

## The Management of High Seas Fisheries

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**Abstract** *A new and acute management problem, now the focus of a major U.N. conference, has arisen in recent years in international fisheries. The problem concerns the management of transboundary fishery resources, in the form of resources to be found in both the coastal state EEZ and the adjacent high seas. The resources are commonly referred to as "straddling" stocks. This article provides a preliminary exploration of the management issue. It reviews the historical and legal background and asks how far the now well developed economic analysis of the management of transboundary fishery resources in the form of resources "shared" by two or more coastal states will take us in examining this second and more recent transboundary fishery management problem. The answer is a very limited distance only. The article concludes by pointing to questions arising from this resource management issue demanding further research.*

**Keywords** Transboundary fishery resources, straddling stocks, theory of dynamic games.

### Introduction

In December 1992, the United Nations agreed that an intergovernmental conference should be held on high seas fishery resources. It is planned that the conference should commence by mid-1993 and that the conference should have its final session before the end of 1994.

The call for the conference came from the United Nations Conference on the Environment and Development, held in Rio de Janeiro in June 1992. The call reflected growing concern over an increasingly important and troublesome international fisheries management issue, namely the management of high seas fishery resources, particularly those to be found in both the high seas adjacent to an Exclusive Economic Zone (EEZ) and the EEZ itself. At the close of the U.N. Third Law of the Sea Conference in 1982, the issue had seemed minor. A decade

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later, the issue was seen as posing a threat to the New Law of the Sea itself (Munro, 1992b).

In this paper, we shall discuss the background to the issue and offer a preliminary exploration of some of the economic aspects of the problem. In no sense do we pretend to offer a complete economic analysis. On the contrary, we devote a considerable part of our effort to pointing to the many areas where economic research is still required. Moreover, we would also warn that important aspects of the problem must be seen as being in a state of flux, since the surrounding legal framework is bound to be influenced by the forthcoming U.N. conference.

### **The Historical Background to and the Legal Aspects of the High Seas Fisheries Management Issue**

The Law of the Sea Convention, which was presented for signing at the close of the U.N. Third Conference on the Law of the Sea in December 1982, has yet to be declared international treaty law. That part of the Convention pertaining to fisheries, however, Part V, The Exclusive Economic Zone, has been implemented so widely that it was long ago declared to have achieved the status of customary international law (Munro, 1992b). Part V of the Convention can thus be seen as providing the "rules of the game" for international fisheries management.

The Law of the Sea Convention, as set forth in 1982, provides the coastal state with what are essentially full property rights to the fishery resources within the 200 mile Exclusive Economic Zone (EEZ). The key article, Article 56, states that, within the EEZ, the coastal state has

"sovereign rights for the purpose of . . . exploiting, conserving and managing the natural resources, whether living or non-living . . ."<sup>1</sup>

The one apparently unsettled issue in 1982 concerned coastal state rights with respect to highly migratory species within EEZ. There was an active debate during the Conference over whether highly migratory species (tuna in particular) were the exception to the rule of coastal states property rights to fishery resources within the EEZ. The United States, in particular, argued that highly migratory species were indeed an exception that should remain as international common property to be managed by international organizations, in which distant water fishing nations, as well as coastal states, would have a significant management role. The debate within the Conference led to a compromise article in Part V of the Convention, Article 64. The article was to be a source of controversy for years after the close of the Conference.

Article 64 contains two apparently contradictory paragraphs. Paragraph 1 of Article 64 states that, where no international organizations exist to manage the resources, the relevant coastal states should cooperate "with other states whose nationals fish these resources," i.e., distant water fishing nations in particular, to establish such organizations.<sup>2</sup> It was clearly understood that distant water fishing nations should have the power within these organizations to influence the management of the relevant fishery resources. Such international organizations,

<sup>1</sup> U.N., "Convention on the Law of the Sea," Article 56.

<sup>2</sup> U.N., "Convention on the Law of the Sea," Article 64.

which confer powers of management upon distant water fishing nations, are now commonly referred to as "Article 64 organizations."

Paragraph 2 of Article 64 states that Paragraph 1 of the article is to "apply in addition to other provisions of the Part [V]."<sup>3</sup> Coastal states interpreted this paragraph to imply that Article 56 applied to highly migratory species as well as other species. That is to say, within the EEZ, the coastal state was to be seen to have sovereign rights with respect to the management and exploitation of highly migratory species that are present in the EEZ. This interpretation was in direct contradiction of the interpretation which distant water fishing nations, *e.g.* the United States, placed on Paragraph 1. The distant water fishing nations saw Paragraph 1 as granting themselves influence over the management of the highly migratory resources within, as well as without, the EEZ (Burke, 1984).

Over time, the distant water fishing nations appeared to give up the struggle. By the turn of the decade, the United States, as leader in the cause of distant water fishing management rights over highly migratory species, had conceded that coastal states did indeed have full property rights to highly migratory species within the EEZ (Munro, 1990a; U.N., 1992).

The Article 64 controversy had subsided, or so it seemed. Yet the dispute was to re-emerge in the context of high seas fisheries management. Article 64 is still very much with us.

The one area covered imperfectly by Part V of the Law of the Sea Convention was high seas fisheries. One possible explanation for this lack of attention is that, in December, 1982, high seas fisheries were deemed to be of minor importance. It was maintained at the time that not less than 90 per cent of the world's ocean harvest of fish was accounted for by fishery resources encompassed by the newly established, or about to be established, EEZs. What was left over seemed of little consequence (Munro, 1992b). Moreover, it is reasonable to conjecture that many coastal states believed that distant water fishing nations could exploit on a commercial basis fishery resources in the high seas adjacent to the EEZs, only if they were granted access to the EEZs as well. Thus the coastal state had the whip hand, or so it appeared.

The articles in Part V most relevant to high seas fisheries are Articles 63, 64, 65, 66, 67, 87 and 116-120. The high seas threat to anadromous species was explicitly recognized at the Conference. This is dealt with in Article 66, which contains the State of Origin Principle, *i.e.* states of origin bear primary responsibility for the stocks. Customary international law now appears to dictate that directed anadromous fisheries (*e.g.* salmon fisheries) on the high seas is to be deemed illegal. The status of non-directed anadromous fisheries, *i.e.* bycatches, is somewhat murkier (Burke, 1991). Article 67 applies the same principles to catadromous stocks.<sup>4</sup>

With respect to all other high seas fishery resources, what are of primary concern, are not stocks wholly confined to the high seas, but rather those to be found in both the EEZ and the adjacent high seas. These have now come to be subdivided by the international lawyers and others into highly migratory species

<sup>3</sup> *Ibid.*

<sup>4</sup> Catadromous species are the reverse to anadromous species. Catadromous species spawn in the sea, but spend most of their life cycle in fresh water. Commercially, they are of minor importance in comparison with anadromous species.

and "straddling" stocks. Highly migratory species, *e.g.* tuna, do, by their very nature, move between the EEZs and the adjacent high seas. The term "straddling" stocks can be viewed as a catchall term. It includes all stocks, other than highly migratory, anadromous and catadromous stocks, to be found in both the EEZ and the adjacent high seas. An example is provided by particular groundfish stocks on the Grand Bank off Newfoundland. The boundary of Canada's Atlantic Coast EEZ slices off two segments of the Grand Bank in the east and south, popularly referred to as the Nose and Tail of the Bank, respectively. There are significant groundfish stocks found both within that part of the Grand Bank encompassed by Canada's EEZ and in the Nose or in the Tail of the Grand Bank.

Article 87, the Freedom of the High Seas article, grants all states freedom to fish on the remaining high seas, subject to other provisions in Part V of the Convention, and with the admonition that states fishing on the high seas shall do so "with due regard for the interests of other States"<sup>4</sup> (*e.g.* coastal states).

Articles 63 and 64 admonish coastal states and other relevant states to cooperate in order to ensure the conservation of "straddling" stocks (Article 63) and highly migratory species found in both the EEZ and adjacent high seas (Article 64). The two articles provide virtually nothing in terms of direction or guidance. Article 65 applies the same admonition to marine mammals.

Articles 116–120 specifically address the issue of the conservation and management of high seas fishery resources, and by implication, the division of rights and responsibilities between coastal states and those distant water fishing nations operating in the adjacent high seas. The key article, Article 116, re-states the right of all states to engage in fishing on the high seas subject to (*inter alia*) "the rights and duties as well as interests of coastal states. . . ."<sup>6</sup>

In a widely cited, much praised, and much attacked, article, Edward Miles and William Burke maintain that "Article 116 establishes that the coastal state has the superior right, duty and interest in straddling stocks beyond the EEZ." (Miles and Burke, 1989, p. 349). The authors go on to concede, however that "the precise distribution of competences to make these [coastal state right, duty and interest] is not prescribed. . . ." (Miles and Burke, 1989, p. 343). In short, Articles 116–120 are together a model of vagueness and imprecision. It is now generally agreed that the high seas fisheries management issue constitutes part of the "unfinished business" of the U.N. Third Law of the Sea Conference (Kwiatkowska, 1992).

The "unfinished business" would have been unimportant if high seas fisheries issues had continued to be a matter of minor concern. The issues did not remain minor, however. Rather, they became a cause of steadily increasing concern during the 1980s and on into the 1990s. Two of the more dramatic examples of the emergence of the problem of high seas fisheries management are provided by North American fisheries. The first involves the aforementioned "straddling" stocks on the Grand Bank of Newfoundland. Canada had, at the inception of Canadian Extended Fisheries Jurisdiction, attempted to deal with the problem in a sensible manner by establishing an international management body, the North-

<sup>5</sup> U.N., "Convention on the Law of the Sea," Article 87, paragraph 2.

<sup>6</sup> U.N., "Convention on the Law of the Sea," Article 116.

west Atlantic Fisheries Organization [NAFO]<sup>7</sup>. All went well for a time, but, by the mid-1980s, the cooperative management regime showed signs of increasing stress. The weakening of cooperation had serious resource management consequences and led to a severe strain being imposed upon Canada-EC fisheries relations (Applebaum, 1990; Munro, 1992a).<sup>8</sup>

The other example is provided by the immense groundfish fisheries of the Bering Sea.<sup>9</sup> The ground fish resources are encompassed by the American and Russian EEZs, except for a high seas enclave popularly referred to as the Doughnut Hole. The Doughnut Hole, about which we shall have considerably more to say at a later point, began to become a problem in the mid-1980s. By the early 1990s, the problem was beginning to take on the attributes of a major resource management disaster.

The Grand Bank and the Bering Sea provide only the most dramatic examples of high seas fisheries management problems. Similar, albeit less dramatic, examples have emerged in the Southwest Atlantic, and the East Central and Southeast Pacific (Miles and Burke, 1989; F.A.O. of the U.N., 1992a). There are now clear signs that the problem is beginning to emerge as well in the Western and Central Pacific and in the Barent Sea.

One should also add in passing that the driftnet problem, which has been the subject of intense, and often vitriolic, debate is to a large extent a high seas fisheries management issue.<sup>10</sup> No one is seriously disputing the use of driftnets within the EEZ.

When looking for reasons for the emergence of high seas fisheries management problems, we should note first that the comfortable assumption to the effect that distant water fishing nations could not operate in the adjacent high seas without having access to the EEZs has proven to be false. Beyond that, we observe the exclusion of distant water fleets from EEZs, often for reasons having little foundation in economics, combined with the surprising lack of decline in distant water fleet capacity since 1982 (F.A.O. of the U.N., 1992b). The inevitable result has been increased pressure on high seas fishery resources.

For an example, we return to the Bering Sea groundfisheries. In 1984, the United States undertook a determined effort to eliminate foreign fishing fleets from its Northeast Pacific EEZ. Prior to 1984, harvests of groundfish in the Doughnut Hole had been trivial, amounting to no more than a few thousand tonnes per annum. By 1988, the per annum groundfish harvest in the Doughnut Hole had risen to 1.6 million tonnes (Miles and Fluharty, 1991).

As concern about the high seas fisheries management problem intensified, pressure mounted to have the issue addressed on an international basis. The issue was placed on the agenda of the U.N. Conference on the Environment and Development (UNCED), held in Rio de Janeiro in June, 1992. The Conference called

<sup>7</sup> NAFO was, in a sense, a successor to a pre-EFJ international fisheries commission, the International Commission for Northwest Atlantic Fisheries (ICNAF).

<sup>8</sup> At the time of writing, there are signs that cooperation in returning to the NAFO region. This will be discussed at later point. How stable such cooperation will prove to be remains to be seen.

<sup>9</sup> Which in terms of volume of harvest is dominated by pollock.

<sup>10</sup> It is true that the use of driftnets has also been attacked on the grounds that the nets destroy marine mammals and birds.

upon the U.N. to mount an intergovernmental conference on the management of highly migratory species and straddling stocks. Six months later, the U.N. General Assembly agreed. The U.N. Conference on Highly Migratory and Straddling Stocks is scheduled to have a preparatory session in April, 1993, and to have its first full session in July of that year.

Two opposing schools of thought are beginning to emerge with respect to the management of fishery resources in the adjacent high seas. Both schools of thought take it as obvious that the management regime for stocks in the adjacent high seas must be the same as the management regime for those portions of the stocks in the EEZ. The first school of thought (of which Canada is a prominent member) supports the so-called "consistency principle."

The "consistency principle" states that the management regime applied to the portion of the stock in the adjacent high seas must be consistent with the management regime established by the coastal state for the portion of the stock within the EEZ (Kwiatkowska, 1992). The "consistency principle" probably made its first appearance in the NAFO Convention (Article XI) (Canada, 1978).

The principle seems innocuous enough, appearing simply to repeat the obvious, namely that there cannot be a discrepancy between management regimes in the EEZ and the adjacent high seas. If the principle stated that the management regimes within the EEZ and in the adjacent high seas should be consistent with one another, the principle would indeed be innocuous. That is, however, not what the principle states. Rather the principle states that the management regime for the adjacent high seas is to be consistent with the management regime established within the EEZ. It is the coastal state alone which determines the latter management regime (Article 56). By implication then, if the "consistency principle" is accepted, the management regime applicable to the portion of the "straddling" or highly migratory stock in the adjacent high seas is to be dominated, if not wholly determined, by the wishes and preferences of the coastal state.

The typical response of distant water fishing nations to the "consistency principle" has been that the principle is a reflection of "creeping jurisdictionalism" on the part of the coastal states. Distant water fishing nations naturally have an incentive to press for arrangements in which they play a significant role in determining the management regime in the adjacent high seas. Yet, if such arrangements were to be established, then, by implication, distant water fishing nations would influence the management regime within the EEZ, as well as without. Indeed, if such a cooperative management regime were administered through an international organization, we should not hesitate to identify the organization as an Article 64 type of organization.<sup>11</sup> To many coastal states, the position of the second school of thought, which, for want of a better term, we can label the Article 64 school, would serve to undermine coastal state sovereignty within the EEZ, and is thus an anathema.

It thus may well be that the positions of the two schools of thought are virtually irreconcilable. As we have noted, it is the hope of the organizers of the U.N. conference on high seas fisheries management that the last session of the conference will be held by late 1994. This hope may be decidedly optimistic.

<sup>11</sup> See, for example, Japan, 1992.

### Some Initial Reflections on the Economics of High Seas Fisheries Management

In keeping with our earlier discussion, we shall in this part ignore fishery resources that are wholly confined to the high seas. Rather, we shall focus on transboundary fishery resources to be found both within the EEZ and the adjacent high seas.

As well as using the terms "straddling" stocks and highly migratory species, international legal experts also refer to "shared" resources. By this term, they mean transboundary fishery resources, which are "shared" by two or more coastal states. The economics of the management of "shared" fishery resources is now reasonably well developed.<sup>12</sup> These authors would suggest that a reasonable approach to the question at hand would be to commence by seeing how far the economic analysis pertaining to "shared" fishery resources will carry us in analyzing the management of the other form of transboundary fishery resources, *i.e.* fishery resources to be found in both the EEZ and the adjacent high seas.<sup>13</sup> Indeed the FAO implies in a recent publication (FAO 1992c) that the two issues are, to all intents and purposes, one and the same. Hence the economic analysis developed for the "shared" stock problem should be all that is required to examine the "straddling" stock problem.

In our initial reflections on the economics of high seas fisheries management, we shall confine ourselves to asking how far the economic analysis of "shared" stock management will carry us in examining the management of the second form of transboundary fishery resource. If we end up disagreeing with the FAO and conclude that the economics of "shared" stock management will carry us only part way, then we shall be in a position to begin identifying issues demanding further research.

We commence with one issue which certainly does not arise in the management of "shared" resources, namely that of new entrants. One of the factors which helped to undermine NAFO was the appearance in the Nose and Tail of the Grand Bank of vessels of "new entrant," *i.e.* non-NAFO member, countries. As we shall argue, under the existing Law of the Sea Convention, current participants in a "straddling" stock type fishery can impose restrictions on would be "new entrants," but they cannot bar the "new entrants" entirely.

Fishery economists scarcely need to be told the consequences of an absence of all barriers to "new entrants." The establishment of a management regime over adjacent high seas fisheries, which shows promise, will attract "new entrants" and lead to the threat of severe resource depletion.

The U.N. argues that the Law of the Sea Convention allows states currently exploiting a "straddling" stock to establish a conservation regime and to insist that "new entrants" abide by the regime (U.N., 1992). This, however, does not really solve the economic problem. If the existing states establish and enforce, let us say, a TAC, but are unable to prevent "new entrants" from sharing in the TAC, then the return from the fishery to an individual fishing nation could steadily

<sup>12</sup> See, for example, the survey article: Munro, 1990b.

<sup>13</sup> From here on in we shall refer to the problem of fishery resources found in both the EEZ and the adjacent high seas, as simply the "straddling" stock problem. This will be understood to include the problem of highly migratory species crossing the EEZ boundary into the adjacent high seas.

diminish. Indeed, the situation described is uncomfortably close to that of a fishery wholly confined to coastal state waters in which the coastal state authorities establish and enforce a TAC, but exert no control over the fleet size.<sup>14</sup>

Canada has raised for discussion a proposal which would not bar new entrants entirely, but which would avoid the aforementioned problems. The proposal is that the states currently exploiting a "straddling" stock could establish a management regime and then declare the fishery to be fully utilized. New entrants would not have access to the TAC unless a state that had been exploiting the resource agreed to relinquish its share of the TAC (Canada, 1993a). While the Canadian proposal makes no reference to the possibility that a state currently exploiting the resource might be persuaded to sell its share to a prospective new entrant, the possibility obviously exists and would have interesting implications.

In any event, if the new entrant problem is mishandled, with the consequence that the economic benefits to be obtained from cooperative high seas fisheries management appear to be ephemeral, then the likelihood of achieving a stable cooperative management regime will be very low indeed. Hence, it is much to be hoped that the "new entrant" problem will be high on the agenda of the forthcoming U.N. conference.

Suppose now, for the sake of argument, that the U.N. does somehow resolve the "new entrant" problem and that access to a given adjacent high seas region is restricted to one, or a few, fortunate distant water fishing nation(s). The situation would now be somewhat closer to that of a "shared" resource, but important differences yet remain. Not the least important of these differences pertains to symmetry.

In the case of a "shared" resource, there is symmetry in the sense that each coastal state has clear property rights to that portion of the fishery resource within its EEZ (McRae and Munro, 1989). The fleets of one coastal state cannot harvest the "shared" resource in the EEZ of its neighboring coastal state, without the strict permission of that neighbouring coastal state.

If the resource in question is a "straddling" stock, or the equivalent, the distant water fishing nation cannot enter the coastal state EEZ without coastal state consent and permission. As the Law of the Sea Convention now stands, however, there is no legal reason why coastal state fleets cannot enter the adjacent high seas region—on the contrary. Hence the coastal state-distant water fishing nation relationship is distinctly asymmetrical.

With this in mind, let us now enquire into what insights, if any, the economics of "shared" fishery resource management can offer us with respect to the consequences of non-cooperation in the management of "straddling" stocks. We remind ourselves that most of the economic analysis of the management of "shared" fishery resources rests upon a foundation consisting of the economist's dynamic model of a fishery wholly confined to the waters of a single EEZ combined with the theory of dynamic games. For cases of non-cooperation, one turns naturally to the theory of dynamic competitive games. Several models pertaining to non-cooperative management of "shared" resources have now been developed. All provide essentially the same predictions.

<sup>14</sup> This is comparable to what Munro and Scott (1985) refer to as a Class II Common Property Problem (with Class I being associated with overexploitation of the resource).



One such model, which the authors have employed extensively in the past (*e.g.* Munro, 1990b), is that developed by Colin Clark (1980). Clark investigates a fishery in which there are two joint owners of the resource. With the underlying biological model being the famous Schaefer model, and assuming that the demand for harvested fish is perfectly elastic, as well as assuming that the joint owners have identical harvesting costs, Clark proves the following in the case of non-cooperation. The solution to a dynamic Nash competitive game produces the result that the fishery will be driven to the common bionomic equilibrium and that the economic rent from the fishery will be fully dissipated. In other words, we have an unequivocal Prisoner's Dilemma type of outcome (Clark, 1980).

It is not obvious why one should be unable to apply the analysis described directly to the "straddling" stock problem. Such evidence that we have suggests that the aforementioned Clark (1980) type model does in fact have considerable predictive powers. We turn yet again to the Bering Sea groundfish fishery for an example.

Reference has already been made to the rapid growth in harvests in the Doughnut Hole after 1984, from a few thousand tonnes of groundfish per annum, to over one and a half million tonnes. By 1992, harvests in the Doughnut Hole had plummeted to an annual rate of 22,000 tonnes. In August of that year, Russia and the U.S. were joined by several distant water fishing nations operating in the region, China, Japan, Republic of Korea, and Poland, in a resolution declaring a two year harvest moratorium with respect to the major groundfish resource in the Doughnut Hole, pollock. The moratorium was to commence in 1993. The resolution implied that the moratorium would, as well, be extended to the American and Russian EEZs.<sup>15</sup>

The aforementioned resolution refers explicitly to ". . . the drastic decline of the Aleutian Basin pollock stock and the need to . . . restore the stock."<sup>16</sup> In short, the stock had been plundered during the period of uncontrolled, and effectively non-cooperative, resource exploitation. The moratorium could be seen as a careful bolting of the barn door after the horse had fled and gone.

The Canadian experience on the Grand Bank is also suggestive of the predictive power of the aforementioned Clark type model. NAFO, which officially commenced operations in January, 1979, appeared to work reasonably well for several years. In 1985, however, the most important foreign partner, the EC, broke with Canada, ostensibly in a dispute over management goals (Applebaum, 1990; Munro, 1992a). EC harvests in the NAFO governed adjacent high seas exceeded (on an annual basis) the quotas assigned to the EC within the NAFO framework by over 400 per cent (Munro, 1992a). The Canadian government complained bitterly about the destruction of stocks off the Grand Bank by the Europeans.<sup>17</sup>

At the end of 1992, Canada and the EC signed a Memorandum of Understanding, marking the renewal of Canadian-EC fisheries cooperation off Atlantic Canada (Canada, 1993b). The Memorandum makes it clear that agreement was

<sup>15</sup> "Joint Resolution of the Fifth Conference on the Conservation and Management of the Living Marine Resources of the Central Bering Sea (August 14, 1992)."

<sup>16</sup> *Ibid.*

<sup>17</sup> Canada, Department of External Affairs and International Trade, "News Release," December 24, 1992.

reached in response to the "gravity of the situation,"<sup>18</sup> and as such makes the agreement not dissimilar in nature to the agreement reached with respect to the Doughnut Hole. One might describe the European willingness to sign the Memorandum of Understanding as post-plunder repentance.

Let us now ask what insight the economics of cooperative management of "shared" resources can provide us on the "straddling" stock issue. The clash between the two schools of thought, the "consistency principle" and the Article 64 schools, would amount to little if the coastal state and relevant distant water fishing nations were in full agreement on the appropriate management strategy. Bargaining would have to take place over the division of the gains from the fishery, but this would be true regardless of which school of thought was the apparent victor.

There is, however, no assurance whatsoever that the coastal state and distant water fishing nations will have identical management objectives. For example, the coastal state and distant water fishing nations may have different fishing effort costs. It can be easily shown that such differences will, in turn, lead to differing management goals (Munro, 1979). We might also note in passing that NAFO was faced with near breakdown by an apparent dispute over management goals.

To get us started, consider the following example, in which we adapt a simple model taken from the economics of cooperative management of "shared" resources (Munro, 1979; 1987). Suppose that the "new entrant" problem is resolved and that in fact there is but one distant water fishing nation whose presence in the adjacent high seas is indefinite. For the time being, we slide over the asymmetry problem and suppose that through negotiation the distant water nation and coastal state agree upon a division of the TAC, whatever that may happen to be.<sup>19</sup>

The distant water fishing nation and coastal state disagree over management strategy. They do, however, agree to bargain over a possible compromise. It is understood that should a compromise be reached a binding agreement shall come into force. We have thus described a cooperative game. In applying Nash's theory of two person cooperative games, and supposing further that side payments are not feasible, the Pareto efficient frontier in payoff space can be represented in Figure 1 by the curve  $\beta = 1 - \beta = 0$ . The implications of the absence of side payments, by the way, is that the returns from the fishery to the coastal state and distant water fishing nation will be determined solely by the harvesting activities of their respective fleets.

Call the coastal state and distant water fishing nation I and II respectively. Let  $\pi$  denote the payoffs to I, and  $\theta$  the payoffs to II, from following a prescribed harvest policy through time.

The payoffs  $\pi_0$  and  $\theta_0$  constitute the "threat point" payoffs, *i.e.* the payoffs I and II would enjoy if non-cooperation prevailed. These payoffs could be seen as those associated with the solution to a competitive game. It is assumed, as is reasonable, that a solution to the game is infeasible if it results in a player receiving a payoff less than its threat point payoff.

<sup>18</sup> Canada, Department of Fisheries and Oceans (1993), "Memorandum of Understanding Between the European Community and the Government of Canada on Fisheries Relations."

<sup>19</sup> When NAFO was working as it should, Canada, the EC and other distant water nations did negotiate and agree upon divisions of the TAC.

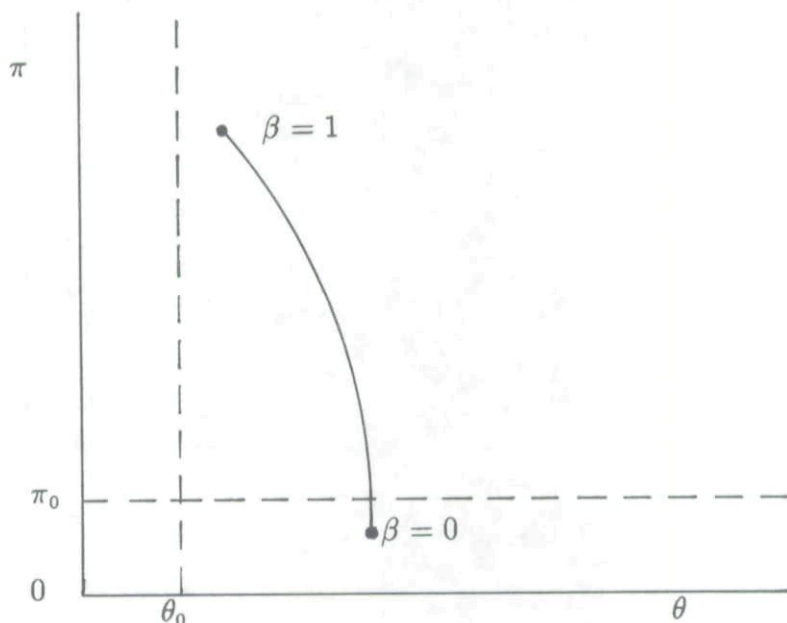


Figure 1. Pareto efficient frontier in payoff space—without side payments.

The term  $\beta$  is a bargaining parameter and is a measure of the weight to be given to the management preferences of the two players. If  $\beta = 1$ , then the management preferences of I are wholly dominant; if  $\beta = 0$ , the management preferences of II are wholly dominant.

The Pareto efficient frontier is determined by solving the following equation for each possible  $\beta$  between 0 and 1:

$$\max PV = \beta PV_I + (1 - \beta) PV_{II} \quad (1)$$

where  $PV_I$  and  $PV_{II}$  are the present values of the stream of net economic returns from the fishery to I and II respectively under a given harvest regime.

The actual size of  $\beta$  arises in turn from the solution to the cooperative game, which in the Nash theory of cooperative games, arises from maximizing the following expression:

$$\max(\pi^* - \pi_0)(\theta^* - \theta_0), \quad (2)$$

where  $\pi^*$  and  $\theta^*$  are the solution payoffs.

An important implication of (2) is that the relative bargaining power of each player depends upon the extent to which it stands to lose if there is no solution to the cooperative game. The more a player stands to lose, other things being equal, the weaker is its bargaining power.

Now let us observe the following. Full implementation of the "consistency principle" is the equivalent of setting  $\beta = 1$ . While we would have to concede that a solution to the game yielding  $\beta = 1$  is not inconceivable, we would also have to point out that, in the absence of side payments, it is quite possible that a solution

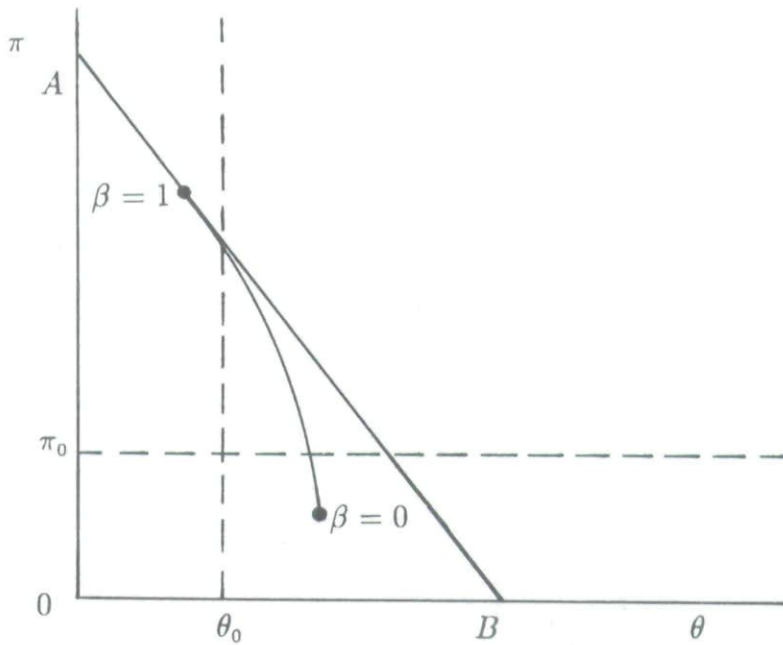


Figure 2. Pareto efficient frontier in payoff space—with side payments.

to the game in which  $\beta = 1$  will prove to be infeasible. All that is necessary is that  $\theta_0$  exceed the  $\theta$  associated with  $\beta = 1$ .

If side payments are possible, then the situation changes entirely. This is illustrated in Figure 2.

With  $\beta = 1$  and with side payments introduced to the game, the relevant Pareto efficient frontier becomes the lines A – B. Bargaining is confined to a division of the gains. In the example illustrated in Figure 2, a solution to the game in which  $\beta = 1$  is infeasible without side payments, but is feasible with side payments. Thus we conclude that the possibility of success of the “consistency principle” is certain to be greatly advanced by the introduction of side payments. Indeed, if side payments are excluded, the outlook for the implementation and retention of the “consistency principle” over the long term is decidedly bleak.

We know from the economic theory of the management of “shared” fishery resources, that there are in fact numerous cases where it is optimal, with side payments, to have  $\beta = 1$  (or 0, depending upon circumstances). As a general rule, it is optimal (with side payments) for the management preferences of the partner placing the highest value in the resource to be dominant (Munro, 1990b).

One could probably expect that, in most “straddling” stock cases, the coastal state will have the greatest stake in the resource and that it would indeed be optimal to have a  $\beta = 1$  type outcome. This cannot, however, stand as a general rule. One does not require a particularly high level of imagination to produce counter-examples, in which optimality would demand that  $\beta = 0$ .<sup>20</sup>

<sup>20</sup> For example, suppose that the distant water fishing nation is a low cost harvester, while the coastal state is a high cost harvester. Or suppose that the social rate of discount of the distant water fishing nation is lower than that of the coastal state.

To this point, we have adopted an heroic assumption, namely that cooperative arrangements once achieved will be binding. It has been pointed out many times (*e.g.* Kaitala, 1985) that the assumption is often highly questionable in the context of the management of "shared" fishery resources. We would contend that the assumption is even more questionable for agreements governing the management of "straddling" stocks.<sup>21</sup>

Once we relax the assumption of binding agreements, the issue becomes significantly more complex. The first, and most obvious complexity, is that of the threat to the agreement of cheating. This aspect of the problem does, of course, arise with equal force in the management of "shared" resources. There is now an extensive literature on various strategies which can be adopted to curb cheating, *e.g.* by establishing a credible system of threats (see, for example, Ehtamo and Hamalainen, 1991; Kaitala 1985; Kaitala and Pohjola, 1988). There is no obvious reason why this analysis should be inapplicable to non-binding agreements pertaining to "straddling" and similar stocks.

The possibility of cheating is not the only problem to emerge when the cooperative agreement is non-binding. There is also the problem of possible shifts in relative bargaining strengths over time. In the context of the cooperative game, the shifts will appear in the form of a shifting threat point. In a cooperative game with binding agreements, the only relevant threat point is that which exists at the commencement of the game. In a cooperative game without binding agreements, this simple state of affairs no longer exists, with the consequence that what was deemed to be an acceptable agreement at the commencement of the harvest program, may well prove to be unacceptable at a later stage.

This problem was first analysed in a fisheries context by Kaitala and Pohjola (1988). In their article, they take the example of a "shared" fishery resource with two joint owners in which the joint owners are identical except that the harvesting costs of one joint owner are significantly lower than those of its fellow joint owner. It is assumed as well that, at the commencement of the game, the fishery resource is at a level which one would associate with a solution to a competitive game, *i.e.* a level at which the high cost harvester is on the verge of leaving the fishery.

The optimal solution to the cooperative game would appear to be obvious. The low cost harvester should, in effect, buy out the high cost producer, by offering a stream of side payments over time. If a binding agreement were feasible, the stream of side payments would be relatively modest, since the high cost harvester's bargaining power would be weak.

If the agreement is non-binding, then account must be taken of the fact that, as the resource is restored, the high cost harvester's bargaining strength will increase. With the larger resource stock, it will become more attractive for the high cost harvester to re-enter the fishery even if that player is certain that it will be detected quickly and that retribution will follow immediately. In effect, the threat point will shift over time. Furthermore, the scope for effective negotiation will be substantially reduced in comparison with the case of binding agreements. If these facts are ignored, then the cooperative arrangement can easily collapse over time (Kaitala and Pohjola, 1988).

<sup>21</sup> As will be pointed out, the agreement under the NAFO Convention is a clear example of a non-binding agreement.

Once again, it is difficult to see why this analysis would not be highly germane to the "straddling" stock problem. The history of NAFO provides an example. NAFO, which commenced operations in early 1979, did, as we have already noted, appear to work well for about the first six years of its existence. There were two dominant players, Canada and the EC. If one lets Canada be Country I, then we had a  $\beta = 1$  situation, which the EC apparently accepted.

The NAFO arrangement, or agreement, was (and is) non-binding in the sense that a party to the agreement, which deems the management regime implemented by the NAFO Commission to be unacceptable, has the right to lodge a formal objection. Upon lodging the objection, the party ceases to be bound by the management measures. In 1985, the EC did just that and NAFO's difficulties began (Applebaum, 1990).

Spain and Portugal, which hitherto had not been members of NAFO and whose fisheries relations with Canada had been subject to severe strain, became full members of the EC on January 1, 1986. The EC, as a partner in NAFO, had been changed, perhaps fundamentally. It is not unreasonable to suppose that the EC's threat point payoff had altered significantly. One can conjecture that this was a factor leading to a breakdown of the cooperative arrangement.<sup>22</sup>

The analysis of "shared" fisheries stock management indeed does carry us part way in examining the question of managing "straddling" stocks. The analysis provides a reasonably clear indication of the consequences of non-cooperation and does offer some useful insights on the current debate on the "consistency" principle. There are, however, several important aspects of the "straddling" stock problem which the "shared" stock analysis does not and cannot address.

Examples are provided by our specific application of "shared" stock fisheries management analysis. First, in that application we carefully avoided the problem of "new entrants." The problem does not arise in the management of "shared" stocks, but can scarcely be avoided in the management of "straddling" stocks.

If the deliberations in the aforementioned U.N. conference lead to an outcome in which new entrants are granted unrestricted access to the "straddling" stock fishery, or an outcome in which prospective new entrants can be banned absolutely, then the consequences would be readily predictable. Neither outcome is, however, likely. If something akin to the Canadian proposal is adopted, in which prospective new entrants are granted access, but only under special conditions, then the consequences are far from predictable. We would then, in analytical terms, be presented with game-theoretic problems that are far more complex than any to be encountered in the analysis of "shared" stock management.

Secondly, in our application of "shared" fishery resource management, we assumed that there were but two "players," a coastal state facing a single distant water fishing nation. The assumption that there are no more than two players is not unreasonable when examining the management of "shared" stocks. Indeed

<sup>22</sup> Canada and the EC have now re-established a cooperative arrangement under NAFO (n. 18). The arrangement was re-established only *after* the post 1985 competitive game had played itself out, *i.e.* after the fishery resources had been heavily exploited. The question which now has to be asked is how stable the new arrangement is (see n. 8). Past history is not encouraging. Indeed, it is possible that a cycle may emerge in which the arrangement remains in place while the resource is being restored, but then breaks down after the resource has been restored. A competitive game re-emerges, to be followed by a new arrangement upon exhaustion of the resource, and so on.

we would be hard pressed to point to examples of "shared" stock management models involving more than two "players." The two "players" assumption is, however, almost certain to be quite unreasonable for "straddling" stock management. Here the norm is likely to be that of a coastal state confronting not one, but several distant water fishing nations. One cannot predict, a priori, the nature of the coalitions which would likely emerge or the analytical difficulties with which we would be confronted.

It can be added that the two examples, which we have cited are not independent of one another.

There are, of course, many other examples in which the analysis of "shared" stock management is certain to prove inadequate in examining "straddling" stock management. One such other example is that arising from questions of asymmetry which we discussed earlier.

We are consequently forced to conclude that the analysis of "shared" stock management falls far short of what we require for a full understanding of the economic management of "straddling" stocks. An important implication is, of course, that the economic management of "straddling" stocks is certain to present us with a broad menu of demanding research projects for the future.

## Conclusions

Within recent years, a new and increasingly important fisheries management issue has arisen from the implementation of Extended Fisheries Jurisdiction. The issue is the management of fishery resources to be found in both the EEZ and the adjacent high seas. The United Nations recently convened an intergovernmental conference on this issue, the first formal session of which is to be held in July, 1993. The fact that the conference has been convened is a reflection of the fact that the existing Law of the Sea Convention addresses high seas fisheries management issues in a wholly unsatisfactory manner.

In this paper, we provide an introduction to the topic. We review the historical and legal background of the issue, and then go on to make a preliminary attempt at examining some aspects of the economics of high seas fisheries management. We do so by adapting the economics of the management of that other form of transboundary fishery resources, "shared" fishery resources, to the issue at hand. The economics of "shared" fishery resources management carry us in fact only a short part of the way. There remain important aspects of the management of fishery resources in the adjacent high seas which demand further and extensive research.

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