4. Ecosystem/Economic Impacts*

■ Analysis of the Impacts of DWFs on Namibia

The objective of this analysis is to assess the impact of fishing by DWFs on both the ecology of the Namibian ecosystem and the economics of Namibia's fisheries. To do this, the ECOSIM/ECOPATH modelling tools are employed to capture the natural dynamics of the ecosystem. The starting point for the analysis are the two ECOPATH models of the northern Benguela ecosystem off Namibia developed in Jarre-Teichmann and Christensen (1998a and 1998b). These models were constructed for the periods 1971-1977 and 1978-1983. The outputs from the models are fed into the ECOSIM framework (Walters et al., 1997), which is a dynamic version of ECOPATH (Christensen and Pauly, 1992), to allow dynamic simulations and analysis of different exploitation scenarios both "with" and "without" DWF participation in the ecosystem. The dynamic simulations are performed in a manner that allows the isolation of the ecological impacts of the activities of DWFs on the ecosystem during the pre-independence era. These impacts are then valued to give an indication of their economic effects.

Distant water fleets (DWFs) started operating in Namibian waters in the early 1960s. Fleets from the former USSR and Spain arrived in 1964, followed by Japan, Bulgaria, and Israel in 1965, Belgium and Germany in 1966, France in 1967, Cuba in 1969, Romania and Portugal in 1970, Poland in 1972, Italy in 1974, Iraq in 1979, Taiwan in 1981, and the Republic of Korea in 1982, according to the FAO Yearbooks of Fishery Statistics.

In concrete terms, this study does the following:

- Extends the ECOPATH models in Jarre-Teichmann and Christensen (1998a and 1998b) to ECOSIM models to serve as the framework for the dynamic analysis of the impacts of fishing by DWFs on both the economics and ecology of the ecosystem.

- Develops scenarios of the Namibian ecosystem in which the activities of the DWFs in Namibian waters before independence in 1990 are captured. The scenarios are developed using information on the catches of hake, horse mackerel, and pilchard during this period.

- Addresses the following questions. (1) What is the state of the ecosystem in terms of its ecology "with" and "without" DWFs? We interpret the ecology here somewhat narrowly to mean the stock size of the fishes in the ecosystem. We are interested in questions such as, given the catch of hake, horse mackerel, and pilchard in the "with" and "without" DWFs scenarios, what are the impacts of DWFs on the biomass of the major species in the ecosystem? (2) How does the impact on the biomass of the system affect the potential catch of these species? (3) How do these impacts on catch levels translate into economic values?

* Prepared by Ussif Rashid Sumaila

In pre-independence days there was little or no surveillance of most fishing operations in Namibian waters (Namibia Foundation, 1994), hence there was a massive assault on the fishery resources of Namibia during this period. For example, the official statistics, which are suspected of being on the low side, show that 1.4 million t of pilchard were caught in 1968. Before this massive catch, pre-1968 catches are reported to have been between 100,000 and 600,000 t, most of it taken by DWFs.

The massive, almost uncontrolled, exploitation of Namibian hake started in 1964 and reached a peak in 1972 when 800,000 t of hake were reported to have been caught. It is believed by many that the catch was most probably considerably higher. The catches were lower between 1972 and 1980 at about 150,000 t. Catches improved again to around 400,000 t in 1985, and declined again until 1991 when Namibia took full control of its resources for the first time. Again most of these catches were taken by DWFs. In fact it is reported that up until 1985, 99 per cent of hake catch was by DWFs. After 1985, 90 per cent was still taken by DWFs (Namibia Foundation, 1994).

Horse mackerel were also heavily targeted by DWFs active in Namibia's EEZ before independence. Annual catches were seldom below 300,000 t, with the peak of 570,000 t landed in 1982, according to the statistics.

The Scenarios

Two scenarios are developed, "with" DWFs, and "without" DWFs.

THE "WITH" DWFs SCENARIO

Based on the background information outlined above, we assume that in the 1970s and 1980s an average of 475,000 t of pilchard were caught annually. The equivalent numbers for hake and horse mackerel are 248,000 and 354,000 t, respectively. Furthermore, we assume that during this period about 90 per cent of these catches were taken by the DWFs, while the remaining 10 per cent were fished by the domestic fleet.

It is also assumed that the ECOPATH model presented in Jarre-Teichmann for the period 1971-1977 captures the state of the Namibian ecosystem in the early 1970s. The output from this model is fed into the ECOSIM framework to obtain what we call ECOSIM 7177.

ECOSIM 7177 is run using fishing efforts that give the DWFs 90 per cent of the assumed catch of hake, horse mackerel, and pilchard. Similarly, fishing efforts that will ensure the domestic fleet 10 per cent of the catch are applied. The model is run for 20 years until about 1990 when Namibia attained independence.

From the model runs we isolate the effects of these high pre-independence fishing levels on the potential stock levels of (1) hake, horse mackerel, and pilchard, and (2) the other major species in the ecosystem. Similarly, we determine the impacts on the potential catches from these species and the other major species in the ecosystem.

THE "WITHOUT" DWFs SCENARIO

ECOSIM 7177 is re-run but this time with only the domestic fishing effort exerted. That is, we eliminate the DWF completely. From the runs we determine the state of the stock and the catch potential of the species in the habitat.

Finally the biological results under the two scenarios outlined above are priced and costed to determine the possible bioeconomic impacts of the activities of the DWFs on Namibian fisheries.

■ Ecological Impacts

The main results of the analysis are presented in Tables 16 and 17. Table 16 reports results for the "with" DWFs scenario, while Table 17 does the same for the "without" DWFs scenario. The second columns in each of these tables present the average annual standing biomass for all the main commercial species in the ecosystem. It is worth noting that to obtain these results, the modellers' best estimates of the ecological parameters of ECOPATH and ECOSIM are used. A more elaborate study would include sensitivity analysis on these parameters to see what impact they will have on the results of the study.

Table 16. **Ecological and economic results in the "with" DWF scenario**

Species	Biomass (t x 10³)	Catch (t x 10³)	1995 Price (N$)	Value (N$)	Net value (N$)	Domestic (N$)	DWF (N$)
Anchovy	706	233	215	50	25	3	23
Pilchard	1,650	476	819	424	212	21	191
Mackerel	108	26	1,050	28	14	1	13
Horse mackerel	777	249	1,050	261	131	13	118
Snoek and Tuna	8	8	6,000	49	25	2	22
Other pelagics	1,269	16	191	3	2	0	1
Hake	1,074	354	4,000	1,417	709	71	638
Other demersals	210	4	3,150	13	6	1	6

Table 17. **Ecological and economic results in the "without" DWF scenario**

Species	Biomass (t x 10³)	Catch (t x 10³)	1995 Price (N$)	Value (N$)	Net value (N$)	Domestic (N$)	DWF (N$)
Anchovy	373	123	215	26	13	13	0
Pilchard	2441	70	891	63	31	31	0
Mackerel	38	9	1,050	10	5	5	0
Horse mackerel	1,303	41	1,050	43	21	21	0
Snoek and Tuna	6	6	6,000	36	18	18	0
Other pelagics	436	6	191	1	1	1	0
Hake	2,122	70	4,000	281	140	140	0
Other demersals	190	4	3,150	12	6	6	0

A comparison of the "with" and "without" DWFs scenarios reveals the following. For hake, the average standing biomass in the "with" scenario is only 51 per cent of that in the "without" scenario. For pilchard and horse mackerel it is about 68 per cent and 60 per cent, respectively. For the ecosystem as a whole, the effect of DWF activities is to reduce the potential standing biomass by about 16 per cent.

The above observations highlight one of the two important impacts of DWF activities on Namibia's ecosystem, namely the impact on the future potential of the stocks at independence. We see that because of the overexploitation that occurred during the period of DWF activities, and according to model estimates, Namibia received at independence, 51 per cent, 68 per cent, and 60 per cent of the potential of the hake, pilchard, and horse mackerel stocks, the three key commercial species in the ecosystem. With respect to the ecosystem as a whole, a 16 per cent decrease in total biomass of exploited species due to the activities of DWFs is predicted. This value is relatively small compared to the losses of hake, pilchard, and horse mackerel. There are two inter-related reasons for this. First, our analysis assumes that only hake, pilchard, and horse mackerel are targeted by the DWF. Second, ECOPATH/ECOSIM account for the indirect effects of release in predation, and increase in competition for resources in the food web. Hence, the balance of masses in the food web causes an increase in the biomass of preys and competitors (e.g. anchovy, mackerel, other pelagic and small demersal fish), with the depletion of hake, horse mackerel, and pilchard; the converse is expected with the reduction in fishing pressure on these three species in the "without" DWFs scenario.

To further illustrate the effect of DWFs on the future potential of the stocks, Figure 20 plots the stock profiles for pilchard, hake, and horse mackerel in the "with" and "without" scenarios. This figure clearly shows that much healthier stock sizes are left over at independence in the "without" than in the "with" scenarios.

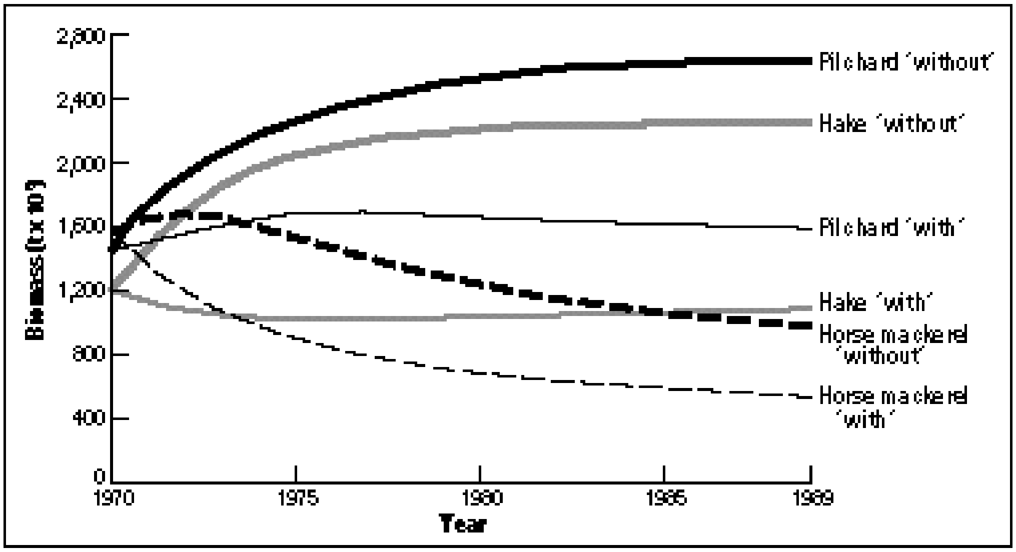
The above results on the biomass are reflected in the catch taken in the "with" and "without" DWFs scenarios. We see from the third column in Tables 16 and 17 that much more hake, pilchard, and horse mackerel are taken in the "with" than in the "without" DWFs scenarios.

■ Economic Impacts

Tables 16 and 17 report the net landed value or the added value obtained from fishing the resources in the Namibian ecosystem in the two scenarios. The net landed value is the revenue from fish landed less all costs, it is therefore the added value obtained by exploiting the resources in the ecosystem. To obtain this, the average catch levels determined from ECOSIM are multiplied by 1995 constant prices obtained from the Ministry of Fisheries and Marine Resources for each of the species of fish. Finally, the gross landed value obtained is reduced by half to obtain the net landed value. This is in accordance with data from the ministry which shows that on average the cost of fishing is about 50 per cent of the gross landed value.

Tables 16 and 17 also show how much of the added value goes to the DWFs and how much to the domestic fleets. We see from these tables that in the "with" scenario, the DWFs make on average N$1,012 million annually while the domestic fleet makes only

Figure 20. **Stock profiles for pilchard, hake and horse mackerel in the "with" and the "without" DWF scenarios**



about N$112 million. In the "without" DWFs scenario, in which the fishing effort by DWFs is taken away, while maintaining the same fishing effort for the domestic fleet as in the "with" scenario, the domestic fleet makes N$236 million. This part of the analysis reveals the second impact of DWF activities in Namibian waters: their presence has led to a loss of about 53 per cent of what Namibia would have earned in their absence employing the same amount of fishing effort as in the "with" case. This is because in the absence of the DWFs, the domestic fleet benefits from exploiting much higher stocks of fishes at lower costs.

Figures 21 and 22 plot the discounted economic rents to the DWFs and Namibia in the "with" and "without" DWFs scenarios. Figure 21 shows that the DWFs take the lion's share of the economic benefits throughout the period. In Figure 22, only the payoffs to Namibia in the "with" and "without" scenarios are plotted to highlight the impact of DWFs. This figure shows that Namibia does consistently better in the "without" scenario, even though it is employing the same fishing effort as in the "with" scenario. The decline in economic rent seen in the figures from 1970 to 1989 is due to discounting.

■ Implications for Namibian Fisheries

The modest objective of this part of the report is to use computational methods to isolate the impact of DWFs on Namibia's ecosystem in the period before independence. Other aspects of DWF impacts are addressed by other parts of the report.

By combining the ECOPATH and ECOSIM approaches, a simple ex post facto analysis has revealed two important impacts of DWF activities on the Namibian ecosystem. First, the analysis shows that because of the overexploitation by DWFs in the years before independence, the newly independent Namibia inherited an ecosystem whose production potential was severely reduced. In the case of the important hake, horse mackerel, and pilchard stocks the reduction ranged between 32 and 49 per cent of the

Figure 21. **Discounted rent paid to the DWF and Namibia in the "with"scenario, and to Namibia in the "without" scenario**

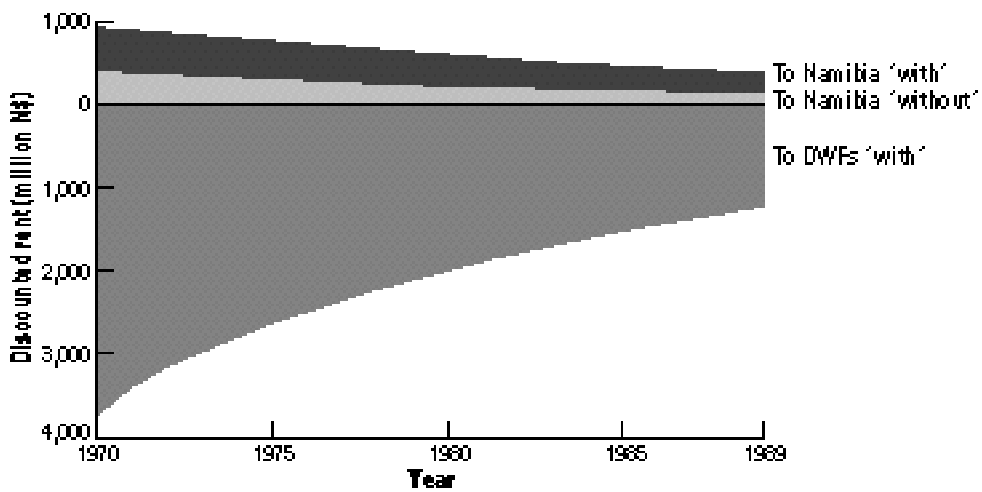
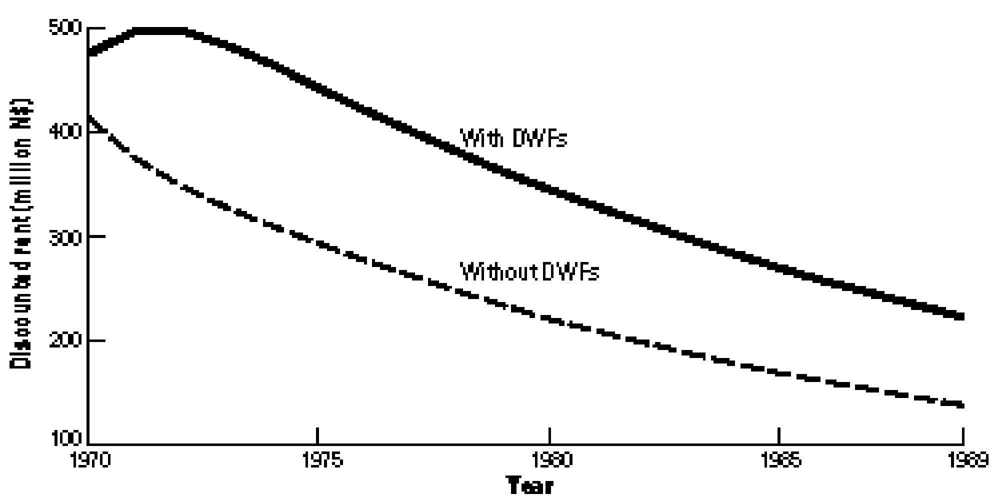


Figure 22. **Discounted rent to Namibia in the "with" and "without" scenarios**



biomass potential. It is little wonder that in the years right after independence, relatively small TACs for hake, horse mackerel, and pilchard had to be authorized by the new government in an effort to recapture some of the lost potential. In 1990 and 1991 the TAC for hake was 60,000 t; for pilchard the 1990 TAC was 40,000 t and the 1991 TAC was 60,000 t; while the 1990 TAC for horse mackerel was 150,000 t (Namibia Foundation, 1994). Second, the analysis shows that had Namibia employed the same fishing effort it used in the "with" DWF scenario, it would have made more that 100 per cent more economic rent from exploiting the resources in the ecosystem in the absence of DWFs.

As mentioned earlier, this is an ex post facto analysis of the exploitation of the stocks of the Namibian ecosystem. The analysis is simple because the scenarios analysed were developed using information on catch data as the starting point. The analysis could be extended in several ways. To mention a few, a more detailed analysis could be undertaken by looking at data on the actual fishing efforts employed by both the DWFs and the domestic fleet, and the cost of fishing. One might also look into how the profits made by the DWFs were appropriated. Furthermore, the current study could be extended to an analysis that seeks to find out the possible ecological and economic outcomes that would have emerged had Namibia taken control of her ecosystem in the 1970s rather than the 1990s. One could then aim to determine what we term the maximum sustainable ecosystem yield and the maximum sustainable ecosystem economic rent. Presumably, the use of these two criteria would reveal greater losses than found here as a result of the activities of DWFs in the Namibian ecosystem.

5. Status of West African Fleets*

Rapid Appraisal of Distant Water Fleet Fisheries Relative to Home Fleets Using the RAPFISH Technique

This section presents a preliminary analysis aimed at assessing the status of fisheries from the point of view of sustainability, by comparing them using RAPFISH, a multidisciplinary, multivariate rapid appraisal technique recently developed at the Fisheries Centre. The technical details of this approach are outlined in the methodology section above. Here, we analyse three of the fisheries described in the case studies. These are the competing fisheries targeting small pelagics off the coast of northwest Africa. The assessment focuses on the situation prevailing in 1989 for a DWF, namely the USSR, and the small-scale home fleet fisheries of the coastal nations, Mauritania and Senegal. For comparison purposes, these three fisheries are analysed alongside 16 other small pelagic fisheries from around the world, which have been previously evaluated using RAPFISH (Pitcher et al., 1998a). The RAPFISH technique has been developed by Pitcher et al. (1998b), Pitcher and Preikshot (1998), and Preikshot and Pauly (1998) to produce interdisciplinary ordinations and evaluations of the sustainability status of a variety of fisheries.

The fisheries analysed with RAPFISH are listed in Table 18. The four disciplinary ordinations, in ecological, social, economic, and technological areas, are shown in Figure 23.

RAPFISH ordinations are bounded by fixed reference points in the form of “good”, “bad”, and “random” simulated fisheries. “Good” represents the best possible fishery that may be constructed using the attributes, and “bad” the worst possible fishery. “Random” fisheries are constructed from randomly chosen values for the scored attributes. The unrotated axes are the thicker grey axes seen in Figure 23; their size represents the 95 per cent confidence interval for 20 random simulated fisheries. The axes after rotation are represented in black. In this analysis, most of the real data points in the analysis are outside the 95 per cent confidence interval of the “random” fisheries, which implies that the results of ordination are not random and represent differences that are significant.

In the ecological RAPFISH ordination we see that the home-based fisheries lie in the mid-range of the other small pelagic fisheries for herring, sardine, and anchovy, but both extremes of the likely range of values for the USSR DWF fisheries are of lower status. In the economic ordination, the home fleet fishery for Senegal lies close to the best of the herring fisheries (the roe fishery of British Columbia) and to the best anchovy fisheries (fixed gear Japanese fisheries). Senegal has slightly higher status than Mauritania, which lies close to the two Atlantic herring fisheries. Both DWF

---

* Prepared by Tony J. Pitcher, David Preikshot, and Ramón Bonfil

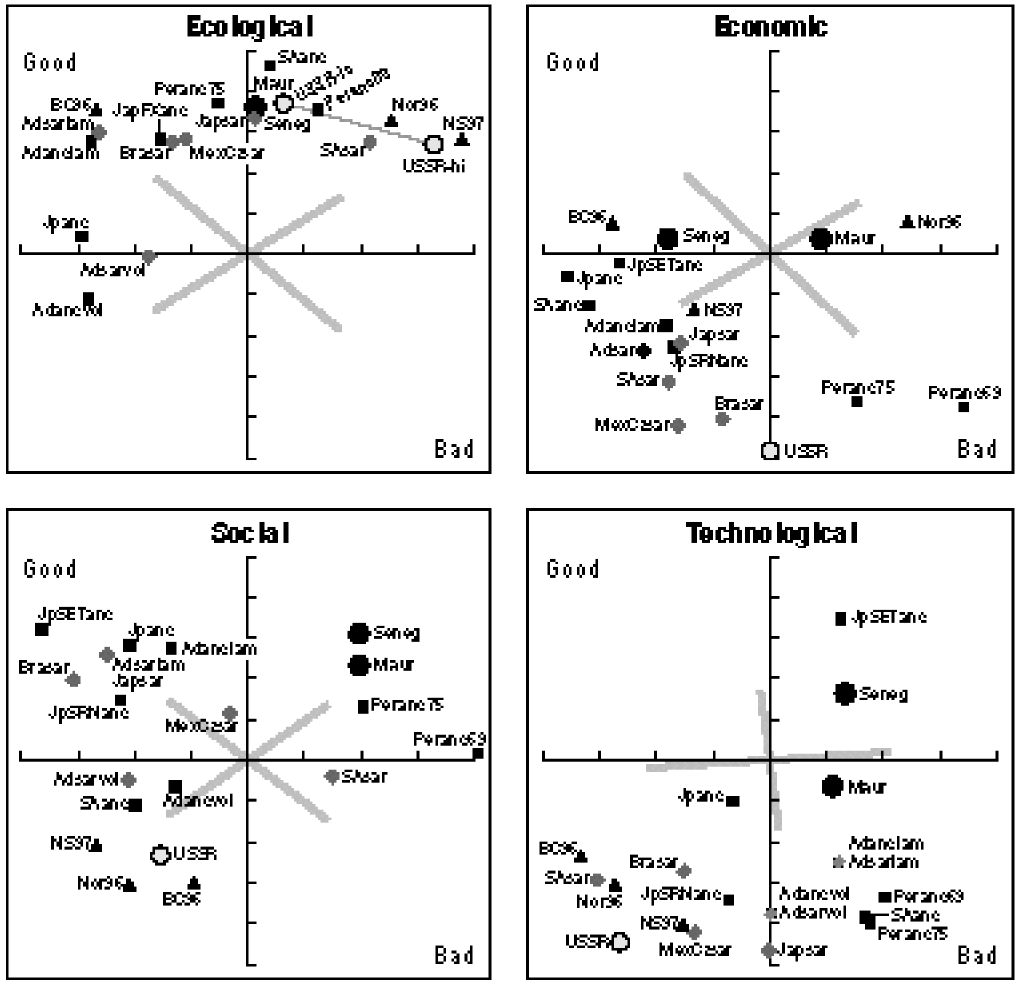
Table 18. **Codes used for the different fisheries**

Code	Fishery
Adanclam	Adriatic Anchovy Lampara
Adancvol	Adriatic Anchovy Volante
Adsarlam	Adriatic Sardine Lampara
Adsarvol	Adriatic Sardine Volante
Bad	Modelled “Bad”
BC96	British Columbian Herring Roe
Brasar	Brazilian Sardine
Good	Modelled “Good”
Japsar	Japanese Sardine
Jpanc	Japanese Anchovy
JpSET anc	Japanese Anchovy Set Net
JpSRN anc	Japanese Anchovy Surround Net
Maur	Mauritanian Small Pelagic
MexCzsar	Mexican Gulf of California Sardine
Nor96	Norwegian Herring
NS97	North Sea Herring
Peranc69	Peruvian Anchovy
Peranc75	Peruvian Anchovy
SAanc	South African Anchovy
SAsar	South African Sardine
Seneg	Senegalese Small Pelagic
USSR-hi	USSR High Catch per Fisher Scenario
USSR-lo	USSR Low Catch per Fisher Scenario

points have much lower economic sustainability status than these, falling among the worst of the fisheries in the analysis, the Peruvian anchovy before and after its major 1971 collapse. In the social ordination, the DWF fishery is little different to the two home-based west African fisheries, all of them falling in the lower quartile of small pelagic fisheries worldwide. They lie on opposite sides of the plot, meaning that there are large differences, but these differences are not related to sustainability along the axis from “good” to “bad”. The same thing occurs in the technological ordination, except that here the west African fisheries lie in the mid-range of sustainability.

Figure 24 shows the combined (multidisciplinary) RAPFISH ordination, which provides an unweighted conflation of the scores from the four separate disciplines. (Note that in Figure 24 the “good” and “bad” fisheries are off the scale of the plot, which has been enlarged for clarity.) The home fleet in Senegal plots among the top quartile of the world small pelagic fisheries, close to the Adriatic “lampara” fisheries which use small wooden purse-seiners operated with lights at night by family groups working from small coastal fishing communities. The Mauritanian home fleet lies close to mid-range of sardine and anchovy fisheries, comparable to the Mexican sardine and South African anchovy fisheries. In contrast, both the DWF range points lie in the bottom quartile of sustainability status, almost as poor as the 1969

Figure 23. **Four Rapfish ordinations as performed on attributes scores in ecological, economic, social, and technology data sets**



Peruvian anchovy fishery on the verge of major collapse in 1970. This analysis suggests that these DWFs, at the least, have low sustainability among the worst of the world's small pelagic fisheries.

Figure 25 quantifies the results of comparing the difference in sustainability status from the combined Rapfish ordination. The plot was rotated so that "good" to "bad" axis was horizontal, and each location expressed as a percentage of the distance between them. For the sardine, herring, and anchovy fisheries we note that the differences between the best and worst fisheries were 10 per cent, 14 per cent, and 20 per cent, respectively. By this technique, the DWF USSR fishery was 7 per cent to 12 per cent less sustainable than the Mauritanian home fleet fishery, and 13 per cent to 18 per cent less sustainable than the Senegalese home fleet fishery. Note, too, that this is likely to be an underestimate of this effect since the local fisheries attributes were collected after the arrival of the DWF. The DWF fishery has almost as great a reduction in status compared to the home fleets as the difference between the best and the worst of small pelagic fisheries worldwide.

Figure 24. **Combined interdisciplinary ordination of fisheries**

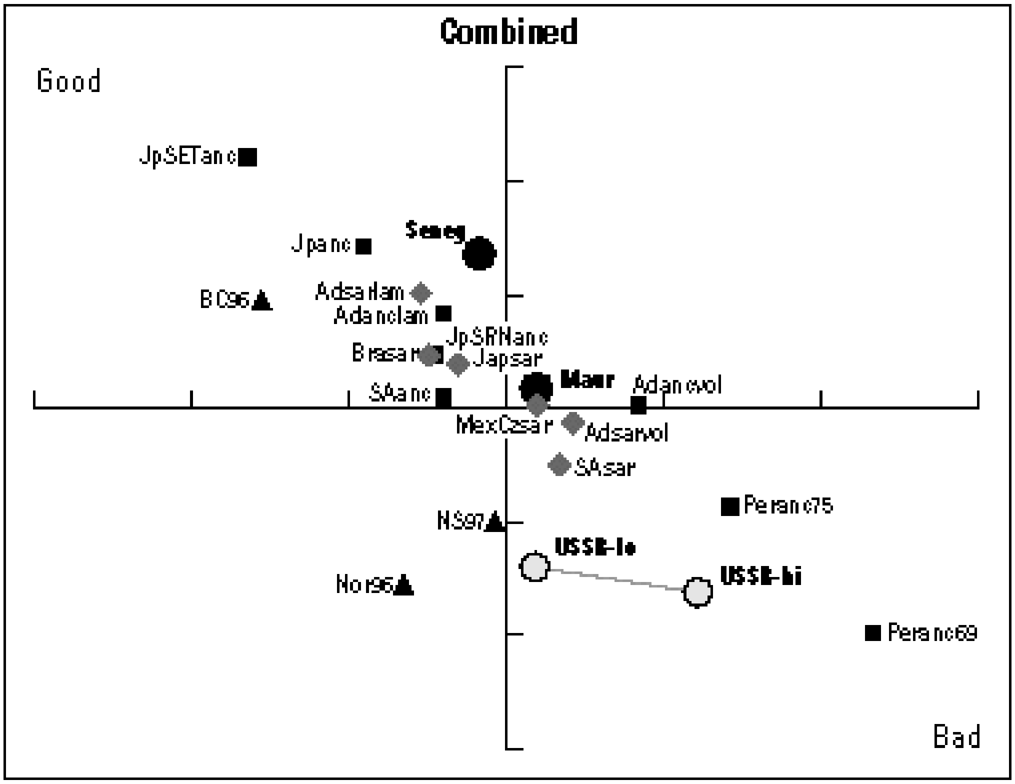
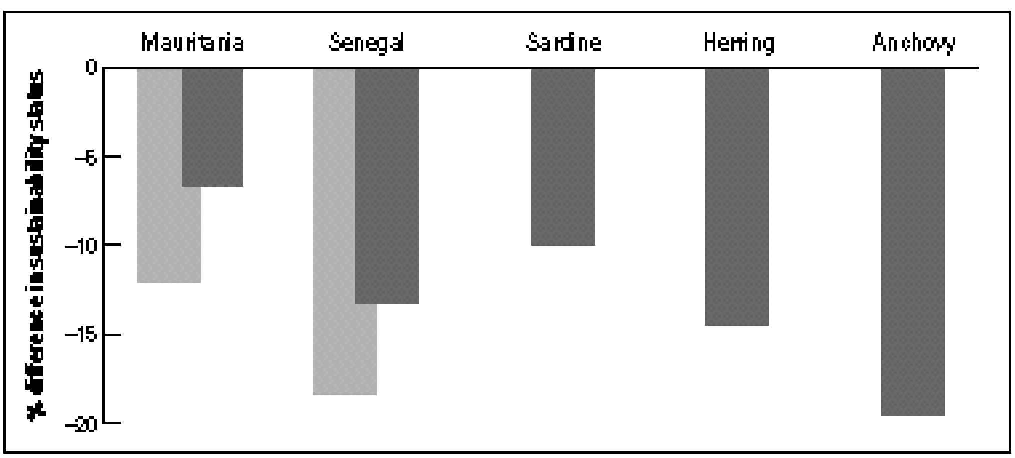


Figure 25. **Differences in sustainability status of best and worst fisheries by category**
Scores were percentage of the distance between the simulated best and worst fishery from the combined RAPFISH ordination.



6. DWFNs and Coastal States

Economic and Social Aspects of their Interactions

The relations between coastal states and DWFNs have been profoundly affected by the extended fisheries jurisdiction (EFJ) arising from the UN Third Conference on the Law of the Sea. As a consequence of the conference, and the resultant UN Convention on the Law of the Sea (UN, 1982), coastal states have been given the power to establish 200-mile EEZs. From this it follows that, when discussing coastal state-DWFN relations, a clear distinction must be made between those fishery resources which lie wholly within the coastal state EEZ, and those stocks which lie both within the EEZ and the adjacent high seas. It also follows that, as a preliminary to discussing coastal state-DWFN relations under the EEZ regime, we should comment on the state of affairs which existed prior to the UN Third Conference on the Law of the Sea and the advent of EFJ.

The Pre-EFJ Era

Prior to the advent of the EFJ and the EEZ regime, coastal states typically had jurisdiction over fishery resources off their shores out to no more than 3 miles. Fisheries jurisdiction out to 12 miles was deemed to be unusual. Hence, the bulk of marine fishery resources were high seas fishery resources.

The high seas fishery resources were subject to control by international commissions, or were subject to no control whatsoever. Where the stocks were subject to management by international commissions, the management was, more often than not, weak. The ICNAF, discussed in the Newfoundland case study, provides an example. In any event, the high seas fisheries were characterized by open access, in which DWFs could fish at will.

The economics of open access fisheries, in which property rights to the resources are non-existent, are well known (e.g. Munro and Scott, 1985). Overexploitation of the stocks is all but guaranteed. The fishers, be they coastal state fishers or DWFNs, have no incentive to conserve the resource. Hence, we should not be surprised to find that the pre-EFJ history of DWF activity was one of chronic overexploitation of the stocks. The cases of Iceland, Namibia, Newfoundland, and Mauritania and Senegal all provide examples of pre-EFJ overexploitation of fishery resources by DWFs.

It was, in fact, the decidedly unsatisfactory state of affairs in high seas fisheries management which provided the motivation for EFJ. To cite but one example, Canada became a strong advocate of EFJ in large part because of its dissatisfaction with ICNAF resource management off Canada's Atlantic coast.

With these preliminary comments completed, let us now turn to coastal state-DWFN relations under EFJ – the EEZ regime.

■ Fishery Resources Wholly within the EEZ

Fishery resources which lie wholly within the EEZ can be said to constitute, to all intents and purposes, the property of the coastal state (McRae and Munro, 1989). It is true that, in the years immediately following the UN Third Conference on the Law of the Sea, there was considerable dispute over whether tuna, and other highly migratory species, found within the coastal state EEZ, could be said to constitute coastal state property. The United States insisted that they were not. The United States was to reverse its position in the early 1990s, and the issue appeared to be settled (UN, 1992). Thus, all fishery resources within the EEZ could now be said to constitute coastal state property.

Nonetheless, it did appear, at first glance, that the UN Convention on the Law of the Sea circumscribed these coastal state property rights in a manner which is of key importance to the issue of coastal state-DWFN relations. While Article 56 of the convention grants the coastal state "sovereign rights for the purpose of exploring, exploiting and conserving the...living resources within the EEZ", and while Article 61 explicitly grants the coastal state the right to set the TACs for fisheries within the EEZ (UN, 1982), Article 62 lays down the so called "surplus principle". In essence, the principle states that the coastal state is to assess its fishing capacity in relation to each of the aforementioned TACs. In those instances in which the coastal state fishing capacity falls short of the TAC, a "surplus" is deemed to exist. Article 62 then calls upon the coastal state to grant "other" states (e.g. DWFs) access to the "surplus" (UN, 1982).

The "surplus principle" is, however, something of an illusion, at least from an economic perspective. First, Article 61 grants the coastal state what amounts to a free hand in setting the relevant TACs. Hence, the coastal state could go a long way towards eliminating surpluses through judicious setting of the TACs. More importantly, Article 62 grants the coastal state very broad powers in imposing terms and conditions of access (e.g. imposition of fees) upon DWFs seeking access to any "surplus" (UN, 1982). In no sense whatsoever is the coastal state expected to grant DWFs free access to the "surpluses" (Munro, 1985 and 1989). With a modest amount of imagination a coastal state could, in fact, devise sets of terms and conditions of access which would serve to discourage all DWFs seeking access (Munro, 1985 and 1989).

Given that the fishery resources within the EEZ constitute coastal state property, and given that the so called "surplus principle" is largely empty in economic terms, then the decision as to whether or not DWFs are, or are not, to be granted access to the EEZ can be seen to rest with the coastal state. Of course, DWFs may attempt to enter an EEZ, and catch the stocks contained therein, without obtaining access agreements from the coastal state, as is exemplified by the case of the Galapagos Islands. Such action constitutes poaching, pure and simple. In principle, such action is no different from say, the stealing of livestock from a farmer or rancher.

The question then becomes why a coastal state, which is capable of defending its marine property rights, should contemplate establishing access arrangements for one or more DWFs, as opposed to phasing out DWF activities within its EEZ with all possible speed. The economic answer is that the coastal state may find that it can increase its economic returns from its fishery resources by establishing the arrangements. The coastal state can be thought of as "importing" the fishing, and/or processing, services of the DWFs. Alternatively, the coastal state can be thought of as "hiring" the services of the DWFs (Munro, 1985 and 1989).

If we think of the coastal state as "importing" the services of the DWFs, then the question as to whether or not it is in the economic interest of the coastal state to grant access to DWFs can be cast as an international trade question. *A* prima facie case can be made for "importing" such services if the DWF has a comparative advantage in fishing a particular resource within the EEZ, and/or processing the catch.

Suppose, for the sake of argument, that the DWF can both fish the relevant resource and process the catch at costs much lower than those which would be incurred by domestic fishers and processors. Then the coastal state might well find that the net economic benefit which it can obtain from the resource would be maximized by granting access to the DWF, with the granting of access being accompanied by a set of fees designed to capture a portion of the net economic benefits, or economic resource rent, from the fishery. The Pacific island nations of the western and central Pacific, which have seen up to 80 per cent of their offshore tuna catches taken by DWFs under access arrangements involving fees, could be thought of as one example (Munro, 1990).

Alternatively, the DWF might have a comparative advantage in fishing the resource, but not in processing the catch. In such circumstances, it could be to the coastal state's economic advantage to enter into a joint-venture arrangement with the DWF, in which the fleet fished the resource and delivered the catches to onshore processors. Namibia provides an illustration of a coastal state which has adopted the joint-venture approach.

If the DWFs have a comparative advantage in neither fishing nor processing, then the coastal state's decision will be straightforward. No access arrangements should be contemplated.

The argument for not granting access arrangements, even when the DWFs possess a comparative advantage, is really an argument for granting protection to the domestic fleets and/or processors (Munro, 1989). Economists maintain that many arguments for protection, when judged from a national perspective, are specious. Not all such arguments are invalid, however. A prominent "legitimate" argument is the so called "infant" industry argument: a country may have a comparative advantage in the production of a particular good or service. The domestic industry producing the good or service is newly established, an "infant". Until the industry has gone through a learning period its costs will appear to be higher than those of its foreign competitors. Thus the country's comparative advantage is latent. Hence, unless the "infant" industry is granted temporary protection, it will not survive, and the country's latent comparative advantage will remain unrevealed.

Hence, one could argue that a coastal state implementing an EEZ regime should provide protection for the domestic industries taking advantage of the new opportunities created thereby, until such time as the "infants" achieve maturity. The infant industry argument has validity, but it has to be handled with great care. The problem in applying the argument is that it is very difficult to determine a priori which "infants" do in fact have a real chance of achieving maturity. Those that remain in permanent childhood risk becoming a permanent drain upon the economy.

New Zealand is an example of a developed coastal state that has explicitly followed a policy of "importing" foreign fishing/processing services. When New Zealand established its EEZ (the fourth largest in the world), it established a quota regime for its domestic fishing companies exploiting the offshore stocks now encompassed by its EEZ. The companies were enabled, within limits, to fish the stocks, and process the catches, with their own vessels and processing facilities, or to engage foreign vessels under charter to do the fishing/processing for them. Extensive chartering of foreign vessels did in fact take place (Munro, 1989). In an address, given a few years ago, the then New Zealand Minister of Fisheries, stated that his country followed a policy of "free trade in fishing services", and noted that 100 foreign vessels were under charter from DWFNs such as Japan, the Republic of Korea, Poland, Russia, and Ukraine (Kidd, 1994).

Two key points must be made in passing. The first is that the use of domestic fishing/processing services, as against the "importation" of foreign services, is not an either/or situation. It is quite possible that it will be optimal for the coastal state to have a mix of domestic and foreign services. The foreign comparative advantage may prove to be limited and specific. New Zealand does, for example, have a definite mix of foreign and domestic services.

The second point is that comparative advantage is not static, but rather can be expected to vary over time. Thus, a coastal state may initially find that it is in its economic interest to import DWF services, but may find that this ceases to be the case, because of shifting comparative advantage. In other words, the initial comparative advantage of DWF over domestic fishing/processing services may be transformed into a comparative disadvantage.

What we might term the "trade in services" argument for establishing access arrangements with DWFs will, if positive, provide a prima facie case for establishing the access arrangements. It does not, however, settle the matter. It is naive to suppose that a coastal state, even if developed, can exert absolute control over DWFs granted access to the EEZ. Consequently, the full benefits of the DWF comparative advantage are unlikely to be enjoyed by the coastal state. For example, the coastal state is likely to find it costly to ensure that the DWFs comply fully and precisely with the terms and conditions laid down by the coastal state.

This type of problem is not unique to the coastal state-DWFN case. Indeed, it is a commonplace in economics, and is referred to by economists as the "principal-agent" problem. It arises when the principal, say an employer, "hires" the agent to perform certain tasks, but cannot control the agent's actions with precision. The principal must remain content with establishing an incentive scheme to motivate the agent. A textbook example is that of a landlord and a sharecropper. The landlord, the principal, cannot exercise absolute control over the sharecropper, the agent, but must rather rely upon a set of incentives.

At an earlier point, we said that one might, as well as thinking of the coastal state "importing" the services of DWFs, think of the coastal state "hiring" the services of DWFs. Thought of in this way, the coastal state can be seen as the principal and the DWF(s) as the agent(s). The terms and conditions of access then can be viewed as the incentive scheme. Principal-agent analysis has in fact been applied to the coastal state-DWF problem (see, for example, Clarke and Munro, 1987 and 1991; Munro, 1994).

In principal-agent analysis, one talks about "first best situations" and "second best situations" faced by the principal. In a first best situation, the agent is no more than the principal's slave. In the second best situation, the agent is imperfectly controlled by the principal through a set of incentives. The difference between the benefits which the principal receives under the realistic second best situation, and what it would receive under the utopian first best situation, is referred to as the "incentive gap" (Munro, 1994). The typical coastal state, in granting access to one or more DWFs, is very much confronted with a second best situation. In terms of benefits, the coastal state must recognize that there will be some "slippage" – an incentive gap – and realistically assess the benefits to be derived from DWF participation, in comparison with those to be derived by relying solely on domestic fishing and processing services.

One aspect of incentives and "slippage" involves monitoring and surveillance of DWFs, in ensuring that they comply with the terms and conditions of access (e.g. not exceeding their allowed catches). Few coastal states have sufficient surveillance capacity to police the DWFs with absolute effectiveness. Indeed, most would find the costs prohibitive, and thus must rely upon incentive schemes of some sort to achieve a reasonable degree of compliance.

One of the best examples is provided by the aforementioned Pacific island nations. The combined EEZs of the Pacific island nations equal the area of Africa. Most of the island nations are at relatively low levels of development, and cannot afford extensive fleets of patrol vessels and aircraft to monitor DWFs operating in the EEZs. The island nations cooperatively have developed an effective incentive scheme, involving a Regional Register of Foreign Fishing Vessels. One aspect of the scheme is that a foreign vessel found in violation of its access terms and conditions in the EEZ of one island nation faces the threat of banishment from the EEZs of all of the island nations (Munro, 1990).

Among the case studies, Mauritania probably provides the best example of "slippage". Mauritania has the potential to enjoy significant economic benefits from the granting of access to DWFs. Due to the coastal state's limited monitoring and surveillance capabilities, however, these benefits have certainly been below the maximum. "Slippage" has been apparent.

■ Fishery Resources Found both within the EEZ and the Adjacent High Seas

Over the last decade and a half , managing fishery resources that are to be found both within the EEZ and the adjacent high seas has emerged as a serious problem. Such resources, referred to as straddling stocks and highly migratory stocks, were the focus of a major UN intergovernmental conference (UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks) from 1993 to 1995. The agreement to which the conference gave rise (UN, 1995), which was designed to supplement, or buttress, the Convention on the Law of the Sea, is now up for ratification. The process of implementation is only just beginning.

With such resources, the coastal state-DWFN relations become quite different. The sovereign rights to the intra-EEZ portions of the stocks, granted by Article 56 of the Convention on the Law of the Sea to the coastal state, remain unchanged. What the coastal state does not have, however, are full property rights to the high seas portions of such stocks. In fact, the nature of the property rights to the high seas portions of these stocks is not entirely clear at the time of writing.

The aforementioned UN agreement calls for straddling stock type of resources to be managed on a region by region basis through regional fisheries management organizations (RFMOs), in which membership will be open to relevant DWFs. The coastal state will have no choice but to deal with the relevant DWFs, although the coastal state will still be left with the power of determining whether the DWFs in question should or should not be granted access to the EEZ.

It should be emphasized, in passing, that the consequences of ineffective cooperation between coastal states and DWFNs in the management of straddling/highly migratory stocks can be severe. Evidence is provided by the case study on the “donut hole” in the Bering Sea. The Alaska pollock stocks in this high seas enclave clearly constitute a straddling stock. The stocks were subject to massive overexploitation by DWFs, as a result of non-cooperation between the DWFs and the relevant coastal states – Russia and the United States. There was cooperation in the end, but only after the damage had been done. It was examples, such as the “donut hole”, that provided the motivation for the aforementioned 1993-1995 UN conference.

It has been argued that, if the RFMOs are to be successful, the relevant adjacent high seas will become high seas in name only (Munro, 1998). It is further argued that, on a de facto, if not de jure, basis, the coastal state and DWF members of an RFMO will share joint property rights to the high seas portions of the stocks (Munro, 1998).

It should also be noted that the 1993-1995 UN conference recognized at a very early stage that it is nonsensical to think of the high seas portion and EEZ portion of a straddling type of stock being subject to separate management regimes. If a DWFN member of a RFMO becomes a de facto joint owner of the high seas portion of the stock in question then it can be expected to exert influence over the management of the stock within, as well as without, the EEZ.

Given that the nature of the management of straddling and highly migratory stocks is still being determined, and will continue to be determined for some time to come, there is little more that can be said about coastal state-DWFN relations with regards to these resources at the present time.

Social Considerations*

Social impacts can be analysed at three different levels, global, hemispheric or international, and national. Global impacts include those of industrial fishing on the common heritage of humankind, primarily the reduction in abundance and diversity of marine fish stocks and the consequent foreclosing of options for future generations. At a hemispheric level, DWFs transfer protein and wealth from underdeveloped to developed nations. At a national level, and certainly prior to EEZs, DWFs impacted on indigenous and artisanal fishers. While the creation of EEZs was widely expected to improve conservation and management, this has not always proved to be the case. Nor have EEZs in themselves alleviated the situation of indigenous and artisanal fishers as each country is free to decide how resources are allocated between coastal and offshore fisheries.

The two key points are that first, for most of human history, fishing communities were located close to the fish. Second, fish populations were more than adequate for local needs. There was little or no population pressure, no global markets. Fish were thus protected by the limited needs of the dependent community, by limitations of vessels and gear, and above all, by weather and sea conditions. Newfoundlanders fished cod from June to September (see the Newfoundland case study above). Similarly, DWFs fishing off Iceland up to the beginning of this century were restricted to the summer months. After that, the cod were safe enough. In fact, merchants who supplied the necessities of life in exchange for salt cod often complained that people commonly stopped fishing while there were still plenty of fish to be caught (Ommer, 1994).

GLOBAL ISSUES

Vessel technology severed the ancient link between fishing and communities anchored by geography. Fishing communities, whether Newfoundland outports, BC Aboriginals, or Senegalese pirogues came to be looked on as relics of the past, or at best, quaint. Big government and big industry became the key players. As local stocks became depleted, various nations took to the high seas in search of new stocks.

The evolution of fisheries management lags very shortly behind the growth of industrial fleets. As the realization dawned that fisheries were finite, government stepped in with successive control measures. The commercial industry is thus the parent of modern fisheries management. It is little wonder that traditional systems received short shrift. The marginalization of traditional management systems and the criminalizing of traditional fishing practices are significant social issues that remain to be addressed (Thoms, 1996).

Pauly et al. (1998) show that, as large, commercially valuable species are depleted, modern industrial fishing is moving steadily down the marine food web. If this continues unchecked, the end result will be a world ocean full of krill, lanternfish, and squid. Areas like the South China Sea are already dominated by fast-turnover pelagic species. This reduces the options for future generations. The most popular remedy, very large no-take marine protected areas, also has significant social implications for indigenous and longstanding coastal fishing communities who might wake up one day

* Section prepared by Nigel Haggan

to find most or all of their traditional fishing grounds declared a "no-take" area in the interest of conservation.

Subsidies are another major issue. Garcia and Newton (1997), estimate the annual global cost of fishing at around US$116 billion, with corresponding revenues of US$70 billion. The difference, US$46 billion per year, consists of direct and indirect subsidies. Subsidies are also a national and indeed domestic issue. The northern cod study shows that Canada's response to international fishing pressure was to invest heavily in advanced catching and processing technology. The former Soviet bloc invested enormous amounts in distant water vessels. In the Newfoundland case, the inshore trap fishers ate into their savings and home equity to buy more traps and gear – running ever faster to stand still. There is a real reluctance to abandon this level of investment.

INTERNATIONAL AND HEMISPHERIC ISSUES

The realization that catching power has outstripped the productive capacity of world oceans led inexorably to the creation of EEZs. Iceland led the way by extending its EEZ to 4 miles in 1952, 12 miles in 1958, 50 miles in 1972, and finally 200 miles in 1975 (see the Icelandic case study above). Well and good, but the new national domains had no effect on the behaviour of walleye pollock in the Bering Sea. Atlantic herring were equally indifferent to the new ocean frontiers.

The social implication is that nations with little or no history of dialogue, cooperation, or indeed war have, all of a sudden, to start to deal with each other. This requires a rapid maturation. Some achieve it, for example the parties to the Bering Sea "donut hole" and Norwegian spring-spawning herring agreements. Others do not, as witnessed by the annual tomfoolery and posturing between Canada and the United States over Pacific salmon and the 1996 Turbot War between Canada and Spain, where the question of whether Canada was within its rights to seize a vessel on the high seas is still being debated in court.

Mauritania, and to a lesser extent Senegal, exemplify the problem of transfer of protein and wealth from poor "southern" nations to the relatively rich DWFNs. The case study shows that for a 45-year period (1950-1994), DWFNs took over 80 per cent of the catch. In recent years, the Mauritanian catch has remained at around 10 per cent while Senegal, with an aggressive artisanal fishery, has increased its catch significantly. Namibia has made a commitment to rebuild stocks depleted prior to independence and appears well placed to maximize economic and social benefits as stocks rebuild.

The need for "internationalization" of fisheries management and responsible behaviour by developed nations identified at the end of the Mauritania/Senegal case study is apparent. The role of Norway, the United States, and Iceland in aiding Namibia to build "respectable capabilities for controlling and monitoring foreign fishing… [and] … for training Namibian personnel and reducing the dependency on expatriates" is encouraging. The need for international bodies which can exert more than moral suasion and the unequivocal political backing of powerful nations for measures such as the FAO Code of Conduct for Responsible Fishing remains to be met.

NATIONAL ISSUES

While the allocation of stocks within the EEZ is at the sole discretion of the coastal nation, there are nonetheless significant social and equity considerations involved in how these stocks are fished. Both Mauritania and Iceland recognized this in setting out regulations to restrict large vessels from inshore areas to protect the small boat fleet. In the case of Mauritania, these measures have not been entirely successful. The economic impacts of offshore fisheries can also be significant. Canada's failure to protect the inshore cod fishery has, so far, cost Can$4.2 billion to mitigate community impact. This raises a number of important social questions, not least of which is whether longstanding communities such as Newfoundland outports have a "right" to continue to exist after their original economic bases have been eroded. When management by big government played a role in eroding the economic base, what is the nature and extent of government's responsibility? Is Can$4.2 billion enough?

■ Concluding Remarks

Extended fisheries jurisdiction has radically altered the relationship between coastal states and DWFNs. DWFs no longer have unimpeded freedom to operate as they please. With regards to fishery resources wholly within the EEZ, the decision as to whether DWFs should be allowed access to these resources lies with the coastal state. The coastal state, if it is acting rationally, will, or will not, decide to grant such access in light of the expected impact that this decision will have upon the state's long-term economic and social interests.

Fishery resources that lie both within the EEZ and the adjacent high seas present a far more difficult problem. In the case of these resources, the coastal state has little option but to seek the cooperation of the DWFNs.