

Working Paper No. 06/02

**The Management of High Seas Fisheries
Resources and the Implementation of
the U.N. Fish Stocks Agreement of 1995**

by

**Trond Bjørndal
Gordon Munro**

SNF-project No. 5400
"Value Added in the Norwegian Seafood Industry"
The project is financed by the Research Council of Norway

*Centre for Fisheries Economics
Discussion paper No. 2/2002*

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION
BERGEN, FEBRUARY 2002

ISSN 0803-4028

© Dette eksemplar er fremstilt etter avtale med KOPINOR, Stenersgate 1, 0050 Oslo. Ytterligere eksemplarfremstilling uten avtale og i strid med åndsverkløven er straffbart og kan medføre erstatningsansvar.

I. INTRODUCTION

From 1993 to 1995, the United Nations mounted an international conference, the U.N. Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, to address, and hopefully to alleviate, a worldwide fisheries management crisis, focussed on straddling and highly migratory fish stocks. The Conference brought forth an Agreement, popularly referred to as the U.N. Fish Stocks Agreement,¹ which became available for signing in December, 1995. Almost exactly six years later, on December 11, 2001, thirty days after the deposit, with the Secretary General of the U.N., of the thirtieth instrument of ratification, the Agreement achieved the status of international treaty law.

During the intervening six years, the Agreement had already come to serve as a framework for an increasing number of regimes, designed for the cooperative management of the aforementioned stocks. Examples, which will be explored at a later point in this paper, are provided by the Northwest Atlantic Fisheries Organisation (NAFO), Norwegian spring spawning herring resource, and Atlantic bluefin tuna.

The fact that the Agreement has come into force, and the fact that the Agreement, had, prior to December 11, 2001, been serving as a framework for an increasing number of cooperative resource management regimes, does not ensure the Agreement's viability over the long run. This paper will, after reviewing the history underlying the U.N. Fish Stocks Conference, 1993-1995, and the resource management crisis, which provided the *raison d'être* of the Conference, attempt to assess, from an economist's standpoint, the long-term viability of the Agreement. The assessment will require a review of the basic economics of the management of transboundary resources.

II. THE HISTORY AND THE ORIGINS OF THE U.N. FISH STOCKS AGREEMENT OF 1995

The origins of the straddling fish stock–highly migratory fish stock management crisis, and the U.N conference to which the crisis gave rise, can be traced back to the U.N. Third Conference on the Law of the Sea, and the resultant U.N. Convention on the Law of the Sea (U.N., 1982).

Prior to the U.N. Third Conference on the Law of the Sea, the extent of jurisdiction of coastal states² over fishery resources off their coasts was very limited. Three miles was the norm, while 12 miles was considered to be exceptional. Under the terms of the U.N. Convention on the Law of the Sea(Part V), coastal states were to have their jurisdiction over fishery resources extended out to 200 nautical miles from shore, through the establishment of Exclusive Economic Zones (U.N., 1982, Articles 55 and 57).

The key article in Part V of the Convention, and one which is of direct relevance to the U.N. Fish Stocks Conference of 1992-1995, and hence to the U.N. Fish Stocks Agreement, is Article 56. The article states that:

In the exclusive economic zone, the coastal State has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living ... (U.N., 1982, Article 56).

In time, there was general agreement that the coastal state has property rights to the fishery resources encompassed by the respective Exclusive Economic Zones (EEZs) (McRae and Munro, 1989). The one disputed area concerned highly migratory species, found within the EEZ.

The consequence of Part V of the Convention was that vast amounts of renewable resource wealth were transformed from the status of international common property to that of coastal state property. It was estimated, at the close of the U.N. Third Conference on the Law of the Sea, that 90 per cent of the harvests from marine capture fisheries would be accounted for by fishery resources that are, or would be, encompassed by the EEZs throughout the world (Kaitala and Munro, 1993).

The drafters of the Law of the Sea Convention fully realised that the mobility of fishery resources would result in many fishery resources encompassed by EEZs proving to be transboundary in nature. That is to say the resources could be expected to cross the EEZ boundaries. Four, non-mutually exclusive, classes of transboundary resources came to be recognised. While there remains some ambiguity about definitions, a significant number of legal experts agree that the classes can be properly defined and described as follows (Hedley, 2000):

A. “Shared” Fishery Resources

These are fishery resources, which cross the EEZ boundary into the EEZ (EEZs) of one, or more, neighbouring coastal states.

B. Anadromous Species

These are species, salmon to all intents and purposes, which migrate from the EEZ to the high seas and back again. As a result of pressure exerted successfully by Canada and the United States, these resources are effectively covered by a special provision in the Convention – Article 66. As a consequence of the Convention, customary international law now deems directed high seas fishing of salmon to be illegal (Burke, 1991).

C. Highly Migratory Stocks

These are fish species so designated by the U.N. as highly migratory (U.N., 1982, Annex 1), and are dominated, in economic terms, by the six major tuna species. Being highly migratory, the species naturally move to and from the EEZ and the adjacent high seas. Needless to say, highly migratory species will also prove, in many instances, to be “shared” resources as well.

D. Straddling Stocks

This is a catchall term for all fishery resources, other than anadromous species and highly migratory stocks, which are to be found in both within the EEZ and the adjacent high seas.

The distinction between highly migratory species and straddling stocks is not immediately obvious, and indeed has been the focus of considerable debate. During the U.N. Third Conference on the Law of the Sea, several distant water fishing nations (DWFNs),³ the United States in particular, insisted that highly migratory stocks are in fact separate and distinct from straddling stocks. The American position was not unrelated to American distant water fishing interests in tuna. On the other hand, the FAO maintains that such a distinction cannot be defended on biological grounds (FAO, 1994), while other authorities have stated flatly that the distinction is a false one (e.g. McRae and Munro, 1989).

In any event, transboundary fishery resources (other than anadromous species) are addressed in Part V of the Convention through Articles 63 and 64. Paragraphs 1 and 2 of Article 63 deal with “shared” stocks and straddling stocks respectively, while Article 64, as a whole, addresses the issue of highly migratory stocks. Article 63(2), the straddling stock paragraph, reads as follows:

Where the same stock or stocks of associated species occur both within the exclusive economic zone and in an area beyond and adjacent to that zone, the coastal State and the States fishing for such stocks in the adjacent area shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary for the conservation of these stocks in the adjacent area. (U.N., 1982, Article 63)

In the reference to “subregional or regional organizations” one can detect the origins of the concept of Regional Fisheries Management Organisations which was to emerge in the U.N. Fish Stocks Conference. Other than that, the paragraph is no more than a broad admonition to relevant coastal states and distant water fishing nations to cooperate for the purpose of conserving the resources. No guidance is given on the form that such cooperation might take.

Article 64 reads as follows:

1. The coastal State and other States whose nationals fish in the region for the highly migratory species listed in Annex 1 shall co-operate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall co-operate to establish such an organization and participate in its work.
2. The provisions of paragraph 1 apply in addition to the other provisions of this Part. [V]. (U.N., 1982, Article 64)

Paragraph 1 of Article 64 is much stronger than Paragraph 2 of Article 63, calling, as it does, for the establishment of international organisations to manage the resources within, as well as without, the EEZs. This reflected the pressure being exerted by the DWFNs, led by the United States. During the Conference, the U.S. insisted, as part of its claim that highly migratory stocks were in a class by themselves, that such resources not be deemed to be coastal state property in any sense. The resources should, the U.S. argued, be managed by true international organisations in which DWFNs (such as the United States) would play a significant role (Munro, 1990a). Paragraph 2, which implies that Article 56 is relevant to highly migratory stocks within the EEZ, was, it was argued, not entirely compatible with Paragraph 1 of the article (Munro, *ibid.*)

The international organisations referred to in Paragraph 1 came to be known, in common parlance, as “Article 64 organisations”. Article 64, and “Article 64 organizations” in particular, became the source of bitter disputes during the 1980s, worsening U.S.–Latin American fisheries relations and leading to an outright confrontation between the United States and several Pacific Island Nations (Munro, *ibid.*). The United States eventually retreated from its position, and in the revision of the early 1990s of its key piece of legislation governing the American EEZ – the Magnuson Fishery Conservation and Management Act – acknowledged coastal state jurisdiction over highly migratory stocks within the EEZ (U.N., 1992).

This seemed to end the debate on Article 64 organisations. Yet the issue was to emerge again in the U.N. Fish Stocks Conference. We shall argue that some of the Regional Fisheries Management Organizations arising from that conference – and to be discussed at a later point – will take on the attributes of Article 64 organisations. That is to say, they will be organisations which will enable DWFNs to influence the management policies for relevant fishery resources within, as well as without, the EEZ. One such attempt, it might be observed, takes the form of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.⁴ Unlike the original “Article 64” organisations, the new version applies to straddling stocks, as well as to highly migratory stocks.

Once the United States had acknowledged coastal state jurisdiction over highly migratory stocks within the EEZ, a general consensus on property rights to “shared” fishery resources appeared to emerge. Consider for example two coastal states, A and B, “sharing” a fishery resource confined to the EEZs of these two states. The emergent view was that the relevant fish, while within the EEZ of A, constitute the property of A, and while within the EEZ of B, constitute the property of B. Thus, one could think of A and B “owning” the resource on a condominium basis (McRae and Munro, 1989).

By way of contrast, the nature of the property rights to fishery resources to be found, both within the EEZ and the adjacent high seas, was left unsettled by the Law of the Sea Convention. While the nature of the property rights to the portions of the resources within the EEZ was clear enough, the property rights to the high seas portions of the resources were opaque at best.

Of key relevance to the high seas portions of the aforementioned fishery resources are, not surprisingly, Part VII of the Convention (“High Seas”), along with Articles 63 and 64 of Part V. Within Part VII, Article 87 and Section 2 (Articles 116–120): “Conservation and Management of the Living Resources of the High Seas,” are particularly important.

Article 87 is the “Freedom of the High Seas” article, which states that “the high seas are open to all States ...”, and that freedom of the high seas comprises, *inter alia*, freedom of fishing, subject to conditions laid down in Section 2 [Part VII]” (U.N., 1982, Article 87). Section 2 (Articles 116–120) qualifies a state’s right to fish on the high seas by maintaining that such a state (i.e., DWFN) must take into account the interests of

relevant coastal states in such resources and must be prepared to cooperate in the conservation of the resource (U.N., 1992).

Beyond this general statement, however, Articles 116–120 are models of vagueness and imprecision. The rights and responsibilities of coastal states, as opposed to those of relevant DWFNs, with regards to the portions of straddling/highly migratory stocks in the adjacent high seas, are exceedingly unclear and were left open to conflicting interpretations (Miles and Burke 1989; Kaitala and Munro, 1993).

During the U.N. Third Conference on the Law of the Sea, the debate over highly migratory stocks focussed on Article 64, and the attempt of the U.S., in particular, to have these resources subject to management by true international bodies. With respect to straddling stocks, there were a series of proposals, extending up to the last year of the Conference (1982), to acknowledge the “special interests” of coastal states regarding the high seas portions of straddling stocks, and to grant to coastal states the right to extend their conservation measures to these high seas portions. The proposals were actively resisted by DWFNs, and were never brought to a vote (U.N., 1992). If the promoters of the proposals had been successful, then the principle established would presumably have applied with full force to highly migratory stocks, once the Article 64 issue had been resolved.

A probable reason why the issue was not brought to a vote, and why Articles 116–120 were left in such an unsatisfactory state, lies in the fact that, at the close of the Conference in 1982, high seas fishery resources were deemed to be of minor importance. It was, after all, believed that 90 per cent of the harvests from marine capture fisheries would be accounted for by resources encompassed by EEZs throughout the world. Moreover, it can be conjectured that many coastal states were convinced that DWFNs could not harvest the high seas portions of straddling/highly migratory stocks on a commercial basis, unless they were also granted access to the adjacent EEZs. Thus, coastal states would have ample bargaining power when having to deal with the DWFNs attempting to exploit such stocks (Kaitala and Munro, 1993).

While the 1982 assessment of the importance of high seas fisheries resources may seem to have been reasonable at the time, the assessment was to prove to be quite simply wrong. What had appeared in 1982 to be a minor resource management

problem, became a highly significant problem over the ensuing decade. By the end of the 1980s, there was no longer any doubt that the problem was a major one.

Case after case emerged of straddling/highly migratory stocks that were being subject to severe overexploitation. Two of the more dramatic examples are provided by the Donut Hole in the Bering Sea, and the groundfish fisheries on the Grand Bank of Newfoundland (see: Stokke, 2001).

Alaska pollock constitutes one of the larger groundfish resources in the world. Harvests of Alaska pollock throughout the North Pacific had achieved levels of 6.7 million tonnes in the late 1980s and had, at one point, been the largest single species harvested in the North Pacific (FAO, 1994). A segment of the fishery is to be found in the Donut Hole, a high seas enclave, lying between the American and Russian EEZs. The pollock stocks in the Donut Hole are without question straddling stocks (FAO, 1994)

In 1984, the United States effectively evicted all foreign fleets from its EEZ off Alaska. Prior to that date, harvests in the Donut Hole had been minor, amounting to no more than 4,000 tonnes. Harvests then grew rapidly, and, by 1988, had reached an unsustainable 1.6 million tonnes per annum (Miles and Fluharty, 1991). The fishery had all of the characteristics of an open access, free for all, fishery. The FAO argues that the resources were, to all intents and purposes, plundered (FAO, *ibid.*)

Harvests subsequently declined rapidly, and, by 1992, had fallen to an annual rate of 22,000 tonnes. In August of that year, Russia and the U.S., along with four DWFNs operating in the area, China, Japan, Republic of Korea, and Poland, entered into an agreement to impose a harvest moratorium in the Donut Hole (Kaitala and Munro, 1993). While the moratorium was initially declared for two years, it remains in effect at the time of writing.

The second example concerned the groundfish resources on the Grand Bank of Newfoundland. The 200 mile boundary of Canada's Atlantic EEZ slices off two segments of the Grand Bank, one in the east, the "Nose of the Bank," and one in the south, the "Tail of the Bank". Groundfish resources in the Nose and Tail of the Bank are, virtually by definition, straddling stocks.

Canada attempted to address the problem before the close of the U.N. Third Conference on the Law of the Sea by establishing the Northwest Atlantic Fisheries

Organisation (NAFO) in 1979. NAFO had as members Canada and several DWFNs, the most important of which was the E.U. NAFO was to oversee the management of the high seas portions of the Grand Bank straddling stocks and to ensure that the management was compatible with the Canadian resource management programme within the EEZ. For a time, NAFO worked reasonably well. In 1985, however, Canada–E.U. cooperation in NAFO broke down, ostensibly over a dispute concerning management goals (Applebaum, 1990). E.U. harvests in the NAFO governed high seas areas exceeded the EU quotas by 400 per cent (Kaitala and Munro, 1993). The situation was aggravated by the fact that NAFO seemed powerless to deal with interlopers – vessels from non-NAFO nations, often flying flags of convenience.

The state of the groundfish stocks off Atlantic Canada in general were deteriorating. Canada argued that DWFN non-cooperation in NAFO was an important contributing factor to the malaise, and complained bitterly about E.U. overexploitation in particular (Canada, 1992).

In late 1992, Canada and the E.U. signed a Memorandum of Understanding, which presumably restored Canada–E.U. fisheries cooperation within NAFO (Canada, 1993). The Memorandum of Understanding proved to be no more than a temporary truce, however. In early 1995, Canada accused one E.U. member, Spain, of violating NAFO regulations and overharvesting turbot on the Nose of the Bank. Canada then proceeded to arrest a Spanish trawler on the Nose of the Bank, i.e., in waters beyond Canada's EEZ. Canada maintained that it was acting properly to ensure the conservation of fishery resources in which it had a "special interest". The E.U. insisted that Canada had acted improperly, and that its action constituted piracy (Gordon and Munro, 1996; Kaitala and Munro, 1995a).

The Donut Hole and the Grand Bank of Newfoundland were but the most dramatic of the straddling/highly migratory stock type of problem, which was becoming pervasive throughout the world. Other examples were provided by pollock resources in the Peanut Hole of the Sea of Okhotsk, and orange roughy on the Challenger Plateau off of New Zealand (FAO, 1994).

What then had gone wrong? Why had a minor resource management problem developed into a serious one? What we might refer to as the basis, or foundation, of

the problem was provided by two factors. First, the comfortable coastal state assumption that DWFNs could not operate on a commercial basis on the high seas portions of straddling/highly migratory stocks, unless they also had access to the adjacent EEZ, had proven to be false. Secondly, DWFN fleets were steadily excluded from many EEZs, often for reasons having little or no economic substance. The excluded DWFN fleets, to the surprise of many, showed little decline (FAO 1992a; 1994). As a consequence, increased pressure on the high seas fishery resources was inevitable.

The non-disappearance of the excluded DWFN fleets is worthy of further comment. A fisheries management issue of growing concern is that of overcapitalisation (excess capacity) (FAO, 1998). It is now recognized that a key aspect of the overcapitalisation problem is the “non-malleability” of fleet, processing, and human capital (Clark, Clarke and Munro, 1979; Clark and Munro 1999). To say that capital is “non-malleable” is to say that it cannot be quickly and easily withdrawn from a fishery or fisheries, without risk of capital loss. If all such capital proved to be perfectly malleable, the overcapitalisation problem would not exist (Clark and Munro, 1999).

One consequence of capital being non-malleable is that, in the short run, the costs relevant to the use of capital are restricted to operating costs (Munro, *ibid.*). With this in mind, consider now the aforementioned DWFN fleets excluded from coastal state EEZs. The capital embodied in the fleets was, more often than not, decidedly non-malleable with respect to world fisheries. The fleet owners were faced with the option of scrapping the vessels, laying them up, or of finding some other form of employment for them, regardless of how unattractive these other forms may have been in the past (Newton, 1999). A set of alternatives, which may well have appeared to be economically unattractive when the DWFN fleets had full access to fisheries now encompassed by EEZs, consisted of the high seas portions of straddling/highly migratory fish stocks. In the new set of circumstances, the high seas resources would have seemed attractive to the DWFN fleet owners if the present value of the expected operating profits to be realised from exploiting the resources exceeded the scrap value of the relevant vessels. The evidence suggests that, in many instances, employing the excluded DWFN fleets in the exploitation of the high seas resources did indeed prove to be more attractive than

sending the vessels to the scrap yard, or laying them up.

One aspect of the overcapitalisation problem, which is gaining increasing recognition (FAO, 1998), consists of the so-called “spillover” effect. When non-malleable fleet (and human) capital is removed from a particular fishery, or fisheries, it may, instead of disappearing, “spillover” into other fisheries (Munro, 1998b). The emergence of the high seas fisheries management can be seen, in part, as being the consequence of a massive “spillover” effect.

While the aforementioned factors provided the foundation for the emergence of the crisis in high seas fisheries management, they are not sufficient, in of and by themselves, to explain why the crisis did in fact emerge. It is necessary, as well, to look to the review, to follow, of the economics of the management of transboundary fishery resources, where the point will be made that, if joint exploiters of a transboundary fishery resource will not, or cannot, cooperate in the management of the resource, the likely consequence is that the resource will be subject to overexploitation, as exemplified by the Donut Hole and Grand Bank of Newfoundland cases.

The source of the non-cooperation lies in the inadequacies of Part VII, Section 2 (Articles 116–120), of the Convention pertaining to the management of high seas fisheries. We have described the aforementioned Articles 116–120 as constituting a model of imprecision and vagueness. An example of the imprecision is provided by a widely cited article of Miles and Burke (Miles and Burke, 1989). The authors contend that Article 116 of the Convention did, in fact, establish that “the coastal state has the superior right, duty and interest in the straddling stocks beyond the EEZ” (Miles and Burke, 1989, p. 349). The authors are forced to concede, however, that “the precise distribution of competences to make these [coastal state right, duty and interest] is not prescribed ...” (Miles and Burke, *ibid.*, p. 343). The Miles and Burke argument found considerable favour among many coastal states (e.g. Canada). The same argument was rejected out of hand by the DWFNs (Kaitala and Munro, 1993).

Two mutually incompatible, and hostile, views of the world of straddling/highly migratory stocks emerged after 1982. The first view, the coastal state view, was that uncontrolled harvesting of the high seas portions of straddling/highly migratory stocks by DWFNs could render meaningless the coastal state management regimes for the

intra-EEZ portions of these stocks. The powers granted to coastal states by Article 56 of the Convention were thus undermined. The second view, the DWFN view, was that the coastal states had been granted immense transfers of renewable resource wealth under the EEZ regime, at the expense of the DWFNs. Not content with this enormous gain, coastal states were now seeking to extend their jurisdiction yet further to encompass the high seas portions of straddling and highly migratory stocks (U.N., 1992). The term “creeping jurisdictionalism” gained widespread currency among DWFNs.

A key U.N. preparatory document for the U.N. Fish Stocks Conference prepared in 1992 (U.N., 1992) noted that, at the time of writing, the issue remained very much unresolved. As a consequence, the document continued, the admonitions of Articles 63 and 64 for coastal states and DWFNs to cooperate in the management of the aforementioned resources had fallen on deaf ears.

Thus, by the late 1980s, there was deepening concern about the state of straddling and highly migratory stocks throughout the world. This fear led directly to a second fear, namely that, if steps were not taken to correct the situation, coastal states would attempt to extend their jurisdiction unilaterally over the high seas portions of the stocks, and would, as a consequence, undermine the Law of the Sea Convention. Several coastal states did, in fact, threaten to extend their marine jurisdiction unilaterally (Balton, 1996). The Canada–Spain “fish war” of 1995 was, in particular, seen as a portent of things to come.

In the year previous to the Canada–Spain “fish war,” Canada had amended its Coastal Fisheries Protection Act to give itself the authority to seize those non-Canadian vessels in the high seas adjacent to its Atlantic EEZ, which Canada deemed to be in violation of NAFO rules and regulations. The amendment was exercised in 1995 when Canada seized the aforementioned Spanish trawler on the Nose of the Bank (Balton, 1996).

The amendment to the Canadian legislation had brought forth protests, not only from the E.U., but the United States as well. The U.N. Law of the Sea Convention was the product of compromise. The fear was that attempts by coastal states to extend their jurisdiction unilaterally, as exemplified by the Canadian amendment, would be seen to

violate the compromise, and for this reason, would undermine the Convention (Balton, 1996).

The growing sense of alarm brought forth action from the United Nations. First, the U.N. General Assembly in 1989 called for a meeting to discuss sustainability of resources and the environment in general. This led to the U.N. Conference on Environment and Development (UNCED), which was held in Rio de Janeiro in 1992. The Conference, as well as producing a declaration (Rio Declaration), produced a document, a manifesto if you will; Agenda 21: Programme of Action for Sustainable Development. Chapter 17 of the Agenda deals with oceans and fisheries. The Chapter called for the convening, as soon as possible, of a U.N. conference on straddling and highly migratory fish stocks. The purpose of such a conference would not be to produce a document that would replace any segment of the Law of the Sea Convention. Rather, the purpose was seen to be that of producing a document which would supplement, or buttress, the Convention, with the object of ensuring the effective implementation of the Convention (Doulman, 1995). In other words, the basic purpose of the conference would be that of correcting the glaring weaknesses of the Convention, as it pertained to high seas fisheries management.

The U.N. General Assembly responded with dispatch to the UNCED call for a conference. In late 1992, the General Assembly passed a resolution announcing that the U.N. would convene in 1993 an intergovernmental conference on straddling fish stocks and highly migratory fish stocks. The primary task of the conference would be that of:

- (i) identifying and assessing existing problems related to the conservation and management of straddling fish stocks and highly migratory fish stocks,
- (ii) considering means of improving fisheries cooperation among states, and
- (iii) formulating appropriate recommendations (Doulman, 1995).

Prior to examining the resultant U.N. conference of 1993-1995, and the agreement emerging from the conference, it is necessary to digress and review the basic economics of the management of transboundary fishery resources. It is to this subject that we now turn.

III. THE BASIC ECONOMICS OF THE MANAGEMENT OF TRANSBOUNDARY RESOURCES: A REVIEW⁵

Since the straddling/highly migratory stock management issue is a relatively new one, it must be conceded that the economics of the management of these resources is still at an early stage of development (Kaitala and Munro, 1997; Munro, 2000b). Fortunately, however, the economics of the management of the other class of transboundary fishery resource, “shared” stocks, is reasonably well developed, to the extent that it now finds its way into official publications (e.g. OECD, 1997). The economics of “shared” stock management does, as we shall see, provide a sound basis from which to start examining the economics of the management of straddling/highly migratory stocks.

The model most commonly employed by economists in analysing the management of transboundary fishery resources is a blend of the economist’s dynamic model of a fishery confined strictly to the waters of a single coastal state, and the theory of games. Since strategic interaction among entities jointly exploiting a transboundary fishery resource is virtually inevitable, the application of game theory becomes all but inescapable.

Let us commence with a fishery resource confined to the waters of a single coastal state. For illustrative purposes assume, to begin with at least, that the appropriate underlying biological model is the well known Schaefer model. Assume, as well, that the demand for harvested fish and the supply of labour and capital services, constituting fishing effort, are perfectly elastic. Without going through the details of the well known dynamic economic model of the fishery (see: Clark, 1990; Bjorndal and Munro, 1998), society’s objective functional can be expressed as:

$$(1) \quad \max J(x_0, E) = \int_0^{\infty} e^{-\delta t} (px(t) - c)E(t)dt$$

subject to:

$$dx/dt = F(x) - Ex$$

where x denotes the biomass, x_0 denotes the original biomass, $F(x)$ the natural growth rate, E the rate of fishing effort, c unit fishing effort cost, p the price of harvested fish, and δ the social rate of discount.

In solving Eq. (1), the optimal biomass level x^* is given by the equally well known decision rule:

$$(2) \quad F'(x^*) + \gamma(x^*) = \delta ,$$

where $\gamma(x^*)$, the so called Marginal Stock Effect, is given by: $\gamma(x^*) = \frac{-c'(x^*)F(x^*)}{p - c(x^*)}$

and where $c(x)$ is unit harvesting cost⁶ (Clark, 1990).

If the fishery is a “common pool,” “Pure Open Access”, fishery, we get the H. Scott Gordon result that the resource will be driven down to the Bioeconomic Equilibrium level (Gordon, 1954), given by the following equation:

$$(3) \quad p - c(x_\beta) = 0$$

where x_β denotes the Bioeconomic Equilibrium level of x . The biomass levels x^* and x_β will be equal, if and only if, $\delta = \infty$ (Clark, 1990).

For future reference, let it be noted that, in the case of species subject to intense schooling, the Schaefer model does not strictly hold. The Marginal Stock Effect becomes small, and, in the limit, approaches zero. The implication is that harvesting costs, in the limit, are effectively independent of x , for all $x > 0$ (Bjørndal and Munro, 1998; Clark, 1985). In such circumstances, Eq. (2) reduces to

$$(4) \quad F'(x^*) = \delta .$$

There is no solution to Eq. (3). Extinction of the resource is a decided possibility (Bjørndal, 1988; Bjørndal and Munro, *ibid*).

Now return to our original example, and suppose that the fishery resource in question is not confined to the waters of a single EEZ, but is rather “shared” by two neighbouring coastal states. Suppose further that the neighbouring coastal states do not, for whatever reason, cooperate in the management of the resource. To analyse the consequences of non-cooperation, the theory of non-cooperative games is brought to bear.

The consequences of non-cooperation are severe. We find ourselves presented with an example of the famous non-cooperative game, “The Prisoner’s Dilemma”. Even though the two coastal states may be able to exercise iron control over their respective fleets, they will be driven inexorably to overexploitation of the resource, except under unusual circumstances. If the two coastal states are alike in all respects, then the theory predicts that the end result will be akin to an open access wholly domestic fishery, i.e., the equivalent of Bionomic Equilibrium (Kaitala and Munro, 1997).

A recent study on Pacific salmon, shared by Canada and the United States, illustrates the point. The two countries attempted to manage the resource cooperatively under a treaty ratified in 1985.⁷ The treaty broke down in the early 1990s, and the two sides reverted to competitive behaviour. The consequences for the resource were decidedly harmful. The two countries subsequently signed a Pacific Salmon Agreement in 1999, in an attempt to “patch up” the treaty. There is no question that the threat of resource destruction provided a powerful incentive to both sets of negotiators to re-vitalise the treaty (Miller, Munro, McDorman, McKelvey and Tyedmers, 2001).

The economics of the non-cooperative management of “shared” stocks can, in fact, be applied, with little or no change, to the non-cooperative management of straddling/highly migratory stocks (Kaitala and Munro, *ibid.*). Thus, the overexploitation to be found in many of the straddling and highly migratory stocks in the early 1990s, as exemplified by the Donut Hole and Grand Bank of Newfoundland fisheries, is entirely consistent with the theory. Indeed, the growing crisis in high seas fisheries management of the 1980s and early 1990s stands as a testament to the predictive power of the theory.

Thus cooperation does indeed matter. Return now to our “shared” resource example. If the joint owners of the resource are able to communicate and bargain in good faith, it may be possible for them to develop a mutually beneficial cooperative management regime, even though their goals of management differ. In examining the underlying economics of cooperative resource management, the theory of cooperative games is, not surprisingly, brought to bear.

Let us start out with the simplest case in which there are but two “players,” i.e., two coastal states, and suppose that the “players,” if agreeing on a joint management programme, are prepared to make the agreement a binding one. The example to follow will have Nash’s model of a two-person cooperative game as its foundation (Nash, 1953)

Among the many divisions in cooperative games is that between those, which allow for so-called “side-payments”, and those which do not. Side payments are essentially transfers, monetary or non-monetary, between and among players. In the context of a fisheries game, a cooperative game *without* side payments would be one in which the benefits derived by a “player” from a fishery would be wholly dependent upon the harvests of that “players” fleet within the “player’s” waters. The chief significance of “side payments” is that they can serve, both to lead to a solution closer to the global optimum, and perhaps of even greater importance, to broaden the scope for bargaining.

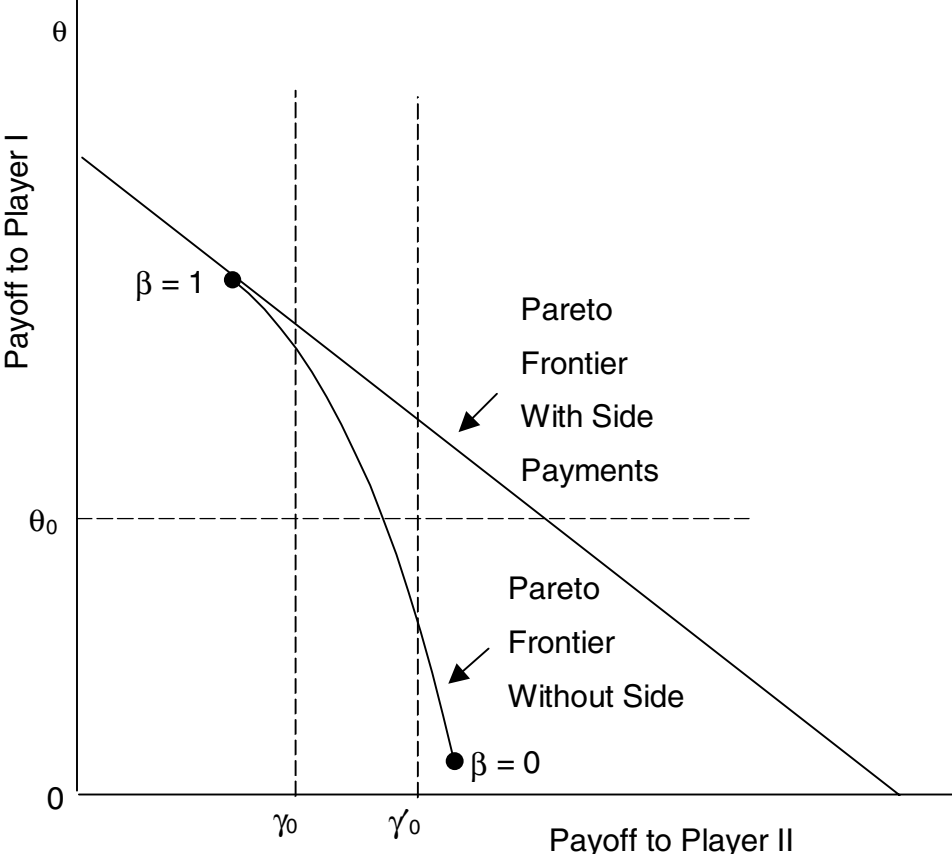
If there is to be a “solution” to the two person cooperative game, two conditions must be met. First, the “solution” must be Pareto Optimal. Secondly, the so called Individual Rationality Constraint must be satisfied. The common sense meaning of this second condition is that each “player” must receive from cooperation a “payoff” at least as great as it would enjoy under non-cooperation. In passing, Nash refers to the set of payoffs arising from non-cooperation as the “Threat Point” in the game (Nash, *ibid.*)

In any event, those game outcomes, which satisfy both conditions, are said to constitute the “core” of the game. There is no guarantee that the “core” will be other than empty. If the “core” is empty, the attempts to achieve cooperation will not be successful, and the “players” will revert to competitive behaviour.

We illustrate in Figure 1 a possible two player game (with binding agreements), with and without side payments. It is assumed that the players have different management goals, which could arise, for example, because of differing fishing effort costs or different social rates of discount (Munro, 1990b). A “payoff” to Player I(II) can be seen as the present value of expected net economic benefits that would accrue to Player I(II) from a particular resource management programme. The curve, concave to the origin, is the Pareto Frontier, in the absence of side payments, and shows the sets of payoffs arising from all cooperative arrangements meeting the criterion of Pareto optimality.

The parameter β , $0 \leq \beta \leq 1$, is a bargaining parameter. If $\beta = 1$ (0), then the management preferences of Player I(II) are wholly dominant.

Figure 1. Cooperative game with, and without, side payments



The payoffs, θ_0 and γ_0 , (ignoring for the moment payoff γ'_0) represent the payoffs that Player I and Player II respectively would enjoy from non-cooperation. They may be thought of as the payoffs forthcoming from the “solution” to a non-cooperative game. The set of payoffs – θ_0, γ_0 – constitute the “Threat Point” (Nash, 1953). In the absence of side payments, the segment of the *Pareto Frontier Without Side Payments*, marked off by the dashed lines emanating from θ_0 and γ_0 constitute the “core” of the game. Where the players will end up on the Pareto Frontier, what set of payoffs that will actually constitute the solution to the game, will be determined by the relative bargaining strength of the two players.

The first lesson, that we have learned over time about cooperative fisheries management arrangements, is that if side payments are possible, life is made much easier. With side payments (i.e., transfer payments), the two players will seek to maximise the global returns from the fishery, and then bargain over the division of these returns. The Pareto Frontier then becomes a 45° line (see Figure 1). Denote the solution payoffs as θ^* and γ^* . If we then denote the cooperative surplus as ϕ^* , where

$$\phi^* = [\theta^* + \gamma^*] - [\theta_0 + \gamma_0],$$

it can be shown (Bjorndal *et al.*, 2000b) that the solution to the Nash cooperative game with side payments will be such that:

$$\theta^* = \phi^* / 2 + \theta_0$$

$$\gamma^* = \phi^* / 2 + \gamma_0$$

i.e., the two players “split the difference”.

If the number of players n is $n > 2$, then sub-coalitions among the players must be considered. The simple “split the difference” rule in determining a “fair” distribution of the gains may no longer be considered to be satisfactory. One approach, which may be used, the Shapley Value, relates the solution payoff to a player to the player’s average marginal contribution, or worth, to each coalition in which it might participate (Shubik, 1982).

Return now to Figure 1. In the case in which management goals differ, the introduction of side payments can have one of two effects – minor and major. Consider the Threat Point (θ_0, γ_0). If side payments were non-existent, the “core” would be non-

empty. The introduction of side payments would be Pareto improving. Both players could, and would, be made better off. This is the minor effect.

Suppose, however, that Player B's Threat Point payoff was not γ_0 , but was, rather, γ'_0 . In this case, the effect of introducing side payments would be major, in that, without side payments, attempts to achieve a cooperative resource management regime would be futile.

One of the cases to be examined in detail at a later point is that of the Norwegian Spring Spawning Herring fishery. The resource is currently exploited, on a cooperative basis, by five "players": Norway, Iceland, Russia, the Faroe Islands and the European Union, with Norway being the dominant player, accounting for 60 per cent of the harvest. The nature of the resource is such that the Marginal Stock Effect is very small (see: Eq. (4)), with the consequence that the resource can be driven to extinction. Arnason, Magnusson and Agnarsson (2000) model the fishery as a five player game. Competition (all against all) can lead to disaster – the extinction of the resource. The economic gains from full cooperation, i.e., the five forming a Grand Coalition, are very substantial. Norway, the leading player, cannot be induced, however, to join and remain in the Grand Coalition, unless it receives side payments. Thus, if side payments are absent, the Grand Coalition will be inherently unstable. The authors conclude by saying that one of their chief findings is that side payments prove to be crucial for effective cooperation in the case studied. In terms of Figure 1, the case described corresponds to that in Figure 1, of a Threat Point consisting of the payoffs θ_0 and γ'_0 (Arnason, *et al.*, *ibid.*).

The model discussed to this point rests upon the implicit assumption that the two players enter into a binding agreement. The second lesson is that there is probably no such thing as a "binding" agreement that will last indefinitely. The Canada-United States treaty governing the joint management of Pacific salmon is as close as one is likely to come to a true binding agreement. Even this agreement, however, was not able to withstand the shock of changing conditions (Miller *et al.*, 2001).

Kaitala and Pohjola (1988) have demonstrated, in a case in which a cooperative agreement was explicitly assumed to be non-binding, the importance of the agreement being "time consistent," i.e., recognising that what may appear to be a sound agreement today, may not be so tomorrow. In practical terms, this means that the cooperative arrangement must be sufficiently flexible to accommodate unexpected changes in surrounding conditions.

“Time consistency” provides yet another argument for side payments. The introduction of side payments can be seen as having the effect of widening the scope for bargaining. Obviously, the broader is the scope for bargaining, the greater the likelihood that the cooperative arrangement will have the requisite flexibility to render it “time consistent.”

In turning to the cooperative management of straddling/highly migratory stocks, one can say the following. As will be seen, the U.N. Fish Stocks Agreement calls for the management to be carried out through Regional Fisheries Management Organisations (RFMOs), to involve both the coastal states and the DWFNs. If the members of a given RFMO:

i. were actively involve in the relevant fishery, or fisheries, at the time of the establishment of the RFMO

ii. are fixed through time , in number and nature

iii. can be protected collectively, in the RFMO, from “interlopers”,

then the analysis of cooperative management of “shared” fishery resources can be applied, without modification. If any one of these conditions cannot be met, then the aforementioned analysis cannot be applied, without significant modification.

There is, in fact, no guarantee that, under the U.N. Fish Stocks Agreement, any of the three conditions will be met, for a given RFMO. Let us now turn to the U.N. Fish Stocks Agreement itself.

IV. The U.N. FISH STOCKS AGREEMENT: PROBLEMS OF IMPLEMENTATION

Articles 116–120 of the U.N. Convention on the Law of the Sea left in doubt the rights and obligations of coastal states, versus those of DWFNs, with respect to the high seas portions of the straddling/highly migratory stocks. These doubts helped to ensure, we argued, that the resources would be managed on a non-cooperative basis.

The U.N. Fish Stocks Agreement (U.N., 1995) attempts to deal with the aforementioned inadequacies of the Convention by calling explicitly, in Article 8, for straddling/highly migratory fishery resources to be managed, on a sub-region by sub-region basis, by Regional Fisheries Management Organisations (RFMOs), or the

equivalent thereof. Importantly, the RFMOs are to be responsible for the management of the resources within, as well as outside, the EEZ (Munro, 2000).

Since the RFMO is to oversee the management of the resource within, as well as outside, the EEZ, one issue which arises immediately, and which was a source of considerable controversy in the U.N. Fish Conference is the question of where within the RFMO the locus of power, with regards to resource management, does, in fact, reside. Does it reside with the coastal states alone, or does it reside with both coastal states and relevant DWFNs? Orbech, Sigurjonsson and McDorman (1998) refer to a “bottom-up,” versus a “top-down,” approach to power over resource management in the RFMO. A “bottom-up” approach implies that all such power resides with the coastal state(s); a “top-down” approach that the coastal state(s) share(s) power with the DWFN members. The authors argue that Article 7 of the U.N. Agreement does, in effect, allow for either approach, with the actual approach being determined on a case by case basis.

During the U.N. Fish Stocks Conference, the coastal states did, not surprisingly, lobby for the mandating within the Agreement of the “bottom-up” approach. The economic theory of the management of transboundary fishery resources suggests that, had the Agreement in fact mandated a “bottom-up” approach, the scope for successful negotiation of RFMOs could have been significantly limited. Return to Figure 1 and consider now a RFMO consisting of one coastal state and one DWFN, and the resulting cooperative game. Let I (Figure 1) denote the coastal state and II the DWFN. A mandated bottom-up approach would be the equivalent of declaring that the only acceptable point on the Pareto Frontier would be that at which $\beta = 1$. In the absence of side payments, the risk would be high that the aforementioned mandate would ensure a cooperative game without a “core,” with all that that implies (see as well: Kaitala and Munro, 1993). It is to the credit of the U.N. Fish Stocks Conference that no such mandate was incorporated in the Agreement.

While the issue of the locus of management power within the RFMO is an important aspect of the U.N. Fish Stocks Agreement, there are three relevant issues pertaining to the U.N. Agreement which, in the view of these authors, are central to the question of the long term economic viability of RFMOs. These are:

- a) the New Member, or Participant, issue
- b) the issue of the “real interest” of the prospective members of a RFMO in the relevant fisheries
- c) the “interloper” issue

All remain essentially unresolved at the time of writing.

In the case of “shared” fishery resource management, the participants in a cooperative resource management arrangement will change over time, neither in number or nature, except under the most unusual circumstances. The members, or participants in such a cooperative arrangement can be seen as constituting a closed and stable club. Such is not the case, with respect to RFMOs. Some of the members of a given RFMO will be DWFNs, the fleets of which are nothing, if not mobile. A DWFN, currently a member of a DWFN, can withdraw. Of even greater importance, a DWFN, not originally a member of the RFMO, may attempt to join as a New Member.

Let us refer to the original members of a RFMO as the “charter” members. The U.N. Fish Stock Agreement does not permit such “charter” members to bar would be New Members outright. Indeed the Agreement (see, in particular, Articles 8, 10 and 11) permits “charter” members of a RFMO to exclude would be New Members only on grounds of non-cooperation, i.e., on the grounds that the New Members refuse to abide by the terms of the RFMO management regime (Orebech *et al.*, 1998). Moreover, Orebech et al. maintain that Article 8 of the Agreement requires that cooperative would be New Members “must be offered *just and reasonable* shares of the TAC available under an [RFMO] management plan” (Orebech *et al.*, 1998, p. 123).

The issue then becomes what constitutes *just and reasonable* shares of the TAC. Kaitala and Munro (1997) demonstrate the following. If *just and reasonable* implies that New Members, upon joining a RFMO, should receive, at no further cost as it were, shares of the Total Allowable Catch, or the equivalent, on a pro-rata basis, then, when planning is undertaken for the establishment of a RFMO, prospective “charter” members could well calculate that their expected payoffs from cooperation would fall below their respective Threat Point payoffs. Hence the RFMO would be stillborn.

The aforementioned interpretation of *just and reasonable* poses the threat described because it gives rise to a “free rider” problem. Suppose that a hitherto

overexploited straddling stock comes under the management of a RFMO consisting of coastal state V, and three DWFNs, W, X, and Y. The four “charter” members undertake the cost and sacrifice of rebuilding the resource over, let us say, a seven year period. In the eighth year, the four are in a position to enjoy a return on their resource investment, through harvesting. At the beginning of the eighth year, a prospective new member, DWFN Z, appears. It demands access to the RFMO, agrees to abide by the resource management rules, but demands a share of the harvest, and by implication, a share of any resource rent. If DWFN Z’s demands were acceded to, Z would effectively be a “free rider.” Having incurred none of the costs and sacrifices of investment in the resource, it will enjoy a share of the return on the investment.

Kaitala and Munro (1997) did not discuss the case in which the “charter” members establish a RFMO, expecting the appearance of no New Members, but are then subsequently unpleasantly surprised. Nonetheless, their analysis could readily be extended, and an outcome predicted. The RFMO would be established and might well appear to be successful, initially. When the unpleasant surprise occurs, however, the “charter” members could be expected to reassess their expected payoffs from cooperation, with the possible consequence that the RFMO would disintegrate.

An example of the potential problems that could be created by the New Member problem is provided by the attempts to manage Southern Bluefin Tuna. The resource had been subject to heavy exploitation. In response, three key countries involved in harvesting the resource, the two coastal states Australia and New Zealand, and the DWFN Japan, came together in 1994 to establish a cooperative resource management regime in the form of the Commission for the Conservation of Southern Bluefin Tuna (Cox, Stubbs, Davies, 1999; Kennedy, 1999). This regime had, as its express purpose, the rebuilding of the stocks. One might have described the Commission as a pre-U.N. Fish Stocks Agreement RFMO.

The cooperative management arrangement, in the form of the Commission, initially met with success. It was, however, subsequently threatened with paralysis and breakdown, with the members quarrelling, inter alia, over scientific assessments of the stocks. Two recent studies on the Commission, while citing several factors leading to the breakdown, give particular emphasis to the impact of the appearance of major “new

entrants” to the fishery, in the form of Indonesia, the Republic of Korea and Taiwan (Cox et al., *ibid.*; Kennedy, *ibid.*).

Kaitala and Munro (1997) argue that the resolution of the New Member issue, or problem, may call for the creation of de facto property rights for the “charter” members of the RFMO. They raise the question of whether a possible solution might lie in New Members being required to “buy their way in” through the purchase of quota shares. The quotas allocated to “charter member” states would take on some of the attributes of ITQs.

All of this should not come as a surprise. It was, after all, the property rights to straddling/highly migratory fish stocks, so ill defined by the U.N. Convention on the Law of the Sea, that lay at the heart of the straddling/highly migratory fish stock management crisis in the first place.

At the 1999 “Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks and the U.N. Agreement,”⁸ held in Bergen, this issue was raised for discussion. Several of the participants were specialists in international law, some of whom had participated in the U.N. Fish Stocks Conference. These international law specialists maintained that “charter members” of RFMO may well have the right to impose charges on New Members. Membership does not *automatically* bring with it free access to a share of the harvests. If that legal opinion should prove to be valid, then we shall indeed have made significant progress towards an effective Agreement.

The issue of “real interest” of prospective RFMO members in the relevant fisheries is somewhat more subtle than the New Member issue, but is closely related to it. Article 8, paragraph 3 of the Agreement states that “---States having a real interest in the fisheries concerned may become members of such organizations [i.e. RFMOs]” (U.N., 1995). The term “real interest” is not defined in the Agreement. Erik Molenaar (2000) argues that states/entities having a “real interest” in the relevant fisheries can be taken to include the following:

- (a) coastal states and DWFNs currently engaged in active exploitation of the fisheries
- (b) DWFNs, which are not currently engaged in exploiting the fisheries, but which had done so in the past, and would now like to re-enter the fisheries.

(c) DWFNs, which had never exploited the fisheries, but which would now like to do so.

Article 8, paragraph 5 of the Agreement, discusses the establishment of new RFMOs. The paragraph calls upon states falling in Category (a), alone to commence the establishment. Article 9, paragraph 2 states that “States cooperating in the formation of a ---regional fisheries management organization [Category (a) states] --- shall inform other States which they are aware have a real interest in the work of the proposed organization [Category (b) and (c) states] ---of such cooperation” (U.N., 1995). Molenaar maintains that one can infer from all of this that, upon so informing such Category (b) and (c) states, the Category (a) states would then invite their (b) and (c) colleagues to enter the RFMO negotiations (i.e. become “charter” members) (Molenaar, 2000, n.80). To the untutored eyes of these authors, the inference is less than evident.

If the Agreement is interpreted, over time, to mean that Category (b) and (c) states must be invited to become “charter” members, then it is easy to see that the same sort of “free rider” problem, threatened by the New Member issue, can readily arise. Return to our New Member problem example, discussed earlier. Now suppose that states V, W, X, and Y are Category (a) states. Suppose, further, that Z is now a Category (c) state, which demands and receives full and undiluted “charter” membership. Z incurs no real sacrifice in the re-building of the resource, because it had not hitherto been engaged in harvesting the resource. Z will simply bide its time over the seven year period, and then, when the eight year arrives, will come to enjoy a share of the return on the resource investment, as the “free rider” that it most certainly is. Once again, the possibility of such “free riding” could undermine the viability of the RFMO.

The third issue, what we have termed the “interloper” issue, pertains to the policing of vessels of states which are, by choice, non-members/non-participants of the RFMO. We know from history that the inability to deal effectively with “interlopers” was a factor undermining pre-U.N. Agreement organizations designed to manage straddling/highly migratory stocks, such as NAFO (Gordon and Munro, 1996).

The threat posed by an uncontrolled “interloper” problem is too obvious to be elaborated upon. It is essentially an aggravated and intensified version of the New Member problem. The realisation by prospective “charter members” that they will face a

future uncontrollable “interloper” problem could be sufficient to cause one, or more, prospective “charter” members to calculate that it (they) would be better off under conditions of non-cooperation.

This issue is addressed in the U.N. Fish Stocks Agreement through Article 17 (U.N., 1995). Article 17(2) admonishes states, which are not members/participants in a RFMO, and which decline to cooperate with the RFMO, not to authorise their fishing vessels to operate in the area managed by the RFMO. Article 17(4) then maintains that, when confronted by true “interlopers”, member/participant states of a RFMO “shall take measures consistent with this Agreement and international law to deter activities of such vessels which undermine the effectiveness of sub-regional or regional conservation and management measures” (U.N., 1995, Article 17(4)). It is not immediately obvious what deterrent powers international law does, in fact, offer RFMO members (Munro 2000).

We can take comfort from a recent paper by legal expert, and U.S. State Department official, David Balton (Balton, 2000), which argues that international law does, in point of fact, grant RFMOs sufficient powers to deal firmly and effectively with “interlopers.” We can derive even greater comfort from the fact that a major international initiative, spearheaded by the FAO, is now underway to address the “interloper” problem, referred to as the problem of “illegal, unreported and unregulated” (IUU) fishing. At the time of writing, intensive efforts are being focussed on developing an International Plan of Action to combat IUU fishing (Doulman, 2000). The initiative must be expected to strengthen the hands of RFMO members attempting to repel “interlopers” through, for example, trade measures and denial of port facilities.

V. A FEW BRIEF CASE STUDIES

We now turn to a few case studies, considered briefly, to provide some illustrations of key points made in the earlier sections.

Northwest Atlantic Fisheries Organisation (NAFO)

From 1949, until the advent of the U.N. Third Conference on the Law of the Sea, fishery resources in the Northwest Atlantic, beyond the territorial seas, were managed by the International Commission for the Northwest Atlantic Fisheries (ICNAF). ICNAF's range extended from Greenland to the Carolinas. Both Canada and the United States implemented 200 mile EEZs unilaterally in 1977. The implementation of the U.S.–Canada EEZ regimes was incompatible with ICNAF, with the consequence that ICNAF was disbanded.

Faced with the problem of straddling stocks on the Grand Bank of Newfoundland, Canada took the initiative to replace ICNAF with NAFO in 1979, as we noted earlier. Canada's chief partner, it will be recalled, was the E.U. There were, however, important non-members, namely the United States, Spain and Portugal. The latter two were not members of the E.U., at that time. Canada's fisheries relations with the two Iberian DWFNs could have best been described as poisonous.

NAFO, in its initial phase was very much a "bottom up" organisation, with the management powers resting firmly with Canada (Kaitala and Munro, 1993). Canada determined the resource management policy for its Atlantic EEZ. It was then necessary for NAFO to ensure that its management policies for the high seas portions of the straddling stocks were consistent with the Canadian intra-EEZ policies.

NAFO worked reasonably well for the first few years as a cooperative game. Canada's relations with the E.U. began to fray, however, and then essentially fell apart when Spain and Portugal joined the E.U. The deteriorating situation was aggravated, as noted earlier, by NAFO's inability to deal with "interlopers." Often the "interlopers" took the form of DWFN vessels flying flags of convenience.

What had begun as a moderately successful cooperative game did not prove to be "time consistent", which is probably not surprising in light of our previous comments

about “bottom up” cooperative arrangements. The cooperative game degenerated into a destructive competitive game, as described earlier, culminating in the Canada-Spain fish war. It is probably no exaggeration to say that, by 1995, NAFO was in a state of paralysis.

A revived NAFO has emerged, which uses the U.N. Fish Stocks Agreement as a framework. NAFO explicitly regards itself as a RFMO (NAFO, 1999), and now has 18 members, including the United States, which joined in November 1995. It is difficult to believe that the American decision to join was not motivated by the concluding of the U.N. Fish Stocks Conference. Be that as it may, the U.S. played a key role as intermediary in the U.N. Fish Stocks Conference, by virtue of the fact that the U.S. had both strong coastal state and DWFN interests. American participation in NAFO should be seen as a decidedly positive development.

The prospective New Member problem, facing NAFO, appears to have been allayed for the foreseeable future, by the breadth of the post 1995 NAFO membership, numbering 18. It is difficult for these authors to identify a DWFN, not already within NAFO, which could be taken seriously as a prospective new member. If any of the 18 should, in fact, be regarded as Category (b) or (c) states, there is no evidence that they are seen as posing a serious “free rider” threat by the others.

The drawback, however, to the all encompassing membership is that 18 is a very large number of “players”. The large number of “players” could obviously make effective resource management cooperation difficult to achieve. There is, however, as we have noted, always the possibility of sub-coalitions emerging, which, if cohesive, could reduce the number of effective players. Such sub-coalitions have, in fact, already emerged. Canada and the U.S. can be thought of as a loose coastal state coalition. Facing this coalition is what might be termed a European coalition, consisting of the EU, the Baltic states, Poland and the Ukraine. Even Iceland and Norway, allies of Canada during the U.N. Fish Stocks Conference, have shown themselves to be friendly towards the European coalition (Robert Steinbock, personal communication).

Interestingly, the new NAFO shows some small signs of having been transformed from a “bottom up” organisation to a “top down”, Article 64 type, organisation. In the year 2000 annual meeting of NAFO, there was a heated exchange between the EU and

Canada over quotas set by Canada *within* the Canadian EEZ for the severely depleted Northern Cod stock. The EU criticised Canada for setting the quotas at too high a level, on the grounds that the Canadian action would have a negative impact on the resources in the adjacent high seas (NAFO, 2000). The very fact that the EU could raise objections to Canada's intra-EEZ resource management, and be taken seriously, is significant. Objections to Canadian resource management policy, within the Canadian EEZ, would have been dismissed as being impertinent in the pre-1995 NAFO.

NAFO is certainly far from a model of harmony, but the available evidence suggests that it is working far better under the U.N. Fish Stocks Agreement, than it did before. The participants, particularly the DWFNs, have greater security of tenure. Moreover, the new NAFO will have the political, legal and physical power to deal with "interlopers," e.g. through the denial of port facilities and trade sanctions. This provides hope that a successful cooperative fisheries game will emerge.

The Norwegian Spring Spawning Fishery

In the 1950s and the 1960s, Norwegian spring-spawning herring (*Clupea harengus*) was a major commercial species, harvested by vessels from Norway, Iceland, Faroe Islands, the former Soviet Union and several European nations. During this period, the fishable component of the Norwegian spring-spawning herring stock is believed to have measured about 10 million metric tonnes (MT). However, during this period the stock was subjected to heavy exploitation by several European nations especially Norway, Iceland and the former Soviet Union, employing new and substantially more effective fishing technology. The annual harvest peaked at 2 million MT in 1966. By this time, however, the stock was in serious decline and a complete stock collapse occurred by the end of the decade. Finally, with catch levels declining to practically nothing, in 1970, a fishing moratorium was declared.

Prior to stock depletion, the species was a straddling stock migrating through several coastal states and the high seas. In the 1950s and early 1960s, adults would spawn off the south-central coast of western Norway from February through March. The adults would migrate west and south-west through international waters toward Iceland (April and May), spending the summer (June through August) in an area north of

Iceland. In September the adults would migrate south to a wintering area east of Iceland before returning to western Norway to spawn. Juveniles, including the recently spawned or "zero cohort" would migrate north, but remain in Norwegian waters until sexually mature, around age four or five, when they would join the adult migratory pattern.

Because of over fishing and poor recruitment, the spawning biomass fell precipitously in 1968 and 1969, leading to near extinction by 1972. In its depleted state, the adult population ceased migration and both adults and juveniles remained in Norwegian waters year round.

Recruitment remained weak throughout the 1970s and it was not until the strong year class of 1983 joined the adult population in 1986 that the stock began to recover. The main component of the stock has re-established itself on the spawning grounds off western Norway. Now, after spawning, the adult herring begin a westerly migration passing through the Exclusive Economic Zones of the European Union, Faroe Islands, Iceland and through international waters called the "Ocean Loop" on their way to the summer feeding area near Jan Mayen Island. In the 1990s, the herring have followed the southern edge of the cold East Iceland stream, north and north-easterly, to winter in the fjords of northern Norway.

The migration pattern of the Norwegian spring-spawning herring takes on importance since, as a straddling stock the herring are exposed to territorial and possibly distant water fleets with strong incentives to harvest the population before it moves elsewhere. If a co-operative management policy, with an equitable distribution of harvest, cannot be agreed upon, Norway, Iceland, Faroe Islands, countries of the European Union, Russia and possibly distant water vessels fishing in the Ocean Loop, may resort to 'strategic over fishing' that could jeopardise continued recovery of the stock.

Until recently the situation was quite chaotic. There was no comprehensive regional agreement about the utilisation of the stock. It followed that Norway, Russia, Iceland and Faroe Islands were able to harvest the stock at will within their own jurisdictions. Moreover, in international waters the stock could be harvested legally by any interested fishing nation.

In 1995, the Advisory Committee on Fishery Management (ACFM) recommended a total allowable catch (TAC) for the Norwegian spring spawning herring of 513,000 MT. Norway ignored the recommendation and announced an individual TAC of 650,000 MT of which 100,000 MT would be allocated to Russian vessels. Iceland and Faroe Islands followed suit and announced their own combined TAC of 250,000 MT. In total, the collective harvest of Norway, Russia, Iceland, Faroe Island and the EU was approximately 902,000 MT of herring, almost twice the quantity recommended by ACFM (Bjørndal *et al.*, 1998). Nevertheless, in spite of these high catch levels, the herring spawning stock continued to increase.

There was, however, progress towards co-operation. In 1996, Norway, Russia, Iceland and Faroe Islands reached an agreement for a combined TAC. The agreement was reached by increasing the quota levels for each country and setting a total TAC of 1,267,000 MT. Nevertheless, the European Union did not take part in a TAC commitment and continued fishing at near capacity. In 1997, the E.U. became a signatory to an agreement limiting the maximum total catch to 1,498,000 MT. The significance of this agreement is that the E.U. in a commitment to international fisheries co-operation agreed to reduce their total catch levels from the previous period, whereas, the four other member countries again increased individual TACs (Bjørndal *et al.*, 1998). It can be argued that the U.N. Fish Stocks Agreement provided the necessary framework, albeit with a one year lag (Munro, 2000a),

The countries involved have agreed to continue co-operation ever since with management taking place through the North East Atlantic Fishery Commission (NEAFC). NEAFC is considered a regional fisheries management organisation in the context of the U.N. Fish Stock Agreement.

Establishing a RFMO for this fish stock has been important to ensure a sustainable fishery. As Norwegian spring spawning herring is a schooling stock, it is very vulnerable to overexploitation, as the experience from the 1950s and 1960s clearly shows. Substantial future changes in e.g. the distribution pattern of the herring may conceivably put the agreement under strain. Nevertheless, the countries involved, through NEAFC, have a vehicle that may deal with such problems should they arise. At this stage, the New Member problem has yet to arise.

The Atlantic Bluefin Tuna Fishery

The Northern Atlantic and Mediterranean Bluefin Tuna (*Thunnus Thynnus*) is a large oceanic pelagic fish. It is the largest and one of the most valuable of the tunas, and is, by definition, highly migratory in nature. A dividing line between the East and West Atlantic has been established, separating the stocks in order to facilitate stock assessment. The Bluefin tuna is distributed from the west of Brazil to Labrador, from the East of the Canary Islands to Norway, in the North Sea, in Ireland, in the whole of the Mediterranean and in the south of the Black Sea. Occasionally, it goes to Iceland and Murmansk. The Bluefin tuna moves according to food abundance and to water temperature, i.e., it moves away from cold waters, seeking warmer areas.

The two existing stocks tend to migrate within their own area. The mixing between stocks is only about 3-4%, i.e., the interchange of bluefin tuna is the exception rather than the rule. This allows the two stocks to be managed separately.

The Bluefin tuna stock has decreased, especially in the West Atlantic, due to increased catches. The Western stock is seriously depleted. In fact, there has been a sharp decrease in this stock, from about 100,000 metric tones (MT) in 1970 to below 20,000 MT in 1995. The stock is so depleted that strict measures have been enforced to prevent stock extinction, through upper bounds on catches. These measures appear to have had a positive effect, as the Bluefin tuna catches decreased and the stock stabilised.

In the East Atlantic, there has also been a substantial decrease in the stock since 1970, but it has remained above 100,000 MT. In the 1990s, catches have increased, especially in the Mediterranean. If this trend is maintained, a complete depletion of the stock is expected within a few years. Therefore, the East Atlantic is currently the main target of regulations. It is upon this resource that we shall focus in this case study.

The Bluefin tuna fisheries are characterised by a variety of vessel types and fishing gears operating from many countries. The traditional and most important fishing gears are the purse seine, the rod and reel, the longline, the trap and the bait boat. Throughout the years, the importance of each gear has changed. Certain fisheries, such

as trap, go back to ancient times. Other fisheries, such as the Atlantic longline and the Mediterranean purse seine, reached full development in the mid 1970s.

The spatial distribution of the different gears in the Atlantic and the Mediterranean Sea have changed through the years. The most important change has been the relocation of the longline fishery to latitudes above 40° and longitudes between 20° and 50° west, close to the dividing line between the Eastern and Western stocks.

Several countries catch Bluefin tuna, each country using different gears. In particular the countries in Europe, such as Italy, France or Spain, use bait boat, longline, purse seine and trap. Non-European DWFNs, such as Japan, generally employ longlines. Such a large number of countries harvesting Bluefin tuna imposes a severe pressure on the stock. In 1995, 29 countries participated in the fishery, with Japan the most important distant water fishing nation. Historically, however, more than 50 countries have participated. A number of past fishing countries may be potential new entrants to the fishery should the profitability improve.

The International Commission for the Conservation of Atlantic Tunas (ICCAT) has for decades attempted to manage the bluefin tuna fishery. This has been done through the setting of annual total allowable catch quotas (TACs), which have been allocated by country and gear type. The question is now whether ICCAT can evolve into an effective RFMO (Brasao, 2000).

To date, the outlook has not been encouraging, with ICCAT being unable to ensure that its management policies and recommendations are actually implemented. There are several reasons for this unfortunate state of affairs. Bluefin tuna is a very valuable species. Thus, there are strong incentives to harvest tuna, even at low stock levels. The migratory pattern of tuna means that it passes through the EEZs of numerous countries as well as the Mediterranean and international waters. As a consequence, a large number of countries participate in the fishery. By itself this makes it difficult to reach an agreement, although some countries, e.g. the E.U., may form coalitions. Furthermore, should the profitability of the fishery improve, a number of “new” countries may want to enter the fishery.

In essence, ICCAT, as a RFMO, is plagued with the problem of exceedingly large numbers, and the potential threat of “free riding” New Members. If ICCAT, or an

alternative form of RFMO, does not find ways of overcoming these difficulties, there is good reason to fear that, in time, there will be no East Atlantic-Mediterranean tuna resource left to manage.

VI. CONCLUSIONS

The U.N. Fish Stocks Agreement of 1995 was brought forth in an attempt to address a fisheries resource management crisis involving the class of transboundary fishery resources, referred to by the U.N. as straddling and highly migratory fish stocks. While the foundation for the crisis was provided by DWFN fleet capital “spilling over” from the newly established EEZs into the high seas, the root cause of the crisis lay in the inadequacies of the U.N. Convention on the Law of the Sea, as it pertained to the management of high-seas fishery resources. The Convention left very much in doubt the rights and duties of coastal states, as opposed to those of DWFNs, with respect to the high-seas segments of the straddling and highly migratory fish stocks.

The U.N. Fish Stocks Agreement of 1995 is an attempt to “patch up” the Convention on the Law of the Sea. In so doing, the Agreement calls for the aforementioned resources to be managed, on a sub-region by sub-region basis, through RFMOs. The Agreement, even before coming into force, had served as a framework for the cooperative management of straddling/highly migratory fish stocks. The Norwegian Spring Spawning Herring fishery and NAFO provide striking cases in point.

Attempts to manage the Norwegian spring spawning herring resource, prior to the advent of U.N. Fish Stocks Agreement, proved to be decidedly unsuccessful. The Agreement provided the necessary framework. With this framework in place, the cooperative management of the resource has apparently been highly successful to date. Thus, to naysayers who maintained that U.N. Fish Stocks Agreement was wholly unworkable from the start, one can point to the example of Norwegian spring spawning herring, one of the largest, if not *the* largest fishery resource in the North Atlantic.

Having said this, however, there are difficulties with the Agreement, which could undermine its effectiveness, over time. The case of Atlantic Bluefin tuna is a sobering

counter example to that of Norwegian Spring Spawning Herring. We have identified three such difficulties, or problems, which we might term the New Member, the “real interest”, and the “interloper” problems. The resolution of these problems will require the combined skills, and ingenuity, of economists and specialists in international law.

REFERENCES

- Armstrong, C.W. 1997. *Sharing Natural Resources – The Problem of Allocation and Distribution*, Tromsø: Norwegian College of Fishery Science, University of Tromsø.
- Arnason, R., G. Magnusson, and S. Agnarsson. 2000. The Norwegian Spring – Spawning Herring Fishery: A Stylized Game. *Marine Resource Economics* 15: 293- 320.
- Balton, D.A. 1996. Strengthening the Law of the Sea: The New Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. *Ocean Development and International Law* 27:125-51.
- _____. 2000. Dealing with the “Bad Actors” of Ocean Fisheries. *Proceedings from the Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the U.N. Agreement*, T. Bjørndal, G. Munro, and R. Arnason, eds., Bergen: Centre for Fisheries Economics, Norwegian School of Economics and Business Administration, Papers on Fisheries Economics 38.
- Bjørndal, T. (1988). "The Optimal Management of North Sea Herring". *Journal of Environmental Economics and Management* 15: 9-29.
- Bjørndal, T., D.V. Gordon, V. Kaitala and M. Lindroos (2000). "International Management Strategies for the Norwegian Spring Spawning Fishery." Discussion Paper No. 12/2000, Centre for Fisheries Economics, Norwegian School of Economics and Business Administration.
- Bjørndal, T., A.D. Hole, W.M. Slinde, and F. Asche. 1998. Norwegian Spring Spawning Herring – Some Biological and Economic Issues. Norwegian School of Economics and Business Administration, Centre for Fisheries Economics Working Paper No. 3/1998.
- Bjørndal, T., V. Kaitala, M. Lindroos, and G. Munro. 2000. The Management of High Seas Fisheries. *Annals of Operations Research* 94:183-96.
- Bjørndal, T, and G. Munro. 1998. The Economics of Fisheries Management: A Survey. In T. Tietenberg and H. Folmer (eds.), *The International Yearbook of Environmental and Resource Economics 1998/1999*. Cheltenham: Edward Elgar.
- _____. 2000. The Management of High Seas Fishery Resources and the Implementation of the U.N. Fish Agreement of 1995: Problems and Prospects. Prepared for the 10th Biennial Conference of the International Institute of Fisheries Economics and Trade. Corvallis: July.
- Bjørndal, T., G. Munro, and R. Arnason (eds.). 2000. Introduction. *Proceedings from the Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the U.N. Agreement*. Bergen: Centre for Fisheries Economics, Norwegian School of Economics and Business Administration, Papers on Fisheries Economics 38.
- Brasão, A., 2000. *Ensaio em Economia dos Recursos Naturais*. Faculdade de Economia, Universidade Nova de Lisboa.
- Brasão, A., C. Costa Duarte, and M.A. Cunha-e-Sá Managing the Northern Atlantic Bluefin Tuna Fisheries: The Stability of the UN Fish Stock Agreement Solution. *Marine Resource Economics*.

- Burke, W. 1991. Anadromous Species and the New International Law of the Sea. *Ocean Development and International Law* 22:95-131.
- Clark, C.W. 1980. Restricted Access to Common-Property Fishery Resources. *Dynamic Optimization and Mathematical Economics*, P. Liu, ed., pp. 117-32. New York: Plenum.
- Clark, C.W., and G. Munro. 1999. Fishing Capacity and Resource Management Objectives. Food and Agriculture Organization of the U.N. Technical Consultation on the Measurement of Fishing Capacity, Mexico City, Mexico, 29 November – 3 December 1999-11-02. Document Number 12.
- Cox, A., M. Stubbs, and L. Davies. 1999. *Southern Bluefin and CITES: An Economic Perspective*. Report for Fisheries Research Fund and Environment Australia, ABARE Research Report 99-2. Canberra: Australian Bureau of Agricultural and Resource Economics.
- de Fontaubert, A.C. 1995. The Politics of Negotiations at the United Nations Conference on Straddling and Highly Migratory Fish Stocks. *Ocean and Coastal Management* 29:79-91.
- Department of External Affairs and International Trade Canada. 1992. News Release, December 24.
- Doulman, D.J. 1995. *Structure and Process of the 1993–1995 United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks*. FAO Fisheries Circular No. 898, Rome: Food and Agriculture Organization of the United Nations.
- _____. 2000. Events Leading to the Elaboration of an International Plan of Action to Combat Illegal, Unreported and Unregulated Fishing. Prepared for the International Conference on Fisheries Monitoring, Control and Surveillance, Brussels, Belgium, 24-27 October 2000.
- Food and Agriculture Organization of the United Nations (FAO). 1992. International Fisheries Bodies: Considerations for High Seas Management. Technical Consultation on High Seas Fishing. FI/HSF/TC/92/6. Rome.
- _____. 1994. *World Review of Highly Migratory Species and Straddling Stocks*. FAO Fisheries Technical Paper 337. Rome.
- Gordon, D.V., and G.R. Munro (eds.). 1996. *Fisheries and Uncertainty: A Precautionary Approach to Resource Management*. Calgary: University of Calgary Press.
- Gordon, H.S. 1954. The Economic Theory of a Common Property Resource: The Fishery. *Journal of Political Economy* 62:124-42.
- Kaitala, V., and G.R. Munro. 1993. The Management of High Seas Fisheries. *Marine Resource Economics* 8:313-29.
- _____. 1997. The Conservation and Management of High Seas Fishery Resource Under the New Law of the Sea. *Natural Resource Modeling* 10:87-108.
- Kaitala, V., and M. Pohjola. 1988. Optimal Recovery of a Shared Resource Stock. *Natural Resource Modeling* 3:91-119.
- Kennedy, J. 1999. A Dynamic Model of Cooperative and Non-cooperative Harvesting of Southern Bluefin Tuna With an Open Access Fringe. Presented to the 1999 World Conference on Natural Resource Modeling. Halifax.
- Kwiatkowska, B. 1992. The High Seas Fisheries Regime: A Turning Point Without Return? Prepared for the SEAPOL International Workshop on Challenges to

- Fishery Policy and Diplomacy in Southeast Asia. Rayong, Thailand, December 6-9.
- Lindroos, M. 2000. *Cooperation and Conflicts in High Seas Fisheries*. Helsinki: Helsinki School of Economics and Business Administration.
- McRae, D., and G. Munro. 1989. Coastal State "Rights" within the 200 Mile Exclusive Economic Zone. *Rights Based Fishing*. P. Neher, R. Arnason, and N. Mollet, eds., pp. 97-112. Dordrecht: Kluwer.
- Mesterton-Gibbons, M. Game-Theoretic Resource Modeling. *Natural Resource Modeling* 7: 93-147.
- Miles, E., and W. Burke. 1989. Pressures on the United Nations Convention on the Law of the Sea of 1982 Arising from New Fisheries Conflicts: The Problem of Straddling Stocks. *Ocean Development and International Law* 20:343-57.
- Miles, E., and D.L. Fluharty. 1991. U.S. Interests in the North Pacific. *Ocean Development and International Law* 22:315-42.
- Miller, K., G. Munro, T. McDorman, R. McKelvey and P. Tyedemers. 2001. *The 1999 Pacific Salmon Agreement: A Sustainable Solution?*, Canadian American Public Policy Occasional Paper No. 47, Orono: The Canadian-American Center, University of Maine.
- Molenaar, E. 2000. The Concept of "Real Interest" and Other Aspects of Co-operation through Regional Fisheries Management Mechanisms. *The International Journal of Marine and Coastal Law* 15: 475-631.
- Munro, G.R. 1990a. Extended Jurisdiction and the Management of Pacific Highly Migratory Species. *Ocean Development and International Law* 21: 289-307.
- _____. 1990b. The Optimal Management of Transboundary Fisheries: Game Theoretic Considerations. *Natural Resource Modeling* 4:403-26.
- _____. 2000a. An Economic Review of the United Nations Agreement for the Implementation of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling and Highly Migratory Fish Stocks. December 1995. *Proceedings from the Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the U.N. Agreement*, T. Bjorndal, G. Munro, and R. Arnason, eds. Bergen: Centre for Fisheries Economics, Norwegian School of Economics and Business Administration, Papers on Fisheries Economics 38.
- _____. 2000b. The United Nations Fish Stocks Agreement of 1995: History and Problems of Implementation. *Marine Resource Economics* 15: 265-280.
- Munro, G., T. McDorman, and R. McKelvey. 1998. *Transboundary Fishery Resources and the Canada-United States Pacific Salmon Treaty*. Canadian American Public Policy Occasional Paper No. 33. Orono: The Canadian-American Center, University of Maine.
- Nash, J. 1951. Noncooperative Games. *Annals of Mathematics* 54:289-95.
- _____. 1953. Two-Person Cooperative Games. *Econometrica* 21:128-40.
- Newton, C. 1999. Review of Issues for the Control and Reduction of Fishing Capacity on the High Seas. F.A.O. of the U.N., *Managing Fishing Capacity: Selected papers on Underlying Concepts and Issues*. FAO Fisheries Technical Paper no. 386. Rome, pp. 49-74.

- Northwest Atlantic Fisheries Organization (NAFO). 1999. 21st Annual Meeting of NAFO 07-17 September 1999. Press Release.
- Orebeck, P., K. Sigurjonsson, and T.L. McDorman. 1998. The 1995 United Nations Straddling and Highly Migratory Fish Stocks Agreement: Management, Enforcement and Dispute Settlement. *The International Journal of Marine and Coastal Law* 13:119-41.
- Pintassilgo, P. and C. Costa Duarte. 2001. The New-Member Problem in the Cooperative Management of High Seas Fisheries. *Marine Resource Economics*. 15: 361-378.
- Stokke, O. 2001. *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*. Oxford: Oxford University Press.
- Tahindro, A. 1997. Conservation and Management of Transboundary Fish Stocks: Comments in Light of the Adoption of the 1995 Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. *Ocean Development and International Law* 28:1-58.
- United Nations (UN). 1982. United Nations Convention on the Law of the Sea. U.N. Doc. A/Conf. 62/122.
- _____. 1992. *The Law of the Sea: The Regime for High Seas Fisheries: Status and Prospects*. New York: Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs.
- _____. 1995. United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. U.N. Doc. A/Conf./164/37.

Notes

¹ The full title of the Agreement is the “Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relative to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.”

² Defined by the U.N. to be states with significant marine coast lines, as opposed to landlocked states, and geographically disadvantaged states (e.g. Singapore).

³ A DWFN can be defined as a fishing nation (entity) some of whose fishing fleets operate well beyond domestic waters.

⁴ See: <http://www.oceanlw.net/texts/westpac.htm>.

⁵ This section draws heavily upon Munro (2000) and Bjorndal and Munro (2001).

⁶ i.e. $c(x) = \frac{c}{x}$.

⁷ Treaty between the Government of Canada and the Government of the United States of America concerning Pacific Salmon, March 1985.

⁸ See: T. Bjorndal, G. Munro and R. Arnason (eds.), *Proceedings from the Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the U.N. Agreement*, Bergen, Centre for Fisheries Economics, Norwegian School of Economics and Business Administration, Papers on Fisheries Economics 38.