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Report on the International Fishers' Forum on Solving the Incidental Capture of Seabirds in Longline Fisheries

Auckland, New Zealand,

6–9 November 2000

Report on the International Fishers' Forum on Solving the Incidental Capture of Seabirds in Longline Fisheries,

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Preface

The incidental capture of albatrosses and petrels in longline fishing operations has become a concern to governments, fishing industries, and the public in recent years. A growing number of programmes to develop solutions to this problem are being conducted and increasingly effective methods are being developed and implemented.

The purpose of the International Fishers' Forum was to provide an informal opportunity for fishers, gear technologists, researchers, and government officials to meet and exchange information on mitigation measures being used and/or developed in longline fisheries around the world. It is hoped that this exchange of information and ideas will result in a more co-ordinated response to this seabird bycatch issue and accelerate progress in solving the problem. In particular, the forum aimed to:

- provide fishers with information on the latest mitigation measures that could be adopted by their fleet;
- review gear development programmes currently underway;
- identify global priorities for future gear development and other research;
- foster a co-ordinated approach to testing mitigation measures thereby reducing duplication of effort;
- establish a network of fishers who would continue to exchange information on further advancements after the forum; and
- provide fishers with information on seabird population modelling programmes, with particular emphasis on how modelling can be used to predict the impact of fisheries on seabird species.

The participants and the organising committee were very pleased with the outcomes from the forum. As is evident from this report, a considerable amount of information was shared and new working relationships were formed that will last into the future. Participants have recommended that a second forum be held in two years' time, so that they can report back on the work they committed to do during the forum.

The forum was held at a critical time. Concern about the impact of fishing on seabird populations is growing as illegal and unregulated fishing in Antarctic waters continues, as results from seabird population studies continue to show declines, and as studies of the foraging range of seabirds indicate significant overlap with unobserved fisheries.

Under the *FAO International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries*, States[1] should assess their fisheries to determine whether seabirds are incidentally caught by their vessels, and if they are, to prepare a National Plan of Action that details how the bycatch will be addressed. Some States are currently preparing their national plans. Hopefully the information shared at this forum can be used as a reference to assist States to prepare their plans with full knowledge of the suite of mitigation measures currently available. States are due to start implementation of their Plans prior to the FAO Committee on Fisheries session in early 2001.

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[1] "States" includes Members and non-members of FAO and applies *mutadis mutandis* also to "fishing entities" other than States.

The International Fishers' Forum was a joint New Zealand Government and fishing industry initiative. The major sponsor was the New Zealand Ministry of Foreign Affairs and Trade whose support enabled fishers and researchers from a number of developing countries attend the forum. Other sponsors included New Zealand government agencies, international agencies including FAO and IUCN, gear manufacturers, and fishing industry associations.

The forum programme (attached as Appendix 1) was structured to provide an overview of information relevant to the issue on Day 1 and Day 2, and discussions to develop an agreed set of outcomes were the focus of Day 3 and Day 4. The report presented here is a summary of the four days, rather than a comprehensive record. In keeping with the informal atmosphere of the forum, presenters were not required to submit written papers before the forum. Consequently only the key points made by presenters are included here. Summaries of the key points of agreement that arose from working group sessions are also recorded. A list of the acronyms used and the scientific names of the main fish target species and seabird species mentioned in the report are given in Appendix 2. General pelagic and demersal longline fishing terms (including those relating to mitigation measures) used throughout this report are explained in Brothers *et al.*(1999)[1].

The organising committee would like to take this opportunity to acknowledge the participants for their generous contributions during the four days of the forum and to wish them success in their endeavours to reduce incidental mortality of seabirds in their part of the globe.

Janice Molloy
Convenor, International Fishers' Forum Organising Committee

[1] Brothers, N. P., Cooper, J., & Løkkeberg, S. 1999: The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation. *FAO Fisheries Circular No. 937*. 100 p.

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Executive Summary

Many of the world's leading longline fishing fleets were represented at an International Fishers' Forum in Auckland, 6–9 November 2000, to exchange information and develop practical measures to minimise the incidental capture of seabirds in longline fishing operations. Participants were from Argentina, Australia, Brazil, Chile, China, Indonesia, Japan, New Zealand, South Africa, Taiwan, United Kingdom (including the Falklands Islands), United States of America (representing Hawaii and Alaska), and Uruguay. In addition to fishers and fishing company representatives, fisheries scientists and gear technologists, biologists, and government representatives also attended the meeting. The forum was organised and hosted by the New Zealand Government's Department of Conservation and Ministry of Fisheries, in association with the New Zealand Seafood Industry Council.

Participants agreed that the incidental capture of albatrosses and petrels in longline fisheries was a serious problem that has resulted in the deaths of tens of thousands of seabirds annually and has had significant impacts on the populations of some species over the past twenty years. Information presented at the forum confirmed that albatrosses in particular are long-lived and slow-breeding species that cannot easily or quickly replace losses of adults from fisheries bycatch. Furthermore, many of these large seabirds migrate across entire ocean basins or may even circle the globe, and are therefore vulnerable to capture by the fishing operations of many countries, either in coastal waters or on the high seas. International co-operation is therefore essential to solving the problem.

It was agreed that several measures available to mitigate this problem could minimise seabird bycatch without significantly reducing the profitability of longline fishing operations. Simple steps such as setting lines at night, weighting the lines to achieve rapid sinking of baited hooks below the diving range of seabirds and the deployment of streamer (seabird-scaring) lines during the setting and retrieval of fishing lines can greatly reduce the incidence of seabird bycatch. A combination of seabird bycatch mitigation measures will be most effective in reducing seabird mortalities.

Other seabird bycatch mitigation measures that may further reduce bycatch include the use of dyed baits, underwater setting devices, bait casting machines, artificial baits, and the retention of recovered baits to avoid attracting seabirds to fishing vessels recovering their gear. It was agreed that further research into these measures was necessary.

Illegal, unregulated, and unreported (IUU) fishing was identified as an extremely serious problem. IUU fishers are suspected of being responsible for the majority of seabird deaths in the Southern Ocean in recent years. Forum participants expressed their strong support for efforts being made by, amongst others, the Food and Agriculture Organisation (FAO), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), and the International Maritime Organisation, and called on governments to take all necessary measures to implement an effective ban on IUU fishing.

There was unanimous agreement on the need for effective education campaigns to inform all longline fishers of the biology, life history, and population dynamics of albatrosses and petrels, the potential threat posed by longline fishing operations, and the seabird bycatch mitigation measures available. It was agreed that the provision of relevant material to fleets that had no education programme was a priority.

Considerable attention was also given to the use of modelling as a tool to better define the likely impacts of bycatch on seabird populations. The modellers stressed that because albatross are long-lived and slow-reproducing species, their populations are especially vulnerable to bycatch, even at low rates. Population declines may take some years to detect and recovery may take many years, even in the complete absence of further bycatch. Endangered species of seabirds may require closer attention than more abundant species. Improved (and more integrated) data on the distribution of seabirds and fishing effort in space and time are urgently required, both to better inform fishers and to develop management responses.

For all fisheries, adequate observer programmes are necessary to provide reliable estimates of bycatch rates of various seabird species and to identify the times and locations of interactions between seabirds and fishing operations. Observer programmes can validate data collection schemes (such as logbook programmes) involving the provision of information by fishers. These need to be complemented by monitoring programmes on seabird breeding colonies, to provide data on age at first reproduction and survival rates. The remote location of many breeding colonies and the long time series required inevitably means that these will be expensive programmes, and similar research protocols are essential to maximise the opportunities for international collaboration and team work.

Participants agreed to share the results of research programmes relating to seabird bycatch mitigation and to report these results to the relevant government or regional fisheries agencies. It was agreed that details of the International Fishers' Forum's discussions and conclusions would be communicated to governments, and to FAO, with a strong recommendation that a report should be submitted to the February 2001 meeting of FAO's Committee on Fisheries. Regional economic groupings (such as the Asia Pacific Economic Cooperation) and the Global Environmental Facility of the World Bank were identified as possible funding sources to facilitate further progress towards the reduction of seabird bycatch in longline fishing operations.

The forum participants decided to meet again in two years' time and Hawaii was proposed as the venue for a second forum in 2002. This will enable participants to further the work started at this forum, report back on the progress made in their individual fishing entities or regions, and encourage those fishing entities or regions not present to attend. It was acknowledged that an integrated "bottom-up" fishery-specific and area-specific approach was required.

Participants recognised the need for ongoing research and development and acknowledged that progress would be determined by their own contributions within their own fishing entities, regions, or organisations. In this way each entity will set their own objectives in recognition of the differences in expertise and economy. In the two-year intersessional period, participants will communicate through a list-server.

Participants agreed to undertake actions specific to their fishing entity or region by the end of 2002 and these are listed below.

Commitments Made by Participants for Work to be Undertaken Before the end of 2002

Fishing entity	Commitments from participants
Alaska	➢ publicise names of non-complying vessels and ask regulatory bodies to detail non-compliance in reports ➢ recommend that training workshops for skippers and crew in the use of effective seabird bycatch mitigation measures be provided ➢ revise and improve the seabird bycatch mitigation measures that are currently required ➢ work collaboratively with Canada ➢ organise seminar or panel discussion of stakeholders for Fish Expo 2001 ➢ develop a plan for monitoring seabird bycatch in the halibut fishery ➢ produce and distribute video of effective seabird bycatch mitigation measures tested in Alaska ➢ arrange port visits to disseminate new information ➢ work on retention of black-footed albatross (*Phoebastria nigripes*) caught on longlines and collect data on captures of this species from other fishing entities in the North Pacific ➢ work with Hawaii to develop a North Pacific Albatross Working Group
Argentina	➢ disseminate information from this forum to government officials ➢ develop relationships with local fishers to educate them about seabird bycatch mitigation measures
Australia	➢ implement Threat Abatement Plan ➢ test underwater setting chute further and disseminate results ➢ develop education strategy ➢ finalise recovery plan for albatrosses and petrels (a draft has been developed and made available for public comment) ➢ recommend reporting of vessels that comply with mitigation regulations ➢ report back form the forum to management advisory committees and industry
Brazil	➢ develop National Plan of Action ➢ select seabird bycatch mitigation measures to be tested, based on information shared at the forum and undertake testing programme ➢ ensure involvement of local fishers
Canada	➢ work collaboratively with Alaska ➢ bring USA fishers to Canada to talk to advisory boards and share information
Chile	➢ present information from the forum to ship owners ➢ propose seabird catch limits for 2001 ➢ attempt to find incentives to encourage voluntary participation ➢ develop a plan to collect seabird bycatch data from small inshore longliners ➢ seek funding from FAO ➢ strengthen links with other South American nations for regional planning

Fishing entity	Commitments from participants
China	➢ disseminate information from the forum ➢ collect data from distant water fleets through fishing companies ➢ seek financial resources from FAO for data collection from Chinese fleets
Falkland Islands	➢ relay feelings and impressions from the forum to industry ➢ pressure Spanish joint-venture vessels to attend next forum ➢ develop a chat web page ➢ share information with the South Americans on seabird bycatch mitigation measures
Hawaii	➢ support continued participation in the Hawaii Pelagic Longline Fishery Protected Species Workshop ➢ test the underwater setting chute ➢ ensure exchange of information with other fleets
New Zealand	➢ continue to upgrade data collection on bycatch in all longline fisheries ➢ continue research and development of line weighting and underwater setting measures in demersal fleet. ➢ ensure compliance with mitigation measures through vessel and skipper contracts in demersal fleet ➢ ensure all new entrants to the tuna fishery are given information kits ➢ include a module on seabird bycatch mitigation in the tuna longline manual ➢ report on the global bycatch of sooty shearwaters (*Puffinus griseus*) by December 2001
Taiwan	➢ collect more detail for the National Plan of Action ➢ compile educational information for captains and crew ➢ ask government to fund technical experimentation for the distant water fleet ➢ enhance research to investigate level of seabird bycatch ➢ seek further information from other fishery entities
Uruguay	➢ integrate fishers into the seabird bycatch work underway ➢ reward seabird band returns with Mustad caps ➢ gain support from the National Institute of Fisheries for seabird bycatch research ➢ host a similar forum for South American fisheries representatives in May 2001
Southern Ocean	➢ investigate access to CCAMLR observer database as part of the establishment of an international seabird bycatch database ➢ disseminate information from the forum into fishers' journals and magazines ➢ provide relevant material to the European Community to assist prompt action against IUU fishing and to improve practice by vessels of European Community countries in their and external Exclusive Economic Zones ➢ update proposal for the global risk assessment of seabirds in relation to longline fishing, consider approaches to the World Conservation Union (IUCN) & FAO ➢ investigate with Spanish-system fishers the feasibility of adapting vessels to use underwater setting devices ➢ continue to experiment with line weighting regimes for Spanish system ➢ further discussion with Norwegian vessel builders on the development of through-the-hull line setting

Day 1 — Monday, 6 November 2000

Welcome/Powhiri

[Chair: Hugh Logan, Department of Conservation, New Zealand]

Representatives of the local Maori tribe Te Whatua welcomed participants to the International Fishers' Forum with a powhiri (traditional Maori welcome). The Director General of the New Zealand Department of Conservation, Hugh Logan, then opened the forum. He acknowledged that the organisation of the forum was a co-operative effort between the New Zealand Government and the fishing industry, and thanked the sponsors who made the forum possible, especially the New Zealand Ministry of Foreign Affairs and Trade for travel support for many of the South American participants. He invited Ambassador Satya Nandan, Secretary-General of the International Seabed Authority, to give the keynote speech, as reproduced below.

Address from the Keynote Speaker — Ambassador Satya Nandan

I am very pleased to be here in Auckland and particularly pleased to have been invited to address this forum on the subject of solving the problem of incidental capture of seabirds in longline fisheries. The problem of incidental catch of seabirds has become a matter of widespread international concern in the light of the large reductions in the populations of a number of species of seabirds. Some of these species are now endangered, such as the short-tailed albatross [*Phoebastria albatrus*]. Seabird bycatch occurs in both the pelagic and demersal longline fisheries.

In recent times there has been growing concern for the environment and, in particular, with respect to fisheries, the concept of ecosystem management has become important as the utilisation of fisheries resources has increased. This is apparent from a review of the international norms that have evolved over the years.

Until comparatively recently, the prevailing norm was that the supply of fish was inexhaustible and that any conservation problems created by over-exploitation could be solved by the establishment of jurisdictional limits. While the rationale behind the 1958 Geneva Convention was that excessive exploitation of fish resources would endanger food supply, the general philosophy at the time was that there was an inexhaustible supply of fish resources in the seas and that any problems involved in the conservation of living resources could be resolved on the basis of international cooperation. The international community was less concerned about the environmental aspects of fisheries than with the availability of fish for human consumption. Thus, the emphasis in the 1958 Convention was on securing the maximum supply of food and other marine products, as may be illustrated by the definition of "conservation" in article 2, "Conservation programmes should be formulated with a view to securing in the first place a supply of food for human consumption."

It was not until the Third United Nations Conference on the Law of the Sea [UNCLOS], which began on 1973, that an attempt was made to deal holistically with the issue of conservation and management of fisheries, together with the issue of the limits of national jurisdiction over living marine resources. The resulting 1982 Convention was an important step forward with respect to fisheries conservation because it established a number of basic principles for conservation and management of fisheries resources. Included among those principles is the need to take measures which will produce maximum sustainable yield while at the same time taking into account relevant environmental and economic factors, among others.

On their own, however, the Convention provisions did not elaborate sufficiently upon the environmental factors that needed to be taken into account. Rather, the issues relating to conservation and management of fisheries were subsumed under the dominant issue of the extent of national jurisdiction. Somehow it was felt that the extension of national jurisdiction would be conducive to better conservation and management of fisheries and the implicit need to further elaborate upon the environmental provisions of the Convention was left to other fora.

The Convention on the Conservation of Antarctic Marine Living Resources, adopted in 1980, recognises the importance of safeguarding the environment and promoting the integrity of the ecosystem of the sea surrounding Antarctica. It aims to conserve Antarctic marine living resources and includes within the term "conservation" the notion of "rational use" thereof. Seabirds are included within the definition of Antarctic marine living resources. Unlike fisheries provisions of the 1982 Convention, the Commission for the Conservation of Antarctic Marine Living Resources [CCAMLR] treaty introduced the ecosystem approach to the conservation of the marine living resources.

By the early 1990s it was widely recognised that the legal regime for the high seas set out in the Geneva Convention of 1958, and largely incorporated in the 1982 Convention, was inadequate to safeguard the fisheries resources of the high seas, particularly those classed as straddling fish stocks and highly migratory fish stocks. It was therefore not surprising, thanks to the initiative led by Canada and others, that the Rio Earth Summit called for a conference to address the problems of high seas fisheries.

The Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks was convened by the United Nations in 1993 and completed its work in 1995 with the adoption of the Agreement for the implementation of the provisions of the United Nations Conference on the Law of the Sea relating to the conservation and management of straddling fish stocks and highly migratory fish stocks. While the Conference was convened to address the particular problem of high sea fisheries, I, in my capacity as Chairman, did not think that that was the only issue to be addressed. The Conference had to take the opportunity to address the problem of fisheries management in general and this is reflected in the United Nations Fish Stocks Agreement [UNFSA], which, in the context of straddling fish stocks and highly migratory fish stocks, establishes principles for management which are of general application and which reflect an ecosystem approach to management.

The Fish Stocks Agreement introduces the concept of the precautionary approach and elaborates how this should be applied. Management strategies are to seek to "maintain or restore populations of harvested stocks, including, where necessary, associated or dependent species, at levels consistent with previously agreed precautionary reference points". In setting out the general principles that are to be applied to the conservation and management of straddling and highly migratory fish stocks, the Fish Stocks Agreement emphasises the need to adopt, where necessary, conservation and management measures for species belonging to the same ecosystem or associated with or dependent upon the target stocks. Moreover, the Agreement requires States to minimise impacts on associated or dependent species, in particular endangered species, through measures including, to the extent practicable, the development and use of selective, environmentally safe and cost-effective fishing gear and techniques. These are significant developments in the evolution of concern for the marine ecosystem, which has been defined in the context of CCAMLR (and generally accepted), and includes non-harvested species that interact with fisheries such as seabirds.

Parallel with the 1995 Fish Stocks Agreement, the United Nations Food and Agriculture Organisation (FAO) Code of Conduct on Responsible Fisheries also reflects the need to apply to fisheries "principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management, and development of living aquatic resources, with due respect for the ecosystem and biodiversity." Among the specific requirements of the FAO code are the use of selective fishing gear so as to minimise catch of non-target species, both fish and nonfish, and the promotion of research on the social and environmental impacts of fishing gear on biodiversity.

The problem of seabird mortality in longline fisheries has always existed, but it was less acute than it is today because the techniques of fishing have changed and become more intensive. In addition seabird and fisheries distributions have overlapped as new species have been targeted. As a result, the seabird mortality has increased quite substantially. It is well established, for example, that seabirds are being incidentally caught in a number of commercial longline fisheries throughout the world, including the tuna, swordfish, and billfish fisheries in other oceans, the Patagonian toothfish fishery in the Southern Ocean and various other fisheries in other oceans of the world. However, in recent years there has been increasing awareness about the incidental catch of seabirds in longline fisheries. Some of the species most affected are already endangered or at severe risk of depletion. This has become a matter of international concern, and this is reflected in the efforts being made to find ways to reduce and minimise the incidental catch of seabirds worldwide.

A number of studies have been undertaken under the auspices of FAO with a view to seeking ways to reduce and minimise seabird mortality associated with fishing activities. These studies and workshops have resulted in the adoption by FAO in 1999 of an International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-SEABIRDS). In addition to such studies there have been studies made at the national and regional level, such as the work done in Hawaii by the Western Pacific Regional Fishery Management Council, the work done in the Bering Sea/Aleutian Islands, the work done in the Southern Ocean by CCAMLR, and the work done by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

Experts agree that it is possible to achieve a significant reduction in incidental catch of seabirds through widespread use of seabird bycatch mitigation measures. Several such measures have been developed over the past 5–10 years, including, for example, the use of seabird scaring mechanisms, bait casting machines, weighting of the longline gear and others. The cost of such measures is minimal and has little negative impact on the conduct of fishing operations. Indeed, the financial benefits to the longline fishery from adopting such measures can be significant in terms of reducing bait loss and improvements in potential catch rates.

The IPOA-SEABIRDS basically requires States, on a voluntary basis, to conduct an assessment of longline fisheries to determine if a problem exists with respect to incidental catch of seabirds. If a problem exists, States should adopt a National Plan of Action for reducing the incidental catch, consistent with the measures suggested in the IPOA-SEABIRDS. The IPOA-SEABIRDS contains a comprehensive set of technical guidelines and recommendations on seabird bycatch mitigation measures which have proven effective in reducing and minimising incidental catches.

The problem that the international community is concerned about can be addressed by the fishing community voluntarily or through an international agreement or treaty which obliges

States to undertake certain measures to ensure compliance by fishers with agreed measures to mitigate seabird mortality. We have seen that where the fishers do not take the initiative to deal with the problem themselves, the international community does act, for example, with respect to the problem we had with large-scale pelagic driftnet fishing. In spite of a large number of expert groups and workshops convened by FAO and others to draw attention to the problem, the fishers were reluctant to act voluntarily. As a result, action had to be taken at international level. The General Assembly had to adopt a resolution requiring a moratorium on the use of large-scale pelagic driftnets. In this region of the Pacific, a formal treaty was adopted to deal with the problem: the Wellington Convention. This involved the imposition by signatory governments of mandatory measures upon their fishing industries. One of the motivations behind the 1995 Fish Stocks Agreement itself was that there was a lack of willingness on the part of the fishers to deal effectively with the problems of straddling fish stocks and highly migratory fish stocks.

Most recently, in this part of the world, States have adopted a Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific. This treaty, which was adopted in Honolulu in September 2000, establishes a cooperative mechanism for conservation and management of all highly migratory fish stocks in the region based firmly on the principles enshrined in the 1995 Fish Stocks Agreement.

Such actions are not necessary if in fact the fishing industry voluntarily adopts measures to deal with the problem effectively. Such voluntary measures may be a great deal more cost-effective than waiting for the State to impose mandatory measures. The problem, however, is how to ensure that everybody plays by the same rules — how to avoid the situation where one fleet makes an effort and commits the necessary expense to implement voluntary measures, while others simply avoid taking any action and continue to fish regardless. This is one of the issues that I hope will be addressed over the next few days.

It is encouraging to note that most countries that fish in parts of the ocean which contain vulnerable populations of seabirds are represented at this forum. Many of you have travelled a long way to be here in Auckland, and at some considerable expense. I interpret that as confirmation of your commitment to solving the problem of incidental catch of seabirds.

Over the course of the next four days, I would encourage you to work together to develop a plan of specific actions so that, when you leave Auckland, you have a clear idea of what needs to be done and what the priorities are. Each of you — fishers, scientists, government officials and technical experts — has a specific role to play in this process. There is a great deal of international interest in the outcome of meetings such as this. Only last week, for example, the issue of incidental catch of seabirds was one of the issues highlighted by a number of countries during the annual debate on oceans and law of the sea by the General Assembly of the United Nations. Among the actions taken by the General Assembly in its resolution on fisheries-related matters was to request the Secretary-General to prepare a report on the status of implementation of a number of international instruments, including the FAO Plan of Action.

Response to Ambassador Nandan

[Chair: Warwick Tuck, Ministry of Fisheries, New Zealand]

The Chief Executive of the New Zealand Ministry of Fisheries, Warwick Tuck, thanked Ambassador Nandan for his words and for providing participants with a challenge for the next four days. He noted the mixture of fishers, scientists, and fisheries managers present at the forum, as representatives from the vast majority of the longlining nations of the world, with a wealth of knowledge, skills, and expertise to share. He then asked for comments or questions for Ambassador Nandan.

Question: How do those who comply exert pressure or control over those who don't comply?

Reply: There certainly are issues between those fleets that follow the rules and those that follow the "freedom of the oceans" concept. There were great problems in convincing driftnet fishing fleets to change fishing practices and it took international and national measures to ban driftnet fishing. Furthermore some countries with big markets took action against the importation of product from those renegade countries. The challenge is to get all fishers to agree to take action by themselves, or otherwise establish some treaty that will obligate fishers. Certainly, there are large difficulties in getting nations to comply.

Question: There needs to be increasing pressure on fisheries management at the international level — how can these issues be dealt with in international fora?

Reply: There have been considerable developments in recent years with regard to fisheries and now there is considerable pressure on fish stocks. The demand for food and more modern fishing techniques has led to a depletion of resources such that species are threatened (for example, the North Atlantic cod), but these issues have been in both national and international waters, and are not only the result of fishing activity of distant water fishing states. Therefore, the attention of the international fora is in the direction of sustainable fishing. No one advocates a total moratorium on fishing; the principles and discussion are directed to sustainability to ensure fish for tomorrow. We need a common standard for all. The Multilateral High-Level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific does that by establishing principles for national and international management so that the same measures apply to all in all areas, and there is a common standard applied to the total stock in the region. With straddling stocks, the same rules need to be applied throughout all areas of the stock movement.

Question: We in the industry understand the pragmatic reasons and moral obligation to comply, but where does the cost lie in the international community?

Reply: There is a relationship between the commercial and moral here; for example in the "dolphin-free" tuna situation, where commercial pressure resulted in rationality. There is a tolerable level of bycatch in all fisheries. The main consideration is sustainability.

Overview of Northern and Southern Hemisphere Longline Fishing Industries

[Chair: Tom Birdsall, Sanford Limited, New Zealand]

This session consisted of short presentations from a selection of participants, covering topics such as location of fisheries, target species, fishing methods, and interactions with seabirds. Summaries of these presentations are given below. Tables are used to summarise the characteristics of the fishing operations for those presentations for which participants provided comprehensive data. A list of the main target fish species and seabird species mentioned in this section is given in Appendix 2.

Alaskan Longline Fisheries

[*Mike Bayle, Alaska Frontier Company, United States of America*]

The longline fleets in Alaskan waters are characterised as ice boats (which target Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), and Pacific cod (*Gadus macrocephalus*)) and freezer longliners (which generally target sablefish and Pacific cod, with some vessels also targeting Pacific halibut). Ice boats were the main domestic fishing vessels in Alaskan waters until the mid 1980s, when the modern freezer vessels moved into the fisheries. At this time Japanese vessels fished under foreign-licence for sablefish and Pacific cod until 1988. Between 1989 and 1992, good catch rates and a strong market demand in Japan resulted in a rapid increase in the freezer longline fleet. By 1996, 51% of the quota was fished by the longliners, 47% by the trawlers, and 2% by the jig fleet.
In 1995 an Individual Fisherman's Quota (IFQ) system was put in place for sablefish and Pacific halibut. Freezer longliners have 80% of the fixed gear cod allocation (about 41% of the total cod Total Allowable Catch) under a licence limitation scheme introduced in September 2000. Furthermore, a scheme by which vessels will be required to have a valid groundfish licence and specified catch record is proposed, with a limit of 43 freezer longliners. A summary of the fishery characteristics for both vessel types is given in Table 1.

The fishing industry began implementing seabird bycatch avoidance measures in 1995, in response to the potential problem of interaction with short-tailed albatross. The 1989 United States Fish and Wildlife Service (USFWS) Biological Opinion on the short-tailed albatross was amended in 1997 such that if four short-tailed albatrosses were taken in a two-year period of 1997 and 1998, the fishery would be closed. Industry requested that the North Pacific Fishery Management Council and the National Marine Fisheries Service (NMFS) immediately implement regulations to promote seabird avoidance devices. As a whole, the fleet has responded proactively to this problem. Further work with Dr. Hiroshi Hasegawa (short-tailed albatross researcher), the USFWS, Washington Sea Grant Program (especially Dr. Ed Melvin), and NMFS has continued and grants have allowed:

- a two-year seabird avoidance device survey;
- preparation and distribution of written material to both ice boat and freezer longline fleets to inform fishers of the problem and provide an identification guide of the short-tailed albatross, and
- financial assistance towards the cost of seabird avoidance devices, especially tori line davit systems.

Table 1: Characteristics of the longline fisheries* in Alaskan waters, by vessel type

Target species	Pacific halibut, sablefish	Pacific cod, Greenland turbot
Fishing grounds	Gulf of Alaska, Bering Sea-Aleutian Islands	
Season	15 May-15 November	January-April and September-November, CDQ†
Type of vessels	catcher	catcher/processors
Fishing system	skate, bottom, tubs, snap-on, auto	auto, tubs
No. vessels	504 (sablefish), 451 (cod, turbot), 1 802 (halibut)	
Vessel size	<18.3 m (83%), 18.3–38.1 m (15%), >38.1 m (2%)	
No. crew	1–8	10–40
Hook depth (m)	500–1000 (sablefish), 50–400 (halibut), 70–150 (Pacific cod/turbot)	
Hook type	13/0–16/0 circle	6 or 7 eagle claw circle, modified "J"
Branchline length (m)	2.5–4.0	4.0–5.0
Bait type	herring, salmon, squid	squid
Setting speed (kn.)	3–7	6–10
Treatment of catch	iced	frozen
Total no. hooks (million)	171 (all groundfish), 25 (halibut)	
Management	Individual Fisherman's Quota	open access, CDQ
Observer programme	for sablefish and cod only: 30% (18.3–38.1 m vessels), 100% (> 38.1 m vessels)	
Seabirds per 1000 hooks	data for all groundfish except halibut: 0.082 (all), 0.008 (albatross)	
Seabird species	black-footed albatross, Laysan albatross, short-tailed albatross, northern fulmars, gulls	
Seabird bycatch mitigation measures	Streamer lines, buoys, education programmes	Streamer lines, weighted lines, nightsetting

* Catch and effort data are for 1997 and seabird bycatch data are from fishing activity prior to the introduction of seabird bycatch mitigation measures.

† CDQ is Community Development Quota issued to Native Alaskan coastal communities.

Uruguayan Longline Fisheries

[*Adrian Stagi*, *Faculty of Sciences*, *Uruguay*]

Tuna fishing began in Uruguay in 1959. During the 1970s and 1980s vessels from Japan, Korea, and China fished off Uruguay. There was little fishing in the following years, until 1994, when five boats fished here. In 2000, there is a fleet of nine vessels operating in Uruguayan and international waters (Table 2). Most of the tuna longline fishing is in the Exclusive Economic Zone (EEZ) and in adjacent international waters where the warm Brazilian current and the cold Falklands current meet, in depths of more than 600 m. This is an area of great upwelling and is further enriched by outflow from the River Plate.

Most longline fishing for tuna is done with the American method or the Spanish method. Observers record the set and haul position, number of hooks, sea surface temperature, time of day, catch data, and data on seabird behaviour around the vessels. Seabirds are caught during setting (when a hook hits the water every 25–30 seconds) and during hauling. Albatross mortality differs with the area fished. In Uruguayan waters, the seabird bycatch rate has dropped from about 10.5 seabirds per 1000 hooks in 1993–94 (most seabirds were black-browed albatrosses (*Thalassarche melanophrys*)) to less than 0.3 seabirds per 1000 hooks.

For vessels fishing in international waters near South Georgia the seabird bycatch rate is 0.5 seabirds per 1000 hooks and 0.2 seabirds per 1000 hooks for vessels in waters near Vitoria (Brazil). Females tend to be caught more than males, and most seabirds are caught an hour or so before the one and a half hours of sunset. Although the killing of albatrosses by fishers continues, most try to avoid catching seabirds and work with the National Institute of Fisheries and the Faculty of Sciences to find effective seabird bycatch mitigation measures. Nightsetting and rapid setting and hauling of the hooks help to reduce seabird mortality.

Tori lines were found to greatly reduce the number of albatrosses caught, but not petrels. Bait-casting machines and underwater setting methods are considered too invasive and expensive for fishers. Seabird bycatch mitigation measures established for vessels in Uruguayan waters follow those established by CCAMLR such as a tori line (at less than $US100) and distribution of technical information explaining the simple methods available to avoid seabird capture and increase target species catch potential.

Table 2: Characteristics of the longline fisheries in Uruguayan waters

Target species	Tuna and swordfish	Hake
Fishing grounds	Uruguay EEZ, about 200 km offshore, adjacent international waters	
Season	March-May, July-October	
Fishing system	American	Spanish
No. vessels	9	
Mainline length (km)	80	
Mainline material	3.6 mm monofilament	5 mm polythene
No. hooks per longline	300–1000	
Hook type	9/0–12/0 game fishing hooks	17/0
Ganglion length (m)	22 or 40	
Bait type	squid and lightsticks	squid or horse mackerel
Time of set (h)	night time	
Observer programme	Yes	
Seabirds per 1000 hooks	0.3 seabirds per 1000 hooks in Uruguay waters	
Seabird species	black-browed albatross, wandering albatross, white-chinned petrels, spectacled petrels	
Seabird bycatch mitigation measures	tori lines	

Chinese Longline Fisheries

[*Liuxiong Xu*, *Shanghai Fisheries University*, *China*]

Distant water tuna longline fishing by Chinese vessels began in 1987, and peaked in 1994 when 450 vessels fished in the Pacific Ocean. In 1999, 226 vessels fished in the Pacific Ocean, Indian Ocean, and Atlantic Ocean, with a total catch of 24 115 t. The characteristics and fishing grounds of the longlining operations are given in Table 3. About 61% of vessels are 24–30 m in length and 54% are 20–120 Gross Registered Tonnage (GRT). Those fishing in the Atlantic Ocean are large Japanese-built freezer longliners, but Pacific and Indian Ocean vessels are mainly small, wood or steel and concrete ex-trawlers. About 20% were built before 1980, 30% during 1980–90, and 50% during the last ten years. Bigeye (*Thunnus obesus*) and yellowfin (*T. albacares*) tunas are the main target species accounting for 40% and 20% of the total catch respectively, though in recent years albacore (*T. alalunga*) has been the main target in the South Pacific Ocean.

There are no data on the incidental capture of seabirds from these fisheries, and there is no observer programme for the distant water fisheries. China is a member state of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC) and participates in the management of Central and Western Pacific tuna stocks. The total number of Chinese tuna longliners is strictly controlled. A non-governmental tuna working group has been established to help with compliance with regional fishing requirements and the collection of catch data, and to encourage fishing companies to set up an association.

Table 3: Characteristics of Chinese longline fisheries

Target species	tuna species: bigeye, yellowfin, albacore
Fishing grounds	Pacific, Indian, and Atlantic Oceans
Fishing system	Japanese (Japanese-built)
No. vessels	226 (in 1999)
Vessel size	20–120 GRT (54%), 120–500 GRT (34%), > 500 GRT (12%)
No. crew	8–9 (Chinese-built), 23–24 (Japanese-built)
Mainline material	monofilament (Chinese-built)
No. hooks	800–1 500 (Chinese-built), 2 300–2 400 (Japanese-built)
Hook depth	150–300 m
No. branchlines per basket	5–7 (Chinese-built), 7–15 (Japanese-built)
Bait-casting machine	No (Chinese-built), Yes (Japanese-built)
Setting speed	8–9 kn. (Chinese-built), 10 kn. (Japanese-built)
Time of set	1800–2300 h (Pacific, Indian), 0500–1000 h (Atlantic)
Time of haul	0500–1700 h (Pacific, Indian), 1600–0400 h (Atlantic)
Observer programme	no
Seabirds per 1000 hooks	no data
Seabird bycatch mitigation measures	none

Chilean Longline Fisheries

[*Marcelo Garcia, Undersecretariat of Fisheries, Chile*]

The Chilean longline fleet mainly operates around southern Chile. The main target species are Patagonian toothfish (*Dissostichus eleginoides*), ling (*Genypterus blacodes*), and hake (*Merluccius* spp.). Fishing effort in 1999, at about 111.5 million hooks, was almost three times that in 1993. During 1999, about 35% targeted toothfish (a third of which was by factory and industry vessels and the remainder by artisanal vessels), and 65% targeted ling and hake (21% was by factory and industry vessels). Characteristics of the fisheries are given in Table 4.

The Patagonian toothfish longline fleet in recent years has consisted of about 10 factory vessels and 2 ice vessels. About 50% of the vessels were built before the 1970s, and most of these vessels are 45–55 m long. Factory vessels fishing for toothfish set the longline from one side and have protected decks so that they can operate in all conditions.

There is no observer coverage of these vessels, though there is legislation underway to set up an observer programme. A study of seabird bycatch in the artisanal hake and ling fisheries showed that there was minimal seabird interaction compared with other fisheries and areas because the longline goes straight to the bottom. It appears that the interaction varies according to area, in that more interactions occur when the fisheries are close to islands. Most interactions occur during the setting time and fewer interactions occur when the sets are made at night. Some skippers have developed strategies to reduce seabird bycatch, but these fishers are in the minority. Three of the five seabirds caught in this study were landed dead: 2 kelp gulls (*Larus dominicana*), and 1 white-chinned petrel (*Procellaria aequinoctialis*). The other seabirds were released alive: 1 black-browed albatross and 1 giant petrel (*Macronectes* spp.).

Table 4: Characteristics of the industrial longline fisheries in Chilean waters during 1999

Target species	Patagonian toothfish		hake, ling	
Type of vessels	industrial	artisanal	industrial	artisanal
Fishing grounds	south of 47° S	north of 47° S	41° 30'–57° S	
Season	Sep-Dec, Jan-Apr	Sep-Dec	Jan-Sep, Oct-Dec	
Fishing system	bottom longliner		bottom longliner	
No. vessels	13	50–200	15	2500
Vessel size (m)	30–60 m	12–18 m	30–60 m	7–10 m
No. crew	30–40	6–12	30–40	2–4
Mainline length (km)	16–30	13–16	10–45	1
Mainline material	monofilament		monofilament	
No. hooks per longline	6 000–20 000 (average=10000)	5 000–10 000	7 000–25 000 (average=16000)	700–800
Hook type	Mustad Kirby Circle 39965 ST No. 14	Mustad Kirby 39965 ST No. 14 & 2330 No. 3–6	Mustad Kirby 2330 No. 9–11	Mustad Kirby 2330 No. 9–11
Branchline length (m)	0.8–1.5	0.8–1.0	0.4–0.5	0.4–0.5
Bait type	mackerel and pilchard		mackerel and pilchard	
Bait state	fresh and salted		fresh and salted	

Bait-casting machine	no		no	
Setting speed (kn.)	5–6	3–5	4–6	1
Time longline set (h)	2200–0600 (70%), 0700–2100 (30%)		2300–0700	0530–0700 (95%) 1100–1500 (5%)
Set duration (h)	2–3	1–3	2–4	1–3
Soak duration (h)	4–12 (average=8)	4	4–10	4–7
Haul duration (h)	6–12 (average=8)	8–12	8–16 (average=13)	2–12
Total no. hooks	14 466 000	24 422 000	15 115 000	57 487 000
Observer programme	No		No	
Seabirds per 1000 hooks	unknown		unknown	0.01*
Seabird bycatch mitigation measures	none at present		none at present	

* Species were: 2 kelp gulls, 1 white-chinned petrel, 1 black-browed albatross, and 1 giant petrel.

New Zealand Longline Fisheries

[*Charles Hufflett*, *New Zealand Japan Tuna*, *New Zealand*]

There are three commercial longline fisheries in New Zealand waters. The northern snapper (*Pagrus auratus*) fishery consists of about 140 vessels ranging in size from 28–60 ft and setting 800–5000 hooks per day. The demersal longline fishery for ling and Patagonian toothfish consists of five autoliners which set 25–35 000 hooks per day and some smaller vessels. About 20 million hooks are set each year, with most of the effort during late August to December, and the longline catch of ling represents about half of the total ling catch of 21 000 t per year.

The third fishery is the tuna longline fishery and effort in this fishery has dropped dramatically since the 1980s when more than 20 million hooks were set per year. Since a low of 2.5 million hooks in 1994 with the withdrawal of the Japanese fleet, there has been a rapid increase in the domestic fleet effort which has open access, though there is a set annual quota for southern bluefin tuna (*Thunnus maccoyii*). About 100 vessels fish in northern waters and set about 1200 hooks daily for albacore, bigeye, southern bluefin, or yellowfin tuna. A fleet of about six larger vessels set up to 3200 hooks daily in southern waters for southern bluefin tuna.

Seabird interactions with longlines include black petrels (*Procellaria parkinsoni*) on snapper longlines and albatrosses, shearwaters, and other petrels on bottom longlines and surface tuna longlines. Tuna fishers are now required by law to tow a tori line and most vessels set at night. The southern tuna fleet has operated a very strict code of practice in the last 3–4 years. Seabirds caught by vessels in the northern fleet are generally caught on the haul. Different seabird bycatch mitigation measures are needed for albatrosses and petrels. Many different measures are used, especially by the southern fleet, but no one method works in isolation.

Finances for mitigation work, monitoring, and population studies have come from the Conservation Services Levy introduced in 1995. The levy is based on the estimated degree of interaction with seabirds, marine mammals, and other protected species. This proved very expensive for many fishers who now realise the importance of a local proactive industry.

Indonesian Longline Fisheries

[*Bambang Edi Priyono, Department of Agriculture and Forestry, Indonesia*]

Most of Indonesia's fishing fleet is artisanal, and only about 16% of the 404 600 small boats fishing in the coastal waters have on-board motors. No seabird bycatch has been reported in these small-scale fisheries, which take place mainly in the Malacca Strait, Java Sea, and Bali Strait. There is the potential to catch seabirds in the large-scale fisheries for tuna and billfish species, but no data are available. These fisheries include longline, pole and line, troll, and gillnet fisheries. In 1997, 766 commercial longline vessels (87% of which were Indonesian vessels) fished in Indonesian territorial and EEZ waters. Most tuna longline fishing takes place in March-June and September-November. The tuna longline vessels range between 48–54 GRT and set 49.5–89.5 km longlines, each with 600–900 hooks. The setting operation usually takes place during the day.

A questionnaire distributed to 14 fishing ports or landing places and one private fishing company resulted in eight replies. The replies were from vessels of < 50 GRT which used traditional longlines and/or gillnets to target tuna and billfish. There was no reported seabird bycatch from these artisanal fisheries. However, the fishing company stated that their larger 100–300 GRT vessels may capture seabirds, but there are no data. Observer data collection at Bitung (Menado), Benoa (Bali), and Banda Sea would provide information about any seabird bycatch.

Brazilian Longline Fisheries

[*Tatiana Neves, Environment Secretariat, State of São Paulo Forestry Institute, Brazil*]

Seabirds are caught in demersal and pelagic longline fisheries in Brazilian waters. Characteristics of these fisheries are given in Table 5. Effort has increased in both these fisheries in recent years: in 1999 about 3.2 million hooks were set a day in demersal fisheries and the number of vessels fishing in the northern pelagic longline fishery increased from about 32 in 1999 to 89 in 2000. There has also been a change in the catch composition in demersal longlining, with an increase in the catch of some species such as catfish (*Netuma* spp.) and a decrease in others such as groupers (*Epinephelus* spp.) and wreckfish (*Polyprion americanus*).

About 50% of the seabirds that interact with pelagic longlines are white-chinned petrels and 25% are black-browed albatrosses with the remainder consisting of Atlantic yellow-nosed albatrosses (*Thalassarche chlororhynchos*), wandering (*Diomedea exulans*) and Tristan albatrosses (*D. dabbenena*), spectacled petrels (*Procellaria conspicillata*), greater shearwaters (*Puffinus gravis*), and Antarctic fulmars (*Fulmarus glacialoides*). Fewer species are caught on demersal longlines, with over 60% identified as great shearwaters, 18% white-chinned petrels, and the remainder being yellow-nosed and black-browed albatrosses and spectacled petrels. The estimated annual seabird catch on pelagic longlines is 6656 (range 4502–8325), based on individual vessel data for 1991, 1994–95, and 1997 and 1998. The estimated annual catch on demersal longlines is 4214 seabirds (2201–6226), based on individual vessel data for 1994–97.

Table 5: Characteristics of the longline fisheries in Brazilian waters

	Pelagic fisheries	Demersal fisheries
Target species	swordfish and other billfish, bigeye, yellowfin, albacore tunas	catfish, tilefish, groupers & wreckfish
Fishing grounds	20–33° S, 51–39° W (off shelf to >1000 m)	23–34° S, 52–41° W (inner coastal waters < 500 m)
Fishing system	American	Spanish
No. vessels (in 2000)	89 (northern), 35 (southern)	50 (southern)
Vessel size	16–22 m	15–26 m
No. crew	12–15	7–9
Mainline material	monofilament	steel
No. hooks per longline	1000 ± 200	1500–2000
Hook depth (m)	45–80 (swordfish), 70–120 (tuna)	
Bait type	Argentinean squid, lightstick	Argentinean squid
Treatment of catch	iced	iced
Seabirds per 1000 hooks	0.095–1.35 (individual vessels)	0.10–0.32
Seabird species	wandering, Tristan, Atlantic yellow-nosed, black-browed albatrosses, and white-chinned, spectacled petrels, great shearwaters, Antarctic fulmars	Atlantic yellow-nosed, black-browed albatrosses, and white-chinned, spectacled petrels, great shearwaters
Seabird bycatch mitigation measures used	blue-dyed bait, nightsetting, tori lines, and artificial squid are being tested	

Plans for an observer programme, in compliance with ICCAT, include obligatory observers on the fleet of leased vessels, and one observer per year on domestic vessels (at one trip observed each year on each vessel this would give coverage of about 7% of domestic effort). Further onboard observation, specifically for seabird bycatch (under the Emergency Actions Project) is also planned. This project involves vessel owners, the Brazilian government, and research institutes and represents a change in approach to the issue. Vessel owners are testing seabird bycatch mitigation measures and the emphasis will be on cheap non-intrusive methods such as blue-dyed bait.

Proposals for the National Plan of Action for the reduction of seabird bycatch have been submitted to the Brazilian Government and meetings are planned for discussions in relation to the draft International Agreement for the Conservation of Albatrosses and Petrels.

Australian Longline Fisheries

[*Anthony de Fries, Australian Fisheries Management Authority, Australia*]

The management of Australian longline fisheries is predominantly under Commonwealth (Federal) jurisdiction, though some demersal longline activity is managed under State jurisdiction. Pelagic longline fisheries for tuna and billfish are currently managed under input controls: limited entry, area restrictions, bycatch limits, and individual transferable quotas (for southern bluefin tuna). A mix of input and output controls is used to manage demersal fisheries: limited entry, bycatch limits, and progression towards quota management.

Historically the Japanese have carried out most pelagic longline fishing in Australian waters, but their involvement ceased in 1997. There has been a large increase in the domestic fleet in the 1990s. Vessels are 10–40 m long (average 20 m) and use mainly nylon monofilament longlines. Most retain the product as fresh chilled.

Extensive observations on Japanese longline operations demonstrated that seabird bycatch was a problem in Australian waters south of 30º S. Limited observation (150 000 hooks in 4 years) of the domestic fleet supports this. No seabirds have been caught during observed demersal longline activity (290 000 hooks in last few years). All seabirds are protected in Australian waters. The government has identified longlining as a key threatening process and has implemented the Longline Fishing Threat Abatement Plan. The National Plan of Action is currently being drafted. Further actions have been implemented under the Fisheries Management Act 1991: mitigation regulations for fishing south of 30º S (nightsetting, offal handling requirements, and compulsory tori line use), observer coverage, logbook amendments, and the development of new seabird bycatch mitigation measures.

Most fishers have been unwilling to use line weighting for safety reasons. Observer coverage remains limited and is contentious in both its scope and cost. The Threat Abatement Plan aims to reduce seabird bycatch rates below 0.05 seabirds per 1000 hooks and industry wants a solution-based approach, such as underwater setting chute developed in tandem with New Zealand industry and government groups, to be progressed. Government fishery and environmental agencies are working with industry to trial underwater setting chutes on a variety of longline vessels off both the east and west coasts of Australia in 2001.

Argentinean Longline Fisheries

[*Patricia Gandini*[1], *Universidad Nacional de la Patagonia Austral, Argentina*]

Longline fishing in Argentine waters began in 1992 and targeted Argentine hake (*Merluccius hubbsi*) and kingclip (ling) on the continental shelf. Since the mid 1990s, Patagonian toothfish (*Dissostichus eleginoides*) has been the main target species of longline fishing activities off the Patagonian Shelf and in deeper waters, with about 10–12 000 t landed in 1999 (valued at about $US80 million). Seabird and fishery interactions in Argentine waters occur with gillnet, shrimp, trawl, and longline fisheries.

The Patagonian Shelf area is important as a feeding area for the seabirds nesting in Patagonia, Tierra del Fuego, and Falkland Islands, and also for species nesting in the CCAMLR area. Wandering, royal (*Diomedea* spp.), black-browed, and grey-headed albatrosses (*Thalassarche chrysostoma*), southern giant petrel (*Macronectes giganteus*), and diving seabirds such as Magellanic penguin (*Spheniscus magellanicus*) and rockhopper penguin (*Eudyptes chrysocome*) frequent the South Atlantic Ocean. The potential threat from this fishery to black-browed albatrosses is high because 70% of this species' breeding population is at the Falkland Islands.

Based on CCAMLR observed seabird bycatch rates, an estimated 3 832–13 514 albatrosses (wandering, royal, black-browed and grey-headed albatrosses) were caught during Patagonian Shelf longline fishing activities by 12 vessels between 43º 50' S and 53º 57' S during December 1993 to July 1995. Data for the following years have been difficult to obtain, but a crude estimation made through interviews with captains indicates that about 30–40 birds are caught per day per vessel, with about 2–3 seabirds per 1000 hooks on autoliners (during daytime setting). No seabird bycatch data from National Observers are available.

Seabird and fishery interactions also occur with trawl, shrimp, and gillnet fisheries. The distribution of longline fishing effort is similar to that of the trawl fishing effort, especially

1 This paper was co-authored by Esteban Frere, Universidad Nacional de la Patagonia Austral, Argentina.

since the collapse of the Argentine hake fishery, which has resulted in the trawler fleet moving south to look for other resources. Seabirds may be caught during trawling operations and the increase in number of vessels at these latitudes will be an attraction to seabird species, and therefore increase the probability of capture on hooks or of drowning in fishing nets. Most seabirds caught in Argentinean shrimp fisheries are Magellanic penguins in the summer, with sooty shearwaters (*Puffinus griseus*), imperial cormorants (*Phalacrocorax atriceps*), and black-browed albatrosses caught during fall. The fish species caught as bycatch, penguins, and shearwaters all consume prey (anchovy) of similar size.

Table 6: Characteristics of longline fisheries[*] in Argentine waters

Target species	Patagonian toothfish, kingclip, hake
Fishing grounds	Patagonian Shelf (43–50º S, 54–57º S), Argentine EEZ
Fishing season	all year
Fishing system	Spanish demersal
No. vessels	9 (2 manual, 7 autoliners)
No. crew	20–25 (autoliners), 40 (manual set)
Mainline length (km)	10
Mainline material	polyester
No. hooks	14–16 000 (autoliners), 10 000 (manual)
Depth of fishing	1 600–1 800 m (toothfish), 300–500 m (kingclip)
Hook type	CCAMLR Code 08
Branchline length (m)	0.5
No. branchlines per magazine	1 000
Bait type	squid
Bait state	thawed
Bait-casting machine	yes
Setting speed (kn.)	7–9
Time of set	day/night (toothfish), night (kingclip)
Treatment of catch	frozen
Management	Instituto Nacional de Investigación y Desarrollo Pesquero
Observer programme	yes, but data unavailable
Seabird species	wandering, southern royal, black-browed, and grey-headed albatrosses
Seabird bycatch mitigation measures	voluntary measures: tori line, splashing buoys

[*] Data are for 2000.

There is an urgent need to establish a legal framework for the reduction of seabird bycatch in Argentina, to evaluate the magnitude of seabird mortality through the observer programme, and to make this information accessible to the Argentine community.

Taiwanese Longline Fisheries

[*Hsiang-Wen Huang*[1], *Fisheries Administration, Council of Agriculture, Taiwan*]

Taiwan has four categories of fishery: distant water fisheries, offshore fisheries, coastal fisheries, and aquaculture. In 1999, 63% of the total fisheries production of about 1.3 million t was from distant water fisheries which accounted for 6% of the fishers and represented 50% of the total value. The remainder comprised 15% from offshore fisheries, 3% from coastal fisheries, and 20% from aquaculture. In 1999, 29% of the total distant water fisheries production was from tuna longline fisheries and this represented 74% of the total value. In 2000, there are about 600 distant water tuna longline vessels which fish using the Japanese system in the Pacific, Atlantic, and Indian Oceans (Table 7). About 17% of the hooks are set south of 30º S and < 0.1% south of 40º S. Management regimes include limited entry (a new vessel may only enter the fishery when an old vessel is scrapped), catch quota for bigeye and bluefin tuna, swordfish (*Xiphias gladius*), and billfish in the Atlantic Ocean, and time and area closures in the Mediterranean Sea (1 June to 31 July).

Table 7: Characteristics of Taiwan* longline fisheries for albacore, bigeye, and yellowfin tunas

Fishing grounds	Pacific, Indian, and Atlantic Oceans
Fishing system	Japanese pelagic
Vessel size	200–700 GRT
No. crew	25–30
Mainline material	monofilament or thick rope
No. hooks	2 600–3 200
Hook depth (m)	50–200
Branchline length (m)	30–40
No. branchlines per basket	8–11
Length between buoys (m)	450
Bait type	saury, squid, mackerel, scad
Bait state	thawed
Time of set (h)	0300–0800
Time of soak (h)	0800–1400
Time of haul (h)	1400–0100
Treatment of catch	frozen
Total no. hooks (million)	Pacific Ocean (38), Indian Ocean (199), Atlantic Ocean (104)
Observer programme	Yes (2 vessels in 1999–2000)
Seabird species†	wandering albatross, black-browed albatross, grey-headed albatross, yellow-nosed albatross, giant petrel, pintado petrel, white-chinned petrel, gannets
Seabird bycatch mitigation measures used	tori line, weighted baits, bait casting machine, nightsetting, thawed baits, dealing with offal

* Effort data are for 1999.
† Species reported from vessels off the African coast.

[1] This paper was co-authored by Yeong-Tye Timothy Day, National Pingtung University of Science and Technology, Taiwan.

In the Pacific Ocean, the major albacore fishing grounds are 155º E–120º W/10º–40º S and 160º E–150º W/10º–40º N. Bigeye and yellowfin tunas are in the tropical region mainly from 160º E–115º W/5º–25º S. In the Indian Ocean, the major albacore fishing grounds are 15º–40º S, especially south of 25º S. Bigeye and yellowfin tunas are targeted between 15º N and 15º S. In the Atlantic Ocean, albacore are targeted mainly at about 30º–50º W/10º–40º S, and bigeye and yellowfin tunas are fished mainly between 20º N–20º S.

Two observer trips were made in 1999 and 2000, one on a purse-seiner in the Pacific Ocean and the other on a tuna longliner in the Atlantic Ocean. In 1996, a survey of about 60 distant water vessels showed that about 22% used tori lines, 80% weighted lines, 93% used bait-casting machines, 95% set at night, 100% used thawed bait and 82% dealt with fish offal. In 1996, 100 automatic bait-casting machines were fitted to longliners. With the permission of Tasmanian Parks and Wildlife Service of Australia, *Catching fish, not birds* was translated into Chinese, and 500 copies were circulated to the fisheries associations and fishermen at foreign fishing ports. Tori lines are mandatory when fishing in South African waters and in 2000, 50 distant water tuna longliners will be funded to install tori lines. In 2000, 3 000 copies of a cartoon leaflet called *Catching fish, not birds – co-existence between fisheries and seabirds* were published to promote the concept of conservation of seabirds to captains and crews.

In the future, the Fisheries Administration will continue to enhance research on seabird bycatch. With the assistance of international fisheries organisations and environmental groups, information on new technologies and measures for reducing the incidental catch of seabirds can be collated and given to fishers.

Hawaiian Longline Fisheries

[*Jong II Paik, Hawaii Longline Association, United States of America*]

The Hawaiian pelagic longline fisheries target swordfish and other billfish species and tuna species such as albacore, bigeye, bluefin (*Thunnus thynnus*), and yellowfin. These fisheries are worth about $US50 million annually. About 120 vessels are actively longlining and these vessels generally make about 1000 trips a year, with two-thirds of the trips targeting tuna species. Average prices of most of these species have dropped in recent years. Characteristics of these fisheries are given in Table 8. At present there are no mandatory seabird bycatch mitigation measures, but individual fishers use a variety of measures such as line weighting, tori lines, nightsetting, blue-dyed baits, and strategic offal discharge.

Japanese Longline Fisheries

[*Charles Hufflett on behalf of Tsutomu Watanabe, Federation of Japan Tuna Fisheries, Japan*]

About 530 tuna longline vessels make up the Japanese high seas fleet and this number represents a 20% reduction in recent years. With approximately 200 Korean vessels, 600 Taiwanese vessels and 200–300 IUU vessels, the total number of tuna longline vessels in the high seas is about 1500–1600. These vessels fish mainly between 40° S and 40° N, in the Pacific Ocean (about 30% effort), Indian Ocean (40%), and Atlantic Ocean (30%). Recently several developments in the management of high seas fisheries have occurred. The IPOA-SEABIRDS adopted at the 1999 FAO Committee on Fisheries (COFI) requires States to take immediate action especially in relation to straddling and highly migratory stocks which are significantly overfished. Each State is to implement its own National Plan of Action no later than the COFI session in 2001 and to co-operate with other States through regional organisations or arrangements to reduce the incidental capture of seabirds.

Japan is establishing an organisation to promote responsible tuna fishing by its vessels in recognition of the high exploitation of the tuna stocks. Japan has the largest market for tuna and monitoring at Japanese landing ports is the most effective way to verify catch information and monitor catches by the Japanese and Taiwanese built Flag of Convenience vessels. Scrapping of the vessels of Japanese origin and the re-flagging of the Taiwanese vessels is the most direct and effective way of eliminating illegal fishing. Recent technological development of seabird bycatch mitigation measures undertaken in Japan includes floating an object at sea with bait to attract the seabirds away from the vessel and analysing seabird reactions to phonetic, visual, and physical objects (for example, testing water as a shower to keep seabirds from the bait). The most effective means to reduce seabird incidental capture has been the combination of a tori line and a bait-casting machine. Further work should be directed to the restoration and preservation of seabird breeding areas and to examine impacts of other fisheries such as trawling and purse-seining on seabirds.

Table 8: Characteristics of the longline fisheries in Hawaiian waters

Target species	bigeye tuna, yellowfin tuna	swordfish and mixed species
Fishing grounds	main Hawaiian Islands, North-western islands, outside EEZ	
Season	all year	
No. vessels	114	
Vessel size	< 56’, 56–74”, 74–108’	
No. crew	4–6	
Hook type	circle (with line shooters) 45–80 g weights <1 m from hook	“J” (no line shooters) 60–68 g weights 5–8 m from hook
Branchline length (m)	25–35	
No. branchlines per buoy	18–25	3–5
Bait type	saury	squid, chemical lightsticks
Setting speed (kn.)	5–7	
Time of set (h)	day (4–5 h long)	evening
Time of haul (h)	night (10–12 h long)	day
Total no. of hooks (million)*	9 (outside EEZ), 7 (main Hawaiian Is.), 2.5 (North-western Is.)	
Observer programme	20%	
Seabirds per 1000 hooks†	0.013	0.758 (swordfish), 0.499 (mixed)
Seabird species		
Seabird bycatch mitigation measures used	line weighting, tori lines, nightsetting, blue-dyed baits, strategic offal discharge	

* These data are for 1999.
† These data are from 1994–98 for the observed catch of albatrosses.

Falkland Islands Longline Fisheries

[*Tony Blake*, *Eurofishing Group*, *Falkland Islands*]

Before 1987, when the longline fishery at the Falkland Islands began, all the fishing around the islands was unregulated and carried out by foreign vessels. In 1987, a conservation zone was established 75 m [120 km] around a central point on the Falkland Islands, which defined fishing grounds of only about 25 m [40 km] from the coast in some places. This was extended in 1993 to a 200 n. mile EEZ. These measures allowed the establishment of a local fishing industry. At present there are only two locally owned and operated longliners licensed to fish in Falkland waters and there are six Falkland Islands-flagged longliners and four foreign-owned joint-venture vessels that fish near South Georgia and in international waters. Most vessels use the Spanish system of longlining to target Patagonian toothfish, and at least one is using the Mustad underwater setting system. In 1997, 228 seabirds were reported caught (mainly black-browed albatrosses), but there are no effort data available. Seabird scaring lines have helped reduce the seabird bycatch to six seabirds in 2000 (for all fishing gear), and in waters around South Georgia, vessels can only fish at night. There is also seabird mortality with trawl fishing and occasional seabird bycatch during squid jigging (Magellanic penguins) in Falkland Islands waters. The government is developing an independent observer programme on longliners, which will monitor the Falkland Islands fleet, but there will still be the problem of the IUU fishing in these waters.

Longline Fisheries of Canada

[*Diana Trager*, *Fisheries & Oceans Canada*, *Canada*]

Longline fisheries in the Canadian Pacific Ocean waters primarily target Pacific halibut, with sablefish, rockfish (*Sebastes* spp.), and dogfish (*Squalus acanthias*) also targeted. The halibut fishery is from 15 March to 15 November, and sets about 5–6 million hooks annually. About 85% of the 250 vessels in this fishery are less than 21 m long and about 1% greater than 30 m. Vessels in the halibut and sablefish fisheries are managed by an Individual Vessel Quota scheme. About 25 vessels (18–30 m) target sablefish with an annual effort of about 1 million hooks. A further 3 million hooks are set annually for rockfish by smaller vessels (< 12 m), and 1 million hooks are set for dogfish.

In 1998, the International Pacific Halibut Commission conducted a dockside survey of halibut vessels (representing 90% of landings) and 30 seabirds were reported caught during effort representing about 6 million hooks. However, there was no real incentive to report seabirds and this is considered to be an underestimate. In 2000, a target of 10% coverage on vessels <18 m was set, but there were logistical problems in getting observers onto the vessels, and the resulting observer coverage represented only 3% of the effort. The halibut industry has asked for mandatory seabird avoidance regulations to be put in place for 2001. Canada has agreed to develop a National Plan of Action for seabird bycatch as part of its international obligations and has formed a national working group to undertake this. At present there is no protected species act in Canadian law, but one has been proposed.

Overview from a Seabird Biologist

[Chair: Janice Molloy, Department of Conservation, New Zealand]

During this session, an overview of seabird issues— including where seabirds feed and forage, brief population biology, and overlap with fisheries — was presented.

Albatrosses and petrels: an overview

[*John Croxall*, *British Antarctic Survey*, *England*]

Albatrosses and petrels are members of Order Procellariiformes which consists of 4 families and about 155 species:

- albatrosses (Family Diomedeidae) of 4 genera, 21–24 species

- great albatrosses *Diomedea*	6–7 species
- northern albatrosses *Phoebastria*	4 species
- mollymawks *Thalassarche*	9–11 species
- sooty albatross *Phoebetria*	2 species

- petrels (Family Procellariidae) of about 12 genera, about 75 species, including:

- giant petrels *Macronectes*	2 species
- *Procellaria*	5 species

- diving petrels (Family Pelecanoididae) of 1 genus, 4 species

- storm petrels (Family Hydrobatidae) of 8 genera, 20 species

The following text is related to the first two families listed above: Diomedeidae and Procellariidae. Giant petrels and *Procellaria* species are confined to sub-Antarctic and cool temperate southern hemisphere. The albatrosses have a similar distribution, but with one species in the tropical central Pacific Ocean and three species in the tropical/temperate Pacific Ocean. Their ranges correspond with the EEZs of about 11 different countries (Table 9). At sea, species have extensive ranges. Southern species extend close to Antarctica in summer and move north to the subtropical waters during winter. Other species circumnavigate the globe between successive breeding attempts. Galapagos albatross (*Phoebastria irrorata*) mainly disperses east to the South American coast, and other northern species range mainly in the cool temperate North Pacific. Countries additional to those within the breeding ranges of these seabirds, and whose EEZs are particularly important for albatrosses and petrels, include Brazil, Canada, Namibia, Peru, Russia, and Uruguay. The distant water fishing fleets of China, European Community, Indonesia, Korea, and Taiwan also frequent areas (including the high seas) which are important to albatrosses and petrels.

There is huge variation in the breeding population sizes of the different species, from the rare Amsterdam albatross (*Diomedea amsterdamensis*) to the common white-chinned petrel (Figure 3). A variety of foraging methods are used, with some species such as white-chinned petrels active at night whereas albatrosses and giant petrels are diurnal. Most feed on squid and fish, though some prefer crustaceans. All these seabirds are capable of large scale foraging over wide ocean tracts. Most of these seabirds can dive quite well; for example, many small albatrosses use plunge diving to exploit prey to about 5–6 m deep. They are readily attracted by offal and waste; this may affect their at-sea distribution and density, with the formation of artificial feeding aggregations. The differences in foraging behaviour described above can have significant implications for seabird bycatch.

Albatrosses and petrels produce one chick per breeding cycle (Table 10). At about 3–5 years old, albatrosses begin courtship activities leading to pair formation 2–3 years later. Such pairs usually lay their first egg at 7–12 years of age. The breeding cycle is described in Table 11. Both parents share incubation and chick-rearing duties. Depending on the species, chicks become independent after 3–9 months, departing to sea for at least 3–5 years before returning to land. Some albatross species breed every two years (*Diomedea* species, *Phoebetria* species, and grey-headed albatross *Thalassarche chrysostoma*), whereas others are annual breeders (other *Thalassarche* species, giant petrels, and *Procellaria* petrels).

Table 9: Range countries for breeding albatrosses and petrels

Country	No. species	No. endemic species
New Zealand	16	8
United Kingdom	12	3
France	12	1
South Africa	9	-
Australia	7	-
Japan	3	1
Chile	3	-
United States of America	2	-
Ecuador	1	1
Argentina	1	-
Mexico	1	-

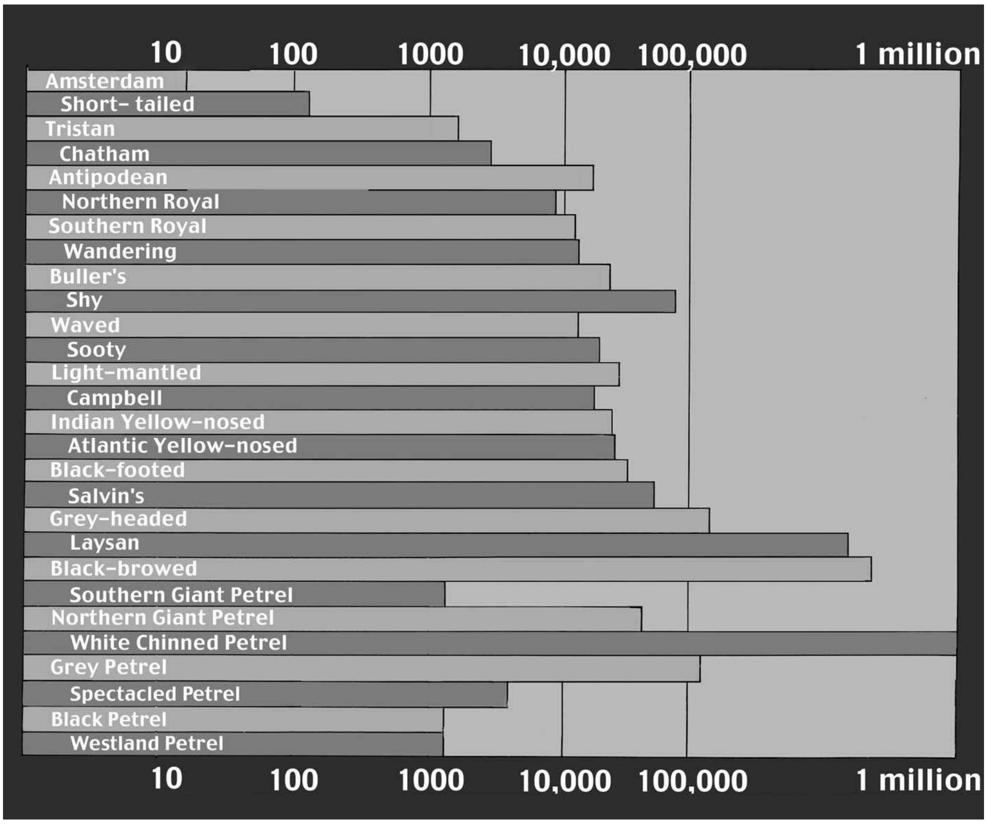

Figure 3: Breeding population sizes (pairs) of albatross and petrel species

Table 10: Life history of albatrosses

Stage	Time	Survival
Single egg laid	30 days to form	100%
Chick fledges	3–9 months	50%
Juvenile returns to land	3–5 years	25%
Immatures form pairs	5–8 years	
Breeds first	6–12 years	
Breeds successfully	8–15 years	10%
Dies	25–50 years (average), 75 years (oldest)	0%

Table 11: The breeding cycle of albatrosses and petrels

Event	Behaviour
Male arrives	Builds/defends nest
Female arrives	Copulation
Female returns	Egg laid
Incubation	Lasts 50 days (petrels) to 60–80 days (albatrosses) Parents alternate shifts of 5–15 days
Hatching	Parents alternate shifts of 1–3 days for 10–30 days
Brood period	Bi-parental care for all (or most) of 46–60 days (petrels) to 100–250 days (albatrosses)
Fledging	Chick becomes independent
Dispersal	Fledglings/adults move away from breeding site
Migration	
Moult	Replacement of worn feathers
Next breeding season	

Breeding of these seabirds is characterised by low productivity (small clutch, moderate breeding success, and low breeding frequency), low reproduction rate (delayed sexual maturity, long generation time), high adult survival, high mate fidelity (low divorce), and high site fidelity (distinct population structure). For some species there may be population-specific (for example, for an island-group) differences in breeding and foraging behaviour, but as yet little is understood about these differences.

There are several constraints involved with studies of albatross and petrel populations:

- key events such as laying and fledging are spaced out,
- there is substantial interannual variation in population size and the breeding success of mollymawks,
- biennial breeding species may show big fluctuations between demi-populations, and
- individuals/pairs frequently postpone breeding attempts.

These imply that long field seasons are required and that several consecutive years are needed for baseline estimates of population size and adult survival. Large samples and many years are needed to detect trends or changes that are statistically significant at the 95% level. Therefore, there are very few long-term studies.

Satellite telemetry is one method that is being used to see where the seabirds go, both during the breeding season and in the time of migration or dispersal after breeding. Up until the 1970s, most wandering albatrosses travelled to the east coast of Australia and to New Zealand after breeding, and about a third went to the Patagonian Shelf when not breeding. This pattern has been reversed in recent years with the increase of fishing on the Patagonian Shelf. Other studies have shown that seabirds of the same populations may forage in different areas. Satellite tracking has only recently been possible for giant and other Procellaria petrels. Data confirm a wide range for giant petrels, especially females, even when breeding and reveal that white-chinned petrels have perhaps the largest oceanic range of any seabird when breeding.

A summary produced in 1998 showed that 42% of 150 albatross populations are decreasing, such that many species are now classed as threatened (Table 12). These decreases result from historical threats (such as hunting, habitat degradation, and introduced predators) and current threats (such as fisheries bycatch, introduced predators, and habitat degradation, including natural disasters and pollution). Order Procellariiformes populations remain susceptible because of their low reproductive rate, their wide oceanic range, small breeding population, and small breeding range. The loss of adults is critical. Some studies have shown that population changes of some species have coincided with the start of longline fishing and the rates of change have been correlated with fishing effort. Large numbers (30 000–40 000) were killed per year before seabird mitigation measures were used. These days, where scientific observer-assisted mitigating measures are used, bycatch mortality rates are often < 10% of previously recorded bycatch rates. Without such measures large numbers of albatrosses and petrels are still killed annually, especially by IUU vessels, and probably also by unmonitored fleets operating on the high seas.

Various practical solutions have been developed to mitigate against seabird bycatch (Table 13). Regulations exist for some of these seabird bycatch mitigation measures for vessels fishing under CCAMLR jurisdiction; for example, offal discharge, streamer lines, weighted lines, nightsetting, and closed seasons. In 1998–99 most CCAMLR vessels in the Indian Ocean and Atlantic Ocean sectors complied with the nightsetting measure (95%), 100% of Indian Ocean and 71% of Atlantic Ocean vessels complied with the offal discharge measure, and 92% of Indian Ocean and 77% of Atlantic Ocean vessels used streamer lines. Between 1997 and 1999, the seabird bycatch rates in these sectors dropped from 0.23 to 0.01 seabirds per 1000 hooks in the Atlantic Ocean sector and from 0.52 to 0.03 seabirds per 1000 hooks in the Indian Ocean.
To implement these solutions on a global level, it will be necessary to:

- educate fishers and fishing managers (including highlighting the financial benefit of not catching seabirds),
- help fishers (provision and use of appropriate fishing gear and incentives for compliance),
- improve fishery management (better enforcement and effective observer programmes), and
- protect albatross through international legislation (and influence non-signatory states).

The problems ahead include the lack of knowledge on seabird bycatch during the high seas and IUU fishing, and thus the impact of these fisheries.

Table 12: Globally threatened albatrosses and petrels (data are from BirdLife International)

Category	Great albatross *Diomedea*	Northern albatross *Phoebastria*	Mollymawk *Thalassarche*	Sooty albatross *Phoebetria*	Giant petrel *Macronectes*	Petrel *Procellaria*
Critical	Amsterdam†		Chatham●‡			Spectacled●‡
Endangered	Tristan●‡ N. Royal●					
Vulnerable	Wandering● Southern Royal‡ Antipodean‡	Short-tailed†‡ Black-footed● Galapagos‡	Salvin's‡ Buller's‡ Grey-headed● Campbell●‡ Indian Yellow-nosed●	Sooty●	Southern●	White-chinned● Black‡ Westland‡
Near-threatened			Black-browed● Shy‡ Atlantic Yellow-nosed●	Light-mantled●	Northern●	Grey●

● = decline rate ‡ = population size ‡ = restricted range

Table 13: Some practical mitigation measures as solutions to seabird bycatch during longline fishing operations

Mitigation measures	Effect
Underwater setting	Hooks/bait inaccessible to birds
Offal discharge	Avoid attracting birds
Streamer lines	Keep birds away from sinking longline
Weighted lines	Sink line too fast for birds to access
Artificial bait	Unattractive to birds
Dyed bait	Invisible to birds
Nightsetting	Albatrosses are diurnal
Closed areas	Protect birds rearing chicks
Closed seasons	Protect birds when breeding

Overview of Population Modelling

[Chair: Jacqui Burgess, Ministry of Fisheries, New Zealand]

This session provided an overview of models as population management tools, including what models can and can't do, data requirements, and how data are collected.

Population modelling

[*Anthony Starfield*, *University of Minnesota*, *United States of America*]

A model is a tool which can be used to make computations with parameters from the real world. For the model to be successful and provide appropriate feedback, there must be a clear-cut objective. Parameters that are essential for the model should then be determined and the model run several times. Further parameters may be required and added in. Therefore it is an ongoing building process.

For example, in long-lived species, the success of different age-classes has a big impact on the success of the population as a whole. An example was offered where the growth rate of a population could be calculated, as a function of time, from the known age structure of the population, with the three demographic parameters of fecundity, new-born survival rate, and adult survival rate, and the assumption that breeding takes place at age 4 or 5. This example was used to illustrate two general results for populations in a steady environment:

- a short-term time period is strongly influenced by the initial age structure of the population.
- a long-term period is independent of the initial age structure and is only dependent on parameters of survival such as fecundity.

Therefore, short-term effects may be anomalies. A short-term time period needs to be related to the life span of the animal. (Five years is short for a whale but not for a sardine.)

In a deterministic model, it is assumed that chance events play no important role. A demographic stochastic model can be used to simulate variation (for example, fecundity may depend on climate) in the model. This model requires replicate random runs and leads to probabilistic rather than definite results. Chance effects can be very important in a small population.

The "rules of thumb" of pragmatic modelling are to work as a team, define the problem first, remember the purpose is to gain insights and improve management decisions, be flexible and adaptable, and use rapid prototyping. It is important to keep the model transparent, avoid extraneous detail (the cost of adding detail is a loss of understanding), and choose the scale carefully. Furthermore, consider the use of a suite of simple models. Finally, sensitivity analysis is essential to show what happens if something in the model is wrong.

Management Approaches to Seabird-Fisheries Interactions

[Chair: Mike Donoghue, Department of Conservation, New Zealand]

This session provided an outline of frameworks for managing seabird-fisheries interactions, ranging from voluntary codes of practice through to international agreements.

Birds, bureaucrats, and bridges

[*Lee Robinson, Ministry of Fisheries, New Zealand*]

Concern for the sustainability of the marine ecosystem underlies many of the international and local initiatives for fisheries resources management. Government-to-government agreements include those that are ratified (UNCLOS), those signed, but not ratified (UNFSA), and those which operate as a voluntary code (IPOA-SEABIRDS). Outside these are fora (IUCN).

The international agreements enable issues that extend beyond EEZs to be addressed consistently. They underpin regional agreements as well as create opportunities to raise issues with governments that may have different values. By securing government "buy-in", these agreements also have the potential to create an international community of interest. The problem with these agreements is that they are generally negotiated in isolation of the fisheries and may therefore result in impractical measures which fail to gain compliance.

There are three types of agreement. The first is a principle focussed agreement which gives guidance and provides a vehicle for discussions and negotiation, but is not prescriptive and, therefore, not enforced. Examples of this include UNCLOS which obliges States to consider the effects of fishing, or UNFSA which requires States to minimise the effect on the environment through best practice. The second type of agreement is process focussed and is facilitative in that it provides guidelines and resources, such as the IPOA-SEABIRDS which provides a framework for nations to develop their own plans of action.

The third is action focussed, usually developed from higher-level agreements, but reaches into specific areas or fisheries and is characterised by information collection systems and detailed conservation measures. An example of this is the CCAMLR convention, which is principle based, but has a direct influence on the management of fisheries in waters within CCAMLR's jurisdiction and places the onus on compliance with conservation measures before fishing. The incentive to co-operate and develop solutions as well as improving fishing opportunities only works with willing parties, there is still the problem of IUU fishing in the CCAMLR area.

In contrast to international initiatives, local initiatives are those often led by fishers or interested groups and these generally produce effective measures tailored to meet the local conditions. Some examples of these initiatives operate in New Zealand waters, where the southern tuna longline fleet has developed a strict voluntary code of practice which relates to seabird bycatch and consists of a package of measures. The northern tuna longline fleet has been closely involved in the development and testing of seabird bycatch mitigation measures, though progress has been slower because these fishers work more independently than the southern vessels. The proposals developed under the New Zealand National Plan of Action will set limits on the seabird bycatch rate and require the co-operation of the fishers to enhance their current efforts to collaborate together and develop effective seabird bycatch mitigation measures to achieve a meaningful reduction in seabird bycatch.

Governments have an important part in developing the appropriate international framework. Collaboration between governments and fishers will ensure the development of international agreements that will be supported by local fishers and have sufficient scope to allow local initiatives to be applied in the fishery.

Day 2 — Tuesday, 7 November 2000

Discussion of Overview of Longline Fisheries

[Chair: Viv Thomson, International Fishers' Forum facilitator, New Zealand]
This session concluded the overview of longline fisheries and provided participants a chance to discuss possible outcomes from the forum.

Discussion: Many fishing fleets are motivated to solve the problem of incidental seabird capture, and international codes and regulations (including the IPOA-SEABIRDS) are in place. Participants agreed that the way forward requires strategic and practical thinking to develop specific actions targeted to build on the mechanisms in place, such as agreed best practice in demersal and pelagic longline fisheries. Participants noted the need to agree on future research and seabird bycatch mitigation measures at both national and international levels, and to find ways of influencing fishing practices of those fleets involved in IUU fishing. It was recognised that, in relation to the seabird species, it was necessary to determine where fishing was causing a problem and that priorities in seabird bycatch mitigation measures needed to be defined.

Modeller's Case Studies

[Chair: John Croxall, British Antarctic Survey, England]
During this session, three seabird population modellers presented case studies on the effect of fisheries interactions on seabird populations.

Modelling the population of short-tailed albatross

[*Anthony Starfield, University of Minnesota, United States of America*]

Age-structure models can be used to project age classes over time. In a study to explore the effects of the incidental take in North Pacific groundfish fisheries on the recovery of short-tailed albatrosses, known information about these endangered seabirds was modelled. The information used included: age at first nesting (6 years), 75% of aged 6+ years albatrosses return to breed, the birds are monogamous and need > 2 years to establish a pair-bond, a single egg is laid, chicks fledge after 5 months and return as non-breeders after 2–5 years, live to 50+ years, adult survival rate is approximately 96% per year, and the annual population growth rate is about 7.7%.

For a population of small numbers, such as the short-tailed albatross, it is not necessary to assume any density dependence. For this study, demographic stochasticity can be used to generate random numbers and calculate the effect for a known number of seabirds in an age class in one year. Environmental stochasticity can be used to account for differences in the annual average survival rates. Estimates of the initial population, the initial age structure, the fecundity rate, survival rates of sub adults and adults, the maximum age, and the current incidental take are required as base parameters for the model.

The first step in the modelling is to develop an initial age structure to get some estimate of the numbers of subadults. Then a simple "widow" effect can be designed to provide a relationship between adult mortality and fecundity, and the model can be run using an estimate of the current take of different age classes, to provide a range of impact. Finally, sensitivity analyses using different ranges of some parameters (for example, different maximum ages) should be run. In reality only about 40% of results are close to the average. The model can then be used to look at the probability of reaching a desired recovery rate. In this example, the incidental take of sub adults results in a higher likelihood of no growth.

The probability of a volcanic eruption on Torishima Island where the albatrosses breed was ignored in this dataset because inclusion of this rare event would not be practical for fisheries management. With this seabird population, the conservation effort should look at developing nest sites. There is no room for complacency in the incidental take of this species. The model can be used to look at what should be monitored to enable good interpretation of the data.

Modelling the black-footed albatross population

[*Jean Dominique Lebreton*, *Centre National de la Recherche Scientifique*, *France*]

Long-lived species, such as the black-footed albatross, are generally sensitive to human activities and have similar demographic characteristics (for example, long-term fidelity to partner). Modelling of these populations can be used to predict the critical level of impact (fisheries bycatch for the black-footed albatross), even when the demographic data are incomplete. Age dependence models such as the Leslie Matrix model use age dependence characteristics of a population to project the future population size and predict the stability of a population.

The use of a model is not to copy reality, but to help as a tool in population assessment. One way is to use elasticity coefficients to predict the effect of a percent change in a parameter on the percent change in growth rate. For example, for an albatross species with a generation time T (mean age of females at reproduction) of about 24 years and a 30% decrease in fecundity, the growth rate change is about –1.25%. Therefore, if there is a sharp change in the growth regime then one first suspects there has been a change in survival (for example, interaction with longline fisheries).

Changes in survival are often especially deleterious in long-lived species because of a low maximum growth rate in the population. The sustainable bycatch proportion is less than λ_{max}–1, for example, a $\lambda_{max} = 1.1$ implies the population can sustain a 10% level of bycatch. In general, the sustainable level is much less because the actual growth rate may be well below the maximum. Furthermore, the reproduction of long-lived species (those with a large T) is so slow that the maximum growth rate is small. A typical maximum growth rate for albatrosses is < 1.05 (5% growth rate per year).

A detailed demographic analysis is not always possible, but comparative studies can be used to predict maximum growth rate. The maximum growth rate decreases with T because it tends to be constant for each generation. The sustainable bycatch proportion is approximately equal to the inverse of the maximum generation time. The matrix model can be used to get the magnitude of T and give a stable age structure to estimate the population size from a number of pairs. The maximum additional mortality will equal the estimated population size over the generation time.

For example, the black-footed albatross adult survival is about 93% per year (based on other albatross data). Generation time is about 25 years and there are about 60 000 pairs (N = 300 000 individuals). Therefore, the sustainable bycatch proportion is about 0.04 which implies that the maximum additional mortality is 12 000 individuals. The annual average bycatch estimate for black-footed albatrosses is greater than 2000 individuals. The calculation gives the upper limit, not the maximum sustainable yield; there are other sources of additional mortality such as ingestion of plastics, increased effects on local populations with any population subdivision, and the imbalance in the age and sex of seabirds caught during fishing operations.

There are problems with these models, for example, senescence and imbalance in the age and sex of bycatch seabirds. However, the models are robust and widely applicable, provide easy generalisations about populations, and provide simple rules for monitoring.

Modelling the effects of incidental seabird mortality from longline fisheries on seabird populations within the New Zealand EEZ

[*Paul Sagar, National Institute of Water & Atmospheric Research Ltd., New Zealand*]

The use of models to determine the effects of tuna longline fisheries on southern Buller's albatross populations in the New Zealand EEZ is at the developmental stage. This endemic seabird species is classed as threatened and is one of the more commonly caught seabirds on tuna longlines in New Zealand waters. The programme aims to: define the spatial distributions of southern Buller's albatrosses, specific to each population, sex, age, and breeding status; derive mortality rates incurred by the southern bluefin tuna longline fishery; and construct a demographic model to assess this additional mortality.

Demographic parameters that will be used include adult survival, breeding frequency, breeding success, age at first breeding, recruitment, and size of breeding population. About 50% of the population are breeding birds. During the breeding season, from incubation through to the late post-guard stage, the adult birds have distinct areas where they forage and are away for different lengths of time, depending on the chick's development. The foraging habits of individual birds differ and depend on the colony of origin, sex, age, and breeding status and experience. The colony of origin, the direction in which the seabird flies, and the destination can be combined in a model with the breeding cycle information to produce a simulated distribution which can be built into a density component. It is hoped that this model will be able to be transferred to other seabird species that share similar lifecycles.

Modeller's comment: Conservation issues need to be defined because of the rarity of bycatch, the diversity of the bycatch, and the associated perceived lack of effect on seabird populations. The distribution of the seabirds necessitates an international level of activity to determine which seabird species are more likely to be impacted upon by longline fishing, both in national or regional fleets as well as in distant water and IUU fleets.

Modellers' panel discussion

[Chair: John Croxall, British Antarctic Survey, England]

This session provided further discussion of seabird population modelling and allowed participants to ask questions of a panel of modellers (*Jean Dominique Lebreton*, *Ed Melvin*, *Henrik Moller*, *Anthony Starfield*, *Kevin Stokes*). *The panel used this session to determine issues that required further discussion amongst panel members to be reported back to the forum on Day 3.*

Modellers' comments: There will always be a need to extrapolate to produce estimates because of the gaps in the data and knowledge. There is an expectation that models give certainty, but they are actually ways of declaring what is known and what is unknown. A model is an "if then" statement. Therefore, when deciding on the best way forward, questions need to be asked: for example, what is the purpose? This would provide an idea of where the most action is required or the best direction for action. Also there must be a distinction between seabird species and their population dynamics: for example, the short-tailed albatross population problem centres around the poor growth rate and population recovery compared with other albatross species that are less vulnerable but are suffering from increased mortality.

Question: In New Zealand, tuna longline fishers pay a Conservation Services Levy based on their catch of southern bluefin tuna. Some of this levy goes towards modelling and population monitoring programmes. How can fishers be convinced that this is good use of funds?

Reply: Some models produce very robust conclusions. Modellers need to know the level of bycatch and also need statistics with a very low level of risk. Often because these data are not available, the only approach available is to use rapid prototyping and adaptive management. Models cannot put certainty into a system with little certainty.

Question: Are there any other data that should be collected?

Reply: The handling of bycatch data needs to be properly organised. Data required include the distribution of fishing effort and seabird bycatch, as well as data for seabird populations (rather than seabird species). However, the reality is that bycatch events are rare in time and space and this creates problems in producing robust error estimates. As with many rare event scenarios, there are huge practical issues to obtain useful data and these require high observer coverage.

Modellers' comments: Agreed objectives between conservation organisations and the fishing industry would define what and how things would be measured and tested. For example, if a population is "at risk", what is a reasonable time to expect recovery of the population to an acceptable level?

There is no model with complete certainty and there is no model with low risk. One way to guide management, especially with regard to those highly migratory seabird species which are at risk in several EEZs and the high seas areas, is to develop systems modelling. For example, with the problem of population growth of short-tailed albatross, modellers require both acceptable thresholds and risks. If the whole system is modelled, then it is possible to calculate the probability of a fishery being closed, and if the ways in which decisions are made and implemented is known, then a cost-benefit analysis can be carried out. Therefore, the first step is determination of robust objectives before any modelling is undertaken.

Fishers' Case Studies of Seabird Bycatch Mitigation Measures

[Chair: Janice Molloy, Department of Conservation, New Zealand]

Some longline fishing fleets have adopted either single or a range of seabird bycatch mitigation measures to reduce or minimise seabird bycatch during their fishing operations. The development of such measures is an evolving process and often specific to the characteristics of the fishing operation or the fishery, at an individual vessel or fleet level. Factors such as the vessel size, type of longline deployed, seabird species associated with the interaction, and economies of the fishers will dictate the types of the seabird bycatch mitigation measures used. During this session, fishers contributed the following summaries of the seabird bycatch mitigation measures used on their vessels.

Seabird mitigation — Antarctica

[*Malcolm McNeil, Sealord & New Zealand Longline Ltd., New Zealand*]

New Zealand vessels have carried out exploratory fishing for Patagonian and Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea area since 1996. Heavy-duty demersal gear is used and the constraints on fishing here are the ice coverage and adherence to CCAMLR Conservation Measures. The main seabird species in the Ross Sea area fished by New Zealand

vessels are Antarctic petrels (*Thalassoica antarctica*), Wilson's storm petrels (*Oceanites oceanicus*), giant petrels, and snow petrels (*Pagodroma nivea*). Other species in the area include skuas (*Catharacta* spp.), light-mantled sooty (*Phoebetria palpebrata*) and black-browed albatrosses, penguin species, Antarctic (southern) fulmars, Antarctic prions (*Pachyptila desolata*), cape pigeons (*Daption capense*), and Antarctic terns (*Sterna vittata*).
Seabird bycatch mitigation measures used in the Ross Sea in past years include CCAMLR-approved tori lines, nightsetting, use of thawed bait, no offal dumping during setting, offal discharge allowed during hauling (on the opposite side to the line being hauled), Mustad underwater line setting device (ineffective due to freezing temperatures), and a short fishing season. Now, voluntary measures and those relating to rule changes include:

- buffer zones of no fishing near known wildlife sanctuaries,
- line weighting so hooks sink at < 0.3 $m.sec^{-1}$ so that vessels can fish during daylight south of 65º S (and therefore make the fishing operation safer),
- total allowable seabird take such that if three seabirds are caught the vessels must set at night and closure of the fishery if 10 seabirds are caught,
- retention of all offal, fish bycatch, and unused baits — vessels either have a meal plant or offal is frozen, and
- changes to the tori line design — these include a boom and bridle arrangement to counteract wind effects.

These measures have impacted on the fishing. Line weighting involves attaching 5 kg weights every 50 hooks and adjusting the setting speed. This reduces fishing time by 30%. This method also has an element of danger and is labour-intensive. Some fish are lost and there is more likelihood of fouling the line on the bottom. Measures relating to offal discharge increase the workload and pressure on the freezer capacity. Tori lines have minimal impact to the fishing operation.

The success of these mitigation methods is measured in the zero seabird bycatch observed on these vessels. Seabirds show little interest in offal or in baits, and the line sinking regime ensures baits sink quickly.

Underwater setting — Australia

[*Dave Chaffey, Australian Seafood Industry Council*, *Australia*]

The testing of an underwater setting chute (developed co-operatively between New Zealand and Australia) has been carried out on one Australian vessel. This 9 m chute sits about 6 m in the water at an angle of 55–60°, and the baited hook release depth is about 4–5 m. After about 30 s the baited hook is about 14 m deep. The branchlines run down a slot in the chute. The crew find it efficient to use and the time taken to bait the hooks is similar to that in a standard setting operation, and bait loss is minimal. Almost 20 000 hooks have been set with this underwater setting chute and no seabird bycatch has occurred. Seabirds show much less interest in the fishing operation than when the lines are set manually. They fly around the vessel and then move on. A trial of the chutes (involving 10 vessels) is planned for early 2001.

Setting using an underwater capsule (also developed by New Zealand and Australia collaboratively) has resulted in no seabird bycatch. The capsule free-falls to a depth of 9 m before being mechanically retrieved. Problems with tangling with the capsule have been reduced, but further work is needed. Both methods are relatively costly compared with other seabird bycatch mitigation measures, with the capsule at about $AUS10,000 ($US5,530) and the chute at $AUS4,000 ($US2,200). Further tests will be required for different vessel sizes and setting speeds.

Line weighting used in Hawaiian longline fisheries

[*Steve Gates, Hawaii Longline Association, United States of America*]

Longline fishers in Hawaiian waters target tuna at about 100 m. They generally set 2–3000 hooks during daylight hours and haul at night. The target depth makes it impractical to set at night because of the interaction with other fish species. Tori lines are stored on vessels and used when seabirds are in the fishing area. Tuna vessels use line shooters with an adjustable speed and weighted hooks with the weight < 1 m (*see* Table 8) from the hook so that no damage is inflicted on the tuna destined for the sashimi market. With the shape of the bait (saury or sardine) and the weighted hooks, the hook sinks to 2.5–3 m in about 5 s.

Fishers targeting swordfish set about 800–1200 hooks per longline. The branchlines on these lines are slower to sink because the bulkier mainline has more resistance and the use of lightsticks makes the line more buoyant. Therefore, the zone of opportunity for seabirds behind a swordfish vessel extends to about 150 m compared with that of 10–15 m behind a tuna vessel. If a line weighting regime is used, fishers should ensure that all the crew are schooled in safe use of the gear. There is more danger to crew when targeting for swordfish because the monofilament mainline is hauled at the same speed it is set, but during tuna longline fishing, the retrieval speed is slower and therefore there is more reaction time.

Some seabird bycatch mitigation devices — New Zealand

[*Tom Mayo, Solander Group, New Zealand*]

A New Zealand longline vessel, which operates as a surface and a bottom longliner, uses a variety of seabird bycatch mitigation measures including two tori lines (operated by hydraulic winches) and two sonic guns (developed from guns used to scare birds in commercial orchards). This vessel sets 2700 hooks a day when surface longlining for southern bluefin tuna with the American system and 22 000 hooks a day when bottom longlining for ling using Norwegian Mustad gear. The mizzen-mast has been fitted with a third tori line that is higher than the other two (thus giving greater coverage) and has the capacity to support longer tori poles. During daylight the seabirds appear not to be affected by the sonic guns, but they appear to be more cautious when the guns are used at night and the ship is blacked out. A high-pressure rotating hose has also been trialled. This involved towing the hose behind the vessel in an attempt to keep the seabirds from settling on the water, but problems with entanglement with the mainline and floats made this method impractical. During the hauling operation, a boom is deployed to position one or more floats above the area where any hooks that still have bait on them are at risk of being taken by seabirds.

Comment: Roberto Imai from Brazil commented that in recent years efforts at education and training captains have led to some voluntary action by fishers to explore seabird bycatch mitigation measures such as blue-dyed bait. *Catch Fish Not Birds* has been made available to fishers. Political changes have led to more open relationships between the government and scientists. However, longline fishing is relatively new in Brazil and there are many vessels from other nations fishing outside Brazilian waters and not using seabird bycatch mitigation measures. Furthermore, the nature of the Brazilian economy and the many social problems create difficulties for funding the adoption of seabird bycatch mitigation measures.

Comment: Some fishers also use snood haulers to ensure quick retrieval of baits during the hauling process and others monitor the hauling process so that baits do not float on the surface where they are available to the seabirds.

Fishers' Panel Discussion

[Chair: Viv Thomson, International Fishers' Forum facilitator, New Zealand]

This session provided further plenary discussion of seabird bycatch mitigation measures. The plenary agreed that the main seabird bycatch mitigation measures available included the following:

Tori lines	Blue-dyed bait	Sonic guns
Education of fishers	Line weighting	Splashing buoy on haul
Underwater setting chute	Day/night sets	Setting/hauling speed
Underwater setting capsule	Retention of offal	

Two working groups were then formed to discuss seabird bycatch mitigation measures as they relate to demersal and pelagic longline fisheries, with the aim of defining research priorities. The discussions are summarised below.

Seabird bycatch mitigation measures relevant to demersal longline fishing

Seabird bycatch mitigation measures discussed by the demersal longline working group were divided into three categories: sink rate measures, surface distraction measures, and temporal measures. Discussion of these categories is summarised in Table 14. Overall, it was felt that the key to all these categories is education, and that there is a large need for improvement of communication and education. Further, comprehensive data collection should be managed as a co-operative and international venture. In summary, this working group concluded that fishers must be educated to try a new measure where seabird capture is a problem and that maximum seabird capture rates should be set before a new measure has to be implemented.

Seabird bycatch mitigation measures relevant to pelagic longline fishing

The pelagic longline working group added further measures to those listed above: strategic offal discarding, area closure, artificial bait, snood haulers, and use of line shooters. From this expanded list, four priority measures were identified: education, tori lines, blue-dyed bait, and underwater setting (Table 15). The dissemination of information, both on the seabird bycatch problem and the use of mitigation measures and their best deployment, in terms of safety and efficiency, must be approached at all levels — from deck-hands through to vessel and company owners. This information must be passed on with crew changes to enable the safe and effective use of mitigation measures.

Table 14: Summary of discussion of seabird bycatch mitigation measures for demersal longlines

<table>
<tr><th>Mitigation measure</th><th>Comments and research requirements</th></tr>
<tr><td>Sink rate measures
➢ line weighting
➢ thawed bait
➢ underwater setting (chute)</td><td>Determine a hook sink rate that would result in baited hooks being unavailable to seabirds. This may vary for different seabird species. Variables required for this include:
➢ weight required and spacing of weight
➢ seabird population
➢ seabird diving capability
➢ depth of line
➢ seabird behaviour (time before seabird gives up attempt)
➢ fish behaviour, location
➢ adjustment of float level of line to maximise catch
➢ materials suitable for line and hardware
➢ effect on hauling
➢ consequences for equipment, use of fishing time, workload, and practicality of solution for individual vessels
Further developments could include: system advancement (automated weight attachment) or other modifications. Data are available from CCAMLR. Experience has shown that integrating the weight into the line, as in the use of braided, lead core rope, doesn't give the fishing characteristics required and is not practical for monofilament. Line weighting must work in all sea conditions and needs to be developed for both the Spanish and the autoline methods.

Underwater setting could reduce the need for line weighting, but requires further development before this method is commercially viable. However, modification of existing vessels is possible. (New purpose-built vessels are at the concept stage of design.)</td></tr>
<tr><td>Action required:</td><td>Provide incentives to manufacturers to pursue the development of products suitable to the industry: development of integrated weighted line.</td></tr>
<tr><td>Surface distraction
➢ tori lines
➢ dyed bait
➢ artificial bait
➢ offal release
➢ sonic gun
➢ splashing buoy</td><td>Tori lines are commonly used and a minimum performance measure: paired lines to the CCAMLR standard could be set. Research could include:
➢ optimum aerial extent
➢ amount of drag needed
➢ solution to retrieval problems
➢ ease of deployment: winch, clip-on streamers of different lengths
➢ possible modifications: luminous tubing, helium balloons
➢ design variation required in response to seabird's learning capability
Research on the use of measures such as sonic guns has shown that seabirds become accustomed to this type of scaring device.</td></tr>
<tr><td>Action required:</td><td>Trial dye bait (Norbait). Address issues: superstition, changing attitudes, dye colour, effect of depth on dye, and response of fish. (Artificial lures used in New Zealand have been effective and have improved fish catch.)</td></tr>
<tr><td>Temporal
➢ area closure
➢ seasonal restriction
➢ nightsetting</td><td>Area closures are seen as a last resort and may act to displace the problem.
Seasonal restrictions are based on risk (CCAMLR research).
Nightsetting works for some species, but not others.</td></tr>
<tr><td>Action required:</td><td>Develop a matrix of measures based on data relevant to specific situations: seabird species or populations, foraging ranges, rationale for endangered species, models, observer programmes, and cost.</td></tr>
</table>

Table 15: Summary of discussion of seabird bycatch mitigation measures for pelagic longlines

Mitigation measure	Comments and research requirements
Blue-dyed bait ➢ Virginia Dare No. 5 (Hawaii) ➢ other blues (Brazil)	Tests have shown that blue-dyed squid are not attractive to seabirds. Further experimentation is needed: ➢ with different blue colours ➢ length of time dye remains on bait ➢ dyeing characteristics of bait other than squid ➢ pre-dyeing bait and dye retention on thawing ➢ target species CPUE with dyed bait ➢ non-target fish and marine mammal and reptile CPUE with dyed bait ➢ effectiveness for all seabird species
Underwater setting chute (Australia/New Zealand)	This device is under development and has the potential to supersede the use of other seabird bycatch mitigation measures. Present cost is about $AUS4,000 ($US2,200). No seabirds have been caught during its experimental use. Further tests on about 10 vessels will take place in 2001. Enforcement of its use may be problematic. Further research requirements include: ➢ effectiveness in different areas, seasons, fisheries ➢ method of counting branchlines through chute (compliance) ➢ funding possibilities especially for developing fisheries (high cost) ➢ efficient deployment (including time taken to bait line) and retrieval ➢ paired chutes ➢ paired crew baiting the hooks ➢ effectiveness with deep diving seabirds
Underwater setting capsule (New Zealand)	This device is under development and has the potential to supersede the use of other seabird bycatch mitigation measures. Present cost is about $AUS10,000 ($US5,500). Enforcement of its use may be problematic. Further research requirements include: ➢ elimination of line tangling ➢ use of hydraulic rather than electric version ➢ development of less costly version ➢ speed of hook deployment ➢ method of compliance ➢ paired capsules
Education ➢ Not strictly a mitigation measure, but central to the use of all measures	All fishing industry participants need to be educated about ways to minimise seabird bycatch at the point of entry to a fishery. There will be different needs for different countries and cultures. Research requirements include: ➢ ways of disseminating information: use of brochures, lottery prizes, phone cards (as in Uruguay) ➢ ways of getting the message across all levels of literacy ➢ ability to make education of seabird bycatch problems mandatory before licence renewal

Day 3 — Wednesday, 8 November 2000

Seabird Behaviour

[Chair: Richard Cade, New Zealand Tuna Trollers' Association, New Zealand]
This session provided a review of aspects of seabird behaviour relevant to the development, use, or evaluation of mitigation measures. This included information about seabird diving abilities, sight, smell, methods of locating prey, and the day/night activity of seabird species.

Seabird behaviour in relation to longline fishing

[*Rosemary Gales, Department of Primary Industries, Water and Environment, Australia*]

An understanding of the flight behaviour of seabirds, the way they locate food, the way in which they feed, and what they feed on is important in trying to solve the problem of seabird bycatch. Flight varies with body size and wing shapes. Larger wings are used for gliding, whereas smaller broader wings allow more manoeuvrability through the use of flapping. Wandering albatrosses can average flight speeds of 60 kph and move continuously in windy conditions, almost never flying to windward. Other species, including the medium sized shy albatrosses (*Thalassarche cauta*), make much less use of wind-assisted flight, with shorter and slower (rarely in excess of 30 kph) flights.

Albatrosses and petrels are thought to use navigational cues such as celestial navigation and magnetic fields in their long-distance searching for food. These seabirds are assisted by well-developed olfactory systems and are thought use their sense of smell to detect food. Odour cues are used for area-restricted searches, and the visual cues of prey and of other seabirds and mammals feeding are thought to be the last cues used in prey detection. Smaller, more cryptic species usually have better developed olfactory systems than other species. These smaller species also often forage at night when a sense of smell is especially useful.

The largest albatrosses are generally surface feeders, but smaller species are proficient divers. Shy albatrosses generally make plunge dives to about 3 m for 5 s, occasionally staying submerged for up to 19 s. They also actively propel themselves underwater during longer swim dives. The smaller petrels, including sooty shearwaters, excel underwater and dive to 70 m.

Albatrosses are generally described as opportunistic feeders. Their prey includes squid, fish, and to a lesser extent, crustaceans. These birds actively catch live food, as well as scavenge dead prey, fishery discards, and baits. In the southern bluefin tuna longline fisheries off Australia, the baits used are very often the same size and species as the natural prey of the birds.

Many seabird species fly vast distances (such as 500–1000 km) to forage and stay within certain ranges, for example, circumpolar or within a restricted ocean section. Different populations of the same species may feed in different areas, and the at-sea distribution of a population may vary also with age and sex. For example, breeding shy albatrosses from three different breeding locations favour mutually exclusive feeding zones as do the non-breeders and the young birds.

Timing of feeding is quite specific. Shy albatrosses show a bimodal feeding pattern, with most activity in the morning and the evening. The birds fly twice as far during the day as the night and are three times more active during a full moon. This habit is reflected in their catch rates on longlines, with over 70% of all shy albatrosses killed at night in Australian waters being killed during periods of full moon. In contrast, wandering albatrosses generally travel less at night, preferring to rest on the water. White-chinned petrels do not show such marked diurnal patterns of feeding and use their enhanced sense of smell to feed at night.

In summary, there are behavioural differences between the seabird species and populations, and interactions between the species complicate the assessments of seabird bycatch. Often the timing and distribution of the highest seabird numbers corresponds with the time of greatest fishing effort. Within the assemblages of seabirds congregating behind fishing boats it is the smaller species (such as sooty shearwaters and light-mantled sooty albatrosses) which search out and retrieve the prey, but often then lose it to more aggressive seabirds. The more aggressive and larger seabirds compete more successfully for the baits and are more likely to swallow the hooks.

The composition of seabird species attending vessels varies seasonally (and regionally) and so the nature of seabird and fishery interactions also varies. To date no seabird bycatch mitigation measures have proven to be adequately effective across a range of fisheries. A suite of measures is needed to mitigate against seabird bycatch as many of the currently identified individual measures are not sufficient in isolation. Consideration of effects on other species must also be a priority when devising and implementing measures to minimise seabird bycatch. The need for development of effective measures remains urgent.

Discussion Session

[Chair: Viv Thomson, International Fishers' Forum facilitator, New Zealand]

This session provided a review of the key points from the overview of demersal and pelagic longline fisheries presented on Day 1 and Day 2. A summary is given below.

1. Fishing fleets use different seabird bycatch mitigation measures, and this is related to cost. Money invested in lower cost measures may be very effective.
2. IUU fishing presents a major problem for seabirds vulnerable to capture on longlines.
3. Attitudes towards seabird bycatch amongst fishers and government organisations differ.
4. Education is an essential component to solving seabird bycatch.
5. Some governments need support to solve the problem of seabird bycatch. This may be government-to-government, industry-to-industry, or individual-to-individual.
6. There is a general lack of data on seabird interactions with longline fisheries. For some major fisheries, there are very few data.
7. Some fisheries are composed of many small vessels, which makes co-ordination of a response to seabird bycatch very difficult.
8. Future progress depends on the best use of the outcomes of the International Fishers' Forum. Regional agreements such as the Asia Pacific Economic Cooperation (APEC) may be one way of furthering progress.
9. On a more local level, all research relating to seabird bycatch must be presented in a useful form and in language relevant to the fishers involved.

Comment: Bambang Edi Priyono noted the necessity of a comprehensive database which included variables such as the number of seabirds (or seabird species) taken as bycatch, a measure of the effort, target fish species, fishing gear, fishing area, time of setting, use of mitigation measures, and vessel size. Data relating to seabird populations would also be included, for example, growth rate of different seabird populations. Combinations of the data could then be run through different procedures to produce the best model to determine the different levels of action (local, national, and international) depending on the degree of seabird mortality and any acceptable critical limit of seabird bycatch defined by seabird biologists. This forecast modelling would take into account the different impacts of seabird bycatch in different areas and fisheries and therefore suggest which seabird bycatch mitigation measures would be most relevant for each fishery.

Comment: John Croxall noted that an FAO process is underway to produce a plan of action to combat IUU fishing. A range of methods are used in the Patagonian toothfish fishery in the Southern Ocean, such as the mandatory catch regulation scheme by which the fish catch is certificated and can be sold amongst the 23 States of CCAMLR. Further regulations specify that States will not provide licences to IUU vessels, will deny IUU vessels access to ports, and will return the money from the confiscated catch to CCAMLR for use in mitigation work in the Southern Ocean.

Integrating Seabird Bycatch Mitigation Measures with Longline Fishing Operations

[Chair: Viv Thomson, International Fishers' Forum facilitator, New Zealand]

This was a working group session in which participants contributed their ideas on the operational aspects of demersal and pelagic longline fishing that needed to be considered when developing mitigation measures.

For the successful and widespread implementation of any mitigation measure, the efficiency and economy of the fishing operation and the safety of the crew must not be compromised. To be readily adopted, seabird bycatch mitigation measures should have no negative effect on the catch (size and quality) of the target fish species or increase in the catch of non-target fish and nonfish species. A combination of seabird bycatch mitigation measures is most effective and the implementation of measures will require ongoing education and support programmes as well as some kind of follow-up or enforcement of use.

The demersal fishery working group considered the requirements for line weighting, offal retention, artificial and dyed baits, and hook design (Table 16). To counteract any negative effects of mitigation measures and their introduction, the demersal working group suggested the following strategies:

- develop both voluntary and mandatory measures,
- address the issue of product availability at local and international levels,
- create opportunities to meet and develop action plans that are driven by the end-users,
- use vessel associations that use mitigation measures to pressurise those that do not,
- be proactive in public relations, education, and branding programmes,
- develop generic education kits, and
- investigate ways to access funding or to provide incentives for progress (for example, $US40,000 per year from IPOA-SEABIRDS fund, levies, fines, additional fishing quota as incentive for research and development, and education grants).

The demersal working group concluded that research should be directed towards increasing the effectiveness of tori line use, artificial baits, hook design, dyed bait trials, and the effect of bait predation on the target catch. It was also noted that any work done on seabird bycatch mitigation measures could be sent to CCAMLR for review, trial, and further development.

A summary of problems and potential solutions related to the use of seabird bycatch mitigation measures that may impact on the pelagic longline fishing operation is given in Table 17.

Table 16: Seabird bycatch mitigation measures used in demersal longline fisheries and factors to be considered with the use of these mitigation measures

Mitigation measure	Factors to be considered
Line weighting	➢ safety issues when hauling: unseen weights hitting crew ➢ autoliners may not want to stop the roller ➢ line deployment ➢ bait loss from predators
Retention of offal	➢ time, space, and labour implications ➢ natural and environmentally friendly mitigation measure ➢ may lessen the attraction of seabirds to the fishing operation, but wash-down process still attracts seabirds
Artificial bait and dyed bait	➢ fish are attracted to bait by smell
Hooks	➢ larger hooks result in smaller bycatch in some fisheries ➢ seabirds swallow the bait with the hook

Existing and New Seabird Bycatch Mitigation Measures

[Chair: James Hufflett, Solander Group, New Zealand]

This session included presentations on scientific programmes designed to assess the effectiveness of existing and new seabird bycatch mitigation measures. Effective seabird bycatch mitigation measures are those that not only significantly reduce or minimise seabird bycatch, but also those that do not affect the catch of the target species or increase that of the nontarget species. This development needs to involve large repetitive samples because of the relative rareness of a seabird bycatch event and requires tests that will result in performance standards to accompany regulations where necessary. The measures must be practical and affordable for fishers and collaboration between research organisations and fishers is imperative to the development of successful avoidance methods. Seabird species interact in different ways with the longline operation in the manner they catch prey (for example, diving seabirds or surface feeders) and their preferred feeding time. Therefore, seabird bycatch mitigation measures need to take into account the different seabird species attending the vessels. Recent experimentation with a variety of seabird bycatch mitigation measures that take these factors into account is summarised below. All these experiments relied on funding both from government and industry.

Seabird bycatch mitigation measures used in Gulf of Alaska and Bering Sea fisheries

[*Ed Melvin, Washington Sea Grant Program, United States of America*]

The potential threat of longline fishing to short-tailed albatrosses was the main reason for the adoption of basic regulations in 1997 for longline vessels in Alaskan waters, though the bycatch of black-footed and Laysan albatrosses and fulmars was also of concern. These regulations specified the use of nightsetting, streamer lines, towed objects, and underwater lining tubes and provided guidelines on increasing the sink rate of hooks, offal discharge, and release of hooked seabirds. Paired streamer lines significantly reduced the seabird bycatch during experiments in the sablefish fishery (*see* Table 1) with 92% reduction compared with the control. Weighted lines (227 g weights at about 11 m spacing) used with no surface deterrent reduced the seabird bycatch by 47% when compared with the control lines (with 2.2–4.5 kg weight at each skate junction).

Table 17: Integrating seabird bycatch mitigation measures with the operation of pelagic longline fishing gear

Fishing operation requirements	Seabird bycatch mitigation measures that may effect fishing operation	Potential solutions to this	Research needs
Smooth line setting operation	Seabird scaring lines – may tangle with the mainline	➢ Break away areas ➢ Spare tori lines ➢ Lazy line with clip to retrieve cut off tori line ➢ No vessel turns during setting	➢ Increase the aerial section and decrease the length
	Underwater setting capsule	➢ Stainless steel ball ➢ Refine capsule	
Crew safety issues	Seabird scaring lines – pole may break	➢ Crew awareness and training	
	Weighted branchlines – weights may fly back towards the vessel when, for example, a fish breaks off the hook	➢ Weight combined with wire trace ➢ Weights further up branchline ➢ Damper system for use on the haul ➢ Slow hauling / awareness ➢ Several heavy swivels placed along the branchline ➢ Helmets with visors ➢ Beaded weights that drop off if hook is pulled off	➢ Research and development of damper system ➢ Design of weights to reduce aerodynamics ➢ Develop soft flexible weights
	Underwater setting capsule – may not return to cradle correctly	➢ Adjustment to "stop" button for emergencies ➢ Shield / protection for crew	
Storage capacity Hygiene Clean deck for crew safety	Offal retention during haul	➢ Storage bins – dump later in day – keep handy to fish operations ➢ Selective dumping away from line ➢ Outboard storage for small vessels Trap door over scuppers in large vessels to control when offal dumped ➢ removal of tips of bills and shark heads	➢ Observations on effects of dumping large offal, such as heads, on seabird activity and bycatch

In the Pacific cod fishery (*see* Table 1) three strategies were tested. The sets which used an underwater lining tube (which sets the gear about 1 m below the surface) reduced the seabird bycatch by 80% and sets with added weight (about 4.5 kg per 90 m) showed a 76% reduction over the control sets. The use of a lineshooter, which shoots the groundline so it is slack, resulted in an increase in the seabird bycatch rates by 54%. There were no significant differences in the catch rates of fish species. Sets made at night resulted in a 330% increase in seabird bycatch (86% of the seabirds observed caught were northern fulmars) and 41% more skates compared with the day sets. These measures are not sufficient on their own.

Initial work testing an integrated weighted line system found large differences between individual vessels and individual sets. The time the hook got to the required depth depended on the line entry point relative to the propeller wash and prevailing physical conditions (weather and current). Sink rates began to converge between 26 and 52 $g.m^{-1}$. Five times less weight was required to achieve a sink rate similar to the rate achieved when 4.5 kg weights were attached at 90 m intervals. Another line weighting idea is the use of a multistranded line with lead woven in, but to date manufacturers have been reluctant to develop such a product for reasons such as the restricted use of lead in European Community fisheries, manufacturing difficulties, and potential problems with auto-baiting systems.

Existing and new mitigation measures

[*Nigel Brothers, Department of Primary Industries, Water and Environment, Australia*]

All known seabird bycatch mitigation measures have been listed in the IPOA-SEABIRDS. The problem now is how to progress things to accelerate uptake of these proven measures. Tori lines are mandatory in some fisheries, but the level of compliance is very low. There is little or no funding available to enforce the use of these measures. The largest problem of all is the fishing by the IUU vessels and as yet there has been no success in policing their activities or even knowing the level of seabird bycatch during fishing operations by these vessels.

Experiences with mitigation practices in CCAMLR waters

[*Graham Robertson, Australian Antarctic Division, Australia*]

CCAMLR has encouraged the adoption of seabird bycatch mitigation measures in the legal Patagonian toothfish longline fishery since 1995. The main measures are setting lines at night, the use of effective streamer lines, proper line weighting regimes, and offal discharge on the side opposite to the line hauling side. In Subarea 48.3 (South Georgia), for which the most complete set of data exists, compliance with the use of streamer lines increased from 23% of vessels in 1997 to 88% of vessels in 2000. Compliance with nightsetting has varied from 81% of sets in 1997 to 92% of sets in 2000 and has been aided by the long nights of the winter-dominated fishing season. Compliance with offal discharge requirements has improved from 0% of vessels in 1997 to 76% of vessels in 2000 (note that proper offal discharge requires a permanent structural change to the vessel's gear). Vessels have continued to use their own regimes for line weighting (about 44 m between weights) rather than the 20 m recommended by CCAMLR. The CCAMLR line weighting regime is thought to compromise fishing efficiency.

The lack of full compliance with the simple and easy-to-use measures (nightsetting, effective streamers, discrete offal discharge) suggests a lackadaisical approach by some fishing masters to seabird bycatch mitigation and this, combined with zero compliance with line weighting requirements, has meant that additional approaches were necessary to reduce seabird mortality to safe levels. Thus CCAMLR has progressively shifted the timing of the fishing season to exclude the seabird breeding season: in 2000 the fishing season commenced on 1 May and ended 30 August, thereby forcing the fishery to operate in winter only. The winter-based season, in combination with improved compliance with nightsetting, has reduced seabird bycatch from 0.23 seabirds per 1000 hooks in 1997 to 0.0014 seabirds per 1000 hooks in 2000.

In the 2001 season, in addition to seasonal closure, only vessels that deploy offal in accordance to CCAMLR requirements will be eligible to apply for a fishing licence. This requirement is intended to encourage vessels to adopt best practice, whether they are fishing in CCAMLR waters or elsewhere.

The results for 2000 suggest that the seabird mortality issue at South Georgia has, for the time being, been solved. However, restricting the fishing season at South Georgia to winter encourages vessels to fish elsewhere in periods of the year when seabird mortality can be expected to be high. Ideally the longline toothfish fishery in CCAMLR waters would operate not only in a seabird-safe manner, but also without seasonal restriction. CCAMLR is working towards achieving this objective.

Testing the tube: the South African experience

[*John Cooper*[1], *University of Cape Town, South Africa*]

South African demersal longline fisheries target Patagonian toothfish in southern waters (annual number of hooks set is 7.5 million) and hake off the continental shelf. A seabird bycatch rate of 0.44 seabirds per 1000 hooks has been observed in the hake fishery and 0.036 seabirds per 1000 hooks in the Patagonian toothfish fishery. Swordfish and tuna are targeted by domestic and foreign-licensed vessels, with about 0.5 million hooks set for swordfish a year and 11 million for tuna species. Seabird bycatch rates for the swordfish fishery are about 0.77 seabirds per 1000 hooks and 2.64 seabirds per 1000 hooks for the tuna longline fisheries. A small number of hooks also target shark species. All of the fisheries except the shark fishery are regulated and observed and this coverage varies from < 10% to 100% (for Patagonian toothfish).

Underwater setting (Mustad) is used in the Patagonian toothfish fishery. A vessel with this tube has dispensation from the regulations to allow line setting through the tube in the daylight. Over a two-season study, 52% of the hooks were set through the tube and a seabird bycatch rate of 0.022 seabirds per 1000 hooks was observed. Seabird bycatch rates during both day and night sets were three times lower when the funnel was used compared with when no funnel was used. Tori lines are used during day and night setting operations, and most of the seabirds caught during this study were white-chinned petrels whether the funnel was used or not. Only 1 of the 114 seabirds was an albatross. Area closures for specific time periods are of concern because of the potential movement of IUU vessels into the area.

1 This paper was co-authored by Peter Ryan, University of Cape Town, South Africa.

Seabird bycatch mitigation measures used in Hawaii

[*Brian McNamara, McNamara Fisheries Consulting, United States of America*]

Black-footed and Laysan albatrosses are the main species encountered by the Hawaiian pelagic longline fishery. The swordfish fishery is near where these seabirds live and feed. Historically some fishers have used the following methods to reduce the attraction or frighten the seabirds away:

- nightsetting — vessels set 1 hour after sunset to catch the diurnal movement of the swordfish;
- bait dyeing — this tactic was borrowed from the United States of America east coast fishers who found that blue-dyed bait increased their catch of swordfish. Fishers in Hawaii catch fewer seabirds when they use blue-dyed bait. Its use requires preparation and can be intrusive to the operation;
- strategic offal discards — fishers discard offal as a decoy to keep the seabirds away from the vessel and hooks. This method involves the need for storage space, time, and labour;
- no offal discards — similar problems as listed above may occur with this method;
- tori lines — seabirds tend to forage behind the aerial streamer portion of the tori line, but there are problems with entanglements with the mainline;
- towing a buoy provides an added splash zone behind the vessel while the baits sink.

The mitigation project studying the swordfish fishery resulted in the following seabird bycatch rates, depending on the mitigation measure in use: 1.57 seabirds per 1000 hooks for the control, 0.88 for the towed buoy system, 0.47 for the tori line, 0.32 for the strategic offal discharge, and 0.12 when dyed bait were used. There were fewer interactions when strategic offal discarding and blue-dyed bait were used on the set. On the haul the towed buoy, tori line, and dyed baits were most effective. The catch per unit effort for the main target species was higher when the dyed bait was used, and the catch of blue sharks was lower.

Report Back from Modellers

[Chair: John Croxall, British Antarctic Survey, England]

This session provided an opportunity for the modellers to report back on issues raised in the modelling discussion held on Day 2. A summary of the presentations given by John Croxall, Anthony Starfield, Jean Dominique Lebreton, and Henrik Moller is given below.

Structured thinking is vital to the modelling process. Endangered species need to be dealt with in their specific context, whereas other species would benefit from general reduction in bycatch. Therefore, there are different solutions for different problems. Decisions need to be made about what is important and urgent. Solutions can then be matched to the problems. An example of this is the Expert System: this computer-based system may consider variables such as where the fishery is, what species of seabird is impacted, and when the fishing takes place.

Data needs for such a system include a global map of where and when seabirds are vulnerable to hooks. This would require data on catch and effort in space and time, on where the seabirds feed in space and time, and on bycatch and mitigation effort in space and time. The use of international systems would provide both global and integrated perspectives, identify any important gaps of knowledge, help define policies and incentives, and provide education and feedback to stakeholders.

To use modelling as a tool to improve monitoring and prioritising of effort, the following would need to be considered:

- can models help design monitoring efforts?

- can models offer a compromise for the financial resources spent monitoring bycatch compared with carrying out population censuses (especially important for those species that are widely distributed)?
- can models provide the information needed to feed back into management decisions?
- can models be used to supply estimates such as the number of individuals and generation time (mean age of females at first breeding) for seabird species?

The complexity of seabird-fisheries interactions includes: multiple objectives and values, different seabird population problems, different human problems, different mitigation capacity, and alternative regulatory methods. A stochastic simulation would produce a decision analysis process to determine the best approach to take, even when some information is not available.

In conclusion, for the best use of models, the modellers need well-defined briefs. These need to be developed by the whole community working co-operatively, such that the whole process can interact more successfully.

Discussion: Participants noted the problem of getting any IUU data and that estimates of seabird bycatch data from landings would produce wide variance. Participants acknowledged that structured observer programmes would ensure reliable estimates. However, there are different levels of resolution, and an integrated bottom-up approach that was fishery specific and area specific could be used on which to base voluntary codes that work well for all.

Day 4 — Thursday, 9 November 2000

Advocacy and Education Programmes

[Chair: Heather Scott, Tuna NZ (Inc), New Zealand]

Fundamental to the success of the uptake and implementation of seabird bycatch mitigation measures is education of the issues involved with seabird bycatch — on local, national, and global levels. Advocacy and education programmes must provide motivation for changes in behaviour and facilitate the development of trust. Programmes developed for the Alaskan, Hawaiian, New Zealand, and Australian fisheries are summarised below.

Advocacy and education programmes in the demersal longline fisheries off Alaska

[*Kim Rivera, NOAA–National Marine Fisheries Service*, *United States of America*]

The demersal fleet that operates in the Alaska EEZ is comprised of 2 primary fleet components: the larger freezer-longliner vessels, most with auto-baiters, that fish for Pacific cod and turbot, and the smaller vessels that are part of the IFQ halibut and sablefish fishery.

Some 80–100 million seabirds occur over the waters of these fisheries. Several of the seabird species are known to interact with commercial longline vessels, such as northern fulmars and Laysan's, black-footed, and short-tailed albatrosses. The focus of the advocacy and education programme is to reduce incidental capture of these species by changing how the fishers set their gear and therefore to minimise the number of seabirds they take.

The message being conveyed to industry, the public, government, non-governmental organisations, and internationally is that the incidental take of seabirds (particularly that of the short-tailed albatross) needs to be reduced, and there are practical and effective ways for doing so. This requires collaborative and cooperative efforts between a variety of groups. The education and advocacy programmes include:

- seminars, symposiums, and advisory sessions at local, national, and international levels,
- research such as the effectiveness of seabird bycatch mitigation measures,
- distribution of printed material and videos including brochures, national magazines, *Catching Fish Not Birds*, regulations,
- public presentations and posters,
- NMFS Alaska Region website, seabird link on website of gear supplier, and seabird bycatch listserver,
- observers providing information on effective use of mitigation devices and seabird identification,
- individual vessel accounting system (run by a private consulting firm) providing summaries of seabird bycatch and its distribution, and
- free paired streamer lines and cost-reimbursement for davit installations to longline permit holders that apply.

Advisory Officer, New Zealand domestic tuna longline fishery

[*Jacqui Burgess, Ministry of Fisheries, New Zealand*]

A position for a technical Advisory Officer to work with the domestic tuna longline fleet was established in March 1999, on the recommendation of industry representatives and government officials. The key objective of the position was to provide a liaison and education role with the domestic tuna longline fleet fishers. The advisory officer had the following tasks:

- meet with the skippers of as many vessels in the North Island tuna longline fleet as possible,
- provide vessel specific advice on how best to address the problem of seabird bycatch and this included the construction of tailor-made tori lines and production of a folder of information relevant to seabird bycatch for fishers, and
- explain to skippers why seabird conservation issues are of concern.

This role also provided information on where there were gaps in the fishers' knowledge and understanding of seabird bycatch and associated regulations. The advisory officer also undertook some trips on small domestic longliners to further understand the interaction of seabirds with this tuna longline fleet. In doing so, he made himself available as a crew member and this enhanced the working relationship and allowed more sharing of information. The funding for this position (and all the other seabird bycatch mitigation research) is recovered from the fishers through levies collected by the Ministry of Fisheries. The role of the Advisory Officer has resulted in a better relationship between the industry and the government. This role is being continued and widened to include other domestic longline fisheries.

The Hawaii Pelagic Longline Fishery Protected Species Workshop

[*Sean Timoney, Hawaii Longline Association, United States of America*]

The Hawaii Pelagic Longline Fishery Protected Species Workshop was designed by NOAA-National Marine Fisheries Service (Pacific Islands Area Office) as an education tool for longline fishers, so that the fisheries can be managed to prevent overfishing and the bycatch of non-target species is minimised. The objectives are to make Hawaii fishers aware of the protected species interactions (especially seabirds, sea turtles, and marine mammals) and to educate the fishers on the handling of live animals and seabird bycatch mitigation methods. It provides information on the protected species laws and regulations, identification of protected species, and mitigation techniques. All Hawaii permitted longline vessel owners and operators will be required to attend annual protected species workshops in order to receive a protected species workshop certificate.

Advocacy and education in the Australian tuna longline fishery

[*Barry Baker, Environment Australia, Australia*]

Swordfish and tuna species are the main target species in the pelagic tuna longline fisheries in Australian waters. Fishing effort has dropped from almost 30 million hooks (set mostly by Japanese vessels) in 1990 to about 13 million in 1999 (all domestic fishing effort). Longline fishing takes place off the east coast of Australia, around Tasmania, and off southwestern Australia. Most of the historic observer coverage has been on Japanese vessels and the seabird bycatch rates for these vessels have varied from about 0.41 to 0.1 seabirds per 1000 hooks. There are no equivalent domestic data, but the bycatch rate is thought to be about 0.1–0.2 seabirds per 1000 hooks. An advocacy and education programme set up by the government and fisheries management in 1993 aims to inform fishers about seabird bycatch and the available seabird bycatch mitigation measures. The educational material produced included *Catch Fish Not Birds* targeting Japanese fishers, *Catching Fish Not Birds* targeting Australian fishers, Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (distributed to all licence holders in 1998), and the video *Catch Fish Not Birds*.

Simple messages about the problems and solutions, the avoidance of bycatch, and the economic benefits of minimising bycatch were relayed with easily read text, simple illustrations, and cartoons. Little success (as measured by a reduction in bycatch rate) was seen in the Japanese fleet fishing around Tasmania in winter — in subsequent years after the introduction of the Japanese booklet, seabird bycatch rates doubled. A survey of domestic fishers in 1998 showed that about 97% were aware of the available seabird bycatch mitigation measures, but that about 67% complied with tori line use, 64% with offal discharge, 56% with line weighting, and 26% with nightsetting. These results imply that full adoption of seabird bycatch mitigation measures and reduced bycatch will not result from education programmes alone, but will require an increase in enforcement activities.

Comment: It was agreed that all education and advocacy programmes must be ongoing, with adequate follow-up mechanisms in place. It was also suggested that there is an increasing role for observers in this work, but that observer duties must be dedicated to seabird bycatch rather than to fish data collection.

Changing people's behaviour

[Chair: Richard Cade, New Zealand Tuna Trollers' Association, New Zealand]

This session provided information on selling ideas and convincing people to change their behaviour to enable participants to turn ideas into action at the close of the forum. A summary is presented below.

Effective ways to change behaviour

[*Linda Hutchings*, *Brainstorm*, *New Zealand*]

People hate change if it is forced upon them, but like it if they have some input and control of change. Ninety percent of our behaviour is habit and to change a habit there needs to be some kind of reward. We may change away from something that is uncomfortable or move towards something that we like. Often we know how to change, but we don't change because of the benefits and comforts derived from our habits.

There are several things to be considered in changing people's attitudes:

- **Who do you want to change?** Whose attitude do you want to change the most for the best impact? Decide on the level of impact you might want — one that offers the best return on investment of your time, energy, and resources. For example, you might look at those on the continuum of support (non-supporters through to the supporters), or those involved in the fishery (people fishing through to those who may fish in the future), or on a larger-scale (from individuals through to the global level).

- **Who is most effective to deliver the message?** The message deliverer must be able to grab and excite. We have the idea that co-operation means that only one person can win, and we see what we expect to see. Therefore, to get co-operation we need to build up trust.

- **What do you want to change?** To attract others we need to have a clear vision of the goal — of what we are trying to draw others towards. This needs to be at their level. Information is power and needs to be accessible and practical. Usually about six things are needed to make a difference of 80%, and each of these has equal importance as together they produce success. You also need to ask, "**what doesn't work?**" and "**What's risky?**", thereby creating a climate of trial and error to find new ways.

- **How do you bring about the change?** "Telling" someone to do something doesn't invite behavioural change. You need to **involve** the person such that there is "buy-in" and commitment. "No involvement, no commitment." You are 10 times more likely to change behaviour if you involve people in the discussion about change.

  - Use **repetition**. The first time something happens is called an "event", the second time is a "coincidence", the third time is a "pattern", and the fourth time is "undeniable". Therefore, the message needs to be repeated in a variety of ways and from a range of different sources.
  - Adapt all the information to all **learning styles** (watching, listening, doing). Remember that learning occurs at the average level.
  - Make the change **multi-layered** — the more layers or goals, the better the changes.
  - Have **written plans** so that people give their commitment.
  - We all can **lead** by example and behaviour and can therefore role-model the changes we want to see. There is a perception that leadership is at the top level of management, but leaders are at all levels. **Celebrate success; acknowledge it.**

Existing international initiatives

Some initiatives aimed at minimising seabird bycatch in longline fisheries are already in place or close to agreement and summaries of these were presented.

FAO International Plan Of Action

The International Plan of Action for reducing the incidental catch of seabirds in longline fisheries (IPOA-SEABIRDS) was developed during FAO Committee of Fisheries meetings in 1998 as a voluntary code within the framework of the FAO Code of Conduct for Responsible Fisheries. The IPOA-SEABIRDS provides technical notes and guidance on the seabird bycatch mitigation measures available and encourages States to:

- conduct assessment to determine if a problem exists with respect to incidental catch of seabirds,
- adopt a National Plan of Action (NPOA) if there is a problem,
- design, implement, and monitor the NPOA,
- implement no later than February 2001,
- regularly assess NPOA, at least every 4 years, and
- report back to FAO every 2 years.

The content of the NPOA should include:

- prescription of mitigation measures,
- research and development to improve and evaluate the effectiveness of mitigation measures,
- education, training, and publicity to raise awareness, provide information about technical or financial assistance, and provide outreach programmes, and
- reliable data collection, as may be provided from observer programmes.

Illegal, Unregulated, and Unreported Fishing

The FAO 1999 Committee of Fisheries meeting agreed to develop a IPOA to combat IUU fishing. The approach taken will be a top-down approach by government agencies, with the aim that governments will:

- collaborate fully in negotiations within FAO on its IPOA to prevent, deter, and eliminate IUU fishing,
- cooperate fully with existing international schemes of catch documentation,
- establish new catch documentation schemes/mechanisms as appropriate,
- develop, contribute to, and use official national and international registers of vessels recorded to have engaged in IUU fishing, and
- refuse to flag and/or licence to fish vessels with a record of engagement in IUU fishing.

Agreement on the Conservation of Southern Hemisphere Albatrosses and Petrels

It is hoped that this regional agreement developed in Australia in July 2000 will be signed off in early 2001. The agreement recognises the threats in the range of these seabirds (including those threats other than fishing, such as plastics and degradation of nesting grounds). The current draft acknowledges that, on a global scale, fisheries management is not lessening the impact of fishing practices on the incidental catch of seabirds and looks to develop mechanisms that would be used by all the States within the range of the seabird species of concern to ensure adequate conservation.

Translating Ideas into Action

[Chair: Viv Thomson, International Fishers' Forum facilitator, New Zealand]

Participants formed the demersal and pelagic working groups and used this session as an opportunity to utilise the information gained over the previous sessions of the forum to generate ideas and actions that will minimise the incidental capture of seabirds in longline fisheries. The main discussion points were: implementation of seabird bycatch mitigation measures, research priorities, and education and advocacy. The following actions were generated from both the pelagic and demersal working group discussions.

Actions required

The implementation of seabird bycatch mitigation measures, research programmes, and advocacy and education programmes are fundamental to the use and effectiveness of seabird bycatch mitigation measures. Actions the plenary considered necessary included:

1. Individual fishing entities and regional fisheries where there is evidence of a seabird bycatch problem will adopt seabird bycatch mitigation measures that suit their fisheries from the suite of proven measures.

2. Individual fishing entities and regional fisheries for which that evidence is not available undertake to collect the necessary information.

3. International agencies will be approached to provide finances to enable exchange of expertise, both technical and educational, and the purchase of seabird bycatch mitigation measures to enable the fishers to go forward with their mitigation programme.

4. Publish lists of fishers that are complying with seabird bycatch mitigation measures in local fishing magazines.

5. Fleets will undertake self-policing and self-reporting.

6. At an international level, information should be disseminated through all sectors of the fisheries, governments, non-governmental organisations, and regional organisations. All information should be produced in appropriate language for its readership and take account of the values of the people in each fishing entity and emphasise the conservation message for today and future generations and the money value to fishers.

7. Codes of Practice should be instigated in some nations with associated incentives and compliance standards.

Outcomes of the Forum

Participants decided unanimously to meet again in two years' time and Hawaii was proposed as the venue for a second forum in 2002. This will enable participants to further the work started at this forum, report back on the progress made in their individual fishing entities or regions, and encourage those fishing entities or regions not present to attend. It was acknowledged that an integrated "bottom-up" fishery-specific and area-specific approach was required.

Participants recognised the need for ongoing research and development and acknowledged that progress would be determined by their own contribution within their own fishing entities, regions, or organisations. In this way each entity will set their own objectives in recognition of the differences in expertise and economy. In the two-year intersessional period, participants will communicate through a list-server.

Participants agreed to undertake actions specific to their fishing entity or region by the end of 2002 and these are listed in the Executive Summary. Furthermore, the New Zealand organising committee offered to form a working group which would identify funding sources to undertake the following tasks:

- establish an international longline fisheries database to enable seabird bycatch information to be overlaid on longline fishing effort data;
- establish a list-server; and
- develop standards for use of mitigation measures to be incorporated into National Plans of Action.

Participants from Australia, New Zealand, and the United States of America agreed to work with South American countries to develop a proposal for the APEC Fisheries Working Group for funding to assist these countries address seabird bycatch in their fisheries. The representative from FAO informed participants that FAO has funds available to assist countries in the preparation of their National Plans of Action.

Closing Address — Ambassador Satya Nandan

First, I should like to commend all the presenters for the quality and quantity of the information provided and all of you participants for your hard work.

In my opening address on Monday, I remarked on the unique nature of this event, particularly the involvement of fishers, researchers, representatives of various international agencies and government officials. I urged you to think about how you would take back to your own countries the lessons that you would learn from being together, and to consider carefully the tools you would need to spread the key messages to your own fleet. I have found myself undertaking a similar exercise in preparation for returning to the United Nations.

For me, one of the most memorable things has been the active and highly constructive role that has been played over the last few days by the fishers. One of the most important messages for me has been that there are several simple, inexpensive, and effective ways in which the bycatch of seabirds on longlines can be greatly reduced. The willingness of some fishers to share their experiences with others who may not be aware of these simple seabird bycatch mitigation measures is extremely encouraging. A range of possible approaches have been discussed, and although the specific mix may vary from fishery to fishery, it seems to be clear that a combination of seabird bycatch mitigation measures will be most effective in reducing seabird mortalities. Each of you therefore needs to consider what will work best in your own situations, and, if necessary, how to persuade your colleagues to adopt at least the most simple seabird bycatch mitigation measures and how to refine and improve on the basic procedures.

Another very encouraging feature of this meeting has been the call by numerous speakers for a “bottom-up” approach, in which the fishers and researchers take the initiative in deciding how to achieve significant reductions in seabird bycatch, instead of waiting for national or international authorities to impose “top-down” solutions.

Ownership of a problem by stakeholders, and the development of voluntary steps to address it, will always be a better way forward than the imposition of compulsory regulations that often cannot be effectively enforced.

There is, however, one important area in which governments of the international community must act decisively and in unison, and that is to eliminate IUU fishing, and I can assure you all that I shall be carrying that message back to my colleagues in the United Nations and other fora.

I have also been impressed by the progress that has been made by some countries represented here in developing their National Plans of Action to mitigate seabird bycatch. This would be a logical and necessary follow-up of the FAO Plan of Action. I hope that in addition to the usual donor sources, organisations such as FAO and the World Bank Global Environment Fund can help to provide the funding that will allow developing countries to begin developing their own Plans. This will be greatly facilitated by the active assistance of many of you in this room. Transfer of information and technology is important not only for mitigation development, but also for the establishment and administration of observer programmes. As you have all recognised, there is also a need for ongoing research and monitoring.

I was particularly pleased that as a group you have identified the following three key areas of future work, all of which have also been identified as key areas in the IPOA-SEABIRDS:

- implementation of seabird bycatch mitigation measures,
- research programmes, and
- advocacy and education.

The great challenge that you will all be facing when you leave Auckland is how to keep up the momentum that has been created in the past four days. The working groups that have been proposed are essential if the sound proposals that have been elaborated are to be implemented. I am delighted that you are all enthusiastic about meeting again in Hawaii in 2002 to review progress. In the meantime, I urge you to keep your governments well informed about your work programmes. Through them, the international community will also be kept advised, and the deliberations of the United Nations and its various agencies, especially the FAO, will be better informed.

On behalf of all the participants, I would like to thank the organisers of this very successful Forum. We have all appreciated very much the efficient manner in which the proceedings have been conducted. We thank you in particular for the very warm hospitality that has been accorded to us.

Finally, I wish you all a safe journey home and hope that you will keep everyone advised of your ongoing efforts to make the world's oceans safer for seabirds. One way of doing this is through reports to the FAO and in the reports of the United Nations Secretary-General on Ocean Affairs and the Law of the Sea. I shall return to my own responsibilities greatly encouraged by your resolve and commitment and the example you are setting to the world.

Appendix 1

Forum Programme

Day 1 – Monday, 6 November

8.30 am	Registration (for those who did not register the previous evening)	
9.00 am	Welcome/powhiri Hugh Logan, Director General of the Department of Conservation	
9.30 am	Keynote Speaker - Ambassador Satya Nandan *Ambassador Nandan will provide an international perspective.*	Chair: Hugh Logan
10.00 am	Response to Ambassador Nandan and Questions Warwick Tuck, Chief Executive, Ministry of Fisheries	Chair: Warwick Tuck
10.15 am	Morning Tea	
10.45 am	Overview of Northern and Southern Hemisphere Longline Fishing Industry *This session will be short presentations from a selection of participants, covering topics such as location of fisheries, target species, fishing methods and interactions with seabirds. The common issues from the presentations will be summarised and recommendations developed during the first session of Day 2.*	Chair: Tom Birdsall
12.00 pm	Lunch	
1.00 pm	Continuation of Overview of Northern and Southern Hemisphere Longline Fishing Industry	Chair: Tom Birdsall
3.00 pm	Afternoon Tea	
3.30 pm	Overview from a Seabird Biologist John Croxall *An overview of seabird issues, including where seabirds feed and forage, brief population biology, and overlap with fisheries. There will be time allowed for questions and discussion.*	Chair: Janice Molloy
4.00 pm	Overview of Population Modelling Tony Starfield *This session will provide an overview of models as population management tools, including what models can and can't do, data requirements, how data is collected. Time will be available for questions and discussions, although the topic will be examined in more detail on Day Two.*	Chair: Jacqui Burgess

4.30 pm	Management Approaches to Solving Seabird-Fisheries Interaction Lee Robinson *This session will outline frameworks for managing seabird–fisheries interactions, ranging from voluntary codes of practice through to international agreements.*	Chair: Mike Donoghue
5.00 pm	Facilitated Discussion on Potential Forum Outcomes.	Chair: Viv Thomson
6.30 pm	Sponsors cocktails in exhibition area, followed by Poolside Barbecue. Entertainment: Polynesian cultural performances	

Day 2 – Tuesday, 7 November

8.30 am	Discussion on Longline Fishing Overview Session From Day 1 *Facilitated session to summarise issues, themes and make recommendations. A panel will assist the facilitator.*	Chair: Viv Thomson
9.30 am	Modellers' Case Studies *Three seabird population modellers will present their case studies on the effect of fisheries interactions on seabird populations.*	Chair: John Croxall
10.30 am	Morning Tea	
11.00 am	Panel of Modellers *A panel of seabird population modellers will answer questions from participants. The panel will take away issues requiring further consideration and will report back on Day 3.*	
12.00pm	Lunch	
1.00 pm	Fishers' Case Studies *Fishers will report on mitigation methods tested on their vessels and describe what has and has not been effective.*	Chair: Janice Molloy
3.00 pm	Afternoon Tea	
3.30 pm	Panel of Fishers *The fishers that presented case studies will answer questions from participants. Others who have used mitigation methods are welcome to contribute their experience. Working groups will then assess mitigation measures and research priorities.*	Chair: Janice Molloy
Evening	Participants sign up into different groups for dinner. Sign up sheets will be available during the day.	

Day 3 – Wednesday, 8 November

8.30 am	Seabird Behaviour Rosie Gales *A review of aspects of seabird behaviour relevant to the development, use, or evaluation of mitigation measures. This includes seabirds' diving abilities, sight, smell, methods of locating prey, day/night activity.*	Chair: Richard Cade
9.00 am	Discussion on progress towards agreed outcome.	Chair: Viv Thomson
9.30 am	Integrating Mitigation Measures with Longline Fishing Operations *A working group session in which participants will contribute their ideas on the operational aspects of longline fishing that need to be considered when developing mitigation measures.*	Chair: Viv Thomson
10.30 am	Morning Tea	
11.00 am	Existing and New Mitigation Measures *A number of presentations will be made on scientific programmes to assess effectiveness of new and existing and new mitigation methods, including descriptions, evaluation of effectiveness in reducing seabird capture, evaluation of impact on fishing operations. Participants that are developing mitigation techniques are welcome to share their ideas, and a discussion will follow.*	Chair: James Hufflett
12.30 pm	Lunch	
1.30 pm	Continuation of Existing Mitigation Methods	Chair: James Hufflett
2.30 pm	Report Back from Modellers *The panel of modellers will report back on the issues raised in Day Two's morning session.*	Chair: John Croxall
3.30 pm	Afternoon Tea	
4.00 pm	Port Visit *Fishing boats from New Zealand's long line industry will be in port, for those who would like to visit.*	
	Forum Dinner – The Tea Room	
7.30pm	Pre-dinner Drinks	
8.00pm	Dinner MC: Bruce Young, Chief Executive Office, Moana Pacific Fisheries Limited Pre-dinner speaker: Kim Westerskov (New Zealand Photographer) Entertainment: The Retro Kids	

Day 4 – Thursday, 9 November

8.30 am	Coffee and croissants in exhibition area
9.10 am	Advocacy Education Programmes — Chair: Heather Scott *People who have been involved with advocacy and education programmes will present their experiences.*
10.15 am	Changing People's Behaviour — Chair: Richard Cade Linda Hutchings *This session will provide information on selling ideas and convincing people to change their behaviour. This will enable Forum participants to turn ideas into action at the close of the Forum.*
11.15 am	Morning Tea
11.30 am	Small Working Group Session. **Theme "Translating Ideas Into Action"** — Chair: Viv Thomson A working lunch provided for each group. *An opportunity to use the information gained over the last 3½ days to generate ideas and actions that will solve the incidental capture of seabirds in longline fisheries.*
1.30 pm	**Where to from Here?** — Chair: Ambassador Satya Nandan *A representative from each group will present the outcomes from the sessions and an overall series of actions will be generated. These will be used as a basis for the outcomes from the Forum.*
4.00 pm	**Close of Forum** Ambassador Satya Nandan

Appendix 2

Acronyms and scientific names used in the report

Acronym	
APEC	Asia Pacific Economic Cooperation
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CDQ	Community Development Quota
COFI	Committee on Fisheries
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organisation of the United Nations
IOTC	Indian Ocean Tuna Commission
IPOA-SEABIRDS	FAO International Plan of Action for reducing incidental catch of seabirds in longline fisheries
GRT	Gross Registered Tonnage
ICCAT	International Commission for the Conservation of Atlantic Tunas
IFQ	Individual Fisherman's Quota
IUCN	World Conservation Union
IUU	Illegal, Unregulated, and Unreported
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPOA	National Plan of Action
UNCLOS	United Nations Conference on the Law of the Sea (December 1982)
UNFSA	United Nations Fish Stocks Agreement
USFWS	United States Fish and Wildlife Service

Alphabetical list of the main target fish species

Common name	Scientific name
Albacore tuna	*Thunnus alalunga*
Antarctic toothfish	*Dissostichus mawsoni*
Argentine hake	*Merluccius hubbsi*
Bigeye tuna	*Thunnus obesus*
Catfish	*Netuma* spp.
Dogfish	*Squalus acanthias*
Greenland turbot	*Reinhardtius hippoglossoides*
Grouper	*Epinephelus* spp.
Hake	*Merluccius* spp. including *M. hubbsi*
Ling, kingclip	*Genypterus blacodes*
Northern bluefin tuna	*Thunnus thynnus*
Pacific cod	*Gadus macrocephalus*
Pacific halibut	*Hippoglossus stenolepis*
Patagonian toothfish	*Dissostichus eleginoides*
Rockfish	*Sebastes* spp.
Sablefish	*Anoplopoma fimbria*
Snapper	*Pagrus auratus*
Southern bluefin tuna	*Thunnus maccoyii*
Swordfish	*Xiphias gladius*
Tilefish	*Lopholatilus vilarii*
Wreckfish	*Polyprion americanus*
Yellowfin tuna	*Thunnus albacares*

Alphabetical list of seabird species* mentioned in the report

Common name	Scientific name
Amsterdam albatross	*Diomedea amsterdamensis*
Antarctic (southern) fulmar	*Fulmarus glacialoides*
Antarctic petrel	*Thalassoica antarctica*
Antarctic prion	*Pachyptila desolata*
Antarctic terns	*Sterna vittata*
Antipodean albatross	*Diomedea antipodensis*
Atlantic yellow-nosed albatross	*Thalassarche chlororhynchos*
Black petrels	*Procellaria parkinsoni*
Black-browed albatross	*Thalassarche melanophrys*
Black-footed albatross	*Phoebastria nigripes*
Buller's albatross	*Thalassarche bulleri*
Campbell albatross	*Thalassarche impavida*
Cape pigeon (Pintado petrel)	*Daption capense*
Chatham albatross	*Thalassarche eremita*
Galapagos (waved) albatross	*Phoebastria irrorata*
Gannets	*Morus* spp.
Greater shearwaters	*Puffinus gravis*
Grey petrel	*Procellaria cinerea*
Grey-headed albatross	*Thalassarche chrysostoma*
Gulls	*Larus* spp.
Imperial cormorants	*Phalacrocorax atriceps*
Kelp gulls	*Larus dominicanus*
Laysan albatross	*Phoebastria immutabilis*
Light-mantled sooty albatross	*Phoebetria palpebrata*
Magellanic penguin	*Spheniscus magellanicus*
Northern fulmar	*Fulmarus glacialis*
Northern giant petrel	*Macronectes halli*
Northern royal albatross	*Diomedea sanfordi*
Rockhopper penguin	*Eudyptes chrysocome*
Salvin's albatross	*Thalassarche salvini*
Short-tailed albatross	*Phoebastria albatrus*
Shy albatross	*Thalassarche cauta*
Skuas	*Catharacta* spp.
Snow petrel	*Pagodroma nivea*
Sooty albatross	*Phoebetria fusca*
Sooty shearwaters	*Puffinus griseus*
Southern giant petrel	*Macronectes giganteus*
Southern royal albatross	*Diomedea epomophora*
Spectacled petrel	*Procellaria conspicillata*
Tristan albatross	*Diomedea dabbenena*
Wandering albatross	*Diomedea exulans*
Westland petrel	*Procellaria cinerea*
White-chinned petrel	*Procellaria aequinoctialis*
Wilson's storm petrel	*Oceanites oceanicus*

* Species used are from Gales, R. 1997: Albatross populations: status and threats. Chapter 3. *In Robertson*, G. & Gales, R. "Albatross Biology and Conservation", pp. 13–19. Surrey Beatty & Sons, Chipping Norton.

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