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IS INTERNATIONAL MANAGEMENT OF TUNA NECESSARY?

by

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Abstract

Movements of skipjack and yellowfin tuna are reassessed and it is shown that long distance movements are the exception rather than the rule for these species and that for countries with large economic zones, stocks may be considered resident. Under current economic conditions, unregulated fisheries will not overexploit skipjack tuna and will not seriously overexploit yellowfin. International cooperation in regulating harvests is probably not required for these two species, particularly where economic zones are large. However, international cooperation in research and collection of catch statistics is necessary since it will be quite difficult for an individual country to evaluate trends in the fishery.

Introduction

The proposition that international cooperation is required for the effective utilization of the tuna resources of the world has become almost universally accepted.¹ The fact that individual fish have been recovered thousands of miles from the place they were tagged has caused most tuna species to be classified as "highly migratory" thus investing them with a unique status in international fisheries. The United Nations Convention on the Law of the Sea, now recognised as common practice by major fishing nations, provides coastal states with the authority and responsibility to manage all fisheries resources within the exclusive economic zone (EEZ), but specifically mentions highly migratory species as requiring international cooperation.² Lack of complete agreement over the extent to which coastal

¹ See Joseph, International arrangements for the management of tuna, a world resource in Rothschild (ed). World Fisheries Policy - multidisciplinary views. University of Washington Press, 1972. Joseph, Scientific management of the world stocks of tunas, billfishes and related species. J. Fisheries Research Board of Canada 30, 1973. Joseph, The management of highly migratory species: some important concepts. Marine Policy, October 1977. Joseph, International Tuna Management Revisited, Chapter 6 in Rothschild (ed) World Fisheries Policy; Joseph and Greenough, International management of tuna, porpoise and billfish, University of Washington Press, Seattle, 1979, 253 pp; Kearney, The Law of the Sea and regional fisheries policy, Ocean Development and International Law Journal, 1978, pp 249-286; Van Dyke and Heftel, Tuna Management in the Pacific: An analysis of the South Pacific Forum Fisheries Agency, University of Hawaii Law Review, 1981, pp 1-65; King, International management of highly migratory species, Marine Policy, Vol. 3 No. 8, October 1979, pp 264-277.

² The Law of the Sea, United Nations Convention on the Law of the Sea, 1983, the United Nations. Annex 1 gives a list of highly migratory species.

states may exercise authority over highly migratory species within EEZs has caused some serious problems on both sides of the Pacific.³

There is no consensus on the most desirable institutional structure for international cooperation in tuna research and management. Organisational models range from the Inter-American Tropical Tuna Commission (IATTC), which has at various times imposed catch quotas, to the Tuna and Billfish Assessment Programme of the South Pacific Commission (SPC), which conducts scientific research on the state of the stocks and harvests but has no management responsibility. Within the biological, economic and legal literature cited above, the inevitable necessity of international catch regulation is not questioned. Implicit in virtually every paper is the assumption that since tuna are highly migratory, serious overexploitation will result unless there is international regulation of harvests.

At the political level, there is no general agreement that international control of harvest is required. Not all nations have agreed to participate in the existing international agencies. Most Latin American nations have withdrawn from IATTC, and their own fishermen are essentially unregulated in their own waters. The U.S. does not recognise national sovereignty over tuna within the EEZ of coastal states, and U.S. fishing boats continue to fish in the EEZ of some countries of the western Pacific without authorisation of the coastal state.

Proponents of international regulation need only reiterate the sad history of the North Sea and Norwegian spring spawning herring stocks, where international disputes prevented effective control and enormously valuable stocks were harvested to commercially insignificant numbers, to make a case for the necessity for international control.

The need for international regulation of harvests rests on two necessary assumptions. The first is that movements of fish are large in relation to the EEZ of the nations concerned, so that harvests that occur in one country or in international waters will significantly affect harvests in other countries. The second assumption is that an unregulated fishery must inevitably overexploit the resource. The reason for the disastrous history of the North Sea and Norwegian herring is that it was economically profitable for an individual vessel to keep fishing even when the stock abundance was very small, as low as 1% of the original biomass. If an unregulated fishery will not overexploit the stock, then there is no pressing need for regulation. If movements of fish are small in relation to the economic zone of a country, then the country can effectively regulate its own fishery.

Are skipjack and yellowfin highly migratory?

The term "highly migratory" has been so widely used in legal writings that any biological meaning it originally carried has become not only obscure but possibly irrelevant. In fact, the term has become almost a synonym for tuna, a development which hides the wide range of migratory behaviour between tuna species. Nevertheless the migratory properties of the principal commercial tuna species merits examination to determine how these properties might be best exploited by management strategies.

There are over a dozen species of tuna captured in commercial fisheries around the world and all show long distance movements. Table 1 summarizes the estimated total global tuna catch. Skipjack and yellowfin constitute approximately 70% of the total catch by all gears, and constitute over 90% of the purse seine catch, the fishing gear considered to be most seriously in need of regulation.

³ Tsamenyi, B.M. The South Pacific states, the USA and sovereignty over highly migratory species, Marine Policy, January 1986, pp 29-42.

Figure 1: Straight line representations of movements of skipjack tagged by the Skipjack Programme and subsequently recovered. Data are selected so that no more than two tag movements are shown between any 10 degree square, which has the effect of representing almost all long distance movement and few short distance movements.

Table 1.1980 world landings of tuna. All numbers in thousands of metric tonnes.

Source :FAO Fisheries Statistics Yearbook.

<u>Species</u>	<u>Landings</u>	<u>Per cent</u>
Skipjack	771	42
Yellowfin	520	28
Bigeye	198	11
Albacore	180	10
Frigate	137	7
Kawakawa	45	2
Total	1851	100

Large numbers of skipjack and yellowfin have been tagged and recaptured in the eastern Pacific by the IATTC, in the western Pacific by the SPC, and in the Atlantic by ICCAT. Figure 1 shows sample long distance movements of marked skipjack from the SPC study. This graph has appeared in over 30 SPC publications, emphasizing the highly migratory nature of skipjack. Figure 2 shows a frequency distribution of the distance moved from the same study. Most fish moved relatively short distances, and the long distance movements of Figure 1 are a minor proportion of the total tags recovered. About 85% of skipjack tag recoveries in the SPC study occurred in the country of release. Figure 1 may be considered typical of the tendency of scientific reports of tuna migration studies to show graphs that overemphasize long distance movement and underemphasize localized movement.

Figure 2: Frequency distribution of distance travelled by skipjack recovered by the Skipjack Programme. Almost all fish were recovered very close to the source of tagging.

Figure 3 shows a graph of average distance moved in relation to time at large for yellowfin tuna tagged and recaptured in the eastern Atlantic.⁴ The monthly movement rate is rather small, and there is an obvious annual movement, thought to be associated with annual cycles in water temperature. Figure 4 shows tag movement data from yellowfin tagging in the eastern Pacific by IATTC⁵, where again tagged fish moved very little.

The long distance movements of some tagged tuna are of great biological interest and understandably dominate the perspective of many biologists. The SPC tuna scientists continue to use the illustration emphasizing long distance movement despite the small average distance moved shown in Figure 2. The IATTC produced a glossy book with illustrations and life history descriptions of the major tuna species with the title "Tuna and billfish, fish without a country"⁶. The biological emphasis on long distance movement can probably be ascribed both to its exciting nature and the fact that most tuna biologists work for international agencies preoccupied by the international nature of tuna stocks.

Although individual fish occasionally move long distance, this behaviour appears to be exceptional for skipjack and yellowfin. Low rates of movement may be the norm. An important tuna management concern is whether adjacent fisheries, whether in adjacent countries or in a single country using different gear types, adversely affect one another. The extent to which movements of tuna cause such interactions obviously depends on the sizes of the EEZs. If an EEZ is very large, then most tuna will be resident; if the EEZ is very small, most will move between countries.

Table 2. EEZ size and radius of an equivalent circle for some large countries in the Pacific Ocean

<u>Country</u>	<u>Sea area within EEZ (square km)</u>	<u>Equivalent radius (kilometres)</u>
Cook Islands	1830000	763
Fiji	1290000	641
French Polynesia	5030000	1265
Kiribati	3550000	1063
Mexico	2851000	953
Nauru	320000	319
Solomon Islands	1340000	653
Tonga	700000	472
Tuvalu	900000	535
U.S. Trust Territories	6200000	1405
Vanuatu	680000	465
Western Samoa	120000	195

⁴ Cayre, Le Hir and Pianet, Marquage et migrations des albacores dans la region de Pointe Noire, Office de la recherche scientifique et technique outre-mer, Documents scientifiques de centre de Pointe-Noire Nouvelle Serie No. 37. 1974

⁵ Schaefer, Chatwin and Broadhead, Tagging and recovery of tropical tunas, 1955-1959, Inter-American Tropical Tuna Commission Bulletin V No. 5, pp 343-452.

⁶ Joseph, Klawe and Murphy, Tuna and Billfish -- fish without a country, Inter-American Tropical Tuna Commission, La Jolla, California.

Figure 3: Average distance travelled vs months since release for yellowfin tuna tagged in the eastern Atlantic.

Figure 4: Average distance travelled vs time since tagging for yellowfin tuna tagged in the eastern Pacific.

Table 2 lists some of the countries of the world where tuna fishing takes place giving the size of their EEZ in square km. and the diameter of a circle having the equivalent area. For the larger countries, the types of yellowfin movements shown in Figures 3 and 4 could easily take place within the EEZ of the country. The fact that 85% of skipjack tags were recovered in the country of tagging in the SPC study is also undoubtedly due to the large economic zone of many of the countries. The qualitative differences between these large EEZs, and the very small EEZs of most central American and West African countries may explain the traditional perspective of skipjack and yellowfin rapidly moving between EEZs.

In a more quantitative analysis, Hilborn⁷ presented two models of interaction between tuna fisheries in different countries and showed that with economic zones of more than 1,000,000 sq km there is likely to be almost no interaction between skipjack fisheries, and only modest interaction between yellowfin fisheries. There are great differences in EEZ area between countries, and we can easily imagine that the largest countries could manage their own skipjack and yellowfin resources with little concern for outside harvest rates, while small countries could be swamped by the fishing policies of their neighbours.

Other factors, in addition to EEZ size and movement rate, will also constrain the capacity of a coastal state to manage tuna fisheries within its EEZ. Mortality rate and recruitment of young fish to the fishery are expected to be important as well.

The two previously discussed factors, EEZ size and movement rate, combine to produce a monthly emigration rate. If the natural mortality is high relative to the emigration rate, then what goes on in one area will be of little consequence elsewhere. However, if mortality is low relative to emigration, then external events will be more important.

Tuna are though to have extremely high mortality rates. The generally used figure for yellow-fin is 6% per month⁸; for skipjack within the SPC area the corresponding figure is 17% per month. These high mortality rates reinforce the possibility that countries with large EEZs may be little affected by their neighbours' fishing policies.

Recruitment of individuals to the fishery is the result of the combined biological processes of reproduction, growth and immigration. If recruitment takes place within a country, then there is a trade off between emigration from the country and natural mortality rates. If recruitment does not take place inside a country's EEZ, then that country is dependent upon the countries that do have recruitment to maintain its stocks. The distribution of spawning is not well known for either skipjack or yellowfin tuna, but the distribution of larvae is a useful guide to identify regions where recruitment occurs. Studies of the larval distribution of skipjack and yellowfin⁹ show that recruitment seems to take place widely across the

⁷ Hilborn, Spatial models of tuna dynamics in the western Pacific. "Proceedings of the Second U.S.-Australia conference on renewable resource management", Lecture Notes in Biomathematics, Springer Verlag.

⁸ Lenarz and Zweifel, A theoretical examination of some aspects of interaction between longline and surface fisheries for yellowfin tuna, *Thunnus albacares*, Fisheries Bulletin 76: 807-825, 1979

⁹ Far Seas Fisheries Research Laboratory, Average Distribution of Larvae of Oceanic Species of Scombroid Fishes, 1958-1981, Shimizu, 424, Japan, S Series No. 12, March 1985.

tropical oceans of the world. Thus most countries can be thought of having their own stock in terms of recruitment. The major exception is the relative absence of skipjack larvae in the eastern Pacific.

We cannot easily classify tuna into highly migratory and not highly migratory groups. There is an enormous difference between the migratory behaviour of bluefin and albacore tuna at the most migratory end of the scale and that of yellowfin and skipjack at the less migratory end. A definition of "highly migratory" apparently used during the Law of the Sea conferences¹⁰ states: "highly migratory species, which are creatures that are believed to undertake extensive migrations, and that carry individuals through many coastal zones as well as the high seas throughout their life." This definition is unlikely to apply to skipjack and yellowfin in the western Pacific, although we can imagine dozens of major commercial species for which it would apply. Simply stated, skipjack and yellowfin are much less migratory than many other commercially important non-tuna species. Thus there appears to be little biological justification for inclusion or rejection of highly migratory species in the current Law of the Sea.

It is more fruitful to ask if the movement rate is high relative to the size of the EEZ of the Country and to the natural mortality rate. In the western Pacific, Papua New Guinea, the Solomon Islands, the Federated States of Micronesia, Kiribati and French Polynesia all have very large EEZs. Most other western Pacific and Indian Ocean countries also have large EEZs, while the tropical countries of West Africa and Central and South America have much smaller EEZs. From the perspective of movement rates, the stocks in larger countries could almost certainly be considered resident, while the stocks in the smaller countries could not. For the small countries international cooperation in regulation of catch would obviously be much more important should such regulations be required.

Will unregulated tuna fishing overexploit the resource?

For countries where movement rates are high relative to EEZ size, international regulation of catch is only important if overexploitation will take place in the absence of such regulation. The stock size toward which an unregulated fishery will tend is often called the "bioeconomic equilibrium", a concept that recognises that the equilibrium stock size is governed by both the biology of the stock and the economics of the fishery.

The collapse of many of the world's fisheries, including the North Sea and Norwegian herring, the Peruvian anchoveta, and many groundfish stocks prior to extended jurisdiction is directly attributable to a low bioeconomic equilibrium stock size. In these fisheries, vessels could still meet operating expenses even when stock size was very low.¹¹

The bioeconomic equilibrium stock size for tuna is not particularly well known, although of all the major tuna fisheries in the world only the southern bluefin fishery by Japan and Australia and the Atlantic bluefin fishery have prompted enough concern that serious harvest restrictions are in place. It is felt that the decline in catch rates from the early 1970s to the early 1980s in the eastern Pacific yellowfin fishery may have been due to overfishing, but the bioeconomic equilibrium was apparently not terribly low, because effort dropped and catch rates increased without catch regulation.

The experience in the Philippines tuna fishery is a useful illustration of the sensitivity of this conclusion to specific fishing conditions and fleet characteristics. This fishery, based on the use of payaos or fish aggregation devices (FADs), is one tuna fishery that may have seen

¹⁰ Joseph 1977, Ibid.

¹¹ Clark, Bioeconomics of the Ocean. Bioscience 31(3), March 1981 pp 231-237.

serious overexploitation and where intense local fishing pressure induced a drastic decline in average size of fish.¹² This experience demonstrates that a specialised fishing method and highly developed local fleet, without the economic structure of the large purse seine vessels, is perhaps capable of overexploiting tuna stocks. However, at the moment only the Philippines have a fishing fleet with such capability.

In summary, at today's prices and fishing technology there does not seem to be any need for smaller countries to worry about a large foreign fleet marauding along the edges of its 200-mile zone, depleting adjacent tuna stocks. The only existing technology that seems economically capable of potentially depleting tuna stocks is the small scale shore based fishery depending on FADs, such as occurs in the Philippines, which does not operate on the high seas. Changes in prices of technology could easily make inshore tuna fisheries more attractive, and prompt the need for regulation within a country. Furthermore, if prices were considerably higher, high-seas purse seine fishing for yellowfin and possibly even for skipjack could pose the threat of overexploitation in some locations.

Biology, international law and national fisheries policies

Tuna have been given special status in the Law of the Sea as highly migratory, a distinction they share with billfish, some marine mammals and sharks. Although regulation of harvests of highly migratory species is given to coastal nations under the Law of the Sea, the convention also encourages international cooperation in harvest regulation. U.S. law, under the Fisheries Conservation and Management Act of 1976, does not recognise coastal state jurisdiction over tuna. The joint House-Senate conference committee¹³ states that "Since there is no justification for coastal nation jurisdiction over such species, this section declares them subject to management pursuant to international fishing agreements established for that purpose." Highly migratory species are defined in the act as "species of tuna which, in the course of their life cycle, spawn and migrate over great distances in waters of the ocean."

A realistic appraisal of the movement rates of different tuna species could well lead to re-evaluation of the highly migratory nature of yellowfin and skipjack. The spirit of the law is clear, and the low movement rates combined with the large EEZs of many countries suggest a somewhat different interpretation.

One must recognise, however, that this section of the U.S. law is not based exclusively on biology, since billfish, also classified in the Law of the Sea as highly migratory, are considered subject to national jurisdiction. This exclusion was made in response to U.S. sports fishing interests who wished to exclude longline fisheries from the areas near U.S. sport fishing centres. While the exemption of billfish from the U.S. law makes it clear that there is no biological basis for U.S. tuna policy, it remains official policy that tuna require international management, and highly migratory skipjack and yellowfin are often cited for special consideration. Perhaps reconsideration of the movements of skipjack and yellowfin, combined with the decline of the domestic US tuna industry, may lead to an official change in U.S. policy.

Conclusions

There are many reasons cited for international cooperation in tuna management and such cooperation is most successful where the reasons have a sound foundation in economics,

¹² Floyd, Development of the Philippine tuna industry. Pacific Islands Development Program, East-West Centre, Honolulu, Hawaii Report. February 1986.

¹³ Anon. Fishery Conservation and Management Act of 1976. Report of the Committee of Conference on H.R. 200, U.S. Government Printing Office, Washington, 1976.

politics or biology. We have attempted to make a case that many countries of the world are capable of managing skipjack and yellowfin tuna stocks without recourse to international catch regulations. There are examples where international management regimes for regulating yellowfin catches have broken down, such as in the eastern Pacific. To the litany of political causes for these breakdowns we would add some biological causes as well. There is clearly no compelling biological reason to impose international management regimes for all so-called "highly migratory" species in general nor for yellowfin and skipjack in particular. Tuna will undoubtedly continue to be a major source of food and income for many coastal states and the need for international cooperation is required however, for the study of tuna dynamics. No individual country will be able to devote the resources required to conduct tagging studies on the scale of those conducted by IATTC, SPC and ICCAT. Without such international cooperation, we would know very little about tuna. Furthermore, for any country to learn about the biology and optimal management of tuna, it will need to know what has happened elsewhere in the world. Most fisheries management techniques involve trying to see a trend from noisy data. Data available to any individual country will contain little information and noise will obscure trends. However, when data are combined on a regional scale, trends will become clearer and significant changes will be detected sooner. All countries will profit by sharing and combining systematic analysis of data. The current structures of the IATTC, SPC and ICCAT are well matched to these problems.

In the above section, we have made a case that under current conditions, international catch regulations for skipjack and yellowfin are probably not required, and almost certainly not for countries with large EEZs. There are a number of reasons, however, why individual nations may need to assess and manage their tuna resources.

First, many countries are permitting substantial industrial scale fishing within their EEZ, and need to know the magnitude of the yield that can be taken, and the impact that industrial scale fishing will have on domestic artisanal and subsistence fisheries. To answer these questions substantial tagging and comparative analysis of catch statistics between countries will be required.

Secondly, the Philippine experience, combined with the increasing use of fish aggregating devices around the world, suggests that many countries may develop local fisheries capable of potentially overexploiting their own stocks. International cooperation in the analysis of such data will be essential if countries are to learn by each other's experience.

Finally, although the current bioeconomic equilibrium appears to pose little threat to skipjack and yellowfin, a substantial change in price or major technological innovation could change this situation dramatically. A well established catch monitoring system, both in domestic and international waters, is necessary to detect overexploitation before it becomes severe and the costs of recovery become excessive. Every effort should be made to ensure that data collection, monitoring and research programmes are in place now to monitor these fisheries as they develop.

In conclusion, the traditional assumption that tuna are highly migratory and what goes on in one country strongly affects its neighbouring countries is probably not true for skipjack and yellowfin tuna in countries with large EEZs. Furthermore, the current economic structure of large scale tuna fishing does not lend itself to overexploitation of yellowfin and skipjack tuna. International catch limitation is probably not required in most of the world for these two species. International cooperation in data collection and analysis is essential if individual countries are to use their tuna resources wisely.