or biological association with any other commercially sought species. Secondly, the common food items found in the stomachs of these salmon are predominantly zooplankton and occasionally small midwater fishes, such as lantern fish, neither of which is the subject of commercial exploitation. The only time that predation or competition by salmon would have any significant effect on other desirable species is when the salmon are close to their host country - well in over the continental shelf - at which time they often do feed on such fishes as herring and anchovies. In this case, however, the effects of competition or predation are a problem for the host country in weighing the pros and cons of maintaining their salmon populations at a high level.

Part II. Special considerations regarding the management of highly migratory oceanic fishes

A relatively small but important portion of the world marine fishery production comes from species which are characterized by extremely broad distributional ranges and large-scale, often trans-oceanic, migrations. A prime example of this type of resource is the tunas.

Distribution and life history

All of the commercially valuable tuna species are characterized by very extensive ranges of their populations, long migrations and high mobility. Their reproduction is not concentrated in space or time but occurs over long seasons and great expanses of the sea, as evidenced by collections of their eggs and larvae.

The principal species of tuna occur around the entire world over a wide range of latitudes, and individual populations of these species also have very broad ranges.

Recent publications by FAO, based on a variety of tagging experiments, illustrate that:

In a single year, albacore tuna migrate from off the east coast of Japan to the west coast of North America;

Northern bluefin tuna move from the East Coast of the United States to north-western Europe, the Bay of Biscay, and off Brazil;

Bigeye tuna migrate from the central Pacific to the far-western Pacific;

Southern bluefin tuna are all members of the same population which has a circumpolar distribution throughout the south Atlantic, Pacific and Indian Oceans; and

Skipjack tuna migrate from the extreme eastern Pacific, where they are only seasonal visitors, to mid-Pacific waters.

Morphological study of yellowfin tuna in the Pacific Ocean has indicated that there are likely to be a number of more or less discreet populations distributed across the tropical zone from Asia to the Americas, probably mingling to an unknown degree where their ranges overlap. The number of such populations and the extent of the area which each occupies are not known with certainty. It is known, however, that in the eastern tropical Pacific the yellowfin from northern Chile to southern California and more than 1,000 miles to seaward react as a single stock to fishing pressure and conservation measures.

Within these enormous areas, the tuna populations move rapidly in response to ecological influences and physiological needs which are as yet little understood. The tunas are fast swimmers, and they are never at rest. It appears that constant motion is a requisite for maintaining a flow of water over their gills, for enabling them to maintain their depth in the water column, and for seeking their food, which consists of a great variety of organisms sparsely scattered through relatively barren oceanic waters. Because of this great mobility throughout the broad areas which they inhabit, the availability of tunas to capture within a given fishing ground is highly variable and largely unpredictable with our present knowledge.

The tunas also grow rapidly, with the result that only a few year-classes are available to fishing at any one time by any given fishing technique. The fecundity of the tunas is high, with large individuals spawning more than a million eggs at a time. However, fertilization is external, and the eggs and larvae receive no parental care, so that the natural mortality in these early stages is undoubtedly great. The young tuna are preyed upon by other fishes, such as larger tuna and billfishes, and the proportion which survive to reach maturity is very small.

The biological characteristics which have been briefly described above have certain implications for the exploitation and scientific study of the tuna resources and for the conservation of the tuna fisheries. Those implications are discussed under the appropriate headings below.

Exploitation

Since the tuna populations inhabit large areas of the open ocean, within which they move extensively, rapidly and to a high degree unpredictably, they can be most successfully fished by vessels which also have long-range, high speed and the ability to operate in open ocean conditions. Smaller vessels of limited operating range must in effect wait for the tuna to come to them, rather than pursuing the schools wherever they may go. Experience has shown that even in the best localized tuna grounds the availability of fish can vary greatly from year to year, even though the abundance of the total tuna population throughout its range may remain at about the same level. For example, in the eastern Pacific there are excellent tuna fishing grounds within a few miles of the coasts of Ecuador and Peru, but there are times when the tuna do not put in an appearance in those areas in good abundance for a whole year or two. At such times, the small-boat fleets are unprofitable while the large vessels of the countries with distant-water tuna fleets may be enjoying excellent fishing in other parts of the region inhabited by the same tuna stocks. Indeed, because the tunas are found in all oceans, it is an efficient strategy in some cases for the operators of large modern tuna-boats to have them fish in different oceans at different times of the year. Thus, we find that many of the most efficient tuna seiners, which have their basic fishing grounds in the eastern Pacific, are now spending several months of each year on the grounds of the eastern Atlantic, while conversely seiners which have traditionally fished in the Atlantic are increasingly spending part of the year on the eastern Pacific grounds.

Tuna longline fishing vessels have particularly great mobility and flexibility of operation, and may fish in the Pacific, Indian and Atlantic Oceans in the course of a year, depending on where the availability of their target species is highest at any given time. Even within the duration of a single voyage, an efficient modern tuna-boat may operate at locations separated by hundreds if not thousands of miles. Since all modern tuna fishing vessels freeze their catches aboard, their product is imperishable and easily transportable. This means that they may base their operations in any port where there are cold-storage facilities and refrigerated cargo ship service for transporting the frozen tuna to processing centres. Many ports around the world are now used for trans-shipment of tuna, and the major tuna canners receive raw material from a great variety of sources in addition to the domestic landings of their national fleets. The United States tuna canning industry, for example, derives more than half of its raw material from imports, which are made up of the catches of vessels of many nationalities, including US flag vessels which trans-ship their catches through foreign ports.

There are three principal techniques used for catching tuna - pole-and-line fishing using live bait, longlining and purse seining. These methods differ in the degree of their independence from the coast and their ability to freely follow

/...

the movements of the tuna through the waters of the open ocean. The pole-and-line fishermen are the most closely bound to coastal waters, since that is where they must catch their supplies of live-bait. However, where this kind of tuna fishing is well developed, as particularly in the western Pacific, the fishermen have developed equipment and techniques which enable them to carry adequate supplies of live-bait to fishing grounds far offshore. Purse seining, although not directly dependent on coastal logistic support as is live-bait fishing, has until recently been carried on in areas relatively close to coasts, and particularly off the coast of the eastern tropical Pacific, because sea conditions in those areas have been most suitable for the use of these large encircling nets to capture the tuna. In recent years there has been a strong expansion of purse seine fishing offshore in the eastern Pacific, with considerable and increasing catches being taken as much as 1,000 miles from the coast. Longline fishing, which catches tuna on hooks baited with small frozen fish and suspended from buoyed lines, is the most truly pelagic and independent of the major tuna fishing methods. It is carried on in all parts of the open sea where oceanographic conditions are propitious for the occurrence of tuna, and it accounts for more than half of the total world tuna catch.

Thus it is apparent that the most effective techniques and strategies for exploiting the tunas must be those which most closely approximate the range and mobility of the tunas themselves, and there is evidence that where tuna fishermen are not prevented from doing so by artificial constraints they strive to become as fully pelagic as the fish which they pursue.

It is quite clear that countries with relatively short coastlines will have very little hope of establishing prosperous fisheries for tunas if their fishermen cannot follow these widely ranging species into exclusive 200-mile zones off the coasts of other countries. It may be argued that there is nothing about a 200-mile zone which prevents neighbouring coastal States in a region from agreeing upon a régime which will permit their fishermen to move back and forth from one nation's zone to another. In theory it may appear to be a sound argument, but the practice of the 200-mile zone doctrine - as opposed to its theory - has not been such as to lead one to find much comfort in that argument.

When such artificial constraints are imposed on the freedom of movement of tuna vessels, efficiency drops, catches are reduced, the supply available to mankind is diminished, and what supply there is, is available at a higher cost - a higher cost not only to the consumer, but to the world as a whole.

Research

Effective and rational conservation of tuna resources, as of other kinds of fishery resources, requires a knowledge of the biology, population structure and abundance of the tuna species which can only be gained through scientific research. Because the tunas spend their entire lives roaming freely in the open ocean, they are only sporadically accessible to direct observation, and the task of obtaining the required scientific information is extremely difficult and costly to accomplish. Large research vessels are needed to do the scientific work, which must cover great areas over long time periods. Experience to date indicates that even the most affluent countries with the greatest interest in the tuna resources have not been able individually to support a research effort adequate to the task. Even the co-operative research programmes supported by a number of interested Governments, like that of the Inter-American Tropical Tuna Commission in the eastern Pacific, have not received financial support that would make it possible to provide a base of scientific information as solid as it should be for making management decisions affecting a multi-million-dollar industry. It seems clear that tuna research approaching adequacy can never be achieved except through broad and intensive international co-operative programmes, which must of course extend into all of the waters inhabited by the tuna stocks under investigation if they are to produce useful results. If, for example, a country exercises jurisdiction over an area of the sea which includes part of the range of a tuna population, and that country is unable to do an adequate job of research on the tuna within that area and unwilling to allow research vessels of other countries to do it, the unfortunate result can only be a gap in the scientific knowledge concerning that stock of tuna. Likewise, since all important tuna resources are exploited by fishermen of more than one country, and since fishery data, such as catch and effort statistics, are an indispensable element in research for fishery management purposes, intergovernmental co-operation is essential for making such data compatible and placing the total body of data at the disposal of competent scientists for analysis. One of the most important research problems for conservation purposes is that of defining the real limits of the various tuna populations. The solution of this problem is commonly sought by the release and recapture of tagged fish, which requires extensive research vessel operations and is very expensive, or by the collection of samples over broad areas and their analysis for morphological and biochemical differences, which require international co-operation for the collection and capabilities found in only a few laboratories for the analysis.

Conservation

Like the research upon which they should be based, conservation measures must also be applied by international co-operation in order to be effective. The things that man can do to conserve tuna resources are limited by the nature of the animals and their ecology. Man can do nothing to actively foster the propagation of the tunas nor can he feasibly control their natural predators. Their open ocean habitat is beyond his power to influence, and even the grossest man-made pollution probably has little effect upon these species. The conservation measures which are in use at the present time are of two kinds: a limitation of the total catch from a given stock in order to maintain it at a high level of productivity, and a minimum size limit of capture in order to maximize the return from each fish recruited into the fishable stock. These measures will be most effective only if they are applied uniformly to all fishing within the total area where the given stock is exploited. If the jurisdictional basis for management of these species did not coincide with their distribution the potential for mismanagement would be great. We might consider the not really hypothetical case of a tuna population which inhabits an area extending into waters over which several nations assert jurisdiction and also into far offshore areas beyond any national jurisdiction. If each of the coastal States were to set independently a catch quota for the waters where it exercises jurisdiction over fishing, and another separate quota were to be established by some other mechanism for the area beyond national jurisdiction, or if various minimum size limits were set for these various subdivisions of the tuna stock's range, the result in terms of conservation could hardly be very rational or effective. If the sum total of the separate catch quotas happened to be less than the maximum sustainable yield of the stock, conservation would certainly be effected, but there would also be a serious risk of wastage of the potential harvest because of the great variability with which tuna become available to fishing in various parts of their range from year to year. For example, a 50,000-ton quota in one subdivision of the range would be meaningless in years when only 25,000 tons become available to capture there, and it would be economically pernicious in years when the same area offers the possibility of catching 75,000 tons out of a total permissible yield from the stock of 150,000 tons. If, on the other hand, the sum total of the separate quotas happened to exceed the maximum sustainable yield of the stock, overfishing would occur.

The result would be similar if, alternatively, an over-all quota were established for a stock which is distributed in several national jurisdictions and in an area not under the jurisdiction of any State and that quota were sub-allocated geographically among the areas of national jurisdiction and the area not under national jurisdiction. While it is true that the over-all limit would likely not be exceeded, the great risk would be that catches would fall substantially below that allowed with the economic results noted above. It seems obvious that the only rational way to apply a catch quota system for conservation of a tuna population is in the form of one single co-ordinated quota for the whole area inhabited by the population. Since the populations do occur in several national jurisdictions and also beyond and they are fished by nationals of several countries, the application of such a co-ordinated quota requires international management of the fishery for conservation purposes.
