PROCEEDINGS OF

THE SECOND INTERNATIONAL FISHERS FORUM

November 19–22, 2002

Hawaii Convention Center, Honolulu, Hawaii

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Edited by Noreen M. Parks

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SECOND INTERNATIONAL FISHERS FORUM

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Table of Contents

Closing Statement

Appendix 1

Appendix 2

Appendix 3: Sea Turtle Identification Guides

Appendix 4: Seabird Identification Guides

Foreword

KITTY M. SIMONDS

Aloha!

On behalf of the organizers of the Second International Fishers Forum (IFF2), I would like to thank all of the people involved in making IFF2 such a resounding success. A special mahalo goes to the Forum sponsors—in particular, the Hawaii Longline Association, the National Marine Fisheries Service, the North Pacific Fishery Management and the Western Pacific Fishery Regional Fishery Management Council.

IFF2 built on the successes and maintained the momentum established at the First International Fishers Forum (IFF1), held in New Zealand in 2000. This second Forum brought together a greater diversity of fishery participants from around the world and focused not only on seabird longline bycatch but also incidental catches of sea turtles in pelagic longline fisheries. Altogether, a total of 236 participants from 28 different countries discussed these issues and exchanged perspectives and solutions during the plenary and breakout sessions.

The state of fisheries around the world and their impacts on marine ecosystems are attracting greater scrutiny and attention from governments, conservation organizations and the public at large. Many seabird and turtle populations have been severely reduced by a variety of man-made or anthropogenic sources, fisheries among them. As with many problems, the solutions will be found within the matrix of the problem itself, and, in the case of fishery bycatch, it is fishermen who can lead the way in finding the answers. IFF2 was successful in increasing the awareness of longline fishermen about the seriousness of seabird and turtle bycatch and fostering a sense of urgency that fishermen must take a leadership role in tackling these problems.

We hope that between now and the next forum that IFF2 participants will continue to work on the commitments they made at this meeting and, in particular, securing greater participation by the major longline fishing nations at the Third International Fishers Forum. We look forward to seeing you there.

Thank you,

Kitty M. Simonds
Executive Director

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Longline fisheries accidentally hook and kill seabirds, such as albatross, by the tens of thousands each year. Finding the solution to this problem is a priority for regional, national and international governments and organizations.

Likewise, sea turtle populations throughout the world have declined greatly over the last century. Some populations have been driven to near extinction. The primary causes of this decline are the direct harvest of nesting females and their eggs; the destruction of nesting and foraging habitat; marine pollution; and the incidental capture of sea turtles in various types of fishing gear, including longline gear.

While work to develop solutions to reduce the bycatch of sea turtles and seabirds by longline gear has begun, fishermen, managers and scientists recognize that these efforts must be enhanced and collaboration must be pursued internationally as these species are highly migratory, inhabiting the waters of many nations during their life cycle.

To further this cause, the Western Pacific Fishery Regional Fishery Management Council hosted the Second International Fishers Forum (IFF2), Nov. 19–22, 2002, in Honolulu.

IFF2 built on the First International Fishers Forum (IFF1) held in Auckland, Nov. 6–1, 2000, organized by the New Zealand Government's Department of Conservation and Ministry of Fisheries, in association with the New Zealand Seafood Industry Council. Many of the world's leading longline fishing fleets were represented at IFF1 to exchange information and develop practical measures to minimize the incidental capture of seabirds in longline fishing operations. Participants agreed that the incidental capture of albatrosses and petrels in longline fisheries was a serious problem that has had significant impacts on the populations of some species over the past 20 years. They recognized the need for ongoing research and development and acknowledged that progress would be determined by their own contributions within their own fishing entities, entity, region and organization was to set its own objectives based on its particular expertise and economy.

IFF2 widened the focus of IFF1 to address the bycatch of sea turtles as well as seabirds by longline fishing gear. IFF2 had the following objectives:

- To increase the awareness of fishermen to the incidental longline catch of seabirds and sea turtles that may pose a serious problem to these populations and to the continued operations of longline fishing.
- To promote the development and use of practical and effective seabird and sea turtle management and mitigation measures by longline fishermen.
- To foster an exchange and dissemination of information among fishermen, scientists, resource managers and other interested parties on the use of mitigation measures and the development of coordinated approaches to testing new measures.
- To promote the development and implementation of collaborative mitigation research studies by scientists, fishermen, resource managers and other interested parties.
- To build on IFF1, encouraging continued progress and new participants.

More than two hundred representatives from fishing industries, government agencies, nongovernmental organizations and other interested parties from 28 countries in the Atlantic, East and Central Pacific, North Pacific and South Pacific participated in IFF2.

Ambassador Satya N. Nandan, Secretary-General of the International Seabed Authority, delivered the opening remarks, setting ambitious goals for the Forum participants: "The longline fishing industry has been proactive in developing mitigation measures for seabird interactions, for example, tori poles, blue dyed bait, and setting chutes are all ideas that stem from longline fishermen, and were developed with the cooperation of the longline industry," he noted. "The same inventiveness now needs to be applied to the problem of reducing longline-turtle interactions. …By taking a proactive role in the development of turtle mitigation technology and strategies longline fishermen will provide an effective rebuttal to more draconian solutions which have been proposed such as outright longline bans or severe constraints on longline fisheries."

Assisted by professional facilitators, the participants engaged in four days of plenary and breakout sessions focused on eight themes. Some of the sessions included "fishermen only" groups, while others were open to all.

The Seabird Mitigation and Research Session participants generally agreed that existing mitigation practices have positive impacts and the need is not for new technologies but for fine-tuning and broadening the use of existing technologies. They also agreed that improved mitigation results would likely come from better crew training, expanded testing in different regions, new vessel construction and the development of minimum standards. Participants strongly believed that no single mitigation technology was likely to serve as a "silver bullet."

Instead, the best results would likely come from developing a "toolbox" consisting of suites or combinations of measures. Ultimately, these solutions would need to be incorporated into the design of new vessels.

The Sea Turtle Mitigation and Research Session participants agreed that the major challenges standing in the way of finding a means to reduce sea turtle–longline bycatch include data needs on the biology of target species and bycatch, effective gear modifications and fishing tactics, research facilitation and dissemination, and industry/public awareness and incentives for action.

The Data Collection Session participants focused on the overarching issues of insufficient data and enduring mistrust between fishermen, on the one hand, and those who collect and use the data, on the other hand. Most participants generally felt that there was ample room for improvement. Several cautioned that it might take some time to overcome the lack of trust that exists between the fishing industry and those responsible for monitoring and regulating it.

The Education/Communication Session participants said that fishermen need broad information on seabirds and marine turtles, such as vulnerability of populations, population trends, how to avoid catching them and how to release them. They said species profiles of marine turtles and seabirds would be useful to fishers, observers and schools and are worth reproducing. They suggested waterproof plastic books or folders, ring binders, or waterproof pocket flipbooks as the reproduction format and translations in Spanish, Portuguese, Mandarin, Japanese and English.

The Obstacles, Lessons Learnt and the Way Forward Session participants suggested improving international technical coordination among fishermen, gear manufacturers, biologists and others to produce new enhanced mitigation measures; closing the gap between fishermen and other concerned parties to enable them to work together more effectively and to build coalitions to realize commonly held goals; and better informing fishermen and consumers about the need for reducing incidental seabird and sea turtle bycatch in longline fisheries and of the progress that has been made by some fishermen and fisheries.

The International Agreements/National Approaches Session participants recommended the creation of an International Plan of Action (IPOA) on sea turtles, incorporating sea turtles into existing IPOAs and making international agreements less generalized and more specific. They noted that new ideas on mitigating turtle interactions have to be sold to the fishing industry, and good science is essential to accomplish this. They said fishing gear should include identification marks for the source fishery, as specified in the FAO Code of Conduct. The group agreed that the remote monitoring of fishing fleets by vessel monitoring systems is only really effective for time–area closures. They said feedback on research should be a professional courtesy and agreed that a mechanism is needed to assess the socio-economic impacts of measures implemented under international agreements. The group also proposed a list of items to be added to international agreements to improve their efficacy.

The Modeling Session participants participated in hands-on exercises using deterministic (where there is no randomness) and stochastic (where chance plays an essential part in the calculations) models. The industry people found models to be more complex than they had anticipated, but they expressed interest in using them in economic or business type applications. Some managers said the session helped them communicate with modelers or people who used models. The researchers were pleasantly surprised to discover what could be done with simple models, e.g., to convey data needs to those who collect the data.

The Fishermen Incentives Session identified effective incentive instruments to minimize the bycatch of seabirds and sea turtles in each represented longline fishery. Participants most commonly expressed an interest in instituting bycatch fee and exemption structures, industry self-policing and eco-labeling.

On the final day, several speakers provided participants with thoughts of encouragement and insightfulness as they prepared to write the Forum's outcomes.

In recounting US efforts to reduce incidental bycatch of sea turtles and seabirds, William T. Hogarth, NOAA Assistant Administrator for Fisheries, said: "One pattern certainly has emerged in these efforts to promote the development and use of practical and effective seabird and sea turtle management measures by longline fishermen: collaboration and an international focus yields the best results."

In a video address, US Sen. Daniel K. Inouye urged participants to "work especially hard to develop the international cooperation necessary for effective management. …One country alone cannot stem the jeopardy to the world's ocean resources; the effort must be international in scope." He proposed a multi-pronged approach efforts amongst industry experts, scientists and managers started at IFF1 and encouraging governments to support cooperative rather than unilateral approaches, efforts to protect sea turtle nesting grounds and mitigation of the effects of marine debris.

With the thoughts of these and other speakers as background, the participants drafted a Forum Resolution, which contains four action items:

- To request that the Western Pacific Regional Fishery Management Council present the findings of the Forum at the next Session of the Committee of Fisheries of the Food and Agriculture Organization.
- To encourage the FAO to organize an expert consultation with relevant international organizations to develop Guidelines leading to an International Plan of Action for the Reduction of Sea Turtle Bycatch from Marine Fisheries throughout the world's oceans.
- To invite the Convention on Migratory Species to consider how best to reflect the findings of IFF2 in the further development of existing and planned instruments for the purpose of conserving marine turtles and seabirds on a global scale.
- To encourage the FAO, relevant regional fisheries management organizations and national agencies to collaborate in the implementation and monitoring of the International Plan of Action to reduce incidental catches of seabirds in longline fisheries.

Another concrete outcome of IFF2 was the 65 commitments made by individual participants to a variety of projects to protect sea turtles and seabirds. They included the following actions:

- Share mitigation technologies with different fisheries in different nations.
- Commit to use and test more mitigation strategies and to encourage the same within particular fleets, fisheries and nations.
- Form a multi-stakeholder advisory committee to address mitigation, data collection and research needs within particular fisheries.
- Increase the involvement of fishermen in the development of new mitigation technologies;
- Secure the participation of more longline fishing nations and fishermen in reducing incidental bycatch of seabirds and sea turtles.
- Create public awareness campaigns regarding the issues being faced and the progress made to date.
- Improve communications between the different stakeholder communities.
- Improve logbooks and other data collection techniques.
- Conduct new research studies (e.g., turtle survivability and mitigation, line weighting studies).
- Develop databases and websites to improve information organization and dissemination and to provide educational materials to all necessary audiences.
- Improve communication and collaboration among agencies around the world that have drafted FAO National Plans of Action for seabirds and mentor other countries that have not yet done so.
- Increase the presence of NGO members on fishing boats.
- Organize further conferences on the topic.

Upon conclusion of IFF2, participants were asked a series of four exit questions. These questions assessed the success of the forum and provided a means to voice concerns or provide recommendations for future meetings. Based on the results of this questionnaire as well as the questionnaire completed during the IFF2 registration period, the following participant observations and recommendations were gleaned.

IFF2 provided participants with education, collaboration and networking opportunities as well as a better understanding and appreciation of regional and international bycatch issues. Participants gained motivation to continue working towards development of bycatch solutions and seemed eager to take home information or institute mitigation methods acquired at the Forum. Overall, this was seen as a positive and successful meeting on many levels, yet it was also widely recognized that work remains to address global awareness and implementation of mitigation measures.

The Forum concluded that there is a need to bring together all the nations that participate in longline fisheries to search for inclusive solutions that allows the fishers, seabirds and sea turtles to survive. The apparent lack of international participation from some major fishing countries, particularly those with distant-water fishing fleets, is a concern. Future organizers should focus on integrating these countries in the Forum process.

Participants also suggested that future Forum breakout sessions be restructured to promote and ensure integration of all stakeholders to facilitate the exchange of ideas, break down cultural barriers between scientists and fishers, and promote transparency. It would have been beneficial for participants to know each other's stakeholder status (fishermen, industry support, academia, research, government, NGO, etc.) and the region/area of the fishermen's operations.

Most important, perhaps, IFF2 concluded that the very active engagement of the fishers was a necessary component for a successful program. They recognized that most of the solutions to bycatch programs have originated with the fishers, so there is a need to develop mechanisms to encourage and channel the creativity of the fishermen.

With the progress and lessons learned from IFF1 and IFF2, the Third International Fishers Forum (IFF3) is bound to bring us closer toward finding and implementing solutions to reach our mutual goal of sustaining food fish harvests while protecting endangered and threatened species. We look forward to seeing you there!

Second International Fishers Forum Resolution

November 22, 2002

Whereas, representatives from fishing industries, government agencies, non-governmental organizations and other interested parties from over 28 countries participated in the Second International Fishers Forum held in Honolulu, Hawaii, for the purpose of addressing possible solutions to mitigate the incidental bycatch of sea turtles and seabirds by longline fishing gear;

Whereas, the participants deliberated on a wide range of issues, including: 1) Seabird and Sea Turtle Mitigation and Research; 2) Data Collection; 3) Education and Communication; 4) Obstacles, Lessons Learnt and the Way Forward; 5) International Agreements and National Approaches; 6) Fishermen Incentives and; 7) Seabird and Sea Turtle Population Modeling;

Noting with satisfaction, the proposed United Nations General Assembly resolution on large scale drift-net fishing, unauthorized fishing in zones of national jurisdiction and on the high seas/illegal, unreported and unregulated fishing, fisheries bycatch and discards and other developments;

Recognizing the need for population assessments, monitoring programs and increased awareness about all factors contributing to the mortality of sea turtle and seabird populations globally;

Aware of the relevance to sea turtle conservation of the Inter-American Convention for the Protection and Conservation of Sea Turtles, and of instruments developed under the Convention on Migratory Species (CMS) for sea turtles of the Atlantic Coast of Africa and of the Indian Ocean and South-East Asia;

Aware that International Plans of Action are currently in place to reduce incidental catches of seabirds in longline fisheries, and for the conservation and management of sharks;

Aware also of initiatives by various regional fisheries management organizations to collect data on the incidental catch of seabirds, and to institute appropriate data collection and mitigation procedures;

The participants of the IFF2 hereby resolve to:

Request that the Western Pacific Regional Fishery Management Council present the findings of this Forum at the next Session of the Committee of Fisheries of the Food and Agriculture Organization.

Encourage the Food and Agriculture Organization (FAO) to organize an expert consultation with relevant international organizations to develop Guidelines leading to an International Plan of Action for the Reduction of Sea Turtle Bycatch from Marine Fisheries throughout the world's oceans;

Invite the Convention on Migratory Species to consider how best to reflect the findings of this Forum in the further development of existing and planned instruments for the purpose of conserving marine turtles and seabirds on a global scale.

Further ***Encourage*** the FAO, relevant regional fisheries management organizations and national agencies to collaborate in the implementation and monitoring of the International Plan of Action to reduce incidental catches of seabirds in longline fisheries.

Welcome and Opening Addresses

2ND INTERNATIONAL FISHERS FORUM

HONOLULU, HAWAII ~ 2002

Welcoming Address and Ceremony

KITTY M. SIMONDS, EXECUTIVE DIRECTOR,
WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Aloha and welcome to Hawai'i. This meeting reflects many months of hard work by the sponsors and organizers of the Second International Fishers Forum. We are really happy to see so many of you here. This forum is going to provide an opportunity for fishermen, the industries that support fishing, fishery scientists and the conservation community to exchange and discuss ideas about ways to reduce the incidental catch of sea turtles and seabirds.

According to our latest count we have more than 220 participants, representing 14 U.S. states and 28 countries with longline fisheries. This includes 71 fishermen, 36 mitigation researchers and members of 14 conservation NGOs, with the balance comprised of fishery managers, representatives from international organizations and fishing gear manufacturers.

As we are all aware, fishing worldwide is under increasing scrutiny for its impacts on marine ecosystems. Over the past ten years longline fishing has been cited as a threat to protected birds and marine turtles. At the same time, longline fishing has continued to expand globally, particularly in Asia and the Pacific Islands. For the Pacific Islands especially, pelagic longline fishing is one of the few options for sustainable economic development. Consequently, reducing interactions with seabirds and turtles in longline fishing has become an urgent priority, both to minimize ecological impacts and to ensure the continuity of these fisheries.

As is often the case, the solution to the problem will likely be found within the elements of the problem itself. Many of the solutions to mitigating the incidental seabird catches by longliners stem from fishermen themselves. Mitigation measures that have been developed and tested by, or in collaboration with, fishermen have a much greater likelihood of being adopted by other domestic and international fishing fleets. Recognition of these circumstances provided the impetus for the First International Fishers Forum (IFF1) in New Zealand in 2000.

We hope that this week's meeting will lead to new ideas for reducing interactions between longliners and sea turtles. We also hope that the spirit of this gathering can carry forward to future cooperative work in progress toward our goals. Even a major reduction in longline bycatch of seabirds and marine turtles will not arrest the wholesale declines of some of these populations, but it will free up more resources to address other serious man-made impacts, such as adult and egg harvest of turtles and the effects of marine pollution and plastics on seabirds. It will also ensure that fishermen continue to pursue ecosystem-friendly longline fishing as colleagues and partners.

We hope you have an enjoyable and constructive meeting. Our work schedule is busy and will require you to be at the top of your game. But this is Hawai'i, and we also have arranged events that will contribute to your relaxation. So let U.S. begin our conference by the traditional blowing of the conch, calling this gathering together.

Opening Address

AMBASSADOR SATYA NANDAN, SECRETARY-GENERAL,
INTERNATIONAL SEABED AUTHORITY, KINGSTON, JAMAICA

I would like to extend a very warm welcome to all the participants and observers to the Second International Fishers Forum here. It was here that delegates from many of the countries represented at this meeting finalized the text of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean during September 2000.

It seems appropriate that at the beginning of a new millennium we negotiated the terms of a management arrangement for the world's largest tuna fishery, which grew from minor domestic coastal fisheries in the 1950s to supplying about one half of the world's tuna a half-century later. Indeed, the Pacific as a whole accounts for about two thirds of all tunas caught in the world's oceans. Part of this enormous expansion of fishing effort has been the spread of longline fishing across the Pacific, initially from Asia, but later with the development of longline fleets in China, Vietnam, Australia, United States, the countries of the Central and South America and, most recently, many small island nations of the Central and Western Pacific.

Unlike the diverse economies of larger metropolitan countries on the Pacific Rim, fisheries have been central to the economic self-sufficiency of the Pacific Island nations. Longline fishing has proven to be perhaps the most appropriate fishery for these small islands, given the limited shelf areas and coastal margins. Hawai'i provided the initial example for other islands in the Pacific to follow in the development of similar pelagic longline fisheries. However, different circumstances in Samoa and American Samoa led to the development of novel, small-scale artisanal longline fishing.

The successful spread of longline fishing has not been without costs. In the higher latitudes of the Pacific, pelagic and demersal longlines have proven to be lethal to seabirds. In some instances—particularly with albatrosses—longline takes have had a significant negative effect on the populations of those birds. This has been exacerbated by other anthropogenic effects on seabird populations, such as habitat loss, pollution and directed harvest for meat and feathers, which reduced some once-abundant species, such as the short-tailed albatross, to near extinction.

This is also true for sea turtles in all oceans. In the Pacific, many turtle populations have suffered alarming declines, to near-extinction levels as measured by nesting beach abundances. Unlike many seabirds, turtles and their eggs are a source of traditional food, medicine and shell material for many different peoples throughout the world. The explosive growth of the human population over the past half century in the Pacific has led not only to a greater volume of turtles harvested, but also to loss of nesting beaches, as more and more coastal areas are developed for building and landscaping. The catastrophic declines in many turtle populations globally, to near-extinction levels in some cases, has meant that the impacts of longline fishing has become disproportionately more severe, requiring innovative solutions to minimize fishery interactions.

Awareness of the problem of longline fishery interactions with seabirds and turtles began to surface in the late 1980s and early 1990s, in common with other serious fishery interaction problems, such as turtle bycatch in demersal trawls and dolphins caught by tuna purse seines. The UN Food and Agricultural Organization (FAO) Committee on Fisheries addressed the issue of seabird interactions with longline fisheries in 1999, which lead to the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds). Various countries have used the IPOA to develop their own national plans of action to minimize longline seabird interactions.

A key to the success of such efforts is the recognition that longline fishermen must be fully engaged in this process and will play a pivotal role in developing successful mitigation measures. To this end, the government of New Zealand took the lead in organizing IFF1 in Auckland in 2000 to address the incidental capture of seabirds in longline fisheries. That meeting included attendees from a broad range of interested persons, including fishers, fishing company representatives, fishery scientists, gear technologists and conservation biologists.

IFF1 recognized the vulnerability of seabirds to longline fisheries, particularly long-lived, slow-breeding species such as albatrosses, which migrate over considerable distances and are, therefore, susceptible to capture by the fishing operations of many countries in coastal areas and on the high seas. Consensus was reached at IFF1 that several measures were available to minimize seabird bycatch without significantly reducing the profitability of longline fishing operations. These included setting lines at night, weighting the lines to achieve rapid sinking of baited hooks, streamer lines to scare seabirds, dyed baits, underwater setting devices, bait-casting machines and retention of recovered baits to avoid attracting seabirds to fishing vessels recovering their gear. IFF1 concluded that a combination of seabird bycatch mitigation measures will be most effective in reducing seabird mortalities and that further research into these measures was necessary.

An interesting feature of IFF1 was the inclusion of population modelers, who demonstrated that because albatrosses 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. As such, improved and better integrated data on the distribution of seabirds, and fishing effort in space and time are urgently required to inform fishers and to develop management responses.

There was unanimous agreement among IFF1 participants about the need for effective education campaigns to inform all longline fishers about the biology, life history and population dynamics of albatrosses and petrels, the potential threat posed by longline fishing operations and the seabird bycatch measures available. It was agreed that the provision of relevant materials to fleets that had no education programs was a priority. Among the commitments made by the various countries at IFF1, there was universal agreement to educate fishers about this bycatch issue.

Lastly, the participants at IFF1 agreed to meet again in two years time in Hawai'i for this second forum which aims to build on and augment the successes achieved in IFF1. Arguably the most important feature of this meeting is the addition of discussions on how to reduce longline interactions with sea turtles.

All sea turtles worldwide are endangered, and many researchers believe the leatherback sea turtle is on the path to extinction, particularly in the Pacific Ocean. Indeed, an international conference held in April 2002 in California went so far as to recommend a moratorium on both longline and gillnet fisheries in the Pacific as a measure to save leatherback turtles. It may be argued that, unlike most seabirds, the harvest of adult turtles and their eggs have a far more devastating impact on populations than longline fisheries. However, stringent environmental legislation in the U.S. has nonetheless required that longline fisheries minimize their impacts on turtles and develop exportable mitigation technologies to other longline fisheries.

Additional legislation, analogous to the regulations governing shrimp imports to the U.S. from foreign trawl fisheries, may be enacted in the future to make imports of longline-caught fish to the U.S. contingent on the use of turtle mitigation technology. Moreover, achieving wholesale mitigation of turtle interactions in longline fisheries will inevitably bring more attention to bear on other and more severe anthropogenic effects of populations, such as adult and egg harvesting.

Unlike seabird longline mitigation—which in most cases is relatively straightforward—the problems of mitigating turtle interactions with longlines is a more subtle and insidious problem, most likely requiring a mix of technology and fishing strategies to be effective. Moreover, research and building awareness to reduce seabird incidental catch in longline fisheries has a longer history than sea turtle bycatch. However, like the seabird problem, fishermen's knowledge—accumulated by the thousands of hours spent observing the interplay of the sea, fishing gear and wildlife—will be an essential ingredient to developing realistic solutions. Further, the many lessons learned during the development of seabird mitigation methodologies and their implementation may help inform efforts to develop sea turtle mitigation initiatives.

The longline fishing industry has been proactive in developing mitigation measures for seabird interactions. For example, tori poles, blue-dyed baits and setting chutes are all ideas that stem from longline fishermen and were developed with the cooperation of the longline industry. The same inventiveness now needs to be applied to the problem of reducing longline-turtle interactions. Indeed, some longline fishermen in the U.S. have taken the initiative to conduct their own experiments with circle hooks to examine the potential for this design of hook to minimize injuries to captured turtles where interactions are unavoidable. By taking a proactive role in the development of turtle mitigation technology and strategies, longline fisheries will provide an effective rebuttal to more draconian solutions that have been proposed, such as outright longline bans or severe constraints on longline fisheries. For this second forum, educational materials have been developed in advance for participants to review and comment on, with the aim of increasing the effectiveness of these efforts.

A continuing goal of this and future meetings is to raise awareness of the problem with fishers and the longline fishing industry and for participants to realize that they can make a difference at the local level, which will make an important contribution to resolving the problem globally. This meeting will review international incentives and national approaches to solving seabird and sea turtle incidental catches and discuss ways fishermen can get involved in finding and implementing solutions to these problems. Fishermen have a strong financial incentive to minimize interactions since every bird and turtle caught is another hook that will not catch a fish.

Another important aspect of this meeting is to review progress since IFF1 on longline seabird mitigation initiatives. Participants at the first forum made a number of commitments to develop initiatives that would contribute to the reduction of the incidental capture of seabirds by their nation's longline fisheries. At this forum we want to review these commitments and determine if there are any obstacles blocking these initiatives, and if so, to then discuss possible solutions to overcome those obstacles.

In some respects the IPOA-Seabirds will continue to provide the momentum for dealing with this issue after this forum. FAO's Committee on Fisheries may also elect to develop a similar IPOA for turtles in the future to provide the same momentum for turtles.

Lastly, I hope the events following this meeting will mark the beginning not only the reduction of turtle longline interactions, but also the recovery of turtle populations. It is often easily overlooked that fishers are effective conservationists and that longline fisheries can be significant assets for conservation. Recent advances in our knowledge of the pelagic life stages of turtles have come from deployment of observers on longline vessels in the Hawai'i longline fishery and from the assistance rendered to scientists by this fishery. Similar efforts have been made in other parts of the world. In fact, recently I've been reading an article on this topic from scientists who have been experimenting in the Japanese waters.

Let me conclude by mentioning that on December 10, the General Assembly of the United Nations will adopt a resolution dealing with large-scale pelagic driftnet fishing; unauthorized fishing in zones of national jurisdiction and on the high seas; illegal, unreported and unregulated fishing; fisheries bycatch and discards; and other developments. The resolution contains extensive references to the issues under discussion here and notes the FAO action. It also recognizes the concerns over the conservation and management of sharks, and urges states to take action in response to the problem that we are faced with regarding seabirds. The resolution also refers to an Inter-American Convention for the Protection and Conservation of Sea Turtles and to the recent adoption of regional sea turtle conservation instruments in the West African and Indian oceans. This resolution represents the first time there has been extensive reference to these two problems in the oceans, in addition to other fisheries problems. It basically endorses the action taken by the FAO and the regional bodies that I've mentioned and encourages states to develop their national programs to deal with these problems.

Looking ahead, I take it that the problems will continue. I hope you will agree to have further fora, to allow for interactions between scientists, fishers, the fishery industry, administrators and other stakeholders such as conservationists. It is better that we exchange views and find practical ways of addressing the problem at this level than to leave it to governments or intergovernmental meetings and the imposition of measures such as commercial sanctions. We would be doing a great service to the fishing industry, as well as to the cause of conservation for seabirds and turtles, if we were to find practical ways to implement the goals we have set out.

Update on the First International Fishers Forum Commitments

JANICE MALLOY, DEPARTMENT OF CONSERVATION, NEW ZEALAND

The First International Fishers Forum (IFF1) was held in Auckland, New Zealand two years ago; 85 people from 16 countries participated. That's about a third the number of people that are here today. The agenda and style of that forum were very similar to this one, but it only addressed seabirds, whereas we'll be discussing turtles as well this time.

Three highlights that participants reported to the organizers from the first forum were:

- People engaged in open and frank discussion, which is critical if we wish to solve the incidental catch of turtles and seabirds quickly.
- There was a free exchange of ideas, which of course is one of the primary reasons we're here this week. In 2000 these discussions didn't stop at the end of sessions but continued on into the social functions and well into the night.
- On the final day of the plenary people spoke about actions they planned to take over the following two years. These commitments included testing new mitigation measures, collection of bycatch data, self-enforcement programs, incentive schemes, and encouraging other countries to become more actively involved.

In the intervening two years significant advancements have been made. Mitigation measures for reducing catch of seabirds have improved, and several additional countries have set up at-sea observer programs. Also, innovative ways to reach people and provide them with education and training materials have been developed.

At the political level, we now have the Agreement for the Conservation of Albatrosses and Petrels (ACAP), which will allow greater cooperation between countries. Another noticeable trend has been the growing number of fishers taking the lead. This is the most significant change of all.

Now, and over the next few days, we will hear more about each of these advancements and the lessons people have learned that may be valuable to U.S.

Presentations on IFF1 Projects

TATIANA NEVES, ENVIRONMENTAL SECRETARIAT, SAO PAULO, BRAZIL

I am the coordinator of Projecto Albatroz, which was created to reduce the seabird bycatch in Brazil. Along with representatives of three longline fishing companies, I attended IFF1. The representatives from Brazil made three commitments: to prepare a national plan of action, to select and test mitigation measures and to ensure that local fishermen are involved with this issue.

IBAMA, the Brazilian Environmental Institute of Natural Renewable Resources, invited Projeto Albatroz researchers to act as consultants in preparing the national plan of action, and the FAO approved the funding to support the project, which started July 2000. A draft version is already available to receive suggestions from all involved parties, such as fishermen, researchers, fishing companies representatives and governmental staff.

Working through this process, we felt the changes in the attitudes in the Brazilian government were significant. Most important was Brazil's signing of the Agreement for the Conservation of Albatrosses and Petrels (ACAP). The ratification of this agreement is underway.

During the last meeting of the International Commission for Conservation of Atlantic Tuna (ICCAT), Brazil joined the U.S. and Japan in signing a resolution on seabird bycatch that will be presented in the next COFI/FAO meeting in Rome next February.

IBAMA also held a national workshop on seabird conservation in November 2001. Researchers from several institutions and universities were invited to draw up recommendations for a Brazilian national strategy for the conservation of albatrosses and petrels.

Also, IBAMA and Projeto Albatroz jointly developed a pilot project to test the feasibility and efficacy of the mitigation measures in domestic longline vessels, with good results. This was possible due to the deep involvement by ship owners that attended the IFF1. In this project we presented information on all known mitigation measures, and the fishermen selected two—tori lines and blue-dyed bait—that they considered the most applicable for Brazilian fishermen, (in addition to the measures of night setting and unfreezing baits that are already used). The tests were made with observers onboard, and the main result was the involvement and the awareness of the fishermen. A consequence is that some vessels are already using such measures voluntarily. Another outcome from the project is a video we prepared a video to present in the incentives breakout session of this forum and as an educational instrument to make other fishermen aware of the importance of seabird conservation and the feasibility of the mitigation measures.

In conclusion, we hope we can present the completed NPOA at the next meeting of the Commission of Fisheries of the FAO next February. The NPOA process is a very important influence on governmental attitudes. After IFF1 it was also very important to involve our ship owners and, in general, to develop our work in the conservation for seabirds in Brazil. The fishermen are open to change when approached adequately and informed correctly. The pilot project that we developed has shown that change in behavior onboard is possible if we have enough fishermen involved and the necessary structure available.

Malcolm McNeil, SeaLords Group, New Zealand

A bit of background on myself: I spent 17 years at sea, and during the last ten of them I was a skipper. Now, as a shoreside manager for SeaLords I spend about 40 or 50 percent of my time on the job dealing with seabird issues.

Over the last two years New Zealand has come a long way in dealing with seabirds and seabird mitigation. I'll discuss five areas of change: demersal, or bottom longlining, pelagic or surface longlining, trawl fisheries, training and education, and the Southern Seabirds Solution initiative. This is not to say there are not other areas that haven't changed.

DEMERSAL LONGLINING – At IFF1, I stated that the mitigation practices we had at that stage were proving extremely effective. But during that meeting the vessel that I look after caught a lot of birds, so I guess our mitigation methods weren't as successful as I had hoped during IFF1.

Following this, I got called up to Wellington by the Department of Conservation, the Ministry of Fisheries, and NGOs, where I got the message that if industry does not do something themselves, then the government will enforce rules and regulations.

I went back to my hometown and formed the Ling Longline Working Group, which includes people from the Department of Conservation, the Seafood Fishing Industry Council (SeaFIC), the Ministry of Fisheries, gear suppliers, skippers, vessel managers and NIWA. The initial idea was to discuss with the skippers what ideas for mitigation they had tried and to share the knowledge, rather than every boat trying to 'reinvent the wheel.' Over a period of a couple of years, we started developing an industry-driven minimum code of practice, which covers basic things such as requiring the use of tori lines, the specifications of the tori line, offal retention during hauling, thawed bait and so forth.

This code of practice (COP) includes minimum standards as a starting point toward further improvements, such as using twin tori lines and incorporating the inshore fleet. Everybody in the working group agreed they could abide by them. We hope that following IFF2 we will be involved in work around a national plan of action and be able increase the standards within the existing COP as we go.

Also, within my company, the SeaLords Group, our contracts require that vessels that supply fish for us must abide by the code of practice. If they don't, they don't catch fish for us. Also in conjunction with the code, a training manual was written for vessel crewmembers. This is a book describing birds and their habitats and how fishing can affect bird populations, a brief description of the COP and other possible mitigations.

Trials of mitigations related to advances in tori lines, underwater setting, and other mitigation measures are ongoing. For example, there's a trial being undertaken on integrated weighted line, which is basically a lead core that's going through the line. We have two people from the Australia Antarctic Division on the boat to observe the technique and record observations such as sinking rates, the number of birds caught on that kind of gear versus standard gear, and comparisons of fish-catching capabilities between the two sets of gear. The results of using weighed line have been so effective in reducing bird catches that we stopped the trial because of the amount of birds being caught on the unweighted line. We're pretty excited about the results.

PELAGIC AND SURFACE LONGLINING – The last couple of years, the Department of Conservation and the Conservation Services Levy (CSL) had funding for a seabird advisory officer to conduct research on seabird mitigation on surface longlining. This was supported by the fishing industry. The officer has been able to visit the majority of the boats to discuss the seabird issues, inform them on the best practices and encourage skippers to make further improvements.

Also funded by the CSL was the manufacturing of approximately 120 tori lines suitable for boats of all sizes. These have been distributed to vessels, along with instructions on how to use them. Within this fishery mitigation trials are constantly being undertaken.

TRAWL FISHERIES – Within the trawl fisheries, the biggest change I've seen over the last year is the realization by crews, skippers and management that there is a problem with seabirds and the trawlers. Mitigation on the trawlers is still being undertaken. At least two trawlers are conducting trials on the Brady Bird Baffler, and the results are positive. Also, the crews on most of the trawlers in New Zealand are doing simple things such as cutting sprigs off the warps and wires to stop the seabirds from being caught on them. An industry COP is being written for the trawlers, while some big fishing companies already have their own COPs.

TRAINING AND EDUCATION – The New Zealand Seafood Industry Training Organization (SITO) is in the final stages of putting together unit standards on bird and mammal mitigation that will be one of many qualifications comprising a national certificate. SITO has worked on the prospectus with groups such as the Ling Longline Working Group, Department of Conservation and M-fish. They have drawn up standards for entrance-level fishermen, and they are putting them in place for other fishermen as well. The entrance-level fishermen standard has undergone trials, with a lot of positive feedback from the trainees. These unit standards are based on the code of practices, training manuals and general information about bird species and effects on them due to the lack of mitigation measures.

SOUTHERN SEABIRD SOLUTIONS – The realization that seabirds caught in our national waters are not necessarily from New Zealand, and that "our" seabirds often end up being caught in waters of other countries led to the formation of Southern Seabird Solutions (SSS). It is an alliance of government departments, fishers, industry, environmental groups, eco-tourism operators, fisheries trainers, Maori fisheries, and others interested in working with other countries to foster the widespread use of seabird-safe fishing practices. Development of SSS has advanced the proactive entry action between all parties involved with seabirds. This has led to much national publicity on the interaction between these groups and has lifted the image of the fishing industry, as most groups are finally recognizing that we are doing something positive in terms of mitigation. As we develop successful mitigation measures, the alliance's next step is to advance into the international arena, especially to South America and South Africa. This will be done on entry actions between fishers, NGOs and governmental departments from different countries.

One of the big obstacles we've overcome is the acceptance by the fishermen that there is a problem, especially in fisheries using trawlers, where there was a blind eye to what was happening behind the vessel. Acceptance of the problem also has been a major accomplishment in the demersal and surface fleet, where even the crews—rather than just the skippers—are now realizing that they are responsible for bird mitigation and it is in their best interest that birds are not caught. With the new entrant training, this mental attitude will be built into fishermen in the future, even before they step onto a vessel.

The barriers between the fishing industry and the NGOs have created an "us and them" mentality for many years. This gap is now decreasing and in some cases has vanished completely. Fishers are now being praised for what has been achieved, while still being gently prodded into action. Because of this, fishers are feeling more comfortable sitting around a table with the other side, and hence mitigation within New Zealand has progressed rapidly since IFF1. An example of this is the invitation to fishers to attend to the IMAF part of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) process dealing with seabirds. This reflects an understanding of the need for fishers' knowledge when making rules and regulations that are to be imposed upon them. Thank you.

Carole Eros, Department of Fisheries and Oceans, Canada

Up to the end of October I was managing the Pacific halibut and sablefish fisheries. Recently I've changed positions, and I am now working on a recovery plan for the leatherback turtles in Canadian Pacific waters. I would like to briefly provide you with you an overview of the steps Fisheries and Oceans Canada (FOC), the federal fisheries management department, has taken to reduce the incidental catch of seabirds in its demersal longline fisheries. Then I will describe the challenges the department has and is facing, and finally I'll outline the next steps.

Initiatives to reduce the incidental catch of seabirds have been addressed nationally, as well as on a regional scale. In 1999 Canada signed on to the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds). To help guide the implementation of this plan, FOC formed a national working group comprised of members from across the regions. This group is currently coordinating the development of a national status report. Data are being gathered to address the extent of seabird bycatch in the fisheries across Canada. The information from this assessment will be used for the implementation of various mitigation measures where appropriate. However, while these data are being assessed, the department has already taken active measures to reduce the incidental catch of seabirds in some of the fisheries, which I will briefly outline. Furthermore, a Species at Risk Act is currently in parliament and is due to be proclaimed in the late spring of 2003. This act sets out the legal basis to protect species at risk and their habitats.

On a regional level some of the initiatives that are currently being undertaken include mitigation through the implementation of avoidance regulations as a condition of license, data collection from observer and fishery logbook programs, initiatives to increase general awareness, and information and collaboration both internationally and nationally. I'll just briefly run through each of these initiatives with a little bit more detail.

MITIGATION – The use of mandatory seabird avoidance devices is currently enforced in the Pacific halibut and sablefish longline fisheries. Some of the measures required to be employed in combination are the use of single and paired streamer lines, use of extra weights on the ground lines to achieve rapid sinking, and several other measures. The types of avoidance devices in use are primarily based on those implemented by the U.S. National Marine Fisheries Service (NMFS) in Alaska. The mitigation measures were adapted for Canadian fisheries in close collaboration with the Canadian Wildlife Service—a branch of Environment Canada—and the Pacific Halibut Advisory Board. Interestingly, it was the Pacific Halibut Advisory Board that initially requested that the use of bycatch mitigation devices be mandatory for their fleet. So halibut fishermen have been quite proactive and collaborative in developing and testing the various mitigation devices for use in their fleet.

DATA COLLECTION – First, the department collects catch data through mandatory logbook programs that record fishing efforts and catches, including hooked seabirds. Second, partial observer programs in place in several fisheries provide information on the catch of seabirds and the type of avoidance device used by the vessel. Third, a question protocol was developed for the observers to record the vessels' general efforts to deter seabirds, to provide extra anecdotal information. Also, any dead hooked seabirds caught are brought in by the observers and sent to the Canadian Wildlife Service for identification. Finally, the department is also examining the feasibility of using electronic monitoring to record catch data at sea. This methodology is currently being tested in the Pacific halibut fishery.

The department has also made use of various tools to raise general awareness of seabird issues. For example, general information on seabird conservation and the specific mitigation measures required in the halibut and sablefish fishery are outlined in those fisheries management plans and on the fishery home pages on the Internet.

To increase industry buy-in, during vessel boardings fishery officers explain and reinforce the requirement to use avoidance devices in the fishery. The department also distributes two types of seabird identification cards to the fishery observers and fishermen. The department was fortunate enough to receive several copies of the albatross guide that is in print from NMFS in Alaska.

INFORMATION SHARING AND COLLABORATION – The FOC has established good connections with the seabird coordinator at NMFS in Alaska. The department has benefited greatly from Alaska's experience in researching and implementing various mitigation measures. The department also collaborates closely with industry, in particular, through the Pacific Halibut Advisory Board and the Sablefish Advisory Committee. These groups are made up of industry representatives, who are primarily fishermen, fish processors, other stakeholders and government representatives.

CHALLENGES – First, there's compliance. 2002 was the first year the use of seabird avoidance devices became mandatory for the Pacific halibut and sablefish fisheries. Prior to that, use of the devices was voluntary. There are some very proactive and keen individual halibut fishermen. However, for the fleet as a whole compliance and buy-in have been low so far. Furthermore, the identification skills of the data collectors, the fishermen and the observers continue to be variable. Also, the department's ability to assess the extent of seabird bycatch in the fisheries is limited by the fact that most fisheries have only partial at-sea observer coverage in place, and information in the fishery logbooks tends to be incomplete, particularly with respect to recording the catch of bycatch species.

NEXT STEPS:

- We need to continue to collaborate with industry to educate and obtain buy-in from the fleets. Recently the Pacific Halibut Advisory Board suggested that a seabird subcommittee be formed to review the current mitigation measures and suggest potential fleet awareness and education initiatives.
- Seabird identification skills need further development. There are two proposals to develop Atlantic and offshore Pacific seabird identification guides. The department, along with other partners, is currently exploring funding options for this.
- The mandatory use of mitigation measures needs to be expanded to other fleets that incidentally catch seabirds. Currently, mitigation measures are only mandatory in the halibut and sablefish longline fleets.
- Starting in 2003 fishery officers will be taking a more active role in enforcing the mandatory mitigation measures in the halibut and sablefish fisheries. In 2002, officers played more of an awareness and education role.
- FOC will continue to emphasize the importance of collecting information on seabird bycatch through observer and fishery logbook programs and is looking at ways to improve data collection methods.
- In 2003 we plan to complete the national status report.

To conclude, I would just like to acknowledge those who provided funding assistance for me to attend this forum. Thank you.

Adrian Stagi, Uruguayan Birds, Uruguay

My group, Uruguayan Birds, is affiliated with Toburou Life International. In South America the problem of incidental seabird mortality has recently been analyzed, resulting in a strategy for the Conservation of Albatross and Petrels in Punta Del Este, Uruguay.

Uruguay fisheries in the South Atlantic Ocean have traditionally used trawl nets to catch demersal species such as hake and whiteclip and—less importantly—longlines to catch pelagic fish such as swordfish and tuna. In the last year, diversification of the species fished has occurred, with fishers applying new methods. This has resulted in a greater emphasis on longlining to carry out exploratory surveys and experimental fishing on potential target species such as hake and Patagonian toothfish.

In the Uruguayan Exclusive Economic Zone (EEZ) the incidental mortality of birds on hooks has been reduced in various situations, and we can see the necessity of mandatory regulations in fishery operations that take birds. Eighty-three percent of the boats using trawl nets operate in the common Argentine-Uruguayan fishing zone. The other 17 percent of boats use hooks, and in these longline operations the crews have not been informed about the seabird problem, and they have not adopted mitigation measures.

The latest data available is for 2001, when the authorities granted temporary licenses to fishing boats for the killing of seabirds and other species in semi-pelagic longline fishing methods that previously had not been used in the Uruguayan EEZ. During the setting and hauling of the boats, 2,209 birds were counted, of which 2,175 were dead. White-chinned petrels, great shearwater and black albatross were the species most affected. White-chinned petrels accounted for 70 percent of the dead birds; great shearwaters, 24 percent. The majority of these birds were hooked on the longlines during hauling in, at a rate of 2.66 birds per thousand hooks. The maximum number of birds per unit of effort reached 142.5 birds per thousand hooks. The maximum rate per unit was 3.7 birds.

The use of curved line was not a regular practice. This is due to the limited experience of the crews, the inadequate design of the line for the type of longlining PBF and PBA, and the difficulty of scaring off some species—in particular great shearwaters and white-chinned petrels, which previously have been observed passing below the scare line or feeding very close to the boat. The use of buoys in the line caused frequent knots and breaks in the scare line, which resulted in their not being used.

Interactions with birds are a significant factor in the initiation of new technology in the Uruguayan fishing fleet and in the gillnet operations in the Uruguayan EEZ. Information on the recreational fisheries is in the process of being published. The gillnet report is expected around Judy 2003. The progress will appear in the resistance of some methods of fishing. With frequent changes in the government, attention to the problem of fishery interactions with birds has not been consistent in governmental agencies, and this has affected the amount of attention the fishermen have paid to the issue.

It is clear that different types of longlining in the Uruguay EEZ produce different rates of mortality. Thus it is necessary to continue developing mitigation measures and expanding them to other fishing methods. We recommend that the current regulations be evaluated and expanded to other types of longlining. And, perhaps we need to consider alternative methods of fishing. For example, vertical lines, which do not affect seabirds, could be used to catch the same species now fished for with longlining. Thank you.

John Croxall, British Antarctic Survey, United Kingdom

I work on albatrosses for the British Antarctic Survey and chair the working group on incidental mortality within the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Two years ago at IFF1 I gave an overview of albatross biology and interactions with fisheries. I took away a number of tasks from the first forum on which I'll report.

First, I was asked to see to what extent we could facilitate access to the scientific observer data held within CCAMLR. With the exception of the krill fishery, in CCAMLR there is 100 percent coverage (i.e. all fishing vessels) by scientific observers. I am pleased to say that all the basic data on bycatch and fishing effort are now in the public domain, and most of it is accessible through the CCAMLR website. More detailed data also are available,

Second, I was asked to look into ways of facilitating the development of fishery-specific maps as risk assessments for seabirds. This has proved challenging, particularly in terms of getting the data-holders together and raising funds for this initiative. Thanks to Birdlife International we will be able to make a start on this by holding a workshop next September in Cape Town. We will assemble and integrate the remote recording data from seabirds and review them in conjunction with biological habitat information and the database of longline fishing effort being compiled by CSIRO in Australia. The essential complement to that initiative is to synthesize the seabird at-sea data from a variety of national and regional programs. I would very much encourage people here who are experts in that field to consider how we might incorporate all these data, which are essential to this global risk assessment.

Third, following IFF1 we were determined to facilitate various developments in the field of mitigation. Many of these developments, particularly in relation to autolining, will be covered in the breakout sessions. One area in particular that CCAMLR has addressed is improving line weighting for the Spanish system of longlining. The

CCAMLR specification currently is 8.5-kilogram weights at 40-meter intervals along the line. Three years ago not a single vessel operating in the fishery was able to achieve that criterion. Two years ago, 20 percent met it, and this year the figure is 65 percent. I think this represents a huge effort by the industry and the fishers involved to meet this standard.

Mitigation work within CCAMLR—ranging from gear improvements (as above) and nighttime longline setting, to the closure of fisheries during critical seasons—has contributed to a dramatic change in bird bycatch over the last five years. Five years ago an estimated 10,000 seabirds—albatrosses and petrel—were killed annually. Last year, with the exception of the French EEZ, where there are still substantial problems, the total estimated bird bycatch from longlining was 27. That is a reduction of more than two orders of magnitude.

CCAMLR is obviously a fairly special case in terms of fishery management, the types of fishing etc. But it shows that such achievements are possible, given the right combination of incentive and collaboration between industry, fishers, managers and governments. CCAMLR now recognizes that for seabirds breeding in the convention area the major problems are illegal, unregulated and unreported (IUU) fishing, and the mortality of birds on their migrations outside of the convention area, particularly in adjacent waters to the north. Regrettably, we have been less successful in further developing underwater settings with the Spanish system of longlining. Also, we've not made the hoped-for progress in through-the-hull settings, particularly in collaboration with Norway. Nevertheless, we have good collaboration with Norwegian gear manufacturers, particularly in developing a longline with integrated (lead core) weight, initial trials showing massive reductions in seabird bycatch and improved fishing efficiency.

Finally, given CCAMLR's large membership and constituency within European countries operating longline fisheries, another of our tasks was to promote outreach to the member states and other regional fisheries management organizations. I would say we have been least successful in achieving this. I hope we can generate some ideas here on productive ways to better address these needs.

Although this forum is principally about longlining, participants have also commented about trawling. The trawl fishery in the Antarctic killed about 73 birds last year—three times as many as the regulated longline fleet (outside the French EEZs). We recognize that trawl fishery interactions are also a problem in adjacent areas, particularly around the Patagonian shelf and warrants more attention than recently given. Thank you.

John Cooper, University of Cape Town, South Africa

Unfortunately, there was no representative from the South African fishery community at IFF1, so we did not formulate any objectives to try to achieve. But I would like to give an overview of the South African longline fisheries and their current situation.

The sole management authority for South African fisheries rests with the central government, so that simplifies things. There are currently only four longline fisheries: the pelagic tuna (*Thunnus* spp.) fishery, the mixed pelagic-demersal shark fishery, and the demersal hake (*Merluccius* spp.) and toothfish (*Dissostichus eleginoides*) fisheries. The combined size of these fisheries is quite small—probably on the order of 200–250 licensed longline fishing operators altogether, landing fish at about ten ports. This all lends itself to a situation of reasonable management abilities.

The current situation with mitigation measures as prescribed and promulgated in our fisheries is quite good. In all fisheries, except for the shark fishery, there are comprehensive regulations prescribed and required of the fisheries as they receive their licenses. However, the level of compliance with these mitigation measures is more of a mixed picture. In the toothfish fishery, carried out in the Southern Ocean under regulations and measures promulgated by CCAMLR, compliance over the previous few years has been very good. Where regulations can be quantified—in the use of bird-scaring lines and the requirement to set at night, for example—compliance has approached 100 percent. It should be noted that this is a fishery with only three vessels currently, so it is quite easy to interact with the companies to work towards this high compliance. In contrast, the hake demersal fishery and the pelagic tuna domestic fishery, compliance is generally poor.

One improvement that has taken place since IFF1 is a steady reduction in bird bycatch and mortality rates over a six-year period for the South African Patagonian toothfish fishery around the sub-Antarctic Prince Edward Islands. Last year only three birds were killed on longlines. Also compliance with the requirement to set at night has steadily improved, approaching 100 percent.

Beginning in 2003 South Africa will no longer issue licenses to foreign longlining vessels, so the practical problems with putting observers on foreign vessels and trying to improve their compliance levels will in effect fall away. The void left by the absence of the 50–60 vessels of the foreign pelagic tune fleet is likely to be taken up by an expansion of the domestic fleet. In addition to the phasing-out of foreign vessels, over the next few years we will be increasing the percentage of observer coverage to about 15–20 percent in the hake and tuna fisheries. Our toothfish fishery in the CCAMLR region already has 100 percent observer coverage. Further, we have instituted formal observer training programs that require observers to be trained in bird identification and hook removal methods, which are leading to an improvement in data collection and a reduction in seabird mortality.

Another development over the next few years will be research towards appropriate line-weighting regimes in our pelagic tuna fishery, which currently kills the largest numbers of birds in terms of numbers and rates per thousand hooks. We are certain that the way to address the dichotomy between our very comprehensive regulations and poor compliance with them is through raising awareness and educating fishers.

We try to avoid a top-down approach in South Africa and work instead toward a participatory approach. With fishers this will be done in fora similar to this, where we will ask for their input as full partners, rather than giving them training courses in methods that would be decided elsewhere. Awareness raising and observer training programs have resulted in many different stakeholders coming together. For example, one company working with BirdLife International has collaborated on the production of bird identification posters.

On the international stage the South African government has approved the signing and ratifying of the Agreement on the Conservation of Albatrosses and Petrels. We hope that South Africa will become one of the five original members of ACAP, which requires that number of members for the agreement to come into force.

Finally, with the support of funding from the FAO, South Africa has moved towards producing a draft National Plan of Action (NPOA) for reducing seabird bycatch in longline fisheries. It has been submitted to the government this month and a stakeholders' meeting is set for January 2003. Thank you for your attention.

Patricia Gandini, Centro de Investigaciones de Puerto Deseado, Wildlife Conservation Society and CONICET Argentina

Our goal following IFF1 was to improve data collection on seabird mortality in the Atlantic waters of Argentina and to disseminate information from the forum to the government and fishing companies. We also aimed to improve our relationships with fishing companies and disseminate information on different mitigation measures among the crew members of the Argentinian fleet.

To improve data collection on seabird mortality, we started a project on seabird mortality patterns in the longline fishery, as a basis for suggesting measures to reduce seabird deaths in this fishery. There are two main species in the longline fishery on the Patagonian shelf: the Patagonian toothfish (*Dissostichus eleginoides*) and the kingclip (*Genypterus blacodes*). Currently three vessels fish kingclip in the north part of the Atlantic, and three vessels targeting toothfish operate in the south. Fifteen vessels operate in the Falkland-Malvinas region. From previous data we knew that two birds per thousand hooks were incidentally killed when setting was done during the day. Other estimates from CCAMLR showed that about 3,800–13,500 albatrosses die every year.

Thawed bait is being used as a mitigation measure, but only one vessel operating in the south is using underwater line setting, and the use of scaring lines is up to the vessel captains. At the beginning of the project we succeeded in getting the fishing companies to allow U.S. to have our own observers on the vessels. These observers record variables such as the type of bait used, the number of hooks set, fishing depth, sea state, and positions and times of the start and end of each set, etc. Also, we designed a laminated card for use in identifying the different bird species, that is being distributed among captains and crew members.

During the nine-month period of our research, two seabird species were caught on longline hooks: white-chinned petrels (*Procellaria aequinoctialis*) and black-browed albatrosses (*Thalassarche melanophrys*). Mitigation measures now used include a splashing buoy, thawed bait, nighttime line settings and the discharge of offal from the opposite side used for hauling or setting.

From our nine months of data we extrapolated an annual estimate of seabird deaths: about 400 birds, of which 55 percent were black-browed albatrosses and 45 percent were white-chinned petrels. Extrapolating to all the legal fleet operating in the Atlantic we can estimate an annual bird mortality of 2,700 birds, at a rate of 0.03 birds per thousand hooks.

Our results showed that white-chinned petrel mortality is highest in autumn, while black-browed albatrosses suffer more deaths in winter, and that the more birds are caught by day around periods of full moon (as other researchers previously have found). We also know that moonlight is a variable that contributes to capture events, and darkness reduces unnecessary seabird bycatch, so increasing the use of mitigation measures such as streamer lines and splashing buoys during nights of the full moon surely will reduce bird bycatch more effectively.

As a result of our study we have signed an agreement with Argentina's main longlining fishing company, Argenova SA, to develop a new project called "Minimizing Seabird Mortality in the Argentine Longline Fisheries." It will be the first project in Argentina involving researchers, NGOs, and the fishing companies. Thank you.

Traci Hsai, Overseas Fisheries Development Council, Republic of China (Taiwan)

It is a great honor for me to have the opportunity to speak to you on efforts by Taiwan's longline fisheries to address the bycatch of sea turtles and seabirds. In recent years the overall production of Taiwan fisheries surpassed 1.3 million metric tons. In 2001, 24 percent of that was from the longline fishery. Of those landings, 87 percent was from distant-water fisheries, and 13 percent from the coastal fisheries.

According to a field survey between 1991 and 1995 in the offshore area of Taiwan, more than 90 percent of sea turtle bycatch occurred in set nets, rather than in longlines. Most of the turtles captured incidentally are alive and are released later. The study results showed that the incidental catch of seabirds mostly occurs in areas south of 30 degrees south latitude. Only 19 percent of Taiwan's distant-water fisheries operate in this area. Most of the seabird bycatch was discarded. Bycatch of seabirds is a rare problem in the coastal longline fishery.

During recent years the Taiwan Fishery Authority (TFA) has actively promoted measures for reducing the incidental catch of sea turtles and seabirds. The Wildlife Conservation Law, enacted in 1989, includes five species of sea turtles. Hunting or killing of the species protected under this law is punishable by imprisonment for up to five years and fines up to NT$1,000,000. Also, the Council of Agriculture has established a sanctuary for green turtles.

The TFA also has provided funds to distant-water longline vessels for installing automatic line-setting machines and tori lines to reduce the chances of the incidental capture of seabirds. In 2001 Taiwan experts attended a meeting on ACAP, and in 2003 the government will support a meeting to be held in our country by the Wild Bird Federation and the BirdLife International.

Taiwanese researchers have studied bycatch in fisheries. During a study to determine if shrimp trawlers in Taiwanese waters caught sea turtles, there was no turtle bycatch. A long-term research project on the biology of green turtles (*Chelonia mydas*) was started at Wan-an Island in 1992 and expanded to Lanyu Island in 1997. In recent years, a combination of GIS and GPS technology has been used to track gravid females to their nesting site.

Seabird research also has involved distant-water longline vessels that installed tori lines. The results of a 2000 survey on incidental catch by 33 longline vessels targeting tunas in the Atlantic and Indian oceans showed that tori lines could significantly decrease the rate of seabird bycatch. In 1999 an onboard observer program was initiated on the distant-water longline fishery to record sea turtle bycatch rates in the tropical Atlantic Ocean. For leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) turtles, the results ranged from about 0.16 to 0.7 incidental turtle captures per thousand hooks set.

A variety of media are used to inform fishermen on methods of avoiding the incidental catch of sea turtles and seabirds. A brochure has been published to educate fishers on the conservation of sea turtles, and a formal training program was carried out to train local villagers in 1997 and 1999. The Green Turtle Exhibit and Conservation Center was opened in 2002 to educate the community.

To promote seabird conservation and teach fishers how to prevent seabirds from going after baited hooks, a technical handbook, an educational pamphlet and a desk calendar were published and circulated to fishers. One of the key impediments in promoting conservation of sea turtles and seabirds is insufficient data. In the future the government will continue to support research and collection of additional data, and a national action plan for seabirds will be drafted. We also will continue to collect information on new technology and measures for reducing the incidental catch of seabirds and sea turtles. Thank you.

Plenary Overviews

2ND INTERNATIONAL FISHERS FORUM
HONOLULU, HAWAII ~ 2002

SEABIRDS

Rosemary Gales, Tasmanian Nature Conservation Branch, Australia

I've been asked to briefly describe aspects of seabird behavior and biology that are relevant to the design and limitations of effective mitigation to ameliorate bycatch in longline fisheries. While my focus is in the Southern Hemisphere, the message is the same in all areas.

The two groups of seabirds most affected by longline fishing are the albatrosses (*Diomedeidae*), with 24 species currently recognized; and the petrels, including the two species of giant petrel and five species of *Procellaria* petrels. The population sizes of these species vary by orders of magnitude. The rarest species is the Amsterdam albatross, which has only 20 breeding pairs; the most numerous is the white-chinned petrel, with perhaps two million breeding pairs.

Three of the four species of northern albatrosses are listed as globally threatened: the short-tailed, the black-footed and the Galapagos. A review that we did in 1998 showed nearly half of the 150 populations of albatrosses are declining. For critical populations like the wandering albatrosses on Macquarie Island, where we work, there are only 12 pairs remaining. Any increased mortality will jeopardize the survival of this population, which is why longline fishing is prohibited around Macquarie Island.

LIFE HISTORIES AND DISTRIBUTIONS

It's the extreme life history traits of these birds—very low productivity and high natural survival rates—that make them so vulnerable to influences that increase their mortality levels. The offspring of albatrosses and these petrels represent a massive investment in terms of time and energy by both parents. All these species lay a single egg, with some species breeding every year, others every two years. The chick stage ranges from three to nine months. The wandering albatross raises its chicks through winter, and sometimes these birds go several weeks between feedings. After fledging albatrosses stay at sea for three to five years before returning to their breeding islands to court for the next two to three seasons. Typically they don't start breeding until seven to twelve years of age. Once paired they generally retain the same mate for life. Their average lifespan is 25–50 years, but some birds live as long as 70 years. Because of this extreme life history, elevated rates of mortality are critical for both the species and population sizes. Of all the life stages, the loss of breeding adults is the most serious.

In terms of fishery interactions, the first element is the assessment of the distribution of albatross and petrel breeding sites. The giant petrels and the *Procellaria* petrels have essentially a cool temperate and Southern Ocean distribution, whereas the albatrosses have a more extensive distribution reaching into the higher and warmer latitudes. Of all seabirds albatrosses and petrels are the most oceanic, with many species showing extensive movements both during and outside of the breeding season.

BEHAVIORAL DIFFERENCES AND CHALLENGES FOR LONGLINE FISHING

We have recently gained a better understanding of the foraging ranges for some of these birds and the degree to which they overlap with fishing operations, thanks to the miniaturization of satellite trackers, which provide real-time at-sea locations for seabirds. Wandering, black-browed and gray-headed albatrosses can travel vast distances, covering as much as 500 kilometers in a single day, with flight speeds averaging 50 kilometers an hour. These birds make extensive use of the wind, moving continuously in windy conditions and never flying to windward. They rarely stop flying for more than an hour during windy conditions; however they may become trapped in the cores of high-pressure systems that immobilize them for days.

Other albatrosses, however, are not as pelagic. For example, the shy group of albatrosses undertake slower flights and generally remain within 300 kilometers of their breeding island during the breeding season. However, we can't characterize the foraging distribution of even one of these species, as our tracking in Tasmania has shown that foraging ranges vary between the different colonies and the stage of breeding season, with birds foraging closer to the islands when chicks are small. For three colonies of shy albatrosses around Tasmania, birds of different ages and genders in many species feed in different waters and so are segregated at sea. This also means that these birds interact at differing levels with fishing operations.

If shy albatross are local birds, then white-chinned petrels are perhaps the most oceanic of all seabirds, traversing over 8,000 kilometers during 15-day foraging trips. These birds commonly feed in waters over 2,000 kilometers from their breeding sites. These extensive distances are possible for white-chinned petrels because they rely less on the wind than albatrosses. They can fly very fast, up to 90 kilometers an hour, and often in straight lines. The other important factor is that they fly and forage at night.

In contrast, albatrosses and giant petrels mainly restrict their feeding to daylight hours. However, when albatrosses do forage at night they are more active during periods of full moon. This translates directly into bycatch statistics. In the Australian fishing zone, for example, our work shows over 70 percent of the albatrosses nighttime deaths were during periods around a full moon. Petrels and albatrosses that forage extensively at night have very well developed olfactory systems, which they use to locate food. This sense is perhaps most acutely developed in the smaller species of petrels and prions.

During long-distance commutes it's likely these birds also use elements of celestial navigation and the Earth's magnetic field to navigate. But on approaching a foraging area, they search restricted areas using odor cues to detect prey. Also, recent work on the eye structure of albatrosses shows that their eyes have amphibious features very similar to those of penguins, suggesting that their vision may be equally well suited to visual pursuit of prey both at and below the surface of the water. Visual cues, therefore, are extremely important.

The presence of other predators is also extremely important in prey detection. A heightened sense of smell in the smaller species allows them to forage at night and also may give them a competitive edge in locating prey before being displaced by the larger, more aggressive species. As for feeding styles, until quite recently it was thought that the smallest birds dip-feed mainly on krill, while the larger shearwaters are capable of some diving and the albatrosses engage in surface feeding. However, supporting the work on vision, we have learned that albatrosses and petrels can be accomplished divers, with some pursuing prey to great depths. And, while the largest albatrosses tend not to dive, through the use of depth gauges on the birds we now know that the smaller albatross species are very proficient divers and regularly pursue prey five to six meters deep. Some of the smaller shearwater species are exceptional divers, regularly going to depths of 40 meters and sometimes as deep as 70 meters.

Thus the challenge for longline fishing. These behavioral differences between species and the differing distribution between and within species complicates the development of effective mitigation, since what is effective for some birds in some areas may not work for different species groups elsewhere. Similarly, what works in winter in one area may not work in summer in the same area, because of the influx of different suites of seabirds.

In the Australian fishing zone shearwater abundance escalates during summer, when the birds return from the Northern Hemisphere to breed. Their excellent ability to detect and retrieve baits from depth results in many of these birds being hooked. In addition, the increased abundance of smaller petrels also results in increased catch rates of the larger birds, as they out-compete the petrels for baits once they've been retrieved from depth. The ability of these birds to swallow the baited hooks whole exacerbates the problem for the larger birds.

EFFECTIVE MITIGATION AND MORTALITY RATES

The design and implementation of effective mitigation measures require a clear and detailed understanding of the various and varying behavior between species, as well as the seasonality factors and the interactions of different species that occur in different areas. During the last 15 years or so various mitigation measures have been tried to alleviate seabird bycatch, including the use of streamer lines to prevent the birds' access to baits, setting underwater or at night and using weighted lines. People have also tried to decrease the attractiveness of fishing operations to these birds by changing offal discharge practices and using artificial or dyed baits. In some areas, fishing has simply been restricted by area or seasonal closures.

However, no single measure has been found to be effective in all waters. Night setting alone, for example, is not effective in some areas because some species continue to forage in darkness. Deployment of bird lines alone is also insufficient in many waters, because some birds are able to retrieve baits from waters well behind the area protected by the tori lines.

The underwater setting chute developed in New Zealand and Australia, has been tested off the east coast of Australia during 2002 to assess its effectiveness in mitigating seabird bycatch in those waters. For daytime deployment, the seabird catch rate after 100,000 hooks had been set approached a rate of two birds per thousand hooks. The trial is continuing and hopefully the incidental catch numbers are improving. But it appears at this stage, in isolation of other mitigation measures, it's not an effective measure in waters or seasons where diving birds are attracted to the baits. Over 90 percent of the birds killed in this trial have been shearwaters, a reflection of their enhanced diving ability.

In the CCAMLR waters of the Southern Ocean, regulations pertaining to a range of mitigation measures—including offal discharge, streamer lines, weighted lines, night setting and seasonal closures—have been set to correspond with assessments of seabird bycatch risk for each area. These risk assessments are based on seabird distribution and vulnerability. As compliance with these measures has increased over the last few years, the number of seabirds reported killed in the regulated fishery has dropped from 6,500 birds in 1997 to only 27 birds in 2002. However, in 2002 alone it was estimated that 50,000–90,000 birds potentially were killed in the convention area by illegal fishing operations. In total as many as 500,000 albatrosses and petrels may have been killed in the convention area since 1997 due to illegal fishing operations.

The impacts of these illegal fishing operations, combined with the effects of legal fishing, are simply not sustainable for many seabird populations. A critical element in solving this issue is to approach solutions broadly, so that by reducing seabird bycatch we don't inadvertently shift the dilemma onto other non-target species. For example, there's a potential for increased shark bycatch during night setting and a potential to increase turtle bycatch with weighted lines.

The responsibility to solve the seabird bycatch issue is a matter of urgency, and it lies with all of U.S. —perhaps most critically with the 11 nations responsible for breeding populations of these vulnerable seabirds, and the other 11 nations that operate significant fisheries in waters where these vulnerable seabirds range.

MARINE TURTLES

Colin Limpus, Queensland Turtle Research, Australia

In addressing marine turtle biology, I will give a thumbnail sketch of what sea turtles do in their life and identify some of the issues that we need to be thinking about.

There are seven species of sea turtles worldwide from two families: Dermochelyidae, in which the leatherback turtle (*Dermochelys coriacea*) is the single remaining species; and Cheloniidae, which includes five remaining genera of hardshell turtles. The six remaining species of hardshell turtles are: Kemps ridley (*Lepidochelys kempi*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*) and green (*Chelonia mydas*). Most of these species have a global distribution. The majority lives in tropical and temperate waters, with the exception of the leatherback, whose range includes the waters of the sub-Antarctic, sub-Arctic and, in some cases, the Arctic Ocean. The flatback turtle is restricted to the Australian continental shelf, and the Kemps-Ridley turtle is restricted to the Gulf of Mexico.

DISTRIBUTION OF STOCKS

The life history of turtles is fairly complicated with different stages involving quite different habitats and diets. After hatching, juvenile turtles head out to the open ocean and spend time as pelagic animals, foraging in currents and traveling vast distances. Eventually they return to coastal waters, where they complete their growth to adulthood and become affiliated with very localized feeding locations. At breeding time they migrate to traditional breeding sites in the area where they are born, and after breeding return to their individual feeding sites.

Adult turtles migrate from the feeding areas in spring; these migrations range from tens to thousands of kilometers. Courtship occurs in the vicinity of the breeding areas. The male courtship period lasts about a month; for the females, normally it's only a day. At the completion of courtship males return to their home feeding grounds, while females head to their particular nesting beaches.

For Pacific loggerheads, almost all breeding occurs in Japan or Eastern Australia, so loggerheads seen elsewhere in the Pacific—such as off the coast of Mexico or in the mid-Pacific—are traveling to their Western Pacific breeding locations. Studies are showing genetic distinctions between major groups of breeding colonies; thus loggerheads that breed in Japan do not interbreed with loggerheads that breeds in Australia or South Africa. Also, from genetic analysis we can identify management units or stocks for species like the green turtle and hawksbill, which have a greater number of breeding assemblages. These stocks can't be identified visually, but we can use genetic markers to identify the stocks individual animals belong to.

Some of these stocks are quite large. For example, of the four identified stocks of green turtles that breed around the Borneo, the annual nesting population of the Sulu Sea stock includes many thousands of green turtles. In contrast, the annual nesting population of the Sarawak stock is only a couple hundred females. So in considering mortality we need to identify the stocks, and small stocks obviously will withstand much less mortality than larger ones.

MIGRATION AND NESTING

Genetics work is revealing that these animals are returning to breed in the area where they were born—not necessarily the exact beach, but certainly their area of birth. A lot of information comes from tagging studies. Traditionally low-cost flipper tags have been used, but thanks to the recent development of satellite telemetry tags, we have better information on the movements and dispersal of animals. So we know, for example, that green turtles go to nesting areas as much as 2,500 kilometers from their feeding grounds, and any one feeding ground can be a source of turtles to many different genetic stocks. This presents a challenge in terms of determining the actual number of mortalities among the particular stocks.

When females come ashore to lay eggs, the eggs must be above high tide to incubate. The requirement for a terrestrial environment for egg incubation exposes turtles to predators and other terrestrial influences that wouldn't normally be encountered in a marine environment. At nesting time females have sufficient follicles for several clutches over a season. For example, green turtles in the Western Pacific lay about five or six clutches of eggs in a single breeding season. It's not necessary for the female to engage in sex between clutches; she stores sperm from courtship prior to the nesting season in a sperm bank in her ovary ducts and fertilizes each clutch as the season progresses.

Studies of the breeding history of individual females reveal a fairly common pattern among marine turtles: the older they get, the shorter the interval between the breeding seasons and the larger number of clutches laid. So, the potential is for greater egg production with older animals; however, when they skip many years between breeding seasons, even slight increases in annual mortality show significant impacts on the capacity to survive long enough to reap the benefits of their increased fecundity with older age. For green turtles in the southwest Pacific, the typical interval between breeding seasons is five to eight years, so their average lifetime fecundity is greatly reduced by this skipping of years between breeding seasons. It's one of the real limitations on population numbers.

The incubation process is independent of the adults. It's largely driven by temperature, which controls the length of the incubation period, incubation success and the sex of the hatchlings. Eggs incubated at a low temperature—about 25–26 degrees Celsius—will produce 100 percent male hatchlings, while eggs incubated at around 30–31 degrees will produce 100 percent female hatchlings. So in some geographic areas lots of females may be produced, and in other areas, lots of males. Within one genetic stock, at different times of the breeding season there are different sex ratios among hatchlings.

LIFE STAGES

The emergence of hatchlings out of the nest, across the beach and into the water is quite an incredible event. Hatchlings imprint on Earth's magnetic field as they leave the nest. They have to dig their way from 50–60 centimeters below the beach surface and then scurry across the beach, without parental help, not stopping to feed or rest. When they reach the water they start orienting to wave fronts and light horizons. All of this is innate behavior. Turtles haven't evolved in the context of the changed environment of the 20th century, with its altered light horizons, human habitation and other human impacts on our shores and in coastal waters.

Hatchlings go through about a three-day swimming frenzy in which they swim nonstop to get as far offshore as possible, away from the high densities of fish and shark that occur inshore. When they stop their swimming frenzy, they basically float, cease active swimming and are carried by the currents. They then attempt to feed on anything in front of them: jellyfish, blue bottles, gooseneck barnacles, log fragments, lumps of floating plastic, tar balls.

However, they primarily feed on plankton and go where the ocean currents take them in the open pelagic environment. After spending some time out there—the period varies between species—juvenile turtles return to coastal waters. For most species, their whole feeding biology changes, and they switch from feeding on surface plankton to benthic (seafloor) organisms. The green turtle is primarily an herbivore that feeds on seagrass and algae. Loggerheads are primarily carnivores that feed on shellfish and other crustaceans, while hawksbills eat sponges, soft corals, algae and so on.

Most of the juveniles grow to adulthood in coastal waters. Their growth is slow, and in most of the species the turtles are decades old when they start breeding. In the southwest Pacific the green turtle is 40–50 years old when at their first breeding, and loggerheads are about 25–30 years old. This delayed maturity is a major problem in terms of mortality. A population cannot afford to lose many animals each year and still have enough survive for 30 years to start breeding. This delayed maturity, combined with the non-annual breeding habit, limits a species greatly in its capacity to withstand any increase of mortality that comes outside of the natural processes. These species need a high annual survivorship for their life history to work.

We know there are a lot of loggerhead turtles living along the coasts of California and Mexico. They originate from Western Pacific nesting beaches, as there is no breeding of loggerheads in the Eastern Pacific. For loggerheads to reach Eastern Pacific waters, juveniles must be carried eastward by currents, and as these turtles travel they are feeding, so there is a potential for them to interact with longline fisheries.

EXPOSURE TO INTERACTIONS WITH FISHERIES

To estimate how long turtles in the southwest Pacific are out there in the currents exposed to the hazard of longline interaction, we can consider the size at which these turtles come out of the open ocean and take up their coastal living. Hawksbills have been measured at about 36 centimeters, so they're about five years old when they make the transition from a pelagic lifestyle to feeding on the continental shelf. Greens are a bit bigger, and it's estimated they are spending five to ten years out in the pelagic environment. Loggerheads are considerably larger and about 15–20 years old when they reach the Eastern Pacific, but they are totally pelagic so they're in that habitat their whole life. So different species have different oceanic exposure. The longer these turtles are exposed to a risk situation, the greater the hazard. Thus leatherbacks, loggerheads, and the ridley turtles—all of which have a major part of their life history in the pelagic environment—are high-priority species in considerations of the risk of interaction with longline fisheries.

DATA NEEDS

However, there are other important aspects of risk in the pelagic environment for a marine turtle. Adults migrate from feeding areas to nesting beaches. Then, having completed their breeding, they return home. The satellite telemetry on the movements of a particular hawksbill that was breeding in the Solomon Islands showed that it migrated almost a straight line back to the Southern Great Barrier Reef. Migrating adult turtles feed very little, if at all, which may reduce their interaction with fisheries. I say "may" because it has never been documented in most instances which turtles are caught in the fishery. We really need data on the species of turtles being caught, as well as details on size, stage of maturity, breeding status, etc. If there is a group that is less likely to be caught I believe it is the adults, but we need to demonstrate that.

Recently we have become aware that turtles' general life history may not be quite as straightforward as we previously thought. There are indications that in some situations turtles may from sometimes leave coastal waters and return to the open ocean to forage. For example, we were tracking an adult green turtle living in Morton Bay, South Queensland, to measure the home range where it foraged on seagrass in shallow waters, when it left to spent a month out in waters about 4,000 meters deep—far too deep for bottom-feeding. It was at the surface, and almost certainly was foraging. It passed three lots of seamounts where we know there longline fisheries operate, so it was likely exposed once again to the risk of capture by longlining.

This illustrates that we still have things to learn about the biology of sea turtles, particularly in the oceanic environment. We need spatial information about where turtles are both horizontally and depth-wise. We need information about the times of year when these animals are present in the various areas. When I started marine turtle studies, this period of life out in the oceanic environment was called the "lost years." More recently researchers have said, they are not really the lost years, because we know the turtles are out in the oceanic environment. But that really doesn't tell us a great deal about what they're doing out there. The exposure of these turtles to the fishing industry, particularly in the Pacific and the Indian Ocean, is very poorly documented, so we don't have any sort of real catch statistics that will help us understand what is happening ocean-wide.

It's a challenge to this forum: How we can overcome these deficiencies in our understanding of these animals as they use this environment? Thank you.

LONGLINE FISHERIES AND DATA COLLECTION

Tim Park, National Oceanic Resource Management Authority, Federated States of Micronesia

I was asked to give an overview of the longline fishery of the Western and Central Pacific Ocean (WCPO). First I'll discuss the industrial fisheries of the WCPO in general, to give a perspective of scale, and then speak about the longline fishery of the WCPO. Because of my experience for the last seven years in the Federated States of Micronesia (FSM), I'll focus on FSM longline fishery as a case study. The composition of the fleet, its characteristics and various other parameters show just how complex the fishery is.

The WCPO— the area west of 150 degrees west longitude—is a statistical reference point usually used for tuna fisheries. It encompasses the waters of many Pacific Island nations, so it's important for the developing countries in the Pacific, as well as Asian countries.

TARGET SPECIES, CATCH QUANTITIES, AND FLEET CATEGORIES

The target species of these industrial fisheries are skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*) and albacore tuna (*T. alalunga*). In 2001 the total industrial fishery catch of the WCPO reached 1.9 million metric tons, which was the second highest catch recorded after 1998, which was slightly over two million metric tons. The total WCPO catch represents 75 percent of the Pacific Ocean tuna catch and 49 percent of the world tuna catch, so it's a very important fishery.

The WCPO longline fishery in 2001 reached a record of 238,729 metric tons, which was 13 percent of the total catch. The other WCPO fisheries are the purse-seine fishery, which took 56 percent of the total catch; the pole-and-line fishery, which captured 17 percent; the handline fishery of the western area, which caught 14 percent; and the developing trawl fishery.

There are several categories of fleets in WCPO longline fishery. The distant water foreign fleets generally operate large freezer vessels over 200 gross tons that store their catch frozen. They travel a long way from their home ports and usually don't use interim ports. The smaller (less than 150 gross tons) 'offshore' vessels are generally Asian fleets domestically based in a Pacific Island nation. They mostly operate under bilateral agreements that allow them to catch tuna for the sashimi market, though many of the Pacific Island nations are using these vessels to target albacore for local canneries.

Of the record 2001 catch of the longline fishery, 35 percent was albacore, 35 percent yellowfin, and 30 percent bigeye. The bycatch component is quite small. Prior to the mid-1980s, the longline fishery in the Pacific had been declining, but since then, it's been increasing, due mostly to the expansion of the albacore fishery over the last five to ten years.

DISTRIBUTION OF CATCHES

Distant water fishing vessels—usually from Japan, Taiwan and Korea—tend to fish the international waters, mostly in the area of the Federated States of Micronesia (FSM), the Marshall Islands and Palau. The domestic offshore vessels, the largest components of which are from Indonesia and the Philippines, are concentrated in the far west of the WCPO. There's also the Hawaiian fishery, and the large alia fleet in the Samoas.

The distribution and relative proportion of the catches of these fleets can be divided into areas or zones. The tropical target tunas, yellowfin and bigeye, dominate the longline catch along the equator out to latitudes 10 degrees north and south. Along this equatorial zone the relative proportion of the catch of either of these species varies. East of longitude 180 degrees, bigeye dominate the catch in the eastern tropical Pacific; west of 180 degrees, yellowfin comprise a greater proportion of the catch. This is particularly true in the far west of the WCPO where the small-scale Southeast Asian fleets are prevalent and target yellowfin. However in the FSM the smaller Japanese offshore and FSM domestic fleets tend to target bigeye specifically.

Albacore dominates the catches in the subtropical and temperate waters where they are targeted. Billfish represent a large proportion of the catch in the temperate waters where swordfish fisheries exist. Also, marlins generally constitute a moderate proportion of the catch in equatorial areas of the WCPO. Sharks and other species are most commonly declared in the catch in the far west of the WCPO.

THE FSM FISHERY

The fishery in the FSM, formerly called the Caroline Islands, is complex. While the land area of the FSM is only about 271 square miles, the EEZ is 960,000 square miles. The three main fisheries—purse seine, longline and pole- and-line tuna fisheries—bring in $12–20 million dollars, about a fifth of the country's total income, in annual license fees. So for this small country economic stability is quite focused on the fishing industry.

Development of the longline fishery in the FSM began in the 1950s with the Japanese distant-water fleet. When there was a boom in the demand for sashimi in the mid-'80s, smaller offshore vessels entered the fishery. Initially they were Japanese and Taiwanese, based either in Guam or at FSM ports. In the early '90s Chinese longliners entered the fishery through a large company that got access agreements. At this point we had up to 550 longliners fishing in the EEZ of the FSM. Since then the number of vessels has declined; in 2001 there were 246 longline vessels. This included offshore vessels from Taiwan (102), China (55) and Japan (51); 17 distant-water vessels from Japan; 18 domestic FSM longliners and three Guam-based U.S. longliners. In total these vessels set over 22 million hooks, with the Japanese offshore longliners reporting the most hooks set. The catch fluctuates considerably. During the mid-'90s, the longline catch was over 18,000 metric tons, whereas last year it was down to about 5500 tons. So it's declined a lot lately,

The longline fleets operating in the FSM are quite diverse. The medium-to-large (100–140 GRT) vessels in the Chinese offshore fleet are mostly of timber construction, though there are some steel boats. These boats have the most rudimentary technology, with a minimum of electronics equipment. The main lines are monofilament and manually deployed. Their branch lines are simple, though often have wire traces. Separate shark lines are often used. The catch is stored in ice, which limits the storage time on board and hence the trip duration, which is about 1.5 weeks.

The Taiwanese vessels are slightly smaller, at 40–80 gross tons, with more modern technology, including better electronics. However, they still manually deploy the lines. The boats are equipped with haulers that bring in the lines, but the lines are in segments, so there's a lot of manual labor involved. However, they do have refrigerated seawater for storage of their catch, so that extends their range and trip duration to about four weeks.

The smallest longline vessels are the Japanese offshore boats, weighing around 20 gross tons. However, they are the most advanced technologically, with lineshooters and coilers, bait throwers, more sophisticated electronics, a lot more safety gear, and so forth. Their superior refrigeration systems allow greater storage time and permit them to spend three weeks at sea. Under the FSM-Japanese memorandum of understanding, there's relatively low observer coverage on these vessels.

The boats based in Guam and operating as U.S. vessels are actually Taiwanese boats. The burgeoning domestic fleet is comprised of seized boats or old secondhand boats purchased through various U.S. companies. The FSM and Guamanian boats can make trips of around two weeks duration.

The larger distant-water boats—mainly Japanese and Taiwanese, but also Korean—are large freezer vessels that are fairly complex technologically. They mostly fish in international waters where it's difficult for us to place observers, so we have very little data on them. The Japanese freezer vessels make average trips of over six weeks vessels—the longest trip time of any of the vessels operating in our region. Having a large storage capacity for frozen tuna allows them sufficient time to fish the more remote areas of the Pacific and return the product to Japan.

Within our EEZ, the various boats fish in different areas, due to restrictions in technology and, particularly refrigeration. The Chinese boats and the domestic boats primarily are based out of Pohnpei and tend to fish in that vicinity. The Japanese and Taiwanese offshore boats are based in Guam, north of our EEZ, but their refrigeration and slightly better technology allows them a broad range through our zone. In 2001 the only recorded distant-water vessels were from Japan.

DIFFERENCES BETWEEN FLEET FISHING PATTERNS

There are temporal differences in the fishing patterns of the fleets also. In the FSM our peak fishing occurs in the Northern Hemisphere summer, followed by a lull during the early part of the year. The Taiwanese and Chinese boats based in the FSM usually have a changeover of vessels at that time. The Japanese boats also have some seasonality, likely related to their bluefin fishery patterns. There's also a link between the fishing effort and the lunar phase. The Chinese boats fish heavily around the full-moon period and the Taiwanese tend to do this also.

The diurnal habits of the fleets are also important. The Japanese, domestic and Guamanian boats are daytime setters; that is, they set the lines in the morning and haul in during evenings. The Taiwanese and Chinese are nighttime setters, setting their lines in the evenings and hauling in the early mornings.

There is a range in relative efficiency of operation of the various types of fleets. The number of hooks used per set is related to the speed at which hooks can be set and hauled, which relates to the technology employed on board. The Chinese vessels using 'basket' technology generally set the fewest hooks among the fleets. Around 600–900 hooks are generally set and take on average three hours to set and six hours to haul. This makes an average speed of about 250 hooks/hour to set and around 133 hooks/hr to haul.

The small Japanese vessels are more efficient in their operation. Most vessels set about 2,400 hooks and take on average five hours to set and nine hours to haul with a setting speed of 480 hooks /hour and hauling speed of around 266 hooks/hour, or about twice as fast as the Chinese vessels. We have little data on the efficiency of the larger Japanese freezer vessels though presumably they would be even more efficient.

The minimum depth fished—defined as the float-line length plus the branch-line length—also varies between fleets. The Chinese and Taiwanese and domestic FSM vessels have a broader range in the minimum hook depth, though they are deeper on average than the other main fleets, with the minimum hook depth over 55 meters on average. The small sample available of Japanese minimum depth data all had a minimum depth of 40 meters. Hence their minimum depth set is shallower and more consistent than the other fleets.

The maximum depths fished are derived from the length of the 'baskets' (length of mainline between floats), its relative looseness in setting and the depths to which the mainline hangs. Therefore the number of hooks per basket is an indicator of maximum depth. Taiwanese and Chinese longliners, which tend to focus on the moon and set at night, set about five hooks per basket. In contrast, Japanese vessels set 16–20 hooks per basket, fishing deeper and through a greater range of depths. The domestic vessels and the Guam vessels mimic the Japanese fishing style. Thus there are two fishing styles in use, the Taiwanese and Chinese shallow night-setters and the Japanese, domestic and Guam deeper day-setters.

Comparing our observer data on the catch of the nighttime shallow-setters versus the daytime deep-setters, there's very little difference in the yellowfin catch, whereas the bigeye catch is better for the day-setters. The bycatch of the night-setters, particularly of billfish and sharks, is higher than that of the day-setters. For the few data on turtle catches that we have, the shallow night-setters caught about four times as many as the deep day-setters.

In conclusion, the FSM tuna fishery is a useful test case in examining the longline fishery of the WCPO. The fleet structure of the fishery is complex compared to many other countries in the Pacific, because of its foreign composition and the distinct operating profiles of the fleets, which are largely related to their differing levels of technology. Importantly for this meeting, there are also differences between the shallow night-setting fleets and deep day-setters in the incidence of capture of protected species such as turtles. The information on operating characteristics and species composition provided here highlight the importance of observer data in the characterization of longline fisheries.

FREEZER LONGLINE OPERATIONS IN ALASKA

Mike Bayle, Alaska Frontier Company, Alaska, U.S.A.

My presentation is centered on a larger class of vessel operating in Alaskan waters, known as freezer longliners, and all my comments are limited to them.

The present-day demersal freezer longline fleet dates back to the mid-1980s, when American fishermen began to supplant the foreign fleets that once fished U.S. waters. The fleet grew dramatically between 1989 and 1992, whereas today there are approximately 39 vessels now operating in the Bering Sea and Gulf of Alaska. These vessels mostly target Pacific cod, but may also target Greenland turbot, sablefish and halibut. Pacific cod remains an Olympic-style fishery, while sablefish and halibut have evolved into what is now considered a successful individual fishing quota (IFQ) program. A license limitation program has now restricted the number of vessels in the Pacific cod fishery, but does not affect the IFQ fishery.

The freezer longline vessels in Alaska range from 20 to almost 60 meters in overall length, are of steel construction and, more often than not, have auto-longline systems for baiting hooks and setting gear. With the wide variety of vessel sizes, the number of hooks set per day may range from 30,000 to over 60,000. The auto-longline and hand-baiting vessels typically use squid for bait. Crew size may range from 10–40,with trip lengths from 15–40 days. Simple processing of heading and gutting is usually the norm, with the vessels utilizing 2–6 plate freezers per boat.

Freezer longline vessels for the most part utilize a pre-made, 9 mm (3/8 in) 4-strand, swiveled, polyester groundline, cut in lengths particular to their longline system. Hooks are either circular or a modified-J hook. Many variations in setting patterns are used, taking into account the effects of weather, currents and fishing strategies with competing vessels.

The incidental take of seabirds really came to our attention in 1995, when the most pressing issue was the short-tailed albatross. We were informed that the incidental take of four of these birds within a two-year period could close the fishery for the remainder of that season. Records showed that two of these birds had already been caught, within almost a week of each other, and it was evident that an aggressive, proactive approach to this issue needed to be taken swiftly.

Early research revealed that fishing operations in the Southern Ocean and by the Japanese fleets had some successes with trailing a tori line behind the vessel. This line is dragged behind a vessel, with a buoy and weights at the terminal end and progressively shorter lines hanging vertically in the water along the length of the main line. A sample of this device from Japan was tested along with several other methods on sea trials in Seattle, Washington, and the tori line, with some modifications, received serious consideration. The industry and our state regulatory bodies now refer to these devices as streamer lines.

The U.S. Fish & Wildlife Service, University of Washington Sea Grant Program (UWSGP), National Marine Fisheries Service (NMFS) and participating private fishing vessels joined forces in a two-year study in the Bering Sea to testing the streamer lines as well as other devices under normal fishing operations. Weighted lines, underwater setting tubes, line shooters, and single and multiple tori lines were all tested and compared against a control that produces no deterrence at all.

In 1996, the industry proposed seabird deterrence regulations—modeled on the CCAMLR seabird avoidance measures—and they were implemented in 1997. Results from the extensive testing at sea demonstrated that paired streamer lines with certain performance standards were an extremely promising method. The underwater setting tube, tested on one vessel, was also very effective at releasing the line far enough below the water surface to discourage most takes by seabirds. However the cost and practicality of equipping all vessels with this large device has prevented it from being seriously considered.

Since May 1998, the first year regulations were in place, the incidental take of all seabird species by freezer longliners has dropped significantly. A third year of study has shown some promising results with varying amounts of weight incorporated in the four-strand groundline. The attachment of weights to the groundline during gear setting can pose a dangerous situation to the fishermen; however, increasing the sinking rates of a vessel's groundline quickly closes the window of opportunity for seabirds to attack baited hooks. The participating scientists will present results from these three-year studies at different times during this conference.

Based on UWSGP research, the North Pacific Regional Fishery Management Council (NPRFMC) has recommended changes to the existing requirements for seabird avoidance, and NMFS currently is in the process of making those regulatory changes. The recommended changes, already being implemented by many vessels, incorporate improved gear configurations and techniques that, when used together, provide the best approach to seabird deterrence. Again, these points refer only to practices by demersal freezer longliners in the Pacific cod fishery:

1. All vessels must deploy a minimum of two streamer lines while setting gear. (This helps avoid hang-ups with the baited lines and reduces seabird attack of baited hooks.) If both lines cannot be deployed prior to setting the first hook, at least one streamer must be deployed before the first hook and both must be deployed within 90 seconds. If wind speed conditions exceed 30 knots, it is acceptable to deploy a single streamer line. If wind speeds exceed 45 knots, the safety of the crew will supercede deployment of streamer lines.
2. Streamer lines must be deployed in such a way that the streamer lines are in the air for a minimum of 40 meters aft of the stern for vessels under 30.5 meters, and 60 meters aft of the stern for vessel 30.5 meters or over. Vessels may achieve this performance standard by increasing the height off the water at the stern and/or increasing the drag at the terminal end with buoys or weights.
3. The minimum streamer line length is about 90 meters, with brightly colored streamer material placed every 5 meters hanging from the mainline to 0.5 meters of the water in the absence of wind, until the performance standard is achieved.
4. Vessels must eliminate residual bait of offal discharge from the stern of the vessel while setting gear.

A written seabird avoidance plan onboard each vessel describes the roles and responsibilities of crew members for deploying seabird avoidance measures.

Experience also shows that a breakaway section should be incorporated into each streamer somewhere near each end to allow it to part more easily if groundline snagging occurs. We have also found that keeping hardware on the streamer line to a minimum lessens the likelihood of hooks on the groundline snagging the streamer lines. We recommend that vessels have spare streamer lines on the back deck, in the event that one being deployed, parts. The short time for exposure to attacks by seabirds, during this critical time, is still great enough that every contingency should be thought out well ahead.

Several vessel skippers have suggested ideas to augment these techniques that have proved noteworthy. For example, sound-producing devices appear to have some deterring effect. A common one used is a liquid propane gas cannon to sporadically set off extremely loud blasts. This is apparently most effective during periods of low wind. Some vessels use a hand-held pistol that discharges a loud or screaming report. However this interferes with crew attempting to sleep.

A significant improvement to the single original tori pole design, has been the development of something resembling a small boat davit, from which to regulate the spread or height of the streamer lines from both sides of the vessel as they are deployed from the stern. These have proved extremely useful to give the crews the flexibility needed to deal with the weather elements of Alaska.

It is important to note that most fishing operations agree that using these deterrence methods have not significantly reduced target catch. It is also widely agreed that the importance of a competent and willing crew to ensure the success of these measures cannot be overstated. Direct supervision of deployment by trained personnel is of paramount importance. Under advisement, fishing vessel captains begin each trip with a brief discussion, with the onboard fishery observer outlining the particular methods and gear that will be used during the fishing trip. Logbook entries into the NMFS daily catch and a production log specifying the seabird avoidance gear used is mandatory. The captain completes an industry-generated seabird avoidance incident reporting form when an incident regarding seabird avoidance measures and performance standards occurs. The NPRFMC notes that minor variations from the performance standards are likely. Reasonable effort displayed by vessels should be taken into consideration prior to enforcement actions. Blatant, intentional and egregious violations should justify enforcement action.

It must be mentioned that regulatory bodies and agencies for our fishery have responded positively with industry initiatives. The U.S. Fish and Wildlife Service makes available the streamer lines of the recommended design, at no cost to the longline fleet, through the Pacific States Marine Commission. In addition, USFWS will reimburse 50 percent of the cost of installation for two davits and either one or two line haulers, up to a maximum of $5,000 U.S. Support such as this makes it difficult for anyone to dispute the regulations based on the costs of gear.

Also, at the behest of industry we began a vessel industry-monitoring program with a third-party entity, Fisheries Information Service (FIS). With 28 vessels participating, in 1999 FIS began providing in-season weekly reports for each boat, which they used to produce “report cards” at the end of each season. They also generated analyses of the relative successes of each deterrent method used at the time. There are currently 37 vessels participating in the program.

Another focus of our industry has been education on this issue across a very large geographical area. Kim Rivera, NMFS Seabird Coordinator with the Alaska region, and Ed Melvin of UWSGP have been instrumental in disseminating valuable information in many of the fishing ports in the Pacific Northwest. Education with an emphasis on compliance remains a goal to be reached.

The desire for fishermen in the Alaska region to be a part of the regulation process has been very positive, and the motivation to continue fishing and coexist with current proposed regulations is extremely high. We have not been discouraged, nor have we found regulations to be extremely burdensome to this point. We also acknowledge there is work to be done, but in light of the outstanding response so far we feel the goals we have set for ourselves are obtainable, reasonable and the right thing to do.

Each country or sector of our industry must step up and demonstrate their willingness to resolve their regional issues. We are all players in the same big picture in the same world stage.

DATA COLLECTION: ALIGNING DATA NEEDS WITH PROGRAM OBJECTIVES

Howard McElderry, Archipelago Marine Research, Ltd., Victoria, B.C., Canada

I work for one of the largest companies in Canada that provides dockside and at-sea monitoring. In my view, data collection is very much a process of aligning data needs with program objectives. All commercial fisheries collect data that are useful in pre-season and in-season decision-making processes. This process has become a lot more complicated with the growing requirement for industry to deal with catch and bycatch quotas, enforcement of regulations, and issues of uncertainty, sustainability and ecosystem-based management principles.

If we can imagine a universe of all of the types of information that could be derived from fishery data, we can set up a general interaction model that incorporates the diverse types of information obtainable. Data collection systems provide a window on, or view of the fishery. There may be more than one window representing different data or different interpretations of the data based on various knowledge systems. Each view is unique, and none encompasses the whole picture. A Johari window represents the potential interactions between different groups using different information sources. This includes information known by both parties; information known by only one party and not the other; and information known by neither party.

Where there are multiple stakeholders, the process of decision-making is ultimately about striving to make the area of information known by all parties as big as possible, minimizing areas of unknown information, and respecting the inevitability of some information being known to one group and not the others. To do this we need to evaluate the data to ensure that it's addressing the needs and that it's of sufficient quality and quantity to support the decision processes.

LOGBOOKS VERSUS AT-SEA OBSERVER PROGRAMS

Let's compare two collection systems used by commercial fisheries: fisher logbooks and at-sea observer programs. Logbooks represent a very common, fairly inexpensive self-reporting system in which the skipper collects the data. Generally, logbooks provide a complete census of the fishery. The methods of collecting data and the quality of logbook data vary, as the skippers' training levels are variable. Some are very well trained and put a lot of effort into logging, while others don't. The amount of effort given to recording data in logbooks is generally in competition with other activities of the skipper.

On the other hand, at-sea observer programs, in which the observer is the data recorder, are less common and very rarely have full coverage on large fleets. Typically the program is a sample of the fishery, not a full inventory. Also the cost is fairly high due to the high labor requirements for observers and for program administration (e.g., hiring, training, and managing the data, etc). In small logistically complex programs, it's not uncommon for every day of onboard observer time to require about 0.4 day of associated administrative time. Observer programs generally attempt to hire and train observers to apply a consistent level of effort to obtain data for the fishing trips. Compared to skippers, observers focus specifically on data recording and employ standardized methodology. There are also differences between the two systems in terms of data feedback. Often logbook programs don't incorporate the data quickly enough to bring the results back to the fishermen so that they can make corrections or incorporate a learning process. In contrast, observer programs usually have some type of debriefing or other way of coalescing the information and providing feedback to the observer fairly quickly.

Independence from the data is another concern. Observers are generally independent from business operations of the fishery, and thus are inclined to report objectively, while fishermen may be requested to record data on sensitive issues in their logbooks. This may be diametrically opposed to the business interest of the vessel, so there's likelihood that they may not report the data honestly.

The two types of systems also differ with respect to the general oversight of reporting. Hired observers develop an employment relationship where there is generally a progressive process of organizing and developing their data collection skills. On the other hand, logbook systems rely on the skipper, who isn't going to get fired because he didn't record data properly. The real problem with logbooks is with verification. Even when logbooks incorporate a lot of high-quality data, there is no external verification in the process, so the usability of the information is questionable.

Both observer programs and logbook programs require careful consideration of objectives. Often a data collection program is implemented for a particular reason, and then as time goes on other data collection needs get tacked on to the programs, such that the information collected becomes compromised due to excessive demands from the data collection process.

Another potential issue with observer programs is with sample design. Sampling seeks to predict the part not sampled, but in making extrapolations to predict the behavior of the entire fishery from a small sampled component, the estimates contain error due to sampling bias. Generally there are three stages of sampling for a fishery, each of which contributes to the total overall error:

- Selection of sample fishing trips, which may vary by space, time and fleet.
- Selection of sample events on a trip where operations typically occur around the clock.
- Selection of portions of the fishing event if it is lengthy.

The British Columbian halibut fishery serves as an example that illustrates logistical constraints to the first stage of sampling. There are a couple of major ports on the coast of B.C. where the fleet is based, and a disproportionate distribution of the fishery along the coast, so it's often difficult to know in advance where a fishing vessel intends to fish. Furthermore, nearly a third of the vessels in the fleet are less than 40 feet long, so they have limited space for an observer. Also, this fishery is very active during certain times of the year, but it's affected by weather, so activity levels vary considerably from day to day. All these factors create difficult challenges in implementing a randomized fleet sampling design.

Another issue concerns the level of sampling and associated sample error in relation to the species of interest. Using the Alaska pollack fishery as an example, in sampling abundant target species the error level declines fairly quickly, and with a small amount of sampling a good estimate of the species occurrence is achievable. In contrast, a very rare species may be so infrequent in the fishery that accurate sampling requires high levels of coverage and it's difficult to achieve a reasonable estimate. Unfortunately many observer programs are limited by budgetary constraints, program operational logistic capabilities, and other factors that don't allow for gearing the program to specific levels of error and desired fleet coverage for many non-target species.

The third issue around observer program sampling is the so-called "observer effect"—the deviation from normal fishing behavior as a result of the presence of an observer. The effects can be subtle, as when the crew pays uncharacteristic attention to the handling of bycatch; or it can be pronounced, for example, an atypical avoidance of areas of high- risk fishing. This problem violates the fundamental goal of sampling—predicting the unmonitored part of the fishery from the monitored part—so it's very important to evaluate whether observers modify fishing behavior of targeted vessels.

I want to emphasize that the point is not to discredit these programs, but to suggest how to address their inherent weaknesses and develop alternative approaches to at-sea monitoring. Logbook programs would benefit by finding mechanisms to improve data quality and build in external verification to make logbook information believable. And at-sea observer programs, with their complex logistics, would benefit from careful scrutiny of sampling levels in relation to the issues. For both types of programs there's the need to determine whether the objectives and the requested program activities are complementary.

ADVANTAGES OF ELECTRONIC MONITORING

These issues led our company to begin investigating electronic monitoring (EM) about ten years ago. We saw EM as an opportunity to add a new tool to the toolbox and get around some of the problems posed by observer and logbook methods. It could be significantly cheaper than an observer program, and it represents an important way of creating verification.

EM entails an automated data recorder, designed for a specific fishery application and installed on board the boat to log data that are analyzed later to recreate the activities of the fishing trip. This equipment includes a sensor suite that gathers a variety of information to record vessel position and pinpoint details such as set and haul locations, so it's a very effective for charting time and area fishing. EM also captures digital video imagery, using closed-circuit TV (CCTV) cameras. Hundreds of hours of imagery can be stored for subsequent viewing, so it can be used to monitor basic vessel operational practices such as gear setting.

To assess the feasibility of video monitoring for seabird interactions, Archipelago joined a study in the Aleutian Islands, conducted by the International Pacific Halibut Commission for NMFS Alaska Fisheries Science Center. CCTV cameras were mounted to monitor gear setting off the stern and gear hauling off the side of the vessel, collecting video imagery of sets and hauls from over 170 sample stations. Gear setting represents about 11 percent of overall fishing trip activity and CCTV imagery was successful in evaluating the effectiveness of seabird streamer devices. Analysis of the video imagery of sets and hauls requires much less time than direct monitoring takes.

We're also evaluating EM as a tool for catch monitoring in the B.C. halibut fishery with Fisheries and Oceans Canada and the Pacific Halibut Management Association. We estimate that haul times account for about 20 percent of the overall fishing trip. We are able to analyze the video imagery at about 80 percent of real-time, so this method saves a significant amount of time compared to the time requirement of an onboard observer. Last summer there were about 700 sets from 60 trips and 20 fishing vessels with EM onboard. About half of these also had an at-sea observer and generated a dataset of about 30,000 records of paired observations with EM and observer identifying the same animals. The overall level of agreement between the two methods was high.

Another benefit in EM is its capability for radio frequency identification (RFID) for gear identification. There are many fisheries studies that use this technology (PIT tags) to monitor movements of fish but we have been using it to monitor fishing gear. For example, the Prince Rupert crab fishery involves about 50 boats collectively trying to keep track of some 36,000 traps. The crab fleet was equipped with EM equipment. All trap buoys are fitted with RFID tags, and as the traps get hauled onboard they are scanned. So you can analyze the cruise track of the vessel and check the serial number of the tag in relation to the trap inventory database. This helps the fishermen to manage their inventory, monitor the soak duration of the traps, and analyze overall fishing effort. It's also a very valuable tool for determining the geographic position of the overall fishery.

At-sea data collection generally has to increase in commercial fisheries, and technological advancements will facilitate that. However I don't think EM will replace observer programs; rather there will be more strategic use of observer programs, with EM being used by observers and to compliment observer coverage. Transcription error is a big problem in observer programs, and EM technology might help address this by allowing data to be captured automatically, or at an earlier stage. Where fleet monitoring can be accomplished with combined EM-observer programs, it will be possible to get much greater coverage per unit of funds, than by an observer program alone. This approach also helps address the issue of monitoring vessels that are unable to host an observer.

Similarly, as fishing logbooks transition into electronic formats, fishers will be able to collect a lot of information more easily. There will be new opportunities to use EM to corroborate fishing logbooks and provide independent records of catch, allowing fishermen to maintain their role as principal data gatherers for their fishing operations, and possibly eliminating the requirement for observer monitoring. Certain datasets can be evaluated to make sure that the declared information agrees with the EM results. This combination promises to improve data quality and zero in on where problems exist.

One of the big issues in our business is the legacy in commercial fisheries of not being monitored. Traditionally fishermen have operated remotely and in privacy and there is a natural resistance to being monitored. However, increasingly this issue will come down to a simple business decision. The level of data quality is directly related to the level of certainty in our understanding of the fishery. The more we know the more likely we will be able to make better decisions concerning uncertainty, sustainability and ecosystem-based management. That presumably leads to more secure, steady access to the resource.
In closing, I think we're moving toward a shifting of the burden of proof from external groups trying to understand what is happening to a fishery to a situation where commercial fishermen are trying to understand the data needs of their fishery find the tools to meet those needs. Thank you very much.

CAN LONGLINE FISHING AND SEABIRDS COEXIST?

Nigel Brothers (retired), Tasmanian Parks and Wildlife Service, Australia

Like many fishing methods, longlining can have serious ecological impacts—and not just on targeted species. Seldom are there economically viable or readily embraced solutions, so fisheries are either closed down or manipulated by management to minimize rather than solve these problems. Sometimes they just blaze on regardless of the consequences. Fortunately for one such environmental impact—the bycatch of seabirds by longline fisheries—there are solutions that are not only dead simple but also economically advantageous. So why, 15 years after the issue became widely recognized does the problem persist today? And why, despite the substantial investment in mitigation measure development and considerably more spent on meetings and forums about the issue, do unacceptably large numbers of seabirds still die on hooks? Perhaps the key to fixing the problem actually lies in first finding answers to these questions, for it is likely that the answers are as simple as those solutions.

At least 15 years ago fishermen were well aware of small operational changes they could make to largely prevent seabird mortalities—line weighting and night-setting, for example. Less widely known, less effective measures such as bird scaring lines already were in use then. The use of such measures at that time was entirely economically driven and had nothing to do with bird conservation. Things had to be pretty desperate for any action to be taken, as when a casual glance astern during setting revealed bird and bait chaos. But on a more typical day, the occasional bird takes bait and plenty of fish still are caught, so why bother avoiding birds?

This is largely still the reality of longline fishing and seabird mitigation. Achieving an acceptable reduction in mortalities relies on simple but effective measures; however even simple measures will fail if they entail additional effort in the busy daily routine aboard. Likewise if choice alone dictates the decision to implement a mitigation measure, it simply won't be used. And all too often when a mitigation measure fails (such as when a bird scaring line gets wrapped around the propeller), the blame is cast on the measure rather than on human error, and, being regarded as unnecessary to catching fish, it is soon discarded. Compliance effort may assist the uptake of mitigation measures, but conventional means for increasing compliance, such as at-sea observer programs, is cost-prohibitive and unrealistic on the scale required to be effective. This is not to say that there are no longline fishermen routinely putting effort into avoiding seabirds there are, but they are too few for the birds to notice. Meanwhile, the majority who choose to ignore the issue threaten the livelihood of those who use mitigation techniques.

Irrespective of the simplicity of a seabird avoidance measure, it always involves change. And change—especially to fishing equipment—is strongly resisted. All these factors help explain why lowering the rate of seabird bycatch in longline fisheries has been painfully slow. Some would argue that after 15 years, the industry has had sufficient time to deal with the problem, and that ignorance is not a plausible excuse for inaction. Considerable effort and expense has been expended toward alerting fishers on the issue, with little apparent benefit. So attempting to precipitate change through education seems unlikely to be effective in the mitigation process.

A common argument states that no single measure or combination of measures will be universally effective, due to the variations in fishing methods, equipment and vessels. Its proponents claim the need to cooperate with industry and avoid alienating fishers, but this only has delayed a worldwide conformity to a mitigation process that is likely inevitable. Considerable effort has gone into adapting mitigation measures—mostly ones with limited effectiveness— for the various fisheries. Laborious and usually inconclusive performance evaluation generally follows. It is unacceptable for the longline industry to adopt inadequate measures and not expect to face the demand for them to take up more effective measures.

Unfortunately, the countries involved in developing mitigation measures have had limited funds and expertise, and time and effort has been lost in "reinventing the wheel" when this problem is basically the same around the world. There are obvious advantages in better coordination of resources and effort.

PROGRESS ON VARIOUS MITIGATION MEASURES

To understand the history of mitigation efforts over time, it is helpful to chart the progress of individual measures. In 1988 seabird catch rates by a longline fishery were documented for the first time, along with causes and ways to avoid the problem. Much was learned about the problem in a relatively short time. Strategies identified to reduce bird mortalities and increase profits included:

- Confining line setting to nighttime, when birds are generally less active and able to locate bait;
- Weighting lines to make them sink rapidly and prevent birds from seizing the baits;
- Using scaring lines that reduce access to baits;
- Improving systems for deploying bait;
- Avoiding the use of frozen bait, which sinks more slowly.

At that time, bird scaring lines was judged to be relatively effective, inexpensive, easy to use and least likely to interfere with routine fishing operations, so this measure was the most rapidly and widely advocated. But today, despite regulations compelling the use of scaring lines in many longline fisheries, for the most part fishermen do not use them unless forced to do so through presence of observers. In Australian fisheries many longline operators have chosen their own line design and materials even though a more effective one has been widely advocated and is available commercially.

While the effectiveness of bird scaring lines has been assessed in a number of fisheries, it is difficult to generalize the results, because different line designs perform differently in different fisheries. Some evaluations suggest they are up to 99 percent effective for demersal fishing and up to 70 percent effective in pelagic fishing. The futility of using bird scaring lines in some circumstances against certain species has also been observed, prompting the pursuit of more effective bird deterrents.

The recognition that the method of deploying bait could contribute to bird mortalities precipitated development of bait casting machines (BCM) beginning in 1988. Commercial units became available in 1992 and were rapidly adopted by many Asian pelagic longliners. Since BCM made fishers' work easier, it promised to be a highly effective mitigation device that would be used irrespective of regulations or enforced compliance. Unfortunately, many of the device's capabilities for reducing bird bycatch were discarded subsequently when a more economical model became available. Here industry demonstrated a lack of commitment to bird bycatch reduction even when the opportunity to achieve this was accompanied by improvements to fishing operations. Apparently widespread use of BCMs continues; however the bird bycatch performance of neither model has been thoroughly evaluated.

The requirement to set lines only at night currently is listed as an optional or required mitigation measure in at least four fisheries. The fishery administered by the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR) first adopted it. Evaluations indicate that nighttime setting can reduce bird bycatch by 60–90 percent. Nonetheless, in Australia pelagic longline fishery operators ignore the directive to set lines at night and apply for exemptions from the regulation. Line setting often occurs at night anyway, but this is difficult to maintain over the course of a fishing trip, when delays due to weather and other variables can mean a choice between setting during the day or losing considerable fishing time. Asynchronous setting can cause tangles with the lines of nearby vessels, and those that attempt to strictly maintain a night-setting routine can be severely compromised by displacement from optimum fishing positions by others that retain a day-setting routine in the same area.

For this highly effective mitigation measure to be viable, adherence to internationally applicable laws would be required. If other means of reducing bird bycatch fail, consideration should be given to the establishment of laws and compliance mechanisms that prevent hooks being set in the daytime in all waters where bird interactions occur. Vessel monitoring systems (VMS) linked to detect line-setting activity may become viable in the near future as a cost-effective compliance strategy.

Of the various measures originally advocated 15 years ago, line-weighting remains the least understood and least evaluated for its effectiveness, primarily due to a suspicion on the part of fishers that this practice reduces catches of the target species and may increase risk to the crew. Researchers are trying to determine how differently weighted fishing gear performs with respect to fish and bird catch rates. To date, the amount of weight required to reduce seabird mortalities to an acceptable level remains to be established, but there is some evidence that line weighting does not reduce target species catch rates. Opinion within industry varies, however there are many examples of line weighting being routinely used safely, even without additional equipment to assist in protecting crew.

It has become clear that the mitigation performance of line weighting is a function of the way gear is set from the vessel as well as the amount of weight on the fishing gear (which dictates the sink rate). In some fisheries with regulations on specific line weights the operators have not adjusted configurations of their gear, and there has been no regulatory consequence. As a result line weighting has contributed little to date to the reduction of bird mortality rates. The failure of longline gear manufacturers to make appropriately weighted lines commercially available has also been a major contributor to this situation in certain demersal fisheries.

In the development of measures to alleviate specific problems care is required to prevent additional complications. For instance, with line weighting there is the consideration that in certain regions sea turtles may be at greater risk from drowning if caught on gear that is weighted.

Industry's inclination to disregard the described measures has been interpreted as evidence that they are unacceptable or inappropriate, and thus we need to pursue alternate measures. Of all the measures investigated so far perhaps the most technically challenging and potentially effective are methods of setting hooks underwater, where they are not visible to birds and/or are beyond their diving capability. To date, all underwater-setting mechanisms, including the chute, capsule and funnel devices, have been developed as add-on attachments. As with integrated line weighting, a vessel design incorporating underwater setting is an obvious technological development, but manufacturers so far have neglected it.

The persistent use of add-on underwater setting devices by several operators is yielding benefits such as more consistent hook spacing, bait retention and, consequently, increased fish catches. Considerable effort and resources are being directed toward further development and evaluation of such equipment, which holds promise to virtually eliminate bird mortalities with minimal alterations or effort required by operators.

So what then are the options for bringing about the required sustained reduction in bird mortalities on a sufficiently widespread scale? First, appropriate line weighting must be universally adopted, with consideration to the different requirements for the various methods of longline fishing. Although overall bird bycatch will be reduced greatly with appropriate weighting, night setting, underwater setting devices and bird scaring lines are necessary. Incentives for adopting them might come from preferential licensing, for example.

Traditionally line setting has been carried out from the stern of a vessel, but this gives birds immediate access to bait. Line-setting from amidships is already carried out successfully by many vessels with obvious advantages, particularly when combined with line weighting, and is a feasible adaptation for the majority of longline vessels. The advantages of setting from amidships include using the vessel itself as the 'bird scaring line' and improved operating efficiency, as in many cases it permits the skipper to actually see the line setting activity. Having line-setting and hauling operations in the one area also saves space and labor. Shipbuilders can better utilize the substantial extra space, but more importantly can cease to build vessels from which line-setting is not only carried out from astern but often from such a height that killing birds is inevitable.

Industry has found the tactic of stalling for time to be the most effective strategy to "overcome" the problem of bird bycatch. And because bureaucracies and non-government conservation organizations have a wide range of responsibilities and issues to confront with their limited resources, their tenacity is challenged when dealing with one industry with a preference to deny or ignore the issue's existence. It could certainly be worthwhile for industry to rethink such strategies and focus aggressively on fixing the problem by means they find acceptable; otherwise measures such as area and/or season closures increasingly will be applied. The need for regulations seems inevitable due to the lack of unity and commitment from within the industry.

To be effective regulations must have international standing and also link to uniform national laws enforced for all domestic vessels, irrespective of where they are fishing. Progress with development and implementation of uniform line-weighting must be achieved rapidly and result in regulations that are proven to be effective and appropriate. If outcomes are unsatisfactory, then the formulation of regulations and enforcement of night setting in addition must be vigorously pursued. If there is a failure by the industry to successfully take up these opportunities to reduce bird bycatch, the viability of the industry will be in doubt. There is an obvious course to take that will not require big dollars, big brain or even big effort to deal with this problem once and for all.

PELAGIC LONGLINE BYCATCH DATA COLLECTION AND MITIGATION RESEARCH

Christopher Boggs, NOAA Fisheries, Honolulu (Hawaii) Laboratory, U.S.A.

Fisheries are always moving around, and in the Pacific during the 1990s U.S. fisheries moved far to the north of the fishing grounds they occupied previously and into the habitat of turtles and albatrosses. So what was an incredibly rare event before 1990, at least in this part of the world, became quite common in the '90s.

In U.S. fisheries there are two places where there's a big problem with turtles: the longline fishery in the western North Atlantic (especially in the northeast distant—NED—region that extends from the New England area to the Grand Banks) and the Hawai'i-based fishery north of the main Hawaiian Islands. Both fisheries concentrate on targeting swordfish at the higher latitudes. In the case of Hawai'i, this is where both the albatrosses of concern nest, forage and migrate, and the higher latitudes of the Atlantic has the highest concentrations of loggerhead and leatherback sea turtles. So, in the 1990s pelagic longline fishery interactions with albatrosses and sea turtles became an important research topic at the National Marine Fisheries Service (NMFS).

In the early 1990s mandatory observer programs on U.S. pelagic longline vessels began collecting data on sea turtles (and in the Pacific, albatrosses) to estimate the extent of fishery interactions. Expert workshops on sea turtle bycatch were held in Honolulu in 1994 and 1995 to assess marine turtle hooking mortality and to develop handling guidelines for the release of hooked and entangled turtles. In 1996 the Western Pacific Regional Fishery Management Council (WPRFMC) initiated annual workshops on interactions with seabirds, turtles, marine mammals and other protected species within the pelagic longline fishery. Participation in these annual workshops is currently a requirement for a license in the longline fishery.

The first relevant fieldwork to address the turtle bycatch problem used satellite transmitters to track pelagic-stage loggerheads caught by the foreign fishery in the Azores. (The latest technology uses pop-up satellite transmitting archival tags that are picked up by a satellite when the animal surfaces.) Subsequent experiments were conducted in the U.S. Pacific and Atlantic fisheries to record sea turtle habitat preferences, post-hooking behavior, and mortality. It was hoped this kind of research could possibly allow us to define turtle migration paths and their preferred habitats well enough to make decisions on possible seasonal area closures. The other major area of interest is better information on how many turtles survive capture and release, so we are striving to increase the amount of time turtles are tracked after they are released.

Unfortunately area closures haven't worked in the way we'd hoped. The Hawai'i-based fishery underwent closures in 1999, 2000 and 2001, in which the off-limits areas started out small and got progressively bigger. The problem was that the need to reduce the turtle bycatch in the fishery was pressing, and the smaller area closures didn't sufficiently reduce turtle bycatch. Currently, swordfish fishing is closed for the entire North Pacific north of the equator.

Research on methods to reduce U.S. pelagic longline interactions with albatrosses commenced in Hawai'i the late 1990s with sea trials of bird-scaring streamer lines, weighted branch lines, and blue-dyed bait. Such methods proved highly successful for albatrosses and were quickly mandated in the U.S. fishery. Subsequent testing of an underwater line-setting chute in this fishery has proven even more beneficial. The number of interactions between birds and gear was reduced by about 95 percent. In contrast, sea turtle bycatch mitigation research has been less successful. NMFS currently is conducting three major fishery experiments to develop sea turtle bycatch reduction techniques:

1. Research with circle hooks, in the Azores fishery;
2. Research on branch line placement, alternative baits and hooks, and soak time duration in the U.S. Atlantic NED fishing area;
3. Research on alternative fishing depths, times, hooks, lines, lightsticks, floats, baits, and branch line placement in the central North Pacific.

The hook research has shown that circle hooks greatly reduce the severity of injury to hooked loggerhead turtles. About half of the turtles caught on J hooks were hooked at the throat, resulting in serious injury and often death. In contrast, only about ten percent of loggerheads caught on circle hooks were hooked in the throat; most got lodged by mouth and in a way presumably much less injurious to the turtle. However circle hooks tested so far catch just as many loggerhead turtles and far fewer swordfish than J hooks, which compromises their economic viability for fisheries targeting swordfish. On the other hand, the use of circle hooks in the tuna fishery doesn't seem to reduce target catch rates, and many pelagic longliners are using circle hooks with satisfactory results. Larger, offset-point circle hooks also are being tested.

A very interesting finding of the Azores study was that the rates of loggerhead catch increase with the hour of the day—something that had been suggested by analyses of observer data in the Atlantic fishery, but not in the Pacific fishery.

Observer data in the Pacific fishery showed that different branch lines caught different numbers of turtles. The one that hangs up closest to the float had a tendency to catch the most sea turtles, compared to the other branch lines. So we want to experiment with modifying the gear to keep all the branch lines farther away from that float or deeper in the water column, since turtles spend much of their time in depths of less than 40 meters. We haven't been able to test this concept in the Pacific yet, but the experiment went ahead in 2001 in the Atlantic NED with a very similar modification. Their results showed that using blue-dyed squid bait and moving the closest branch line at least 20 fathoms away along the main line from the float line didn't reduce loggerhead or leatherback bycatch.

We have applied for a permit to test a more substantial, 40-fathom displacement of branch lines in the Pacific, following NMFS's review of the Atlantic results. The 40-fathom displacement concept is supported by analysis of observer data from the Pacific fishery, which uses more widely spaced and deeper branch lines to target a different swordfish habitat with different oceanographic characteristics than the NED area. Results from the Atlantic NED experiments did show that branch lines farthest from the float lines (40–60 fathoms) caught significantly fewer leatherback turtles than branch line placed 0–20 fathoms from float lines. The most encouraging finding of the NED tests was that loggerhead turtle bycatch was significantly higher during the last quarter of the longline haulback. The experiments going on in the Atlantic this year include a shortening of the soak time to reduce the amount of time the gear is in the water late in the day, as a potential means of reducing bycatch. They are also using mackerel as alternative bait.

The other major change to fishing gear that we tried in the Hawai'i fishery was setting swordfish-style baits, line and lights at depths where swordfish at depths where swordfish swim during the day, but well below the zone where turtles spend most of their time. Unfortunately this gear configuration resulted in about a 70 percent loss in yield. However part of the problem may have been that the gear wasn't set deep enough, so we would like to repeat this experiment with a vessel that has more experience and better equipment for fishing deep.

Results from testing camouflaged ("stealth") gear as a possible means of reducing visibility to sea turtles were more promising. This fishing gear uses blue lines, floats, snaps and blue-dyed bait, along with yellow electronic light sticks that shine down-welling light of narrow frequency. In comparison with normal fishing techniques, this gear modification reduced economic yield for swordfish by 33 percent. Captive turtle experiments have shown that yellow light doesn't attract turtles; however it also is the color least preferred by fishermen. More experiments with captive turtles are planned to find other colors of light unattractive to turtles that may improve the performance of stealth fishing gear. A total of only 3 turtles were caught, and they were caught on normal swordfish-style fishing gear set as a control for the stealth and deep gear or set with hook timers (below). The few turtles caught were insufficient to infer a direct effect of the gear modifications.

The NMFS Honolulu Lab is carrying out other basic research on turtle sensory physiology, and contracting universities and other research institutions to improve our understanding of turtle vision, olfaction and behavior to find clues as to ways to modify the gear. The work with captive turtles is what led us to experiment with blue-dyed bait.

Other research is measuring the time and depth of turtle bycatch with hook timers, which we invented here about a decade ago to investigate bottom longline gear saturation. These devices measure the time at which an animal hooks up on the gear. Data from the Atlantic suggests that gear catches more turtles in the afternoon, but we don't know exactly when. Since this doesn't seem to be the case in the Hawai'i fishery, we're particularly interested in knowing at what time during operations the turtles get hooked up. To date we don't have sufficient results to draw conclusions on this.

INTRODUCTION TO MODELING AND THE USE OF MODELS

Anthony M. Starfield, Department of Ecology, Evolution and Behavior, University of Minnesota, U.S.A.

Modeling is the interface that a lot of decision-makers and fishers see when they interact with scientists, so they think modelers are the scientists. But in reality modeling is the tool that delivers or represents the science, so it behooves fishers and decision makers to basically understand what modeling can and can't do. Unfortunately, especially in the fishing industry modelers have tended to make modeling as esoteric as possible, when in fact it is simple and the concepts behind it are simple.

Modeling is an activity you all do all the time without necessarily realizing it. For example, here's a problem to solve: In 45 seconds, figure out how many soccer balls can fit into this room. In order to address this problem—to even come up with a guess—you have to build a model. Every model begins by looking at the real world (in this case, this room) and designing a model or virtual world. In this case the model world is perhaps a huge shoe-box filled with spheres or maybe even cubes. In the model world things get simplified and even distorted; a model is an abstraction, a simplification. So as the soccer ball moves from the real world to the model world it switches from a sphere into a cube. Once you have designed the model world, you can develop the model to determine how many of these cubes that are about the size of a soccer ball can fit into the box that is about the size of this room.

The model says the number of cubes (soccer balls) that can fit into the box (the room) is the volume of the box divided by the volume of a cube. So we need to estimate the volume of the box (its length times its width times its height) and the volume of soccer ball cube (the diameter of a soccer ball cubed). Once the model is developed, you need data. In this case you need figures for each of the dimensions: the length, width and height of the room and the diameter of the soccer ball. So you would collect data to estimate those numbers, and then you would make a calculation.

The important point is that the calculation tells you something about the model world. It doesn't tell you how many soccer balls you can fit into this room; it tells you how many cubes the size of a soccer ball you can fit into a big box that is roughly the size of this room. With that answer, you can interpret back to the real world. You now have an answer, but what does it mean? This is where you confront the difference between the model world and the real world. So you might realize that you left out all sorts of things that take up space in the room, so the answer is an over-estimate. But on the other hand, balls are actually spheres that can kind of fit into each other, so the answer is also going to be an under-estimate. Maybe those two main simplifications will cancel out each other, so the answer may be reasonably good.

At this point the key question is, was it a good model? The answer to that depends on its purpose. For example, if the purpose is to fill up the room with balls to surprise Kitty when she first gets here in the morning, we'll have to figure out if there are enough soccer balls in Honolulu to fill the room and whether we can afford to buy them all. If that's the purpose, then the model we put together is probably pretty good. On the other hand, if you are vying for a $10 million prize for the best estimate of how many soccer balls can fit into this room, that's a very different purpose. In that case, you'll want to come up with a much better estimate of how much space the stuff in the room takes up and how many soccer balls can fit. You'll want to build a much more detailed model.

So modeling isn't about the truth. It's not a perfect picture of the real world. The process of modeling is that of building a tool to help solve a problem. Recognizing that is the key to understanding modeling.

In any given application this whole process tends to become fuzzy for several reasons. First, often people don't know why they want to build a model in the first place. They think they understand their problem and know what they want to do, but very often they don't. Second, they are unsure of how to design their model world and tend to clutter it with unnecessary detail. Third, they might not be able to get good estimates for all the data needed in the model. Fourth, the situation might be more complicated than the model can at first represent. For example, if you are modeling a population there might be years of good recruitment and poor recruitment, and chance events could be important. So there's a fair degree of uncertainty in this process.

Given the uncertainty, what is the value of modeling? What you are really doing with a model is saying, "If this is the way the world behaves and if these numbers I've used are reasonable, then these are the conclusions I can draw." Then you test all the "ifs." Once you've got your model set up on a computer, it's easy to say, "Suppose the numbers are 10 percent higher, or ten percent lower, what difference would it make?" This is the power behind modeling. It's not that models are perfect, but the process of using them helps you think through a problem, evaluate different scenarios and make a decision. The idea is not necessarily to get a perfect answer, but to suggest that one action rather than another is preferable. In the context of decision analysis, modeling is a very powerful tool.

So, how does this tie in with fisheries and seabird and turtle bycatch? First, models help you interpret data within a context about which you might not know as much as you know about your data. Models also help you design your data collection. So you can start running a model and ask questions such as, "If I had a certain kind of data how would I interpret it and how would it help me?" Models also can help you deal with uncertainty and understand its sources. However it's important to understand the uncertainty isn't in the model; it's in the real world.

Examples of modeling in everyday life might include modeling your budget and figuring out whether you can afford to buy a new car or make modifications to your fishing vessel. Or, if you're running a business you build a model of your projected income and expenditure over the next year. With models like these, you've got to input numbers such as the interest rate, the cost of borrowing money and the inflation rate. Maybe you don't know these exact numbers, but you can estimate them. It's useful to build a model even with estimates, because it can help you look at a range of values and see how those numbers affect the decision you are trying to make. In this way models help you deal with the uncertainty of the real world.

Another real life example of dealing with uncertainty is a model of the short-tailed albatross (Phoebastria albatrus) population that a former student of mine (Jean Cochrane) built with me. After we built it, someone asked what would happen if the volcanic island where the birds nest erupted. He thought we should build into the model the probability that the volcano could erupt and kill short-tailed albatrosses. It is easy to do this, but it doesn't make any sense to do it: you can't justify putting controls on a fishing operation because there is a chance that a volcano may erupt in the future. But you can run multiple scenarios in a model. You can run a scenario in which the volcano doesn't erupt to decide what course to take in that context. And then you can run a scenario supposing the volcano does erupt and wipes out a certain percentage of the breeding population, so you can start considering post-eruption courses of action. Modeling blindly (putting a probability of eruption into the model) is dangerous, whereas thinking about the design of the model world and the purpose of the model leads one to exploring questions like "How important is it to establish breeding colonies on other, safer islands?"

This illustrates how modeling helps you understand the problem. The process forces you to be totally logical, think through your assumptions and make sure the numbers work together. Finally, modeling helps you to set goals when you are looking for solutions. It helps you to do cost-benefit analyses and find win-win options.

You also can expand that model of a bird or turtle population, to take in the entire system, including the animal population, the fishing industry and the options for regulations or mitigation methods. Modeling that whole system (without getting snarled in details) can give you a feel for what matters and what doesn't, and what the tradeoffs, the costs and benefits are. For decision-making, this is perhaps the most valuable way to model. I would encourage people to explore models of this kind.

RECONCILING INTERNATIONAL AGREEMENTS WITH NATIONAL AND REGIONAL APPROACHES TO REDUCING SEABIRD MORTALITY IN LONGLINE FISHERIES

John Cooper, University of Cape Town, South Africa

The regulation of fisheries, whether at a national or international level, is ultimately a political matter. At the international level tension inevitably develops between negotiators forging an agreement or treaty. This tension is related to a dichotomy in what countries expect and what they end up achieving. By definition, nations act out of self-interest.

Contrast that situation with the predicament of seabirds and sea turtles. Seabirds live in the world's seas— essentially a single ocean—and those species affected by longlining inhabit the open ocean with no regard for international boundaries. So at that level, one could hypothesize that a nation's self-interest for protecting its own seabirds would best be served by compromising and working at the international level. However while there is probably an infinite number of ways nations or other groups of interested people can work together internationally towards a common goal, the devil is in the details.

You can categorize types of international collaborations in terms of what they primarily address. It's also useful to consider these efforts on a scale of formality. At the most informal level international activities can take place without governments, for example, holding a meeting such as this to discuss an issue of common concern to many countries. Coming out of that might be a consensus view formalized in a resolution. This happens in fora such as the World Conservation Union, the Albatross and Petrel International Conferences and Workshops, and others. The resulting recommendations or guidelines are voluntary, but interested parties can take up such recommendations and perhaps move them to a more formal level. This occurred when a workshop on the black-footed albatross (Phoebastria nigripes) and a later conference in Hawai'i inspired the formation of the North Pacific Albatross Working Group (NPAWG). This group includes professionals in U.S. and Canadian agencies, and while it does not have legal standing, it has the scope to expand by adding members from other Pacific Rim and island nations, and its findings could potentially influence policy-making. The advantage to such a group is that it can be very flexible.

At a slightly more formal level is the Asia-Pacific Migratory Waterbird Conservation Strategy, which has a committee that serves about seven Pacific nations, including some of the larger high-seas fishing nations. While that committee focuses on wetland waterbirds, it has potential for expanding its concerns to migratory species on the high seas and working toward an action plan for those birds. In addition to these more or less informal groups not bound by international legislation, there are international groups, such as BirdLife International, working on seabird conservation in the Pacific region.

More formal are the bilateral international agreements that address migratory birds, such as the four migratory bird agreements between the U.S. and Canada, Japan, Mexico and Russia. Unfortunately the issues of pelagic seabirds apparently are not high on the agenda of these bilateral agreements, so they might not be the best way to further our conservation needs. But, of course, they represent important opportunities for these countries to link up with each other.

The more multilateral agreements allow for membership within a geographical region. Obvious examples are regional fishery management organizations (RFMOs) such as the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). From my perspective the existing RFMOs are not very promising fora in which to address seabird bycatch programs. A dichotomy exists between seabird conservation nations and the high-seas fishing nations, although there are some nations that are both. At many fora there seems to be an "us and them" attitude. RFMOs and most international agreements work by consensus, and one holdout can block the process so decisions develop slowly. For example, the southern bluefin tuna convention (CCSBT) has been held up significantly over certain issues due to a division between fishing nations and countries with more developed conservation interests. Without consensus on the management of fish stocks within some of these regional organizations, it is difficult to get issues about bycatch on the table that are not central to their main agreement about the target species. Likewise, the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean reached an impasse on a proposed agreement when two fishing nations decided they couldn't support it.

The FAO has adopted several international plans of action, including the IPOA-Seabirds, which addresses the reduction of seabird mortality in longlining, and the IPOA for reducing or deterring illegal, unreported and unregulated fishing. These are voluntary arrangements; no country is obliged to produce a national plan of action on these issues. To date, some four years since the FAO adopted the IPOA-Seabirds, only the U.S. has formally adopted a related national plan, although other countries are working on draft plans.

In the category of relevant formal international agreements, perhaps the one with highest standing in international law is the Convention on the Conservation of Migratory Species of Wild Animals (CMS), also called the Bonn Convention. It is a sort of a framework convention that allows for the setting up of "daughter" bodies to forge agreements and memoranda of understanding. The daughter bodies, which would address a specific group of species or specific region for a group of species, have their own standing within international law and the legal process. Even more importantly, it's not required that a country be a member of the CMS to join a daughter agreement.

The CMS has produced several agreements relevant to our issues. The first is the African-Eurasian Waterbird Agreement (AEWA), which has recently expanded the species covered to include some seabirds as well as wetland birds of inland waters. Even more important is the Agreement on the Conservation of Albatrosses and Petrels (ACAP), which has not yet come into force. So far only Australia and New Zealand have ratified it. The original concept was for an agreement for Southern Hemisphere albatrosses and certain petrels, but wisely the agreement's architects designed ACAP such that it could easily become a global agreement simply by adding Northern Hemisphere species to the action plan of the agreement. Thus it is a very flexible international agreement.

I'd like to sum up the advantages and disadvantages of informal versus formal collaboration. The informal level allows for quick action, the financial burden of involvement is minimal—which is critical to small and developing nations—and there's no requirement for passing binding legislation through government authorities. The disadvantages of informal arrangements are that they may not survive beyond the lifespans of supportive individuals and government agency staff. And, by their very nature, such arrangements have little or no standing in international law.

In contrast, formal agreements are slow to develop because they need consensus, and consensus works at the level of the slowest denominator. The new Pacific tuna convention took seven meetings from 1994 to 2000 to be adopted, and it has not yet gone into effect. Even when they have been set up, international agreements long in the making may not attract members quickly. For example, very few northern Pacific Rim countries—including most of its major fishing nations—are members of the CMS.

I would like to suggest ways to use some of the entities I have mentioned to facilitate progress on the issues we are concerned with here. First, the NPAWG could initiate an informal consultation with the Asian-Pacific Migratory Waterbird Conservation Committee to discuss setting up a sub-group on high-seas pelagic seabirds as a means to get these issues on the international table in the North Pacific. Second, NPAWG could expand its membership to gain better representation of Pacific Rim countries, including the fishing nations of Asia. Convening a conference, workshop or a more informal meeting could achieve this. If these steps were taken and they led to greater collaboration, then those bodies, or perhaps a new one, could monitor the progress of the ACAP. Once the agreement comes into force in the Southern Hemisphere, as I'm sure it will, these groups could evaluate the effectiveness of ACAP over subsequent years and perhaps work toward its appropriate expansion into the Northern Hemisphere, specifically the North Pacific.

I would argue that all the approaches I mentioned can and do serve an important role in reducing seabird mortality by longliners. Which suite of approaches a country becomes or should become involved with depends on a various factors, including national knowledge and expertise base; capacity in terms of funding and personnel; political will; the type of political system operating in the country; the level of public understanding and interest in conservation; and how well developed the national NGO conservation and fishery management sectors are.

The conservation status of seabirds affected by longline fisheries will be improved if countries engage in as many as possible of the above approaches over the long term. However, each country needs to select as immediate priorities those approaches most likely to lead to both quick and long-lasting improvements in the situation.

INTERNATIONAL AGREEMENTS/ NATIONAL APPROACHES FOR SEA TURTLES

Douglas Hykle, Deputy Executive Secretary, Convention on Migratory Species, Bonn, Germany

I would like to demonstrate the level of interest and determination shown by governments in addressing sea turtle conservation and management by giving examples of legal and non-binding instruments from around the world. I think it is in fishers' interests to know the origins of regulations impacting their industry, so they might be in a better position to influence and improve the process by which regulations are negotiated.

To begin with, there are a number of international conventions and related protocols. The Convention on Migratory Species (CMS), for example, covers a wide range of species, including marine and terrestrial mammals, as well as the seabirds and turtles of concern here. CMS works by providing strict protection for endangered species, including all sea turtles; by developing cooperative agreements between countries that have shared populations of migratory species; and by offering support for collaborative research. With respect to sea turtles in particular, the convention requires member states to conserve and restore their habitat and to remove or mitigate obstacles to migration.

Another important international instrument is the Convention on International Trade in Endangered Species (CITES). It has nearly 160 member states—the largest membership of any wildlife convention. CITES regulates international trade through a system of permits. For sea turtles, it effectively prohibits any commercial trade in live turtles, and their body parts and derivatives.

A third legally binding convention is the Inter-American Convention for the Protection and Conservation of Sea Turtles, which came into effect in 2001. It is the only international convention specific to sea turtles, and it includes specific or explicit requirements for bycatch mitigation. The last convention that I would mention as an example is the Cartegena (Wider Caribbean) Convention, one of many regional instruments that exist around the world. It has a protocol or an annex that deals with specially protected areas and wildlife, and includes provisions for the protection of sea turtles.

In contrast to these international conventions, memoranda of understanding (MoUs) are not legally binding in the formal sense, but they have characteristics similar to legally binding treaties. One of these is the Agreement on the Conservation of Marine Turtles of the Atlantic Coast of Africa, in which nearly all of the Atlantic coastal countries actively participate. This year the signatories finalized a detailed conservation plan that includes provisions for bycatch mitigation and vessel monitoring. A second memorandum of understanding, also concluded under CMS, covers the entire Indian Ocean and Southeast Asia and contains similar provisions. There are also a number of bilateral and trilateral arrangements among governments, such as those between the Philippines and Malaysia, and between three Central American countries.

There are also stand-alone action plans or recovery plans, such as one that has been developed in the Mediterranean region, as well as a suite of recovery plans for Pacific populations of sea turtles. None of these is legally binding or is subject to formal endorsement by individual governments; rather, each serves the purpose of setting non-binding goals and targets for compliance.

In addition there are resolutions and recommendations formally adopted by conferences and assemblies that relate to the issue of bycatch; for example, the United Nations resolution on driftnet fishing developed in the 1980s and early '90s, and other more recent ones adopted under CMS auspices, with provisions relating to bycatch mitigation. Finally, the FAO Code of Conduct of Responsible Fisheries is a useful and pertinent document.

There are also regional programs or networks, such as the South Pacific Regional Environment Program, whose sea turtle conservation program has been in operation seven or eight years; WIDECAST, a Caribbean regional network made up of government and nongovernmental participants; and Projecto TAMAR, a highly respected Brazilian network.

So how do the activities from this range of instruments for sea turtle conservation get translated into action at a national level? Primarily through national legislation and regulations; however another means of effecting change is the imposition of international import bans to bring about compliance with certain conservation norms. Equally important, interest in sea turtle conservation has to be translated at more fundamental levels of civil society, through established traditional practices and community-based conservation programs, for example.

The focus of these instruments varies from particular species, to more general conservation and biodiversity-related interests, to even broader concerns such as pollution and fisheries management. And the actors involved in the implementing these instruments ranges from supranational bodies, such as intergovernmental organizations and regional fisheries management organizations, to all levels of governments, industry, nongovernmental organizations and civil society. In fact, most of these groups are represented in this meeting and each has a role to play in addressing the issues at hand.

Breakout Sessions

2ND INTERNATIONAL FISHERS FORUM

HONOLULU, HAWAII ~ 2002

Seabird Mitigation and Research

Session Leader: Ed Melvin, University of Washington Sea Grant Program
Facilitator: Scott McCreary (CONCUR)

The main objectives for this session were to identify and discuss the best existing seabird mitigation practices for pelagic, demersal, and Spanish demersal longline systems and the research needed to evaluate new and existing mitigation measures.

Introduction

Ed Melvin

Mr. Melvin presented an overview of the mitigation measures available for reducing seabird incidental catch in longline fisheries. No summary available.

Issues Identification/ Background Presentations

LINE WEIGHTING AND INTEGRATED WEIGHT GROUNDLINES

Bruce King, Gourock New Zealand
Collaborators: Jakob Hals (Norway), Jan Foss (Rena International, U.S.A), Graham Robertson (Australian Antarctic Division), Malcolm McNeil (New Zealand)

Line weighting is the process of attaching externals weights to the swivel-line of longline fishing gear. As currently practiced in CCAMLR fisheries, to achieve the specified sink rate of 0.3 meters per second, the technique requires the attachment of a six-kilogram weight every 35 hooks. Thus, sinking 33 magazines of unweighted gear requires attaching 1,170 six-kg. weights. Externally attaching this number of individual weights is time-consuming, inefficient and poses a safety risk to crew members. Furthermore, during the hauling operation the line hauler needs to be stopped for about five seconds per weight, which amounts to more than 1.5 hours spent removing weights each time the line is hauled. These factors and a demanding workload on board the vessel can result in poor compliance to the use of external line weighting as a mitigation measure by crew members.

Integrated weight (IW) line has lead beads built into each individual strand of swivel line. A key advantage of IW line is that it requires no external attachments or changes to gear or fishing methods. Also, IW line has a constant weight distribution, which causes the sink rate to have a lineal profile.

Graham Robertson, Ed Melvin and Malcolm McNeill are some of the key people responsible for getting IW line manufactured and tested. Through past experience and trials using the line weighting method, four weight regimes needed to be explored: 25 grams per meter, 50 g/m, 75, g/m and 100 g/m.

The initial trial was to test and prove the operational aspects of IW line. The objectives were to confirm that the line would:

- Sink immediately upon entering the water and thereafter sink with a lineal profile.
- Sink significantly faster than unweighted gear.
- Be practical to use.
- Not compromise catch rates of target fish species or increase bycatch of other species.

The initial trial was conducted aboard the FV Janas, a 46.5-meter. Norwegian-built autoliner owned by New Zealand Longline, Ltd. From June 8–18, 2002, the Janas targeted ling cod in 600-meter depth waters on the Pukaki Rise, 300 miles east of the Auckland Islands. Janas has a 40,000–12/0 hook capacity and uses a Mustad Autoline system. On board is 9 mm AS Fiskevegn "Silver" Swivelline at 1.4 meter spacings. (Its specific gravity is 1.1, so it has negative buoyancy). Line is set on the starboard side at 6 to 6.5 knots and lands in the updraft of the propeller wash.)

Because the initial trial was to test it operational suitability the amount of IW Line was minimal, involving 20 coils of each weight and 2560 hooks, which entailed approximately 20 minutes of setting time. Electronic time-depth recorders (TDRs) and bottle tests were used to determine average sink rates for the four weights of line.

The results were:

WEIGHT	SINKING RATE
0 gm/m (unweighted) control	0.11m/s
25 gm/m	0.227m/s
50 gm/m	0.272m/s
75 gm/m	0.317m/s
100 gm/m	0.353m/s
longline with external weights	0.32m/s

Observations revealed that all IW lines commenced sinking as soon as they entered the water and had sufficient weight to counter the upward thrust of the propeller. In contrast, unweighted lines sank just beneath the surface and appeared to stay there, buffeted by propeller turbulence.

The benefits to seabird conservation are that fast-sinking longlines reduce the visual cues to seabirds, reduce the time available for birds to seize bait at the surface, and make it harder for diving species to make contact with baited hooks. Although IW lines increased the period of maximum attractiveness of bait to fish, this drops off rapidly after about two hours soak time (Bjordal and Lokkeborg, 1996). Unweighted gear sinking at 0.11 m/s reaches 600 meters in about 90 minutes, while 50gm/m IW line reaches 600 meters in less than 40 minutes. In addition, IW Line eliminates the need for external weights (saving 1.5 hours of time in removing weights each time the line is hauled)

The effect of IW lines on the catch rate of target species (in the trials, ling cod) is unclear. However, the similarity in catch rates associated with operations using external weighting suggests there is no reason to suspect that IW lines will reduce catches. No negative effects on operations occurred during the trial of IW lines. The lines ran normally through the baiting machine, the line hauler and hook separator. The main problem identified before the trial is the combined extra weight of IW lines on the magazine system; 2–6 metric tons of extra weight are added to the magazine room; however this is less than the combined weight used for external weighting. [The combined weight of 0gm/m Swivelline (3.526 mt) plus external weights (7.040 mt) for Janas is 10.56 mt, while the weight of 50g/m IW line for Janas is 6.128 mt.]

In conclusion, the choice of an IW line will be a compromise between sink rate, combined weight of the gear and the operational efficiency of the vessel.

Of the four IW lines tested, the 50g/m is recommended for further testing. It began sinking immediately at the rapid rate of 0.272m/s. It did not appear to compromise fishing efficiency, and it was practical to use

The FV Janas left Dunedin on November 1 for a six-week trip with two observers on board to oversee and report back on a complete trial of 50gm/m IW line. Half the vessel's magazine capacity is rigged with IW line, and half is rigged with unweighted line. The very preliminary results to date are that 25 birds have been caught on unweighted line and no birds have been caught on IW line. So far, the skipper and crew prefer working with IW line.

It's still very early in the trial stage for IW line, and future trials will need to be carried out on other vessels, but we have identified a weight regime that works. Nonetheless, if IW line proves to be the most effective method of bird mitigation, other materials of comparable weight need to be found for replacing lead. And it needs to be remembered that the best swivel-line is a compromise between rope diameter, breaking strength, durability and cost.

UNDERWATER CHUTES

Dave Kreutz, Australian fisherman

No summary available.

REDUCTION OF INCIDENTAL TAKE OF SEABIRDS BY THE USE OF BLUE-DYED BAIT

Hiroshi Minami, National Research Institute of Far Seas Fisheries, Fisheries Research Agency, Japan (Collaborators: Masashi Kiyota and Hideki Nakano)

The incidental take of seabirds by the tuna longline fishery occurs during line setting. It is possible to achieve a significant reduction of incidental take of seabirds by appropriate mitigation measures during line setting. Experiments on the use of blue-dyed bait were conducted in the Hawaiian swordfish fishery, and it was reported to be effective in reducing the incidental take of seabirds. We examined the effect of using blue-dyed bait on the reduction of incidental take of seabirds and the catch rates of target fish species for the Japanese tuna longline fishery.

The response of seabirds to blue-dyed and undyed squid baits was examined in a longline survey conducted in the western North Pacific (37°–40°N, 151°–160°E) from June 29 to July 20, 2000. During nine fishing operations, feeding activity and bait-taking behavior of Laysan and black-footed albatrosses were observed.

The catch rates of target fish species were examined in longline surveys conducted in the Western Pacific (20°–24°N, 172°E–179°W) on 31 operations using blue-dyed and undyed baits from February 9 to March 11, 2000, and in the eastern tropical Pacific (5°N–4°S, 128°–147°W) on 20 operations from May 16 to June 9, 2001. Also, the catch rates of seabirds were surveyed in 62 operations using blue-dyed and undyed baits in conjunction with tori poles, along with catch rates of Southern Bluefin Tuna using both baits, in the Southern Ocean (39°–45°S, 23°–45°E), from November 1, 2001 to January 19, 2002.

RESULTS AND DISCUSSION

In the western North Pacific survey testing blue-dyed and undyed bait, a total of five birds were incidentally taken in association with undyed bait. Feeding on blue-dyed baits by Laysan and black-footed albatrosses was much lower than on undyed baits. Albatrosses apparently had difficulty finding blue-dyed baits at the sea surface. These results suggested that the blue-dyed bait was effective in reducing bait taking by seabirds.

During the longline surveys in the western and eastern tropical Pacific, the catch rates of tunas and tuna-like species did not significantly differ between operations using blue-dyed baits and those using undyed baits. Likewise, catch rates of Southern Bluefin Tuna were not significantly different between operations using either of the two baits. On the other hand, marked differences were recorded in the catch rate of seabirds, and no birds were taken when blue-dyed baits were used.

In conclusion, the surveys demonstrated that blue-dyed bait was effective for reducing of incidental take of seabirds and bait taking by seabirds. The use of blue-dyed bait doesn't require changes in fishing operations, and it has little effects on the catch rates of target fish. The combination of the blue-dyed bait and the other mitigation measures such as tori-pole streamers will be more effective in reducing the incidental take of seabirds by tuna longline fisheries. Although the blue-dyed bait is much more costly than conventional bait, if the cost problem were solved the use of blue-dyed bait in tuna longline fisheries might become popular for fishermen.

THE SPANISH SYSTEM: BEST PRACTICES AND POTENTIAL RESEARCH

Ben Sullivan, Falklands Conservation

The Spanish (double line) longline system is the most commonly used longline method in the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) waters and in the South American region. The system is ideally suited for demersal longlining in areas with a rough seabed and strong currents, because it is designed so that the mother line takes the weight during line hauling and can therefore still be hauled if the hook line is snagged and/or broken, reducing gear loss and associated costs.

The CCAMLR has lead the way in reducing seabird mortality in the Southern Hemisphere, and the suite of mitigation measures required for Spanish longliners has successfully reduced mortality in critically important regions (e.g. South Georgia) to negligible levels. However, it is difficult to decipher the effectiveness of individual mitigation measures because of interactions between the various methods.

The range of mitigation measures available for the Spanish system fit broadly into four categories: streamer lines, line weighting, line setting and line hauling.

- STREAMER LINES – Best practice: Standard specifications include overall length, streamer length, tension device at seaward end and attachment height. Recent results from Alaska suggests that twin streamer lines are more effective than single lines. Further research is required in the Southern Hemisphere to test their effectiveness with seabird species that are adept divers.
- LINE WEIGHTING – Best Practice: CCAMLR regulations require 8.5-kilogram weights attached at 40-meter intervals, or 6-kilogram weights at 20-meter intervals.
- LINE SETTING – Best Practice: Offal discharge should be prohibited during line setting. Weights should be pushed from the setting window prior to applying tension on the hook line. Research and trials of the line-setting chute in 1999 were unsuccessful. Alternative chutes and midship-setting have been discussed, but both would require considerable research and development.
- LINE HAULING – Best Practice: All factory waste should be discharged on the opposite side of the

vessel to the hauling bay and preferably stored until hauling is completed. Setting up a curtain or streamers around the hauling bay (i.e., a brickle curtain) can effectively reduce hook-ups during hauling. In addition, hooks should be removed from all fish heads prior to discharge of waste. Research suggests strong snoods reduce hooks lost outboard from the hauling bay.

The greatest advances in reducing seabird mortality associated with the Spanish system will most likely be made by the relevant fisheries (including IUU fisheries) adopting a combination of existing measures. However, there are several areas where technological advances may improve the suite of measures available.

SEABIRD MITIGATION IN NEW ZEALAND'S BOTTOM LONGLINE FISHERY

John Bennett, Sanford Ltd.

The *San Aotea II* was built for longlining in 1993. It operates a Mustad automatic system and has accommodations for 25 crew, including scientific and official observers. The vessel is certified and meets the requirements of AS/NZS ISO 14001 Environmental Management System issued by SGS International Certification Services. The seabird mitigation measures on the vessel have been developed and fine-tuned over the years to meet the fishing style that this vessel uses. We have developed an efficient system that works and are keen to pass our knowledge on to others. We pride ourselves in not only our seabird mitigation practices but also our efforts toward good environmental management procedures.

OUR FOUR MAIN MITIGATION METHODS ARE:

- A "can-do" attitude to tackle the problem.
- An understanding of sea bird behavior.
- Retention of offal while setting.
- A range of efficient bird-scaring devices.

In the vessel's boom-and-bridle system the birdline moves back and forth at one meter per second. The birdline winch, line jiggler and cannon can all be operated from the stern deck or bridge. The birdline is set well over to starboard. This helps keep the streamers flying directly over the baited hooks while setting with a strong cross wind. The amidships boom helps detour birds that sometimes dive on small scraps from the factory deck.

The winch drum holds 500 meters of 6mm line. This is enough for two birdlines if one is accidentally lost. A new birdline can be put together in less than 15 minutes. Trained crewmen are designated with the responsibility for birdline maintenance. The winch was designed and built seven years ago and has been modified several time since. The crewman has the winch control in one hand while he removes the streamers with the other as the birdline is set or retrieved. The streamers are stowed close to the operators working position. A shark clip is used to attach the streamer to the birdline. A 4-meter length of mooring line is used to keep the birdline trailing directly behind the vessel. With an easy to operate system and a "no smoking inside" policy it's easy to find volunteers to operate the bird winch. At times we have too many volunteers and the job has to be rotated so everyone gets a chance to come up on deck.

A fishmeal plant and the retention of offal is one of the biggest advantages in trying to discourage birds from following the boat. Screens over the scuppers reduce waste from the factory and processing deck. The vessel also has a gas-operated bird cannon. One boom from the cannon usually keeps birds from the hooks for 10 to 15 minutes.

To achieve a line sink rate of 0.3 meters per second, one 5.5-kg weight is attached to the line at every 35-hook spacing. It takes approximately 170 x 5.5kg weights (about 930 kilos) to fill a 44-gallon drum. The weight transfer chute transfers 5.5-kg weights 30 meters from the hauling room to the baiting machine at the stern. Water pressure is used to force the weights aft. A timer controls the amount of water used, so there are no valves to open and close.

The weights arrive at the stern and are automatically stowed in any one of three locations. On average days fishing in the Ross Sea about 3.5 ton of weight is moved about the ship. The entire setting operation is monitored from the wheelhouse with a high-sensitivity video camera. During times of increased bird activity a crewman is permanently stationed at the stern while setting. This man keeps the streamers flying above the baited hooks and fires the bird cannon if and when needed. We're always experimenting with different or multicolored streamers.

Teaching young fishermen good practice is by far the best and most cost-effective mitigation method.

SUMMARY OF DELIBERATIONS FROM BREAKOUT GROUPS

Approximately 30–40 participants attended each of the seabird mitigation sessions. Following the introductory presentations discussions were directed toward:

1) Reviewing mitigation strategies most commonly used or having the greatest potential for each of the major long-line gear types (pelagic, demersal, and Spanish demersal).
2) Discerning the strengths, weaknesses, and research needs for each of these mitigation strategies.

The participants elected to focus their attention on the following mitigation strategies for each gear type.

	GEAR TYPES: **Pelagic**	**Demersal**	**Spanish Demersal**
MITIGATION STRATEGIES	Streamer lines (scaring or tori)	Streamer lines (scaring or tori)	Streamer lines (scaring or tori)
	Integrated line weighting	Integrated line weighting	Standardized weights
	Setting chute	Offal management/ retention	Setting chute
	Stealth bait/gear	Night setting	Stealth bait/gear

As setting chutes and integrated line weighting are currently in the research and development phase, and therefore only available for testing at this point, participants decided to focus on their potential.

Participants generally found all of the main mitigation strategies are effective in diminishing the bycatch of seabirds. Each strategy was also found to have its particular strengths and weaknesses, as summarized below, along with recommendations for further research.

- STREAMER LINES – Participants listed major strengths of streamer lines as: applicability to all gear types, low cost, low impact on target catch and safety. The jiggler line developed by John Bennett was given special mention. Weaknesses of streamer lines noted were: deployment difficulties for smaller boats, high effort to retrieve the lines, entanglement problems and poor compliance. Participants recommended further research to test the effects of two lines versus one line in reducing seabird strikes and to explore the creation of standards for streamer line materials, operations and performance.

- INTEGRATED LINE WEIGHTING – Among the major strengths of integrated line weighting, participants pointed to good applicability to both demersal and pelagic gear types, safety, ease of integration into crew activities and ease of use. Major weaknesses included high cost and limited availability. Participants recommended that additional research be conducted on the durability and wear of weighted lines and on the effects of integrated line weighting on target and bycatch rates.

- SETTING CHUTE – The strengths of underwater setting chutes noted by participants include ease of use, minimal adverse effect on target catch, ease of integration into fishing operations and easy compliance. Participants mentioned as major weaknesses high cost, limited availability, questionable durability, limited application for smaller boats and maintenance concerns. Participants suggested additional research be conducted on the reliability of setting chutes, their performance in other regions and potential design modifications (e.g., different chute gradients, use of gimbals and flexes, double chutes).

- STEALTH GEAR/BAIT – The advantages of stealth gear and bait—and of blue-dyed bait in particular—is good applicability to all gear types, relatively low cost and ease of use, according to participants. The disadvantages noted included poor availability, messiness of on-board dyeing, the lack of color standards and potential safety issues associated with dye toxicity. Discussants suggested that additional studies be carried out on different bait colors and dyeing techniques to determine which had the optimal impacts on target and bycatch rates.

- OFFAL MANAGEMENT/RETENTION – Participants identified a reduction in the attractiveness of fishing vessels to seabirds as the principal advantage of managing and retaining fish offal. The drawbacks noted were the additional space and labor required to store and manage offal. Participants recommended carrying out more research on new types of reducers or extractors for offal and additional products that might be derived from it.

- NIGHT SETTING – The strengths of night setting listed by participants included low cost, enforceability and effectiveness with regard to surface-feeding birds. Weaknesses included potential negative impacts on target catch, exposing fish to sand fleas and increasing seabird bycatch for certain species (e.g., the northern fulmar). Participants recommended additional research on the effects of night setting on particular species and on the impacts of reduced deck lighting.

Several key themes crosscut the sessions. Participants generally agreed the existing mitigation practices are having positive impacts. The current need is to fine-tune and broaden the use of existing technologies rather than create new ones, they said. Participants also agreed that improved mitigation results would likely occur with better crew training, expanded testing in different regions, new vessel construction and the development of minimum standards. Participants strongly concurred that no single mitigation technology was likely to serve as a “silver bullet,” but that the best results would likely be achieved by developing a “toolbox” consisting of combinations of measures. Ultimately these solutions would need to be incorporated into the design of new vessels.

Sea Turtle Research and Mitigation

Co-Leaders: Christofer Boggs, John Watson
Facilitator: Bennett Brooks (CONCUR)

The main objectives of this session were to review the progress that has been made in finding viable means of reducing sea turtle longline bycatch, to identify the challenges that stand in the way, and to brainstorm solutions to those challenges.

Introduction

Christofer Boggs, U.S. NOAA Fisheries,
Honolulu Laboratory (now the Pacific Islands Fisheries Science Center)

There are several challenges to finding effective measures for reducing turtle bycatch. The first involves obtaining baseline information on the biology of target species and bycatch, which will facilitate a better understanding of turtle mortality from all sources and the survival rates of turtles that are hooked and released. Specifically, more data are needed on:

- Species and stock composition, ages and sizes of turtle bycatch.
- Bycatch distribution patterns and characteristics; e.g., are they seasonal, annual, vertical/diurnal, climate-related, etc.
- Turtle diet studies and what attracts some turtles, such as loggerheads, to fishing gear.

Increasing the number of tagged turtles tracked by satellite and expanding fishery-based data programs and collaborative research with industry and nongovernmental organizations will assist us in these efforts.

A second challenge involves finding effective gear modifications and fishing tactics to reduce turtle bycatch. These efforts require financial support for additional research related to bait (e.g., types, size, baiting techniques), hooks (e.g., types, size, geometric configuration), and designs for floats that would make them more "stealthy." Also, continued studies using sensors, including hook timers, will help determine more accurately at what point during operations fishers encounter turtles and target species. More research also is needed on tuna-directed fishing and the effects of area closures and fishing effort reduction. All this information could be used to provide fishermen with real-time information to avoid turtle interactions and, possibly, real-time closures via vehicle monitoring systems (VMS) communications.

A third area of need is to overcome the legal and logistical barriers to better coordination, standardization and timely dissemination of research on turtle bycatch issues. Establishing an international plan of action on sea turtles that includes a technical working group focused on these needs would open the door for more effective international action and coordination. Such international cooperation would allow stakeholders to craft legislation for facilitating and accelerating progress of mitigation research.

Progress in reducing turtle bycatch will be limited without strong awareness of the issue on the part of the fishing industry and the general public and persuasive incentives for action to address it. International solutions are needed, and that requires broader international representation at fora such as IFF2. Given the critical need to increase the spread of knowledge on turtle bycatch, there should be no penalties for sharing data, and information on or access to the most effective fishing gear, particularly with countries with developing longline fisheries. Educating consumers, the driving force for the market, through programs such as eco-labeling also will serve to raise public awareness. In general the industry is not convinced that longlining is a major threat to turtle populations, so there's a pressing need to effectively translate the hard data on the real impacts to fishers.

To determine the level of impact of longline fishing to turtle population status relative to other impacts, we must be able to quantify turtle mortality from all sources and get a better understanding of survival rates among turtles that are caught and released. There are fishers committed to adopting bycatch reduction and mitigation methods that have proven economically viable, and they can help obtain these data on mortality and survival.

EVALUATION OF THE EFFECTS OF HOOK TYPE ON SEA TURTLE BYCATCH IN THE SWORDFISH LONGLINE FISHERY IN THE AZORES

Alan Bolton, Department of Zoology, University of Florida

The waters around the Azores are an important developmental habitat for juvenile Atlantic loggerhead turtles. The duration of this oceanic juvenile stage is 7–12 years. The young turtles are exposed to fishing gear in the waters around the Azores for up to five years, depending on the age when the turtle migrates out of the area. The source rookeries for this population are primarily in the southeastern U.S.A.; thus the nesting populations of loggerheads from that area are the primary populations affected by the swordfish longline fishery in the Azores.

A workshop convened in 1998 designed an experiment to evaluate the effects of hook type on the rates of sea turtle bycatch and on the location of hooking (for example, mouth versus throat). The location of hooking may be significant to the survival of hooked turtles. The effect of hook type on rates of catch for target species was also evaluated. Collaborators on the experiment included commercial longline fishermen and biologists from the University of the Azores and government agencies.

On a 25.4-meter commercial longline vessel, 93 sets were conducted from July–December 2000, the primary swordfish season. There were approximately 1500 hooks per set, (eight per line interval between floats). All were baited with squid. The experiments tested three hook types: straight J, offset J, and circle. The three types of hooks were individually alternated along the set, so the relationship between hook type and position on the gear varied. Data collected for all turtles caught included species, body size, manner of capture, status, type and position of hook in the captured turtle, and position of hook between buoys. Turtles were tagged with standard flipper tags before release and skin samples were collected for genetic analyses to monitor source rookeries. Data collected on fish caught included: species, size, hook type and position between buoys. Environmental parameters were noted for each set.

THE RESULTS WERE:

- 237 turtles were captured (232 loggerheads, 4 leatherbacks, 1 green turtle); a catch rate of 2.5 turtles per set.
- Not all sets caught turtles; turtles were not uniformly distributed but clustered within the fishing area.
- The size range of loggerheads caught represented the largest turtles in the area.
- The number of turtles caught by each hook type did not differ significantly, but the location of the hooks in the turtles did: 57 percent of loggerheads caught on J hooks were hooked in the throat, while 81 percent of loggerheads caught on circle hooks were hooked in the mouth. This difference may have important implications for sea turtle mortality.
- The rate of turtles caught increased significantly with line retrievals later in the day. The rate of fish caught remained constant as the hour of day of line retrieval increased.

CONCLUSIONS:

- The use of circle hooks significantly decreased the rate of throat hooking in loggerhead turtles. This result has important implications for reduced sea turtle mortality because throat-hooked turtles would be expected to suffer higher mortality than mouth-hooked turtles.
- Gear modification has excellent potential to reduce bycatch.
- Turtle bycatch can be reduced by retrieving the lines earlier in the day.
- Results can be exported to other regions and ocean basins.

EXPERIMENTS IN THE WESTERN ATLANTIC TO EVALUATE SEA TURTLE MITIGATION MEASURES IN THE PELAGIC LONGLINE FISHERY

John Watson, U.S. NOAA Fisheries, Mississippi Laboratory

In 2001 the Southeast Fisheries Science Center of the National Marine Fisheries Service initiated a multi-year project to develop measures for reducing sea turtle bycatch and mortality by pelagic longline gear. Eight commercial longline vessels served as platforms for evaluating two potential mitigation techniques: the use of blue-dyed squid bait and positioning of hooks away from floats. The researchers also collected data on 18 other variables that affect sea turtle interaction with longline gear: fishing location, including color, diameter and test strength of branch lines; size, position and depth of hook; hooking location on turtle; leader length; mainline color and diameter; time of day; set and haul order; and water temperature.

The eight vessels made 186 sets over two trips to the northeast distant waters (NED) during September and October 2001. In total 142 loggerhead turtles and 77 leatherbacks were caught, with no observed mortalities. Analysis of the results of the experiments testing whether turtles are less attracted to blue-dyed bait than natural undyed bait showed there is no statistically significant difference in preference among loggerheads and leatherbacks.

RESULTS FROM INVESTIGATION
OF THE OTHER VARIABLES SHOWED:

- Loggerhead catches were much higher in the later portion of the gear as it is hauled (200 percent higher in the second half of set hauls). The results indicated that loggerhead turtles interact with longline gear during the day. However, this was not the case with leatherbacks, which suggests that they may be interacting at night or during both day and night.
- The majority of loggerhead captures occurred as a result of feeding on the bait, while leatherbacks captures were a result of hooking in the flipper or shoulder. This indicates that leatherbacks are not trying to eat the bait, but rather getting hooked when they swim into the gear.
- There was an increased occurrence of leatherbacks on hooks associated with the float; fishing with hooks directly under floats appears to capture fewer turtles than fishing hooks 20 fathoms away from the floats.
- Modeling results from the experiments indicated the only significant explanatory variable was average daylight hook soak time: Every additional 100 minutes of daylight hook soak time increases the probability of loggerhead turtle interaction by 35 percent.

Additional experiments conducted during 2002 in the Atlantic tested the effects of three variables: reduced daylight soak time; the use of two types of circle hooks (0- and 10-degree offset 18/0 circle hooks), with the J hook used as a control; and the use of mackerel bait. The preliminary results showed a 60 percent reduction in the number of turtles hooked with squid bait, but unfortunately there was also a reduction in swordfish catch. The use of 18/0 circle hooks with mackerel bait showed a reduction in turtle takes of between 65 percent and 90 percent and significantly higher swordfish catches than squid-baited hooks.

These preliminary findings suggest that different combinations of hook and bait could be used to reduce turtle bycatch without significantly affecting swordfish catches. However, varying environmental parameters may affect the results in different geographic locations, so the beneficial combinations may not be universally applicable.

OVERVIEW OF HAWAI'I LONGLINE FISHING EXPERIMENTS TO REDUCE SEA TURTLE BYCATCH

Christofer Boggs

In January 2002 the NOAA issued a research permit under the Endangered Species Act, authorizing the Southwest Fisheries Science Center Honolulu Laboratory to begin a three-year program of experiments to develop mitigation measures for the longline fishery to reduce the bycatch of sea turtles. The research is designed to complement similar studies in the Atlantic Ocean, but is distinctly different because of the differences between Pacific and Atlantic fishing strategies. Environmental factors that give the two oceans distinct characters also affect the success of various fishing tactics. For example, colder water temperatures in the Atlantic apparently drive turtles to be more active in foraging later in the day when surface temperatures are warmest, likely accounting for greater numbers caught late in hauls. In contrast, this pattern isn't seen in the Pacific where water temperatures are warmer.

Observer data from the Hawai'i longline fishery has shown that branch lines attached less than 40 fathoms from float lines catch the most turtles, so experiments have been designed to test the benefits of attaching branch lines at greater distances from the float lines so that all hooks are at a universal depth. Also, previous studies have shown that turtles will ignore blue bait for up to 10 days when natural, undyed bait is available, so experiments are proposed for testing the efficacy of using blue-dyed bait to deter turtles from taking hooked bait.

Due to legal challenges to the permit, the allowed research activities were limited in 2002. The branch line and blue bait experiments have not been authorized yet. However, approval was given for testing camouflaged (“stealth”) longline gears and deep daytime swordfish fishing to evaluate if these modifications impact the economic viability of the fisheries. Also allowed is research using electronic hook timers and time-depth recorders to document when and where turtle bycatch occurs in the sequence of longline deployment and retrieval—information that is vital to the development of additional turtle bycatch mitigation methods. In conjunction with these experiments large (18/0) circle hooks, which have proven less injurious to turtles, are also being tested. NOAA will decide whether to proceed with the full scope of Pacific experiments following a complete analysis of the Atlantic experiments on turtle bycatch reduction (described by Alan Bolton and John Watson) and the 2002 Pacific experiments.

In the experiments testing whether deep daytime fishing of swordfish could be economically viable, 33 sets were made in areas where shallow nighttime fishing had proven successful. While no turtles were caught on the deep daytime sets, swordfish catches were 30 percent lower. One turtle was caught during control fishing with regular swordfish-style gear.

The stealth gear experiments employed counter-shaded floats, dark-colored lines, dulled hardware, blue-dyed bait and down-welling LED lightsticks in an effort to make gear less detectable by turtles. In 33 sets with stealth gear no turtles were hooked. While the stealth gear was not as economically viable as normal (control) gear, with some modifications it shows promise of viable catch rates for target species.

Two vessels made 95 sets with hook timers and large circle hooks, hooking one leatherback turtle that provided the only timer data and one loggerhead turtle (with a timer that failed). The circle hook experiments yielded normal tuna catches but substantially lower swordfish catches than fishing with J hooks.

In conclusion, the results suggested that the modified gear had serious negative effects on target species but could be modified to improve fish catch rates. With regard to turtle bycatch, the results were not statistically useful given that only three turtles were caught.

SUMMARY OF DISCUSSIONS FROM BREAKOUT GROUPS

About 30 participants attended each of the sea turtle mitigation sessions. There was a great deal of agreement across the sessions regarding on the major challenges standing in the way of finding effective means of reducing sea turtle longline bycatch. The primary challenges identified were:

- Developing good baseline information on the biology of target species and bycatch.
- Finding gear modifications and fishing tactics that effectively reduce turtle bycatch.
- Facilitating, coordinating and standardizing the timely dissemination of research results, and overcoming the legal and logistical barriers involved.
- Generating interest and awareness of turtle bycatch problems within industry and the general public, and developing incentives for action.

Participants offered a wide variety of suggestions for overcoming these challenges. They are listed by problem area, as follows:

- BASELINE ON THE BIOLOGY OF TARGET SPECIES AND BYCATCH – Participants agreed a range of data needs exists, including general information on species composition, size distribution, and stock composition for target and bycatch species; data on distribution patterns of bycatch and target species (including age and size, and seasonal, annual, vertical, diurnal, and climate-related variations). They recommended conducting studies on turtle diet and factors that attract turtles to gear. Participants advocated larger sample sizes, greater employment of telemetry, and increased use of control animals. They also called for increased levels of research collaboration between scientists, the fishing industry and NGOs.

- EFFECTIVE GEAR MODIFICATIONS AND FISHING TACTICS – Participants called for increased financial support for research and mitigation. This would support additional research on bait types (e.g. mackerel), size and baiting techniques; hook type, size and geometry; and float design to make longline gear more "stealthy." They also recommended increased study of tuna-directed fishing and more use of sensors and hook timers to determine at what stages of fishing activities turtles and target species are encountered. With regard to fishing tactics, participants suggested providing fishermen with real-time information and possibly real-time closures with vessel monitoring system communications to help avoid turtle interactions. Participants also were open to the idea of area closures and effort reduction when appropriate.

- RESEARCH FACILITATION AND DISSEMINATION – Participants called for the production of an international plan of action on sea turtles to encourage greater levels of international action and coordination. They recommended creating an international technical working group that would be responsible for facilitating, coordinating and standardizing research, and disseminating results in a timely fashion. Participants also discussed the need for stakeholders to craft and promote legislation that would help expedite and centralize future mitigation research.

- INDUSTRY/PUBLIC AWARENESS AND INCENTIVES FOR ACTION – Participants noted that while international solutions may be needed to address sea turtle bycatch issues, many of the key international players were not present at IFF2. Ideas offered for increasing international participation on this issue included developing consumer awareness through education programs and marketing tools such as eco-labeling to help use the market as a driving force. Participants recommended limiting penalties associated with sharing data and giving countries with developing longline fisheries access to gear that would help mitigate turtle bycatch and information about such gear. Participants also noted that hard data on the impacts of the longline fishery need to be translated effectively to help convince the fishery industry of the threat it poses to turtle populations.

Throughout the breakout sessions participants also discussed the need to provide better scientific context for sea turtle mortality, including an examination of post-hooking survival. Fishermen in particular were concerned that other sources of mortality were being overlooked. They favored developing an overall picture of the causes of sea turtle mortality comparing longline fishery contributions to mortality with mortality from other causes.

Data Collection

Leader: Howard McElderry, Archipelago Marine Research, Ltd., Victoria, B.C., Canada
Facilitator: Eric Poncelet, CONCUR

Introduction

Howard McElderry

The main objectives of this session were to define current information needs for different fisheries, examine how well existing data-collection programs are meeting these information needs, investigate available technological opportunities, and explore building stronger ties between fishery participants and users of the data. The focus was on three main types of data-collection programs: logbooks, observer programs, and electronic monitoring systems.

THE FOUR THEMES FOR THIS SESSION WERE:

- The needs for more data and better-quality data are growing.
- Existing data-collection programs have difficulty meeting certain information needs.
- Technology solutions may assist with these growing information needs.
- Industry should be proactive in ensuring that their fishery information needs are met.

Issues Identification/ Background Presentations

DATA COLLECTION PROGRAMS IN MICRONESIA

Tim Park, National Oceanic Resource Management Authority, Federated States of Micronesia

Issues of data collection in Micronesia are common to many Pacific Island nations where coordination, analysis of data and management issues are largely dealt with in a regional manner. The Forum Fisheries Agency (FFA) coordinates data for the purposes of regional compliance, monitoring and surveillance. The FFA also manages the regional register of fishing vessels as well as the vessel monitoring system (VMS). The Secretariat of the Pacific Community (SPC) coordinates and manages data for scientific analysis and stock assessment. The SPC's data collection committee has drawn up standardized logsheets, unloading forms and observer forms for the region.

Problems related to the collection of this data for the region are closely related to the fact that most vessels fishing in the area are foreign and often not domestically based. This makes it difficult to assess the level of reporting through submission of vessel logsheets. Likewise, vessels unloading in countries other than where they fished hampers the collection of information and biological data used for demographic assessment of stocks. In addition observer programs face logistical difficulties due to their scattered geographical locations and the time and costs associated with placement of observers on boats. There are about 2000 longliners in the region. Longline observers collect protected species information. Observer coverage is a widespread problem throughout the region. There are only about 200 trained observers in the Western and Central Pacific, covering vessels in the five major fisheries. U.S. purse seiners have about 20 percent observer coverage, but coverage for many other vessels is much lower; the average is about three percent. For example, the regional coverage of the tuna industry is less than two percent. Memoranda of understanding with certain fleets limit their onboard coverage and bias the results of overall observer coverage. Another big problem is the time delay in processing data; for example, takes about a year to completely process a logsheet.

We are striving to overcome these problems by harmonizing collection tools. Regional agreements and the development of a regional management commission are facilitating these efforts.

THE HAWAI‘I-BASED LONGLINE LOGBOOK COLLECTION PROGRAM

Russell Ito, NOAA Fisheries, Honolulu Laboratory, Fishery Monitoring and Economics Program

The NOAA Fisheries Honolulu Lab Fishery Monitoring and Economics Program began collecting data on Hawai‘i commercial fisheries in 1986. The program initially collected market data (e.g., fisher, date of sale, individual fish weights, prices and buyer) from the United Fishing Agency Ltd. Public auction, where most Hawai‘i-based longline vessels and some smaller Hawaii commercial fishing vessels off-loaded and sold their catches. FMEP later expanded the data collection duties for the longline fishery for several reasons. While the market data were used to estimate landings and ex-vessel revenue for the longline fishery, the need for more detailed information increased as the number of vessels participating in the fishery grew rapidly in the late 1980s. Gear conflicts between small trolling and handline vessels and longliners and reports of interactions between longline gear and protected species in the Northwestern Hawaiian Islands also occurred during this expansion. Consequently, the Western Pacific Regional Fishery Management Council (WPFRMC) developed and implemented several measures in 1990, including the mandatory submission of daily longline logbooks promptly after each trip. The first version of the logbook was distributed to Hawai‘i-based longline vessels in November 1990, and the first logbook data were submitted the following month. The data summarized fishing operations, effort, positions, catches and protected species interactions.

Standard procedures were developed for monitoring compliance by fishers as well as logbook data handling, editing, archiving, and reporting. Monitoring is facilitated by the fact that almost the entire Hawai‘i-based longline fleet is docked in Honolulu Harbor or Kewalo Basin. The work entails daily tours of the docks to maintain an inventory of longline vessels in port, at sea, or in dry dock. Newly arrived vessels are asked to submit logs at the dock. If available each logbook page is examined for missing and questionable data entries, and any errors found can be corrected if approved by the vessel operator. These dockside checks foster good rapport with fisher and reduce the need for return interviews for additions or clarifications. If data is not submitted or is incomplete, vessel operators or owners may be subject to enforcement actions.

Minor editing back at the office (e.g., expression of time as the 24-hour clock) is also done before keypunching. The data are keypunched twice by different data entry clerks and are archived when there is full agreement. The original data (i.e., the log sheet transcript with only the minor edits) are archived and then run through a computer program with range checks for each field. “Out of range” values are checked against the original log sheets, which are maintained in secured storage to ensure confidentiality. The output from this research database is also archived. After the research database is edited, summary files are generated and reports issued 45 days after the end of each quarter. Annual reports are generated similarly. All theses reports are publicly available in print or on the FMEP website.

Issues that continue to affect the quality and quantity of certain data items include underreporting of discarded bycatch—particularly sharks and protected species—misidentification of marlins and changes to logbook format.

The mandatory daily longline logbook program is now in its twelfth year. These data represent the most important resource concerning fleet activity, effort, and catch available to NMFS scientists and the WPRFMC. These data are also used in several collaborative research projects, statistics on U.S. fisheries, studies on the status of stocks of highly migratory fish species and in international agreements such as the one governing the Secretariat of the Pacific Community (SPC).

NORTH PACIFIC GROUNDFISH OBSERVER PROGRAM

Shannon Fitzgerald, U.S. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, Washington

Administered by the National Marine Fisheries Program, the North Pacific Groundfish Observer Program operates in conjunction with industry and private companies. The program deploys observers to vessels and processing facilities participating in the groundfish fisheries under the management plans for the Bering Sea, Aleutian Islands and Gulf of Alaska. The groundfish fisheries there produce two million metric tons of fish annually, and the role of the observers and the information they collect is central to sustainable management of these fisheries. The participating vessels include longline, stern trawl and pot vessels that operate as catcher vessels delivering to shoreside or floating processors, or catcher boats delivering cod-ends to mothership processors.

To achieve sustainability within these fisheries and those potentially affected by their bycatch, NOAA Fisheries uses a quota-based management system heavily dependent on timely and accurate data from at-sea observers. Requirements for vessels to carry observers are based on fishing days and the vessel's size. Vessels larger than 124 feet in overall length (LOA) must have an observer on board for 100 percent of the days it lands and retains catch. Vessels 60–124 feet LOA must meet quarterly requirements to carry an observer for 30 percent of its fishing days. Observer presence is not required on vessels of less than 60 feet LOA, while some special management programs require two observers. Processing plants are monitored according to tons processed per month.

The primary objective of the observer program is to provide accurate and precise information on catch and bycatch, and biological measures for the conservation and management of groundfish resources and protection of marine mammals, seabirds, and other protected species. Specific program activities include:

- Providing timely, reliable catch information for quota monitoring and management.
- Collecting information and samples required for stock assessment analysis.
- Providing information to document and reduce interactions between fisheries and protected species.
- Collecting observations and samples as required for marine ecosystem research.

Observers sample a subset of the hauls made while they are on board and provide information on fishing area and effort, total catch, species composition of the catch, incidental takes of protected species, biological and life history information and other data. Prior to each fishing season, stock assessment scientists use this fishery-dependent information, along with fishery-independent information from research cruises, to recommend the allowable biological catch for each fishery component. During each fishing year quotas are managed and fisheries opened or closed where appropriate, based on a blend of observer data and reports from industry on the amount of fish processed. Quotas are established for target and some non-target species, and management of the quota can be either fisher-wide, fleet-wide, or on an individual vessel level.

To meet observer program objectives, we annually deploy 330 observers, who complete about 550–600 cruises. They collect data on 300 vessels and 20 plants, for a total of more than 30,000 days of coverage. (The longline component of the total is about 6,000 days.) The industry and NOAA share program costs, with the industry contributing about $10 million annually toward compensation, insurance, and logistical support, and NOAA paying $3 million for program staff and operations.

The need for accurate and timely data is met through standard data quality control features (such as training, debriefing, and post-cruise data checking) and the development of a real-time electronic data reporting system. The system allows for data checking and communication between observers and program staff while an observer is at sea. This greatly increases the accuracy and overall quality of data used for in-season management and programs for reducing bycatch.

As approaches in fisheries management continue to change, information requirements will also evolve, Current changes include attempts at "rationalizing" fisheries, identifying much more of the catch to the species level, gathering information to understand essential habitat and developing methods to avoid bycatch. Fishery managers need more real-time data that provides a high degree of accuracy without exceeding reasonable costs. Industry, which has the same needs, is very involved in management overall and on an individual vessel basis. There are limitations on what a single observer can do, and a high cost for additional observers. These constraints and conflicts will need to be resolved to continue the positive changes occurring in these fisheries.

AFMA FISHERIES DATA COLLECTION PROGRAMS

Bruce Wallner, Australian Fisheries Management Authority (AFMA)

The Australian Fisheries Management Authority (AFMA) was established in 1992 to manage the Commonwealth's 22 wild fisheries, including pelagic tuna and billfish longline fisheries. The gross production value of all fisheries totals about A$480 million annually with pelagic longline fisheries accounting for about a quarter of this.

AFMA collects data for all fisheries to support its decision-making on catch allocations and fishing rights, provide information for research and monitoring and assess the status of the fishery. By law the authority's main objectives are:

- The sustainable use of fisheries resources with regard to the precautionary principle.
- Economic efficiency.
- Consultation and communication with stakeholders.
- Efficient and cost-effective fisheries management.

Under these objectives, AFMA has the responsibility to assess fishery impacts on the marine environment and monitor and mitigate the longline bycatch of turtles, seabirds and other species. This mandate is reinforced by legislation and policy imposed by Environment Australia, the country's environmental regulatory agency, and commitments to regional fisheries management organizations such as the Secretariat of the Pacific Community.

AFMA collects five categories of fisheries data: licensing data, biological and other data for research, vessel tracking (monitoring) data, fisher logbook data and at-sea observer data. We use the last two types of data to understand, monitor and manage bycatch such as turtles and seabirds in longline fisheries.

LOGBOOK DATA PROGRAMS

Logbook programs require fisher cooperation, but are relatively cost-effective, reach all fishers and are responsive to change. As fisheries management has shifted from a focus on stocks to considerations of whole ecosystems, logbooks have served as the first tool for gathering data on bycatch and ecological parameters. Current regulations in Australia require all skippers on pelagic longline vessels to record information daily on the vessel and gear, catch and effort, type of bait used, bycatch, discards, wildlife interactions, mitigation methods and environmental observations. The accuracy and representativeness of these data are variable. Generally data on retained catch are of good quality, but recording of bycatch, discards and wildlife interactions is often poor. While there are a number of reasons for this, fisher concerns about data confidentiality and the threat of prosecution for incidental takes of protected species such as turtles and seabirds are frequently cited. Without sound data verification logbooks are unlikely to provide the data needed to effectively monitor bycatch, understand the scale of bycatch issues and measure the effectiveness of mitigation strategies.

Currently electronic logbooks are being tested in two trawl fisheries, and there is interest in developing "e-logs" for longline fisheries as well. Such approaches may not have the same limitations as paper logbooks, and could offer the opportunity to expand the range of data collected. However, we recommend that the purpose and quality of the data undergo critical review as this technology is developed.

OBSERVER PROGRAMS

Observer programs can be the seagoing eyes and ears of a management agency, providing a wide range of valuable data on fishing operations. Observer duties include:

- Verifying logbook catch and effort data.
- Accurately describing fishing gear and operations.
- Collecting biological samples for measurements of fish size and age.
- Deploying tags for tracking species movements.
- Determining processing conversion rates.
- Liasing directly with fishers.
- Recording interactions with protected species.
- Documenting entire catch, including bycatch and discards.
- Monitoring compliance with regulations.

Despite their accuracy, observer programs are relatively expensive, and in Australia—where industry pays the total program cost—fishers are often resistant to implementing them. Consequently these programs cover a small portion fishing activities in a fleet (the target in Australia is 5 percent). This limited coverage gives rise to many logistical and sampling problems that restrict the representativeness of the observer data and hamper program objectives.

OTHER APPROACHES

Data validity must be balanced against cost and coverage, and the collection program must be matched to the data needs. Two other approaches may be developed for longline fisheries in Australia. The first is train volunteer vessel crew members, who can provide greater sampling coverage cost-effectively, to collect particular data. Australia's northern prawn trawl fishery has used this approach to document turtle catch and mortality and it may be applicable to longline vessels. The second strategy would employ electronic monitoring utilizing video cameras and other sensors to remotely record and relay key data from sea. These potential solutions require further development and critical evaluation of costs and benefits in Australia.

ELECTRONIC MONITORING OPPORTUNITIES FOR COMMERCIAL FISHERIES

Howard McElderry

Commercial fisheries are under increasing pressure by resource regulators and the public to provide accurate, timely and verifiable fishing information for various purposes, including compliance monitoring, in-season fishery management, stock assessment and scientific research. Currently the only effective means of providing reliable independent data of high quality is with at-sea observer programs. However, several issues constrain the widespread use of observer programs, including cost, vessel suitability for hosting an observer, and logistical difficulties with fielding large numbers of observers according to specified fleet sampling plans.

Archipelago Marine Research, Ltd., a leading provider of at-sea observer programs in Canada, has been developing an alternative means of meeting this need with automated electronic monitoring (EM) systems. The company has conducted pilot studies on the use of EM in several commercial fisheries for various purposes, including:

- SALMON SEINE FISHING – monitoring time and area of fishing, restrictions on seine net handling and requirements for handling bycatch.
- SALMON TROLL FISHING – monitoring time and area of fishing, catch numbers and bycatch species and numbers.
- HALIBUT LONGLINE FISHING AND SEABIRD INTERACTIONS – monitoring time and area of fishing, longline setting practices with seabird avoidance devises, catch numbers and species.

We have also set up large-scale EM programs in two British Columbia fisheries. The first gives 100 percent coverage for the 50-vessel fleet operating in the Area A crab fishery. Now in its third year the program provides monitoring for time and area of fishing, trap limits, and trap soak duration, as well as surveillance of traps for theft of catch and equipment. The cost is about one-fifth that of an at-sea observer program. The second program, in the halibut longline fishery, began on a pilot scale in 2001 and expanded to 500 sea days of EM deployment in 2002. About half of the second-year deployment included a live observer to evaluate accuracy of the EM data. This program was designed to monitor time and area of fishing and the number and species of catch and bycatch. The estimated cost is about half that of an at-sea observer program.

In addition to their lower cost, EM-based programs are better suited to many vessels than are observer programs. EM-based programs can be very effective in monitoring fishing time and area and gear requirements for seabird avoidance and onboard catch handling. Where process control points enable viewing the catch individually, EM also can be used to identify and count catch and bycatch. However, EM programs are more than just equipment, they require infrastructure for field support and data analysis, as well as an organizational framework that ensures proper use of the equipment and prevents misuse of the data.

A summary comparison of EM with at-sea observer programs shows the potential virtues of well-designed EM programs to be better round-the-clock coverage, less intrusiveness to vessel operations, lower cost, and greater appeal to industry. Organizational structure can be set up to ensure program efficiency. For example, with the crab EM program, a fishing association represents its members in procuring the monitoring service and also takes punitive measures when members violate program rules. The fishing agency sets the program standards and receives data, while the contracting firm (Archipelago) ensures objective, "arm's-length" program delivery and an "info-mediary" role with respect to program data. On the other hand, observer programs may be more versatile and less technologically complex; and certain data collected by observers may be regarded as more trustworthy.

EM will occupy a prominent place in the fisheries of the future, providing strategic and cost-effective monitoring that will complement or even replace observer programs. As well, the application of EM may enable the development of alternative approaches to fishery resources management.

SUMMARY OF DELIBERATIONS FROM BREAKOUT GROUPS

Approximately 20 participants attended each of the data collection sessions. Following the introductory presentations, breakout discussions focused on two main tasks: identifying problems impeding adequate data collection, and exploring potential ways of overcoming these problems.

Discussions on the challenges in improving data collection identified the following problem areas:

- UNCLEAR OBJECTIVES – Participants found that many data collection programs suffered from either a lack of clear goals or from overlapping or conflicting goals. Such situations may produce data of poor quality or limited use. In all cases, this lack of clarity led to resistance or lack of engagement in data-collection activities.

- LACK OF TRUST – Participants described a lack of trust between the designers of the data-collection programs and the subsequent users of the resulting data, on one hand, and the fishermen who were assisting in the collection of data, on the other. Fishermen expressed the fear that the data they collect might in some way turn out to be self-incriminating. This makes them reluctant to assist in data collection efforts. In addition, control over how data are used and who has access to data may weaken cooperation, particularly with programs involving skipper-recorded data. These and other factors can affect the consistency, reliability and utility of data, compromising its overall quality.

- INSUFFICIENT DATA, PARTICULARLY ON BYCATCH – Participants commented on the incompleteness of the data being collected via logbooks or observer programs. With regard to logbooks, participants expressed the concern that data on bycatch were often lacking when compared to data on target catch. Participants also noted reliability concerns with regard to logbook data. In regard to observer programs, participants noted that coverage levels were low or absent in most fisheries.

- POOR DATA SHARING – Participants noted that data, once collected, were not often shared in an effective or equitable manner. Fishermen complained that they seldom saw the results of research conducted on their boats or within their fisheries. Also, some fishing nations and jurisdictions may not share their data, or have not established protocols for sharing data.

- ISSUES OF DATA USE – Participants discussed how different visions exist over how data, once produced, should be disseminated. Members of governmental agencies, the research community, and environmental groups generally favored broader and more rapid dissemination of data, while the fishing industry wanted more involvement in decisions over how data would be used.

- LACK OF COMMITMENT – A widespread lack of commitment toward collaborating on the collection and sharing of data and maximizing its usefulness is reflected in the shortage of funding for relevant programs. The inadequacy of funding and a general lack of political will represent major impediments to improving data-collection programs.

- ILLEGAL, UNREGULATED, AND UNREPORTED FISHING – Participants noted that while significant efforts have been made to improve the quantity and quality of data being collected within particular fisheries, the completeness and overall reliability of this data will continue to be questioned so long as illegal, unregulated, and unreported (IUU) fishing remains a serious problem. Furthermore, IUU fishing creates a data gap of unknown proportions that hampers making assessment decisions that require good data.

Participants then discussed possible steps to overcome these hurdles and improve data quantity and quality. A wide variety of creative suggestions surfaced, many directed to the issues of insufficient data and enduring mistrust. These included:

- Devise minimum standards for data collection and sharing at the international level.
- Improve the training available for both skippers and on-board observers; develop a certification system.
- Build flexibility into data-collection systems so that they do not become entrenched and unresponsive.
- Mix different methods and technologies (such as at-sea observers and electronic monitoring) as appropriate, to provide greater coverage and quality of data than any single method could achieve alone.
- Ensure that the data to be collected clearly meets well-defined needs for resource management.

To improve the level of trust among fishermen, researchers, representatives of governmental agencies and members of the environmental community, participants made the following recommendations:

- Involve the fishing industry to a greater extent in the design of data-collection programs, in decisions regarding how the data will be used, and in generating funding to support the data-collection programs.
- Promote strong two-way communication on data issues that provides practical feedback to fishers and reinforces the benefits of cooperation.
- Institute a greater degree of transparency with regard to the objectives of particular research programs and the intended uses of the data collected.
- Employ the assistance of neutral third parties to work with governments and the fishing industry to collect data.

While most session participants generally felt there was ample room for improvement with regard to the obstacles facing adequate data collection, several cautioned that it might take some time to overcome the lack of trust that exists between the fishing industry and those responsible for monitoring and regulating it.

Education/Communication

Leader: Sandy Bartle, Museum of New Zealand (Te Papa Tongarewa), New Zealand

The main objective of this session was for forum attendees to view and discuss exhibits by various agencies and presenters. The session was held as a walk-through event, open throughout the day.

Exhibits:

- SEABIRD IDENTIFICATION: SKINS – Sandy Bartle, Te Papa Tongarewa
- SEABIRD IDENTIFICATION: ILLUSTRATIONS – Derek Onley, Blueskin Stone, New Zealand
- SEABIRD SPECIES PROFILES: Derek Onley, Blueskin Stone
- VIDEO VIEWING AREA: Cindy Knapman, Western Pacific Regional Fishery Management Council
- SEABIRD HANDLING: Katie Swift, US Fish and Wildlife Service, Honolulu
- SEA TURTLE FLIPPER TAGGING: Shandell Eames, NOAA Fisheries Honolulu Laboratory
- GENETIC SAMPLING: Peter Dutton, NOAA Fisheries, La Jolla, California
- SEABIRD DISTRIBUTION: David Hyrenbach, Duke University, North Carolina
- SEA TURTLE DISTRIBUTION: Yonat Swimmer, NOAA Fisheries Honolulu Laboratory
- SENSORY PHYSIOLOGY: Yonat Swimmer, NOAA Fisheries
- MODELING DISPLAY: Milani Chaloupka, Ecological Modeling Consultancy, Queensland, Australia; and Jean-Claude Stahl, Museum of New Zealand, Te Papa Tongarewa
- SEA TURTLE SHELLS AND HANDLING: Thierry Work and Randall Arauz, Sea Turtle Restoration Project, Costa Rica
- PROTECTED SPECIES DVD/CD-ROM INTERACTIVE PROJECT: Eric Sandberg, NOAA Fisheries, Honolulu
- FISHERMEN WORKSHOPS: Karla Gore, NOAA Fisheries, Honolulu

SUMMARY OF DISCUSSIONS WITH PARTICIPANTS

Participants comments on several key issues related to the exhibits:

- INFORMATION MOST NEEDED BY FISHERMEN – Many participants said the greatest need is for broad information on seabird and turtle species vulnerable to incidental bycatch. The kinds of information needed include: species identification, information about the threatened or endangered status, up-to-date data on populations trends, threats to the species, mitigation techniques, handling and release techniques.

- MOST USEFUL EDUCATIONAL PRODUCTS EXHIBITED AT IFF2 – Some participants felt the seabird and sea turtle identification guides were the most helpful educational products on exhibit, while others enjoyed the videos and seabird tracking information the most.

- USEFULNESS OF SPECIES PROFILES FOR MARINE TURTLES AND SEABIRDS – Participants said species profiles of marine turtles and seabirds would be useful to fishers, observers and schools in identifying and handling the animals, and generally increasing knowledge about each species. Participants stated that such profiles are worth reproducing and suggested the format be waterproof plastic books or folders, ring binders, or waterproof pocket flipbook. They recommended translations be made in Spanish, Portuguese, Mandarin, Japanese and English.

- IMPROVEMENTS IN ADDRESSING EDUCATION/COMMUNICATION ISSUES IN FUTURE FISHERS' FORA – Suggestions included more thorough coverage of Atlantic issues, better data on seabird populations and more representation from regional fisheries. Also recommended was the addition of more interactive activities on seabird handling and practical deployment of mitigation measures.

Obstacles, Lessons Learnt and Ways Forward

Session Leaders: Janice Molloy (New Zealand Department of Conservation), Jim Cook (Pacific Ocean Producers), and Carlos Moreno (Instituto de Ecologia y Evolucion, Universidad Austral de Chile)

The purpose of this breakout session held on Day 3 was to provide a bridge between the first two days of the forum and the final day. The goal was to build on some of the experiences gained from IFF1, as presented on Day 1, and more particularly on some of the obstacles and solutions identified in the Mitigation, Data Collection and Research breakout sessions on Day 2 for the purpose of moving toward a discussion of concrete actions on Day 4.

Three broad questions were used to guide the session discussions:

- What obstacles are preventing us from solving seabird and sea turtle bycatch?
- What ways of overcoming these obstacles can we learn from each other?
- How can each of us contribute to solving seabird and sea turtle bycatch?

Multiple sub-sessions—all with identical agendas—were run concurrently. Two sessions were designated 'fishermen only' participation to encourage greater freedom of expression and brainstorming among fisher; however, due to the large number of other breakout sessions scheduled for Day 3, one of these restricted sessions was canceled. Attendance for the other three sessions ranged from 20–30 participants.

Prior to commencing the sessions, a proposal was made to have them be confidential. This meant that, unlike the reports from the other breakout groups, the details of these sessions would not be presented to non-attendees or reported in these IFF2 proceedings. This idea was forwarded to encourage participants to think as creatively and 'out-of-the-box' as possible as they began to imagine ways of surmounting the barriers to limiting seabird and sea turtle bycatch on longline vessels. The feeling was that the real fruits of this exercise would not be lost, since the plan for the Day 4 plenary was to build on and recapture them. All of the session participants agreed to this ground rule.

Session Activities

The breakout sessions began with participants forming into sub-groups, each focused on one of the following topics: pelagic/seabirds, pelagic/sea turtles, demersal/seabirds, and demersal/sea turtles. Participants were then asked to imagine they had been transported two years forward to the Third International Fishers Forum in 2004, and they had been asked to report on accomplishments they had achieved on bycatch issues related to seabirds and sea turtles. The objective was to produce a list of key "visions" accomplished. The "visions" were to be bold, yet realistic.

After presenting these "visions" to the rest of the group, each sub-group was asked to think of the steps required to make their accomplishments a reality. This included exploring the skills, experience, networks, and actual actions that individual sub-group members could bring to this effort. Next, the sub-groups were asked to anticipate obstacles they might encounter in achieving these steps and draw on the collective wisdom and expertise of their sub-group to brainstorm ways of surmounting these obstacles.

Each of the sub-groups presented summaries of their deliberations to the rest of the breakout session participants. This was followed by general group discussion and reflection.

General Outcomes

One of the striking results of the sessions was the breadth and ambition of the envisioned achievements. Some sub-groups reported on the widespread use of best practice mitigation measures and the generation of substantial funding to support additional research. Others reported on new low levels of bycatch. Still others reported success in engaging a wider group of nations on these issues. Although the paths to accomplishing these "visions" were strewn with obstacles, many of the participants felt their sub-groups had the skills, capacity and know-how to overcome them.

While the participants proposed a wide variety of specific actions for surmounting these obstacles, common themes emerged in most of the sub-groups. For instance, most envisioned steps that involved improved international technical coordination among fishermen, gear manufacturers, biologists and others to produce new enhanced mitigation measures, with an emphasis on finding ways of improving information sharing. A second theme involved closing the gap between fishermen and other concerned parties. Actions were envisioned that enabled all parties to work together more effectively and build coalitions to realize commonly held goals. A third main theme involved taking steps to better inform not only fishermen but also the consumers of the need to reduce incidental seabird and sea turtle bycatch in longline fisheries and the progress being made by some fishers and fisheries.

International Agreements and National Approaches

The main objective of this session was to review in general the existing agreements and conventions pertaining to the incidental catch of seabirds and sea turtles by longline fishing and consider possible ways to improve them as well as future international efforts.

Leader: John Cooper, University of Cape Town

Identification of Issues/ Background Presentations

WHAT CAN BE DONE TO MAKE INTERNATIONAL TREATIES AND AGREEMENTS MORE EFFECTIVE TO CONSERVE TURTLES

Douglas Hykle, Secretariat, Convention on Migratory Species

Mr. Hykle reviewed the instruments relevant to the conservation of sea turtles. See his plenary presentation, given at the end of Day 1 of the forum.

BACKGROUND INFORMATION ON INTERNATIONAL AGREEMENTS AND TREATIES WITH RESPECT TO CONSERVATION

Denzil Miller, Convention for the Conservation of Antarctic Marine Living Resources

No summary available.

Summary of Discussions by Participants

EXISTING AGREEMENTS AND ASSESSMENTS OF FISHERY IMPACTS – Participants noted that non-binding treaties are likely to have limited effectiveness in protecting turtles and seabirds. Incorporating time frames into agreements is necessary to ensure implementation, they said. Participants recognized that ineffective compliance and enforcement of agreements is a problem with both developed and developing countries. One concern raised was the lack of timely sanctions for noncompliance with treaties and agreements. They suggested creating an international plan of action (IPOA) for sea turtles, incorporating sea turtles into existing IPOAs, or adding specific measures to existing instruments (e.g. appending conservation/management plans with time-bound commitments). Participants recommended making international agreements less generalized and more specific. They agreed that funding is critical to implement international agreements, especially for developing countries. Signing international agreements is an indication of commitment, which might attract funding, depending on the scale of the international agreement, e.g., the number of countries and scope of provisions. Some participants suggested reducing fishing industry subsidies and developing substantial marine protected areas. Another suggestion was integrating a more “bottom-up” approach into conservation treaties that would include elements of education and outreach.

BYCATCH MITIGATION MEASURES – Participants said that legal mechanisms exist globally to implement technical solutions such as gear modifications. They pointed out that regional agreements require consensus to implement, which is time-consuming and may be difficult to achieve. Also, Developing countries may lack the resources for implementing gear modifications. They said specificity is likely only under non-binding conservation plans, and dispute resolutions may be slow and ineffective. The group concluded that new ideas on mitigating turtle interactions must be sold to the fishing industry, and sound science justifying mitigation is essential to those efforts.

MARINE DEBRIS AND GEAR LOSS REDUCTIONS – Participants identified marine debris as an important threat that hasn't been given adequate attention, and said that its necessary to quantify the direct impacts of debris and its indirect impacts on habitat that could be important to sea turtles. They noted a lack of standardization in the process of documenting lost gear and proposed that it needs to be improved. One recommendation was that fishing gear should include identification marks for the source fishery, as specified in the FAO Code of Conduct.

VESSEL MONITORING SYSTEMS AND OBSERVER PROGRAMS – Participants agreed that observers recording turtle takes where regulations apply are de facto enforcement officers. They also said instances of coercion and tampering with observer reports could occur when the continuity of fishing is threatened under an international agreement. The group concurred that remote monitoring of fishing fleets by vessel monitoring systems is only effective for time/area closures.

RESEARCH – A mechanism to provide fishers with research feedback should be a professional courtesy rather than part of a legal instrument, participants said. Feedback also is essential for policy makers to evaluate the effectiveness of management measures. The fishermen said they should be involved in the planning and development of research activities, so they can understand the purposes of data collection. A mechanism for evaluating the socioeconomic impacts of measures implemented under international agreements is needed, the group concluded.

Participants proposed the following initiatives and additions to international agreements to improve their efficacy:

- Integrate ecosystem approaches into fishery management.
- Reduce subsidies, particularly for large fishing vessels, or transfer existing subsidies from production to conservation.
- Examine the concept of area and seasonal closures and long-term marine protected areas; integrate provisions for them in regional agreements where necessary.
- Develop a valuation system to compare biological values versus socioeconomic values, e.g., risk of species extinction versus the impacts of management measures on humans.
- Recognize species diversity and other biological values as well as economic values to assess the real cost of exploitation of the resource.
- Incorporate socioeconomic concerns in the implementation of mitigation measures.
- Recognize that management measures in one location may create fishing opportunities elsewhere, i.e., transferred effects.
- Explore ways to subsidize compliance and conservation in countries that otherwise would not comply.
- Implement a "tax" on the fishing industry to financially support compliance and conservation efforts in countries with limited resources.
- Develop incentives or rewards for minimizing turtle catches and/or for participating in research and monitoring programs.
- Raise consumer awareness through education, ecolabeling, and other means, to modify fish demand and consumption patterns and link the costs of fishing (including environmental costs) to the cost of eating fish.
- Transfer training/expertise and knowledge gained by countries successfully addressing incidental takes of seabirds and turtles with countries that have yet to do so.
- Reduce fishing effort in areas identified as critical for seabirds and sea turtles (this could result in an increased value of product).

Modeling

Leaders: Anthony Starfield, University of Minnesota, and Milani Chaloupka, University of Queensland

The main objective of this session was to give participants an appreciation of what modeling is and how it is used. Participants used the concept of modeling to consider current and projected populations of seabirds and sea turtles. Twenty-three participants engaged in hands-on modeling exercised designed to:

- Build a model
- Use an albatross model to explore the effects of bycatch
- Examine interaction between bycatch and climatic events
- Use a stochastic model to predict turtle bycatch

MODELING EXERCISES

Anthony Starfield

Everybody makes models. When you figure out how long it is going to take you to drive to the airport, you are building a mental model that takes into account the distance to the airport, traffic conditions at that time of the day, and whether or not you want to risk getting a speeding ticket. Sometimes mental models are not good enough; you need to actually do the arithmetic. For example, you might use a spreadsheet to estimate your income and expenses for the next year. That too is a model.

There are some useful lessons to be learned from these two simple examples: First, you do not get caught up in details. You don't try to estimate how long you will have to wait at a particular stop sign, nor do you figure into your annual budget whether or not you are going to buy an ice cream next week. Second, you don't have all the data you need, and there is a certain amount of uncertainty in the data you do have. You don't know whether the price of gas will go up or down over the next year, and if you have an adjustable mortgage you might not know your precise mortgage rate. So you make assumptions. You might even make alternative assumptions to see what happens; for example, what difference does it make to my finances if the gas price goes up or goes down? Third, you do not expect the model to be totally accurate and reliable. You are not building the model to make a precise prediction. The purpose is to use it as a planning tool, to help you make decisions like "Would it be prudent to leave an extra 10 minutes for getting to the airport?" or "Can I really afford to buy a new car this year?"

All of these points apply to population and ecosystem modeling. We build models to help us think through problems and to help us communicate the way we are thinking. Each model is an "IF – THEN" statement: IF the numbers we are using are reasonable, and IF our model is more-or-less correct, THEN these are the consequences.

We build models not to get perfect answers, but to help us make sensible, defensible decisions. Without explicit models we are likely to misunderstand, miscommunicate, and miscalculate. If a model helps us to make even a slightly better decision, it has served its purpose. A model is not a precise photograph or representation of reality; it is a problem-solving tool. Like all tools, there are things models can and cannot do, and there are good ways of using models and stupid ways of using models. The purpose of these notes and the spreadsheet exercises is to give you some appreciation of what these tools are, and how they are used.

EXERCISE ONE: BUILDING A MODEL

Consider an imaginary albatross; let's call it the Virtual Albatross ("Diomedia digitalis"). We want to build a model to see how its population might change over time under different circumstances. What do we think we need to know? We have to start with something, so we need a good estimate of the size of the present population. It would help to know how many are breeding adults and how many are juveniles. Then we need to think about how the population will change from one year to the next, so we need to know something about reproduction and natural mortality.

We take these questions to biologists who have been studying the Virtual Albatross, and this is what they tell us:

> Their best estimate of the total population is 5000 birds. They don't know how many of those are breeding adults, but from their ringing data they know that the birds first start nesting when they are five years old and that approximately 70 percent of the adults nest each year. They have good data from nest surveys. Each pair lays two eggs. The eggs do not all hatch and some of the hatchlings die within the first few days. A useful number is that, on average, each pair produces 0.6 chicks by the end of the survey (when the chicks are about four weeks old).

Mortality data is much harder find. Some studies suggest that approximately 10 percent of juveniles die per year. Adult mortality is much harder to estimate because it is very low. All they can really tell you is that the birds are long-lived (they think they commonly reach 30 or more years of age), and that the population, which was severely depleted by harvesting (which was stopped more than 20 years ago), now seems to be growing at a rate of about 5 percent per annum.

We are going to try to model how the population changes from one year to the next. To do this, we need to divide the model into age classes. We will divide the population into chicks, 1-year olds, 2-year olds, 3-year olds, 4-year olds and then adults. (One should really keep track of all ages up to a maximum age of 35, say, but we want to keep this example as simple as possible.) Let's try to develop our model in words, working from the adults back to the chicks:

Adults this year = adults from last year that don't die plus all surviving 4-yr. olds from last year.

In other words, adults this year = (adults last year) x (adult survival rate) + (4-yr. olds last year) x (juvenile survival rate).

Then, 4-yr. olds this year = (3-yr. olds last year) x (juvenile survival rate).

Applying similar equations for 3-yr. olds and 2-yr. olds:

1-yr. olds this year = (chicks last year) x (juvenile survival rate).

Chicks this year = (adults this year / 2) x (proportion that breed) x (chick production).

This is the model we will develop on a spreadsheet. We are going to run into problems, however. We don't know how the 5000 birds are divided up amongst the different age classes, so we are going to have to guess at that, and we must not forget that all our numbers are estimates. In particular, we have guessed at the adult survival rate. But once we have our model working on the computer, we can use it to calculate the annual growth rate and compare that with the estimate of 5 percent. This should help us to improve our guesses.

LESSONS FROM EXERCISE ONE:

- Models are logical.
- Models can be described in words; math is just another way of writing the equations so that computers and mathematicians can work with them.
- Spreadsheets provide a quick and easy way to develop simple models.
- A model can be built without all the needed data, but it is essential to tune (or calibrate) it to fit all the available evidence. There may be more than one way of doing this. If the model will be used to help solve problems, we need to keep track of alternative versions and determine how robust the conclusions are to these "alternative realities."

EXERCISE TWO: USING AN ALBATROSS MODEL TO EXPLORE THE EFFECTS OF BYCATCH

The spreadsheet program "albie3" is similar to the model built in the first exercise, with the main difference being that all the adult age classes are included. The model also allows a specified proportion of either adults or juveniles (or both) to be taken in the bycatch, and its layout makes it easy to play with. A model is like a laboratory; it is set up for performing experiments. Modeling experiments usually try to answer questions that begin with "what if…?" or "what difference does it make if…?"

For example, we could ask "Under what circumstances will the population still grow, albeit more slowly? Under what circumstances will it decline? Does it make a difference whether the birds caught in the bycatch are mainly juveniles?"

LESSONS FROM EXERCISE TWO:

- The way to use a model is to ask good "what if" questions.
- Exploring how the answers change when data values are altered tells you which data values are the most

important to try to measure. In this case, the adult survival rate is really important, but it is also the most difficult to measure. So we have to use the estimated growth-rate to try to guide us in our choice of survival rates.

- In fact, the precise values of the survival and reproduction rates are not that important provided we make sure their combination matches the observed growth-rate.
- The loss of a certain number of juveniles through bycatch has less of an effect on the population than the loss of a similar number of adults. This is an example of a general rule in conservation biology: long-lived species like albatrosses are very sensitive indeed to an increase in adult mortality.
- Notice that the model provides no cast-iron answers. Very small differences in bycatch can cause the population to decline instead of increase. Nevertheless, the model gives one a good understanding of what the effects of different levels of bycatch might be.
- Also notice that the model predicts exponential growth whenever the growth rate is positive (above 1.0). In practice, of course the population will not go on growing forever. It will eventually be limited by nesting space or competition of some sort. This model ignores that possibility because we assume that the population is still recovering from the effects of over-harvesting. The model is designed to explore sustainability (whether the population shows an increasing or decreasing trend) and one shouldn't believe long-term predictions for the size of the population. All models make assumptions, and one has to be careful about drawing conclusions that are incompatible with those assumptions.

EXERCISE THREE: THE INTERACTION BETWEEN BYCATCH AND CLIMATIC EVENTS

Since 1989 fur seals have been caught in significant numbers in the waters off the west coast of South Island, New Zealand by the Hoki fishery. The number taken as bycatch has tended to increase during periodic climatic warming events, the La Niña phase of the El Niño-Southern Oscillation. During these warming events, nutritionally stressed seals range further than usual to seek food. Demographic studies of west coast rookeries have shown a pattern of reduced pup births and survival during La Niña events, accompanied by reduced births in the year following a major La Niña.

The question that arises is: How does the combination of La Niña events and bycatch impact the seal population? The model "furseals" addresses this question. The core of the model was developed in cooperation with Hugh Best at the New Zealand Department of Conservation and is a work in progress. We have chosen one version for the sole purpose of illustrating how a model can be used to look at this kind of problem.

This model assumes, for the sake of our "experiments" that La Niña events occur at regular intervals and affect survival and reproduction rates during the event as well as in the subsequent year. The model also assumes that the proportion of seals caught in the bycatch is constant from one year to the next. This might look like a poor assumption since we know that the bycatch is higher during La Niña events. However, one of the important things we have learnt from using different versions of the model is that it is the average bycatch that matters over time, not the details from year to year.

LESSONS FROM EXERCISE THREE:

- The model offers an understanding of how bycatch adds pressure to a population that might already be under pressure for other reasons.
- Given that global climate change could increase the frequency of periodic climatic warming events, the model can also be used to explore how the combination of increased warming event activity and bycatch could cause the population to decline.
- Modelers never just make one calculation with a model; understanding grows out of a suite of model experiments.

It should be noted that for this exercise La Niña signifies periodic climatic warming in New Zealand, but in other regions, such the eastern Pacific, warming events arise during El Niño conditions and cooling events during La Niña conditions.

EXERCISE FOUR: HOW MANY TURTLES WILL YOU CATCH? A STOCHASTIC MODEL

So far all our examples have used deterministic models. By this we mean that there is no randomness in the models. We may be uncertain about our data, but once we have chosen and entered numbers, the only way we can get a different answer is by changing at least one of those inputs. If we repeat the calculation with the same inputs, we will get exactly the same answers as before.

In contrast, a stochastic model has randomness built into it. For example, in modeling the toss of a coin we know that on average half the time it will come up heads, and half the time tails, but any one toss could be either. By choosing a random number from an appropriate distribution, we can ensure the correct average behavior while allowing anything to happen in any one toss. In this case, repeating the calculation without changing any of the input data could generate a completely different answer.

Stochastic models require more interpretation than deterministic models, which is why modelers build deterministic models whenever they can get the needed results with them. However, when chance plays an essential part in the calculation, a stochastic model is called for.

"Turtlecatch2" is a very simple example of a stochastic model that examines how many turtles are likely to be incidentally caught in a given area. Suppose we are fishing in an area that contains turtles. How many are we likely to catch? This surely depends on how many turtles there are in the area: the more turtles, the more likely we are to catch some of them. It also depends on how we fish. Taking certain precautions, we should reduce the number of turtles caught, but we can't be absolutely certain about this. We therefore represent the fishing method in our model by the probability of catching a turtle if it is in the fishing area. The more precautions we take, the lower that probability will be.

The model works like this: For each turtle in the area, we generate a random number. If the random number is less than the probability of catching a turtle, we mark that turtle as caught; otherwise it remains free. You could think of the random number as the equivalent of throwing a dice. If the probability of catching a turtle is 1 in 6, we say the turtle is caught whenever a 1 is thrown. If the probability is 2 in 6, we say the turtle is caught whenever either a 1 or a 2 are thrown. The model then counts up how many turtles are caught.

If we go through exactly the same exercise again, without changing either the number of turtles or the probability of catching a turtle, in all likelihood we will get a different answer. So, of what use is a model that gives a different answer each time it's used? For a start it is informative to see how much the answers change. Looking at the variation from one calculation to the next gives one some understanding of how different the bycatch of turtles could be under essentially the same conditions. Chance plays a part. But to really understand what is happening, we must collect and look at the suite of answers we are getting. For example, suppose we have repeated the calculation 10 times. Suppose in 6 out of the 10 times, the model tells us we caught 3 or more turtles. Then we could estimate the probability of catching 3 or more turtles as 6 out of 10, or 0.6. It is probably not a very good estimate because we only have 10 replicates, but if we repeated the calculation not 10 but 100 times, and found that we caught 3 or more turtles in 57 of those replicates, we could estimate the probability of catching 3 or more turtles as 57 out of a 100, or 0.57.

LESSONS FROM EXERCISE FOUR:

- There is a distinction between a deterministic model (in which no randomness exists) and a stochastic model (which has randomness built into it).
- Stochastic models are much more "realistic," but they are also much more difficult to use, and so modelers use them only when chance can affect the outcome of whatever they are modeling.
- We learn nothing from running an experiment with a stochastic model only once. (It would be like flipping a coin only once and, because it comes up heads, concluding the coin is biased towards heads.) We therefore need to repeat each experiment a number of times and show the results as a distribution or a probability graph.
- To compare two different experiments, we need to compare their distributions or probability graphs.
- Models represent inherent uncertainties in the real world, and there is no way to get rid of them. Stochastic models are useful because they provide a laboratory for exploring that uncertainty. In practice we seldom have the luxury of observing, under comparable conditions, as many replicates as we need to observe in order to draw conclusions. However, stochastic models provide us with virtual experience.

SUMMARY OF FEEDBACK FROM THE SESSIONS:

Participants from the fishing industry found models to be more complex than they had anticipated, but they expressed interest in using them in economic and business applications. Some managers said they thought what they learned would help them communicate better about models. Researchers were pleasantly surprised to discover what could be done with simple models, and at least two attendees saw ways in which they might use one of the simple spreadsheet demonstration models. For example, a simple model could be used to convey data needs to those who actually collect the data.

Incentives for Sustainable Bycatch of Sensitive Species in Longline Fisheries

The goals of this session were to have participants identify effective incentive mechanisms for the various longline fisheries to minimize the bycatch of seabirds and sea turtles, and to commit to specific actions for instituting the identified incentive schemes for their fisheries.

Co-Leaders: Eric Gilman, National Audubon Society, Hawai'i; and Patricia Gandini, Universidad Nacional de la Patagonia Austral, and Wildlife Conservation Society, Argentina

Introduction

Eric Gilman

Longline fishing has recently raised concerns over interactions with seabirds, marine turtles, marine mammals, and non-target fish species such as sharks. The incidental mortality of albatrosses, petrels, and sea turtles in longline fisheries is considered significant enough to cause population declines of some seabird species and contribute to population declines of some sea turtle species. Incentive instruments are a useful tool for biodiversity conservation, and hold promise for minimizing bycatch of sensitive species in longline fisheries. As defined by the Convention on Biological Diversity, incentive measures are inducements designed and implemented to influence societal actors to conserve biological diversity or to use its components in a sustainable manner. Incentive instruments are a type of management intervention for supporting natural resources management.

MOTIVES INVOKED BY INCENTIVES

An understanding of the motivations invoked by various incentive methods and the desired outcome from instituting each may help identify the most effective options, given the local context of the fishery they represent. Four possible categories of motives include:

- ECONOMIC – A desire to increase or maintain current income profit, and/or avoid reductions in profit.
- SOCIETAL NORM – A desire to follow cultural and social conventions, be praised locally and internationally and hold a sense of responsibility for operating a business that meets the community's environmental standards (Convention on Biological Diversity, 1996); a desire to avoid local and international disapproval and disgrace.
- CONSERVATION ETHIC – A desire to preserve biodiversity per se.
- TRADITION – A desire to maintain traditional and cultural practices. In these considerations, fishing is a desired way of life for many in the longline industry.

Applying some of these categories to the longline industry, a fishery might participate in an eco-labeling program if fishers are motivated toward economic gain, perceive that product differentiation via eco-labeling will result in net economic gain and desire to be perceived as meeting societal norms. Fishery participation in an eco-labeling program can result in a fishery complying with stringent and effective conservation measures developed by a certification body or prescribed by a seafood consumer guide.

Understanding a longline fishing community's economic, social, political, management and environmental context, and the motives invoked by alternative incentive instruments will help in identifying incentive methods likely to be accepted by stakeholder groups and effective at achieving desired outcomes.

DESIRED OUTCOMES FROM INSTITUTING INCENTIVES

Promising incentive instruments are expected to result in significantly diminished bycatch in targeted longline fisheries. Anticipated related outcomes include:

- Compliance with national and regional bycatch avoidance rules (e.g. CCAMLR regulations).
- Use of known effective and practicable bycatch deterrents (i.e., mitigation measures effective at avoiding capture of seabirds and turtles and are cost-effective or perhaps increase fishing efficiency).

- Innovation of new methods for deterring interactions with seabirds and marine turtles.
- Cooperative research and commercial demonstrations of such deterrents by industry, government, academia and environmental organizations.
- Collection of observer data on bycatch, retention of carcasses for necropsies and genetic analyses, collection of bands and tags from killed birds and turtles, and banding/tagging of live-caught birds and turtles prior to release.
- Development and implementation of effective national plans of action for reducing incidental seabird catch in longline fisheries, pursuant to the U.N. Food and Agriculture Organization's international plan; compliance with the Convention on Migratory Species Agreement on the Conservation of Albatrosses and Petrels; and compliance with other multilateral accords and policies of regional fishery bodies in support of seabird conservation.
- Longline industry participation in fisheries planning and management to address bycatch issues.
- Identification of additional ways to encourage longline industry to be involved in remedying bycatch problems.

By identifying the specific outcome(s) desired from implementing an incentive instrument, and having an understanding of the stakeholders targeted by the incentive instrument and their unique local context, it is possible to identify incentive instruments that can abate a specific bycatch problem, invoke motives likely to gain the targeted group's acceptance and ultimately result in the desired outcomes.

Table 1 lists incentive methods that the longline industry, national fishery management authorities, regional fishery bodies, environmental NGOs and other interest groups can take to induce stakeholders to avoid and minimize the incidental mortality of sea turtles and seabirds. The table also identifies supporting or "flanking" instruments actions that strengthen the effectiveness and acceptance of incentive methods and the motives invoked by each.

TABLE 1

INCENTIVES AND FLANKING INSTRUMENTS	MOTIVES INVOKED			
	ECONOMIC	SOCIETAL NORM	CONSERVATION ETHIC	TRADITION
Eco-labeling	X	X		
Industry self-policing		X	X	X
Rewards and compensation	X	X		
Improved fishing efficiency and practicability	X			
Free or subsidized mitigation methods	X			
Alternative income generation	X			
Bycatch fee and exemption structure	X	X		
Formal constraints: national laws, regulations, policies, surveillance and policing	X	X	X	X
International/regional accords, regulations and policies	X	X	X	X
Industry awareness and capacity-raising	X	X		
Public awareness-raising	X			

BYCATCH FEE AND EXEMPTION STRUCTURE

Government management authorities can create a fee and exemption structure for the bycatch of sensitive species in longline fisheries, applicable to individual vessels or to an entire fleet, similar to a "polluter pays" system. For instance, governments could reduce or withhold subsidies to vessels or an entire fleet, charge a higher permit or license fee or require payment of a higher tax rate if bycatch rates, Total Allowable Catch of bycatch species or other thresholds are exceeded. The fee structure would serve as an economic and social penalty if established bycatch performance standards are not met. The fee structure can likewise provide a positive, reward-based incentive where a higher subsidy, lower permit or license fee, or lower taxes apply, and a positive image is portrayed when a vessel or fleet meets bycatch standards. For example, CCAMLR permits vessels that have demonstrated compliance with management measures to initiate the fishing season early.

INDUSTRY SELF-POLICING

A longline industry can create a program where information for each vessel participating in the fishery on the catch of sea turtles and seabirds, compliance with seabird and turtle regulations and other relevant information is made available to the entire industry. This method is especially effective where regulations contain industry-wide penalties (such as threat of reduced length of fishing season, closed areas or complete fishery closure) if the fleet exceeds annual bycatch rates or mortality levels of specific species. This self-policing program uses peer pressure from within the industry to criticize bad actors and publicly acknowledge good actors. For instance, such a program exists in the Alaska demersal longline fleet, where regulations permit the annual incidental take of four Short-tailed Albatrosses (Phoebastria albatrus) by the entire fleet, and if more than four are caught the fishery is at risk of closure.

ECO-LABELING

Consumer demand can alter industry behavior. For instance, encouraging a fishery to pursue certification or accreditation from an eco-labeling certification program can provide industry with an incentive to meet criteria for certification as a sustainable fishery. A longline industry can use certification under an eco-labeling scheme as a marketing tool to develop and market an image and product differentiation, through advertising, sales promotion, public relations, direct marketing, and media coverage. The company can differentiate their seafood products as coming from a fishery that follows internationally accepted practices to ensure environmental sustainability from other industry's seafood, which may not come from fisheries that adhere to the same environmental standards. This is a form of cause-related marketing, a proven means to promote recognition and develop a positive company image and reputation.

Certification under the Marine Stewardship Council program may provide an economic incentive for industries to meet guidelines for a sustainable fishery. Seafood guides that recommend consumers purchase only species from fisheries identified as sustainable, are another eco-labeling method. For instance, the U.S.-based National Audubon Society has produced the Seafood Lover's Almanac, which ranks popular seafood based on criteria, including the species' life history, record of fishery management, health of the species' habitat and bycatch.

Identification of Issues/ Background Presentations

CREATING CONSUMER SUPPORT FOR SUSTAINABLE LONGLINING: HOW A MARINE STEWARDSHIP COUNCIL ECO-LABEL COULD HELP

Duncan Leadbitter, Marine Stewardship Council, Australia

A number of factors have conspired to make certification and labeling of increasing value to the world's fisheries, including tuna fisheries. Some of these factors include:

1. Tuna is a commodity and, as such, product differentiation is an important factor in maintaining either market share or price or both. Labeling for sustainability can help in these efforts.
2. Consumers are increasingly becoming aware of fisheries issues such as bycatch and are looking for products that satisfy their concerns.
3. Fishers who make the hard decisions required to make their fisheries sustainable and well managed are keen for acknowledgment of some sort or another.
4. A large number of the world's fisheries suffer from poor management and require a mix of tools, such as economic incentives, to address the issues.

The Marine Stewardship Council (MSC) has been in operation for five years, and products bearing the MSC eco-label are becoming increasingly available to consumers. With the availability of eco-labeled salmon some retailers have created a demand for labeled tuna, and the council is seeking to stimulate interest from tuna fisheries in being certified to the MSC standard.

Certification provides the mechanism for evaluating a fishery to ensure that its credentials are sufficient to support a claim of sustainability. The eco-label carries that message to interested consumers. In this way there can be a direct relationship between benefits received and the efforts taken towards sustainability.

With tuna fisheries undergoing increasing scrutiny over issues of stock status and bycatch, the MSC certification process provides a mechanism for conducting a comprehensive fishery assessment. This mechanism allows for identification of conservation issues that require further attention and, provided they are not too serious, for action to be taken within the requirements of using the label.

The MSC has employed a full-time outreach person to work with the tuna fishery industry and other stakeholders on achieving certification. The UK retailer Sainsbury's has funded this position as part of their commitment to sustainable sources of tuna.

BIRDLIFE'S COMPETITION OF IDEAS: INVOLVING FISHERMEN TO DEVELOP MORE SEABIRD-FRIENDLY FISHING METHODS

Carles Carboneras, SEO/BirdLife, Spain

In 1997 BirdLife International launched its "Save the Albatross" campaign, which aims to halt the decline of seabirds threatened by longline fishing. BirdLife's representatives in various countries are actively involved in promoting the use of mitigation measures that will allow the continuation of fishing without causing the death of seabirds. To achieve this the organization encourages governments to sign and ratify international treaties, such as the Agreement on the Conservation of Albatrosses and Petrels (ACAP); adopt national legislation promoting seabird conservation; develop national plans of action following the guidelines of the United Nations Food and Agriculture Organization; and work cooperatively to reduce seabird bycatch to sustainable levels. BirdLife International also trains and educates fishermen and appears in the media to draw public attention to this global environmental problem.

Seabird mitigation measures developed so far include setting gear at night, adding weight to the lines, using paired streamer (tori) lines, using blue-dyed bait, installing underwater setting devices, abstaining from dumping fish discards while setting, implementing temporary closures of fisheries, etc. However, apart from measure, fisheries closures, none of these measures is totally effective as a sole means of mitigation; the best results are achieved when these means are used in combination. Furthermore, these methods have been developed by non-fishers, and it is often difficult to get them accepted and effectively used unless fishing license-holders are required to do so in managed fisheries with enforcement for compliance.

To address this situation SEO/BirdLife, a partner organization in Spain, is launching a "competition of ideas" to induce fishermen worldwide to participate in developing new mitigation measures to reduce seabird bycatch. The competition will be held from December 2002 through March 2003, and is open to fishermen and experienced seamen from all countries. Participants may provide their ideas in any format. A prize of 18,000 Euros (about US $18,000) will be awarded for the best idea in a public event in Spain scheduled for June 2003. Preference will be given to those proposals that have been successfully tested at sea. An international panel of seabird experts, conservationists, fishermen and experienced sea-goers will judge the proposals.

SEO/BirdLife will publicize the competition widely and distribute a brochure in several languages to notify fishermen about the competition. Inquiring competitors will receive booklets with information on the current mitigation measures and the behavior of seabirds at sea and suggestions of potential approaches to new mitigation methods. Following the competition SEO/BirdLife will produce and globally distribute to fishermen a digital video containing practical information on current and newlydeveloped fishing techniques that help conserve the world's seabirds while maintaining or perhaps even improving fishing efficiency.

Funds for these activities, including the prize, are being provided by the membership of BirdLife partner organizations, a bank in Spain and a private donor from the United Kingdom.

Through this innovative initiative fishermen worldwide will be invited to offer their input toward the development of more seabird-friendly fishing methods. We anticipate that a secondary benefit of the communication efforts associated with this campaign will be an increased level of information and awareness on the problem of seabird bycatch.

OUTREACH EFFORTS TO PROVIDE INCENTIVES FOR MITIGATING SEABIRD AND SEA TURTLE BYCATCH IN BRAZIL'S LONGLINE FISHERY

Tatiana Neves, Projeto Albatroz, Brazil

Partnerships between fishing vessel owners, businessmen and researchers who participated in the First International Fishers' Forum enabled the development of a strategy to investigate the reduction of the incidental capture of seabirds in Brazil's longline fishery. Mitigation measures were developed and tested. Despite these efforts even vessels that possessed tori lines neglected to use them even in the presence of at-sea observers.

To encourage the use of mitigation measures, we concentrated our efforts on raising fishermen's awareness of the importance of using mitigation measures, highlighting both the benefits of conserving seabirds and sea turtles and the advantages to fishing efficiency. In partnership with SEO/BirdLife of Spain, Projeto Albatroz and Projeto Tamar, two environmental groups from Brazil, are developing educational materials and training observers to provide educational opportunities during research cruises.

To systematize and strengthen this partnership we developed a conservation plan to establish criteria and standards to guide fishing companies and researchers in reducing the incidental capture of birds and turtles. After this plan is tested and approved by the stakeholders we anticipate it will establish a framework for a certification process for Brazil's longline fleet. The conservation plan provides for estimating the incidental capture of seabirds and sea turtles and testing mitigation measures suitable for use in the fleet.

It is important and necessary to formalize partnerships between the fishing industry (vessel owners, skippers and crew) and organizations that are coordinating projects to study and conserve seabirds and sea turtles. Likewise we must continue the onboard observer program, education projects and training programs for crew. The hope is that this strategy will significantly reduce the incidental capture of seabirds and sea turtles in the pelagic and demersal longline fisheries in the western South Atlantic.

THE STREAMER LINE GIVE-AWAY PROGRAM AND REGULATIONS IN ALASKA'S GROUNDFISH FISHERIES

Greg Balogh, U.S. Fish and Wildlife Service, Anchorage, Alaska

The U.S. Fish and Wildlife Service provided over US $900,000 to fund a streamer (tori) line give-away program for the Alaskan longline fisheries. The Pacific States Marine Fisheries Commission was contracted to administer the purchase, assemblage and distribution of the streamer lines to demersal longline fishermen operating in Alaskan waters. Our goal is to supply a free pair of streamer lines to every boat in the Alaska longline fleet, which consists of more than 2,000 vessels.

Researchers at the University of Washington Sea Grant Program (UWSGP) designed the streamer lines for optimal performance under Alaskan fishing conditions, taking into account vessel size, presence or absence of vessel superstructure, beam width, gear-setting speed, gear sink rate and streamer line materials needed to keep streamers aloft for the necessary distance astern. The system uses bright orange and blue streamer lines attached to a drag-producing device that allows the lines to track true behind the vessel, thus minimizing risk of gear entanglement. When paired, lines create bird-free corridors in which baited hooks can sink undisturbed. UWSGP research has shown the lines to be 90–100 percent effective in reducing seabird bycatch.

While free streamer lines represent the "carrot" in this model, the "stick" is industry-wide regulations mandating the use of seabird deterrent devices with specific performance measures. The U.S. National Marine Fisheries Service is currently revising seabird regulations for Alaska longline fisheries based on the results of research by the UWSGP, with additional input from regulatory agencies, the fishing industry and the public.

INCREASED FISHING EFFICIENCY AND EFFECTIVE SEABIRD DETERRENCE: PERFORMANCE ASSESSMENT OF AN UNDERWATER SETTING CHUTE IN HAWAI'I'S LONGLINE TUNA FISHERY

Eric Gilman

Sponsored by a unique public-private partnership, research was conducted in 2002 to determine if an underwater setting chute is effective at deterring interactions with seabirds and is practicable for use in the Hawai'i longline tuna fishery. The collaborators included the National Audubon Society's Living Oceans Program, the U.S. National Marine Fisheries Service (Honolulu Laboratory), the Hawai'i Longline Association, Pacific Ocean Producers, the captain and crew of the F.V. Katy Mary, a marine ecology consultant, and Albi Save. First developed in 1995 and tested previously in New Zealand and Australian pelagic longline fisheries, the underwater setting chute for pelagic longline fisheries releases baited hooks underwater—out of sight and reach of diving seabirds.

In the Hawai'i research and commercial demonstration the chute significantly reduced seabird interactions and increased fishing efficiency. Bait retention when setting through the chute was significantly higher than when setting without the chute. Bait loss was 30.5 percent under conventional setting methods versus 9.9 percent using the chute; thus setting with the chute allowed for a savings of 20.6 percent of the conventional bait requirement. We attributed less than a quarter of the increased bait retention to the chute's ability to prevent seabird interactions, while over three quarters of the increased bait retention resulted from the chute's mechanical effectiveness in reducing physical stress on the bait as it enters the water. This suggests that longline vessels setting with the chute would benefit from increased catch per unit of effort. The effect would likely apply to all fishing grounds, with or without seabirds that are caught on longlines.

Given the results of increased bait retention and assuming that vessels have sufficient time and mainline to complete slower sets using the chute, or that a reduction in the conventional hook setting is unnecessary, we estimate that vessels setting with the chute would experience a 29.6 percent gain in efficiency when albatrosses are abundant. The estimated gain in efficiency in the absence of seabirds would be 21.5 percent. However, if slower setting with the chute reduces efficiency (by a maximum of 11.5 percent), then the net gain in efficiency would be 14.7 percent when seabirds are abundant, versus 7.5 percent in the absence of albatrosses. Converting this range of gains in efficiency into annual gains in catch and dollars produces a rough estimate of an additional 28,125–111,000 pounds of fish, or $56,250–$222,000, per vessel using the chute.

The chute eliminated seabird capture during this short-term trial. During control replicates the capture rate was 4.24 captures per 1000 hooks and, when normalized for albatross abundance, the seabird catch rate was 0.114 captures per 1000 hooks per albatross. Expressed as contacts per 1000 hooks, the chute was 98 percent effective at reducing albatross contacts with fishing gear compared to a control. Expressed as contacts per 1000 hooks per albatross (normalized for the average number of albatrosses present), the chute was 95 percent effective at reducing albatross contacts with fishing gear compared to a control.

The chute is the most effective technology tested to date in the Hawai‘i longline fishery to minimize seabird capture, and preliminary results indicate that the chute has the added benefit of increasing fishing efficiency even in the absence of albatrosses.

SUMMARY OF DISCUSSIONS BY PARTICIPANTS

About 70 people from 17 countries and territories (the majority from the Americas and Australia) attended the two meetings. Roughly 30 percent were fishers and longline industry representatives, 25 percent were from fishery management authorities of national governments. The rest were from NGOs, regional fishery management organizations, academic institutions and industry.

Session participants considered the suitability of alternative incentive instruments for specific fisheries based on two primary criteria:

- Would implementation of each of the identified incentive instruments result in outcomes that would significantly contribute towards abating bycatch problems?
- Is it likely that the incentive instrument could be successfully implemented given the local context? (To address this question, participants considered issues such as the expected reactions of stakeholders such as industry, seafood consumers and managers, to the incentive instruments.

Participants were asked to identify and commit to take actions to institute incentive methods that they determined are appropriate for their fishery and capable of achieving desirable outcomes towards resolving bycatch problems. Given that participants in all likelihood lacked authority to make commitments on behalf of their longline company and entire fishery, their commitments were to take specific actions to attempt to catalyze support to institute a prioritized incentive instrument.

Participants recorded information on incentive instruments suitable for specific fisheries in a large table posted at the front of the room. When a participant identified an incentive instrument for their fishery, they were asked to record and explain in the table:

- Outcomes they anticipate from implementing the instrument.
- Value of the outcomes towards abating bycatch problems (i.e., will instituting the incentive instrument reduce bycatch directly, indirectly, or not at all).
- The feasibility of successfully implementing the instrument given the local context (i.e., will stakeholders support the initiative).
- Anticipated obstacles to implementation.
- Actions the fishers will take to pursue instituting the incentive instrument.

Participants most commonly expressed an interest in instituting bycatch fee and exemption structures, industry self-policing and eco-labeling. Table 2 presents information on these three incentive instruments for which participants expressed the most dominant interest during the session.

TABLE 2

SUITABLE INCENTIVE INSTRUMENT	EXPECTED OUTCOMES	VALUE OF OUTCOMES	FEASIBILITY	OBSTACLES	ACTIONS TO INSTITUTE INVENTIVE METHOD
Bycatch fee and exemption structure	Vessels will pursue minimizing interactions with turtles and birds in order to reap economic benefits.	Indirectly contribute to abate turtle and bird mortality.	Feasible, as demonstrated by CCAMLR program.	May require 100 percent observer coverage or electronic monitoring.	Lobby fishery management authorites to institute a suitable fee and exemption structure.
Industry self-policing	Broad fishery-wide compliance with regulations, increased effort to avoid capture of birds and turtles.	Indirectly contribute to abate turtle and bird mortality.	Feasible, as demonstrated by Alaska fishery.	May require 100 percent observer coverage or electronic monitoring.	Lobby industry to create a self-policing program.
Eco-labeling	Fishery will improve practices and maintain sustainable practices to avoid interactions with birds and turtles in order to meet criteria for eco-label.	Indirectly contribute to abate turtle and bird mortality.	Feasible, as demonstrated by fisheries that have been certified under Marine Stewardship Council principles and criteria.	Due to insufficient awareness of the eco-label in seafood markets, the cost for certification may exceed increases in value of certified product.	Have fishery association pursue eco-label from existing program such as Marine Stewardship Council or other program.

CONCLUSIONS

Participants recognized that instituting incentive instruments is especially important in fisheries where available resources and political will for effective management and enforcement are scarce. In fisheries where formal constraints and enforcement are ineffective, alternative incentive instruments are much needed to induce industry to voluntarily minimize incidental mortality of sensitive species.

Possible reasons that many, if not most, longline vessels fail to employ effective seabird deterrents—despite the availability of successful methods that also increase fishing efficiency—include low industry awareness of the availability, effectiveness, and practicability of such methods and/or a lack of a strong enough economic incentive to change long-standing fishing practices.

Participants perceived that the longline industry responds most strongly to economic incentives and disincentives. For instance, mitigation methods that can be demonstrated to significantly increase fishing efficiency have the highest chance of being accepted by industry. Conversely, if the regulatory consequences from inadequately addressing seabird and marine turtle mortality are economically significant and enforcement resources are sufficient, the likely result will be broad industry compliance with bycatch management measures.

Plenary Presentations

2ND INTERNATIONAL FISHERS FORUM

HONOLULU, HAWAII ~ 2002

PARTNERSHIPS AND PROGRESS: THE NOAA FISHERIES COMMITMENT TO REDUCING INCIDENTAL BYCATCH OF SEA TURTLES AND SEABIRDS

William T. Hogarth, Assistant Administrator, U.S. NOAA Fisheries

Thank you very much for inviting me to speak on the final day of the Second International Fishers Forum. This has been a very exciting week filled with thought-provoking presentations on seabird and sea turtle biology, longline fisheries, mitigation techniques, modeling and many other topics. I am especially gratified to see how this forum has grown in scope and enthusiasm from the initial forum in 2000, which focused on seabirds and longline gear. I also have been happy this week to have shared the company of our friends from New Zealand, South Africa, Australia, Canada and other international partners who share the commitment of the National Marine Fisheries Service (NOAA Fisheries) to protect seabirds and sea turtles from fishing gear interactions.

I would like to take this opportunity to describe what NOAA Fisheries has been working on related to bycatch and how it affects fishermen, other agencies and countries and nongovernmental organizations (NGOs). We want to continue to enhance our efforts to collaborate and cooperate with the fishing industry, fishery agencies, academic institutions, NGOs and international bodies on seabird and sea turtle bycatch research and outreach.

POPULATION IMPACTS

In order to understand the population-level impacts of incidental longline bycatch of seabirds and sea turtles, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) have undertaken studies to monitor population status and threats. These studies have identified numerous threats that continue to affect sea turtle and seabird populations. It is important to remember that in the United States, NOAA Fisheries has joint jurisdiction with USFWS for sea turtles—USFWS on land and NOAA Fisheries in the water. The USFWS has primary responsibility for monitoring populations of seabirds.

All six species of sea turtles found in the United States are currently listed as endangered or threatened under the Endangered Species Act (ESA). There are many reasons for the continued threatened and endangered status of sea turtle populations, including illegal and legal exploitation, which can include the harvesting of eggs, immature turtles, and adults. Incidental captures in commercial fisheries—especially trawls, longlines and gillnets—continue to seriously impact sea turtle populations. Other threats include propeller strikes and vessel collisions in areas where boat traffic is heavy and coastal ports are active. Coastal development can interfere with nesting and degrade foraging habitats. Shoreline protection techniques and beach nourishment projects have significantly degraded nesting beaches. Marine debris, from oil to discarded fishing gear, remains a threat to turtle populations. A sometimes-fatal disease called fibropapillomatosis also is threatening the recovery of green, loggerhead and olive ridley turtle populations.

The endangered short-tailed albatross has recently been estimated to number between 1,300 and 1,600 individuals worldwide. Populations of Laysan and black-footed albatrosses, which are not listed as endangered under the ESA, exhibit extreme interannual variation. The worldwide population of Laysan albatrosses numbers about 2.4 million, and the worldwide population of black-footed albatrosses is about 280,000–300,000 birds. Many factors may contribute to the colony population levels and trends of the three North Pacific albatrosses: marine pollution (particularly the ingestion of plastics), organic contaminants, nest predation, and habitat degradation, as well as climatic and oceanographic factors that affect prey availability. But by far the most noted contributing factor is commercial fisheries bycatch.

COOPERATIVE EFFORTS – INTERNATIONAL AND NATIONAL

As with all highly migratory species, management must occur at a multilateral level. Seabirds and sea turtles migrate across thousands of kilometers of ocean and occupy the waters and lands of many nations throughout their life histories. Bycatch is a global problem that can be solved only if each nation with longline fisheries acts proactively, responsibly and cooperatively to reduce bycatch.

In 2002 NOAA Fisheries added seabird bycatch issue to the agendas of several bilateral fisheries meetings to highlight the issue and promote and encourage implementation of the FAO's IPOA-Seabirds. The agency has placed or supported the placement of seabird bycatch on the agendas of several international meetings, including those of the Asia-Pacific Economic Cooperation (APEC), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the International Commission for the Conservation of Atlantic Tunas (ICCAT). At the recent ICCAT meeting in Spain a resolution was passed to begin gathering data on seabird-fisheries interactions, though this is not a binding resolution. A mail-in ballot will complete another resolution addressing sea turtles.

We also have formed a bycatch reduction task force to seek ways to address the issue of seabird and sea turtle issues in the international arena. The U.S. government has raised the topic of seabird and sea turtle bycatch with more than 20 nations that have longline fisheries. And, we have asked these countries about their activities to carry out research and implement mitigation measures for seabirds and sea turtles and national plans of action on seabirds.

Our collaborative international efforts, along with those made by other governments and groups, will be pivotal to continued progress on the bycatch issue. Two particular groups I would like to acknowledge are Southern Seabird Solutions and BirdLife International. Southern Seabird Solutions is a recently formed alliance in New Zealand of people from government, fishing industry, environmental, and tourism groups that are working collectively to foster seabird-safe fishing practices in fishing fleets that overlap with New Zealand albatrosses and petrels. New Zealand has more species of breeding albatrosses under its jurisdiction than any other country in the world! BirdLife International has developed a Seabird Conservation Program that works with its in-country national partners to foster cooperative projects aimed at practical solutions to seabird bycatch. The recent testing of an underwater-setting chute in the Hawai'i pelagic fishery involved BirdLife's U.S. partner, the National Audubon Society.

International cooperative research has led to significant discoveries about turtle distribution and additional international protections for turtles. NOAA Fisheries has partnered with NGOs, universities, local fishing communities and foreign governments to conduct green turtle research and implement activities that have reduced the mortality of green turtles in key areas such as Baja California. We also have collaborated with colleagues in Ecuador to determine the status of green turtles in the Galapagos and with researchers in Peru and Chile to discover a significant, new forage area for this species in northern Chile. Collaborative research on the loggerhead turtle with Mexico and Japan has shown that large foraging aggregations of loggerhead turtles off Baja California are from Japanese nesting beaches. And our work with Chilean and Peruvian collaborators has resulted in identifying loggerheads off the west coast of South America to be descended from Australian nesting stocks. So there's a lot of international research taking place, and we will continue to pursue those efforts.

NOAA Fisheries has devoted significant resources to promoting the development and use of management and mitigation measures by longline fishermen. With the WPRFMC we have initiated mandatory annual workshops designed to help Hawai'i longline fishermen reduce seabird interactions. In the North Pacific this year NOAA Fisheries collaborated with the University of Washington Sea Grant Program (UWSGP) in holding bycatch avoidance workshops for commercial longliners in Alaska ports. The North Pacific Regional Fishery Management Council is changing existing regulations for seabird avoidance measures required in the groundfish and halibut hook-and-line fisheries off Alaska, and NOAA Fisheries is promoting the USFWS free streamer-line program there. Researchers from UWSGP with NOAA Fisheries support concluded that paired streamer lines effectively reduced seabird bycatch by 88–100 percent compared to a control of no deterrents.

UWSGP also began another study to test the effectiveness of fast-sinking demersal gear at reducing bycatch, which is also being tested on longliners in New Zealand with assistance from Australia. A NOAA Fisheries study in Hawai'i found that blue-dyed bait and weights added to baits reduced number of gear interactions by about 90 percent. And a recent study conducted in Hawai'i and jointly sponsored by the National Audubon Society, Hawaii Longline Association, NOAA Fisheries, and the WPRFMC found that underwater line-setting effectively reduced bycatch by 95–100 percent compared to a control of no deterrents.

Turtle bycatch has been a major problem for us and a major economic impact on our industry. We are finishing up our second year of experiments in the western

Atlantic to evaluate sea turtle mitigation measures in the pelagic longline fishery, focusing on blue-dyed squid, hook position relative to floats on sea turtle bycatch, delayed haul times, and offset circle hooks. We also funded a study by the University of Florida in the longline fishery of the eastern Atlantic to evaluate the effects of different style hooks on sea turtle bycatch.

The agency's Honolulu Laboratory has also initiated research on sea turtle mitigation techniques, focusing on testing the effectiveness of using blue-dyed squid bait and moving branch lines more than 40 fathoms away from float lines, as well as the use of stealth gear and deep-sets for swordfish. Linkages between sea turtle movements and oceanographic processes have also been studied, and computer simulation models have been developed to better assess the effects of the Hawai'i-based longline fishery.

The agency has continued and expanded observer programs to document sea turtle bycatch. For the Hawai'i-based longline fishery we are required to maintain a coverage level of at least 20 percent. For 2002 the percent coverage of the fishery is projected to be around 25 percent, with about 250 observed trips. NOAA Fisheries has promulgated regulations to reduce sea turtle bycatch in the domestic pelagic longline fisheries in the Western Pacific region, including a prohibition on shallow-set longline fishing for swordfish, a trip limit on swordfish bycatch and a requirement for vessel operators—including those based in American Samoa—to annually attend a protected species workshop. This year NOAA Fisheries certified 280 U.S. longline fishermen, including vessel owners, in the Western Pacific for completing the workshop requirement. We also implemented regulations for Atlantic fisheries targeting highly migratory species that closed the northeast distant statistical reporting area to fishing, placed requirements on gangions and hook types and required vessels to post guidelines on turtle handling and release.

Our future needs with respect to sea turtles include continuing and expanding:

- Observer programs to evaluate fisheries interactions with sea turtles.
- Collaborative efforts with states to address sea turtle bycatch in nonfederal fisheries.
- Multinational efforts to conserve sea turtles.
- Improvements in our knowledge of sea turtle populations, trends and status.

For seabirds we need to implement the U.S. National Plan of Action (NPOA) for Reducing the Incidental Catch of Seabirds in Longline Fisheries. This entails:

- Assessment of longline fisheries for seabird bycatch by February 2003, including the use of and expansion of existing observer programs.
- Implementing measures to reduce seabird bycatch within two years of determining that a problem exists.
- Preparation of an annual report on status of seabird bycatch mortality for each longline fishery.
- Advocating national plans of action (NPOAs) at relevant international fora.

One pattern has emerged in these efforts: Collaboration and an international focus yields the best results. I believe it is through the synergies created with the partnerships and collaborations of the various stakeholders that we can best tackle the problems of seabird and sea turtle bycatch in longline fisheries. The examples I've described and that you've heard about in the last several days illustrate successes in a mostly non-litigious environment and productive partnerships among resource managers, scientists, fishermen and conservationists. Thank you.

STRATEGY TO MITIGATE TUNA-DOLPHIN BYCATCH

Martin Hall, Inter-American Tropical Tuna Commission (IATTC)

Why are we mixing purse seines and dolphins with longlines, seabirds and sea turtles? Because the tuna-dolphin problem is one of the oldest bycatch problems, and it took many years to address it, and we need to build on the experiences of what have we learned, what have we done and how it happened.

Even though it is a very different fishery from the longline fishery, I want to give you a flavor of the methods that were tested, how they were tested, what worked and how the fishers, NGOs and various countries interacted. This is a history of dolphin mortality between 1986—when the international program began with full participation, and dolphin mortality was at a high of about 130,000 animals—and 2001, when mortality was around 2,000 animals a year. So the first message is, it didn't happen overnight.

In general for any fishery or any gear type, reducing bycatch requires either reducing fishing effort or reducing the average mortality per unit of effort; that is, fish less or fish better. Reducing effort reduces the fishery. So unless you can find some alternative gear that allows you to switch effort from one gear to another, this is not the preferred tactic for fishers to take if they can avoid it. The preferred approach is reducing bycatch by reducing the average bycatch per unit of effort.

For the member countries of the IATTC, the issue was to find ways to reduce the average bycatch per unit of effort (i.e., per purse-seine set) in order to reduce the total mortality while continuing the fishing operation. In the case of the longline fisheries, the equivalent would be to reduce the mortality of birds or turtles per thousand hooks and avoid government regulations that ban or limit fishing effort.

The trajectory of dolphin mortality is a result of the interaction between fishing effort and bycatch per unit of effort over time. As this graph shows, the purse seine fishery currently operates at the same level of effort as in 1986, but the average mortality per set is about one percent of 1986 level. This process of mortality reduction was driven by fishers implementing improvements in operations, not by eliminating fishing effort or by policies or campaigns. The effect of those campaigns was to create the pressures that worked as the incentives needed for the process to take place.

So how did this happen? I will discuss four important components of this solution: data, technical operational changes, training of crews and management actions.

THE DATA COMPONENT IN REDUCING BYCATCH

Data are the parents of the solution, so to speak. To assess the impact of bycatch you first need data on overall mortality, which is estimated by multiplying the bycatch per thousand hooks times the number of hooks deployed. We can get some idea of the number of hooks set in different ways—each with some error—but we need a very good estimate of bycatch rates. In the longline fishery sample sizes are small and it's tricky to obtain accurate estimates. For example, if bycatch rates are extrapolated from a fishing area that is very productive and has a lot of bycatch, it may result in disproportionately high rates. So you need solid, good-quality data for all the fleets in all areas and periods.

To consider mortality in relation to the abundance of the species of concern, you need data on species or stock abundance and all the sources of mortality acting on that population. Dividing the overall mortality by the species abundance produces an estimate of relative mortality. To get these numbers we use fishery observer data, which gives us estimates of incidental mortality and the causes of bycatch. It's not the only way to get data, but it has been extremely valuable. For the longline fishery, combining observer data with some of the automated systems discussed here may be a good way to increase the collection of data quickly and broadly.

Observer data helps to improve the estimation of mortality, but it also improves an understanding of the causes of bycatch. Bycatch issues are complex. The causes of bycatch depend on the species, the gear, the fishermen and the environment—all of which combine to cause a bycatch event. When you understand the nature of these factors you can address them properly. Given the high number of factors, a very large amount of data is needed to assess the impacts of each one of them.

Automated methods could increase your data collection, but observers and the interpretation of some of the data are critical. Every country fishing in the Pacific that has significant data on the purse-seine fishery is currently taking observers; they all made this decision many years ago. The coverage is nearly 100 percent. Data come from the whole fleet continuously. It was expensive and logistically challenging to set up, but invaluable in terms of data.

There are a variety of factors that affect mortality rates in the purse-seine fishery, though the factors in the longline fishery may be quite different. Factors related to Mother Nature or chance events include currents, visibility, behavior and physiology of the species of concern and the size of their groups, the catch of the target species, and malfunctions. For example, a vessel might make a set and encounter a surface current that wasn't detected, and the net collapses, resulting in dolphin mortality. Or some equipment malfunction occurs in the middle of the set and dolphins are trapped in the net and die.

Other things are human-related. For instance, are the crews receiving the proper training and motivation to use all the mitigation measures, to deploy and retrieve gear optimally and release bycatch? Other factors are the responsibility of the boat owner, such as providing the crew with all the necessary equipment and motivating them to fish efficiently with minimal cost to the environment and ecological damage.

To be able to deal with these variable and interrelated factors, you need a lot of data. Once our group had identified the specific factors and collected lots of data, we went to the fishers who had the best record on low dolphin mortality and we "picked their brains" for solutions to the problems encountered under various circumstances. We have been holding seminars for skippers for almost 20 years. We verified statistically that the solutions they recommended were effective, and that information was feedback for the next seminar. So we are learning from the fishers and disseminating the information to other fishers. This can be done from fleet to fleet or from the most qualified and cleverest fishers within a fleet to the others.

OPERATIONAL CHANGES AND CREW TRAINING

The technological and operational changes used in our fishery to reduce bycatch—which don't pertain to the longline fishery—originated from fishers. Some of them are incredibly cheap, simple, and ingenious. First, there was the back down maneuver—a simple but very clever way to release captured dolphins. Then came the small mesh in the net, then other rescue procedures or equipment. This was an area where science was useful to determine which of the proposed solutions were truly effective. Then came the training and motivation of the crews, and they all had learning curves. In 1986 less than 40 percent of dolphin sets had zero mortality. By 2001 less than 10 percent of the sets have dolphin mortality.

We worked with the fishers by presenting the different factors one by one. For example, when a net collapse occurs the mortality rate more than doubles. We begin by explaining how the factor in question affects mortality. Then we discuss how to avoid net collapses with the fishers and take their suggestions for solutions to the problems. Solutions include avoiding strong currents, properly maintaining gear, setting the net downwind, towing vessels and nets, minimizing set delays, herding dolphins away and backing down with a proper arc configuration. The list keeps growing and changing. We have reduced malfunctions to half, but they still occur, so we also discuss what has to be done to respond to them when they happen.

THE MANAGEMENT COMPONENT

For the management aspect of the dolphin mortality problem, we have had many options because of the high observer coverage. There are per-vessel limits on bycatch, which is important in an international fishery. Our fishery includes Mexican, Venezuelan, Ecuadorian, Spanish, Colombian and American fishers. They are not homogeneous groups. They have gears that are similar, but in every fleet that we looked at there were great fishers and not-so-great fishers, and in every fleet there were vessels that led the reduction of dolphin mortality and the ones that had higher mortalities. We wanted to set the standard for the leaders and push the others to improve, so every vessel has a bycatch limit for the whole year. If they can stay within that, they fish the entire year; if they are really bad, and exceed their limit early in the year, they may be unemployed the next season.

Another important component has been the incentive programs. We have seen a lot of development in this area. The major incentive to consider is to bring everyone to the table, from an international point of view.

To show you some of the original power of the data I'm going to take a quick detour to sea turtles. These data from different researchers were presented at a recent meeting on Pacific leatherbacks. These are curves of the number of animals coming to nest at beaches in different parts of the world, and they show very significant declines in leatherback populations. At the same meeting Scott Eckert showed these satellite tracks of migrating turtles, some of which are traveling our fishing areas. For instance, some of the leatherbacks nesting in Mexico come outside of our coasts and down to Peru.

So, are there interactions with leatherbacks in our fishery? Well, if we go to the database with the bycatch record for every set and every boat, we find only one leatherback as bycatch in the last ten years. However, this plot of the locations of sea turtle mortalities associated with sets on floating objects from 1991–2001 shows mortalities have occurred. What these data are showing is that the spatial and temporal patterns of mortality are not uniform. There are hot spots with high mortality and other areas with very low rates.

If you overlay effort on top of this you can see that mortality is prevalent along a couple of latitudinal zones that show an alignment of effort in the east-west direction, and that other areas have little mortality. So if we needed to find a policy or a solution that allowed the fishery to continue with minimal turtle encounters, the data would give us something to work with. The options will have some cost for the fishers, but they provide an alternative to a policy of closing fishing in an entire area. Data will lead you to the solutions, and that's why they are so important.

Out of curiosity, we looked at sightings of leatherback turtles. Some of the data supports the notion that they move along corridors. If we could identify where the turtles are and where they headed to, and if the fleets knew—which would not be difficult to do with our technology—then targeted closures could be implemented at the time and in the area where we find the turtle concentrations that we want to protect. These closures would allow the continuation of the fishing operations while mitigating the impacts on turtles.

MULTIPLE "LINES OF DEFENSE" FOR AVOIDING BYCATCH

In dealing with bycatch problems it is practical to use the concept of different lines of defense in avoiding captures and reducing encounters as an organizational tool. You don't want to start with an animal on a hook if you can avoid it. So you want to put up some lines of defense as far as you can from the problem to avoid encounters between the endangered species and the gear.

The first general line of defense is to reduce the encounters between turtles and hooks, and it may include factors such as fishing areas, seasons, time of day and depth. But we can't just look at bycatch rates. A very high priority, in my opinion, is to search the data for high ratios of bycatch to catch. These ratios serve to highlight the ecological cost of producing fish, which is what you want to minimize. There are hot spots, and you can identify them. We have seen cases where 60 percent of the bycatch of a certain species is generated by effort that produces less than three percent of the catch. You can achieve a significant reduction in bycatch without a high cost in terms of production. When you find hot spots, they offer you great opportunities, and there are options for dealing with them. If the bycatches are simply proportional to the catches in the whole area, then your options are limited to technological or operational changes.

Adaptive approaches will likely work best to reduce the encounters. Adaptive in this case means that instead of fixed measures (e.g., area closures), you use flexible rules to reduce the impact on the location where the turtles are at a given time. You have to carefully consider environmental factors in decisions on areas and seasons. In this region of the world everything changes with El Niño, for example, so setting up fixed areas that will be closed all the time is very difficult. Perhaps you can identify where the animals are by satellite tracking or a fleet information system or other major reporting system for fishing boats. Vessel confidentiality is an issue, but a rapid, fleet-wide warning system could be developed, identifying the concentrations of the species that you wish to avoid. In this way you will place the protective system where you need it.

The second line of defense deals with deployment conditions, including time of day, duration of fishing operations and fishing depth. There are a lot of mitigation strategies—night-setting, offal management, underwater shooters, weighted lines, decoys, repellent sounds, streamer lines, dyed bait, stealth gear, etc.—that if implemented broadly would practically eliminate the hooking of seabirds. In the case of sea turtles more science, experiments and improvements are needed. But what we have seen here seems so promising. Perhaps a technical working group should be set up to design and coordinate the experiments needed to refine, select, and assess all the options and produce common guidelines for everyone to follow in the experiments and in the data collection in different fisheries.

INCREASING THE RELEASE OF BYCATCH

Other lines of defense relate to increasing the release of bycatch. Circle hooks have been shown to hook turtles with lower frequency and far less damage than other styles of hook, and devices such as dehookers and line cutters can be used to release animals from lines. There are optimal handling procedures and equipment for releasing animals from the line or the deck, and training the crews on these with video presentations and so forth will improve this line of defense.

A few other suggestions: The international FAO plan of action to reduce sea turtle bycatch may be slow in developing, but is very important in catalyzing some of these processes at the international level. Bycatch networks for sea turtles and seabirds also can be beneficial. We have a cetacean bycatch network with a website that supports a forum for the exchange of technical information. It's not an NGO, a research group a media outlet or a tool for awareness building.

Other elements that will assist your efforts are incentives of many kinds. These are necessary, especially at the international level. You need improved information and training systems for fishers, and more advanced multi-species models that include all the factors affecting populations. This doesn't mean that you hide behind the environment and say that we don't have to do anything because "global warming is doing this." But we do need to understand how inter-decadal changes are affecting populations. And we need to think in ecosystem terms, along the lines that John Croxall outlined so lucidly earlier at this meeting. We have focused here on technical solutions and approaches, but there's a lot that we don't understand ecosystem-wise. For example, imbalance is created by fishing activity that doesn't have to do with bycatch but may be connected with it. There are species that benefit from fishing activity, and others that don't; if they are competitors, we may be tilting the ecological balance.

The human participants in the process are extremely important. In our fishery we saw an evolution among different participants. When we started, the fishers were very confrontational. They spent a lot of time saying, "we don't have any problem; we cannot do any more than this" when the problem was pretty evident. They also wasted a lot of time and energy trying to switch the blame to others, and this caused dissent when the fishers needed to work together. The organization was very rigid; it just expected to get political solutions. Rather than creating the solution, they were trying to stop things from happening. They also created conflicts between nations when we also needed the nations working together.

Now the fishermen in our meetings talk with NGOs fluently, as I've seen here. The communication is excellent and people understand what is happening. You need to show people what is happening and demonstrate that we don't need to be adversarial. Intelligent fishers and intelligent environmentalists have the same objectives. Being open to dialogue and actively seeking solutions is essential. Another issue is extremely important: If the fisheries expect environmental groups to support and accompany them down the road, transparency is critical. In our commission, environmental groups are represented even in the group dealing with the most delicate topics of infractions and sanctions.

The Inter-American Tropical Tuna Commission will follow everything you are doing. We have several important longline fisheries in our area, and in addition we are in contact with fisheries agencies from the U.S. to Peru, and with fishermen from the European Union and other areas. We'll continue disseminating information, inviting them to meetings and passing along everything that you produce. We also will continue to support your forum and other activities. Thank you.

LUNCHEON ADDRESS (DELIVERED VIA VIDEOTAPE)

Daniel Inouye, U.S. Senator, State of Hawai'i

Aloha. I wish to express my appreciation to the Western Pacific Regional Fishery Management Council for hosting this second International Fishers Forum. I am pleased to have this opportunity to address the world's leading longline fishing fleets, researchers, gear manufacturers, managers and other interested parties. I take heart in knowing that every nation represented here shares a common goal: to enjoy the wealth of our oceans while preserving its health.

This forum's importance cannot be overstated, because we are at the crossroad for maintaining the health of our Pacific fisheries and conserving our endangered species. To achieve these goals sustainable harvesting of food fish and protection of the rest of the marine ecosystem must go hand in hand. This holds especially true for such endangered species as the sea turtles and seabirds.

People around the world—including those who fish for a living—recognize the importance of saving such unique species from extinction. Yet protection and management efforts have proven especially challenging due to cultural differences, the highly migratory nature of valuable species such as swordfish and tuna, and the uncharted migrations of endangered species. While endangered ocean-going species may nest within one country's boundaries, throughout their lifecycle they migrate around the world, moving in and out of different countries' boundaries. Thus we as stewards of the oceans must work especially hard to develop the international cooperation necessary for effective management.

While many steps have been taken through international agreements and domestic law to manage our fisheries and marine resources, much remains to be done. Sea turtles and other marine species continue to be threatened through unintentional bycatch in the longline fisheries. Discarded nets and other marine debris pollute our ocean environment. Coastal nesting grounds are being disturbed by encroaching human development.

Conservation efforts continue through vehicles such as the recently finished negotiations on the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. These talks have yielded an international approach for managing highly migratory fish, and the convention include provisions that require member countries to adopt measures to minimize bycatch. Yet this important agreement will not succeed without greater international support. I hope that representatives of countries that have not signed this agreement will be persuaded through this conference to carry favorable messages home with them.

In the United States we take our obligations to protect endangered species very seriously—so seriously in fact, that Hawai'i longline fishers have been barred from the swordfish fishery, even on the high seas, in order to protect endangered sea turtles. Yet human interaction with these and other endangered species in the Pacific continues to be a serious problem.

One country alone cannot stem the jeopardy to the world's ocean resources; the effort must be international in scope. There are four steps that I urge other nations to take to help us reach our common goal of a sustainable international fishing industry and a healthy ocean ecosystem.

1. I call on you to continue the collaborative efforts started at the First International Fishers Forum. Continue to share your expertise and work with other industry experts, scientists and managers to find innovative new fishing techniques that minimize bycatch and other unintended human interaction with ocean-going wildlife. This forum provides an excellent opportunity to share such knowledge and to commit to new cooperative ventures for gear development and techniques. I know research is ongoing in the United States to find alternative gear that will reduce bycatch, and I invite other countries to join us in furthering such work and to adopt and implement the new gear.

2. I call on you to urge your governments to support cooperative rather than unilateral approaches. There are a number of international agreements that provide an avenue for doing so. For example, there is the Memorandum of Understanding for the Indian Ocean and Southeast Asia for sea turtle protection that addresses bycatch and habitat issues. While this agreement is not binding, it does provide strong language about actions to be taken. My colleagues and I in the U.S. Senate also have made a strong statement in favor of these kinds of international approaches by committing substantial resources in the fiscal year 2003 appropriations bill for the Department of State, for the specific purpose of negotiating a binding agreement for reducing sea turtle mortality in the longline fisheries of the Western and Central Pacific. It is our strong hope that other countries will engage with the U.S. to agree on meaningful commitments.

3. I call on you to support efforts within your governments to protect the nesting grounds of turtles. Many of the turtles that hatch in Asia find their way, if they are lucky, to the seas where the Hawaiian fishing fleet has traditionally fished. While the United States has taken unprecedented measures to protect the adults of the species, these efforts must be matched by strong protection of the turtles' nesting grounds. In the United States, government, business, and nonprofit partners are taking steps to protect nesting grounds on coastal lands through the acquisition of sites such as Kamehame Beach on the Island of Hawai'i, the single most important nesting beach for hawksbill turtles in the United States. The Nature Conservancy purchased the site in August of this year, continuing the legacy of protecting turtles that agribusiness, the National Park Service, and the U.S. Fish and Wildlife Service started more than 10 years ago. This effort has crossed the spectrum of stakeholders, showing the importance of having government agencies, the private sector and nongovernmental organizations work together to provide management solutions.

4. I call on you to encourage your governments to mitigate the effects of marine debris. When human waste ends up in the ocean it poses hazards to marine life. Animals are drowned or strangled in discarded or lost fishing gear and suffer and even die from eating plastics and other garbage. In the United States, a partnering between federal agencies and volunteers from state and private organizations has developed a multi-agency effort for coral reef restoration and the clean-up of marine debris in the Northwestern Hawaiian Islands. Since 1996 this effort has removed 239.4 tons of debris from the region's coral reefs. Much of it was discarded fishing gear, some of which weighed over 500 pounds and took hours to remove.

The United States stands ready to do all that it can to be a strong international partner for responsible marine management. We are ready to share what we have learned with interested nations, and are eager to benefit from their experiences. Let us build on the foundation established at the First International Fishers Forum to move closer to our vision of cooperative international management of our Pacific resources.

Key Outcomes

2ND INTERNATIONAL FISHERS FORUM • HONOLULU, HAWAII ~ 2002 •

Key Outcomes:
Mapping the Way Forward and Taking Action

The objective of the final day of the forum was to shift the focus from ideas to action. Following the plenary presentations, forum participants explored concrete ways of personally contributing toward the forum's overall mission of diminishing the incidental bycatch of seabirds and sea turtles by longline fishing gear. The goal of these activities was to produce a series of concrete project plans that forum participants would commit to undertake during the two-year period between IFF2 and IFF3.

In the first phase of activities, "Mapping the Way Forward," participants brainstormed on concrete actions that could achieve the forum's mission. In the second phase, entitled "Taking Action," participants worked individually, in pairs, or in larger teams to plan actions to which they were willing to commit—not as guarantees but as good faith statements of their intent. At the end of this exercise participants were invited to stand and present their commitments to their assembled colleagues in the plenary session. To protect confidentiality forum participants agreed that the commitments listed in the forum proceedings would be attributed to specific regions and topical foci but not to particular individuals.

MAPPING THE WAY FORWARD

In this first phase participants were invited to focus their brainstorming efforts on one of the five overarching themes that served as umbrellas for the primary cross-cutting issues that had emerged during the forum's breakout sessions. The themes were:

COALITION AND TRUST-BUILDING – This theme focused on the need for greater levels of collaboration, coalition formation and trust building among the many players involved or interested in seabird or sea turtle bycatch issues.

ENHANCING BIOLOGICAL RESEARCH – This theme focused on the need for improved research on the foundations of seabird and sea turtle biology. It also highlighted the need for increased cooperation among scientists, fishermen and governmental agency representatives in ongoing and future research programs.

IMPROVED MITIGATION STRATEGIES – This theme focused on the need to develop more effective mitigation strategies for addressing seabird and sea turtle bycatch problems, including imperatives for improving international cooperation and standardizing fisheries data.

EXPANDED INTERNATIONAL PARTICIPATION – This theme addressed the problems caused by illegal, unreported, and unregulated fishing as well as the lack of comprehensive international engagement on the issues of seabird and sea turtle bycatch. It included the needs to create incentives to expand such international participation and produce international plans of action (IPOAs).

EDUCATION, TRAINING AND INFORMATION DISSEMINATION – This theme concentrated on the need to increase fisherman awareness of seabird and sea turtle bycatch issues and the importance of developing training regimens to assist skippers and on-board observers in collecting high-quality data. Also addressed was the need to improve the dissemination of information between researchers, fishermen, governmental agency representatives and the NGO community. This involves expanding public and consumer awareness of bycatch mitigation goals and progress.

From this exercise a list of possible actions was compiled and passed out to all forum participants.

TAKING ACTION

In this phase participants worked as individuals or joined to form teams to produce written statements describing concrete actions addressing seabird or sea turtle bycatch to which they were willing to make personal commitments. The commitments made ranged widely in terms of geographic scope and the tools, techniques and strategies for carrying them out. The commitments generated included:

- Sharing mitigation technologies with different fisheries in different nations.
- Committing to use and test more mitigation strategies and to encourage the same within particular fleets, fisheries and nations.

- Forming multi-stakeholder advisory committee to address the needs for mitigation, data collection and research within particular fisheries.
- Increasing involvement of fishermen in the development of new mitigation technologies.
- Securing the participation of more nations with longline fishing fleets and the assistance of more fishermen in reducing bycatch of seabirds and sea turtles.
- Organizing an informal working group to consider the feasibility of developing an underwater setting chute for the Spanish demersal longline system and continuing development of the "capsule," another underwater setting device.
- Collating data on the seasonal presence of large flocks of migrating birds near fishing grounds, for example, in Alaskan waters.
- Creating public awareness campaigns related to the issues of bycatch of seabirds and sea turtles and the progress made to date in addressing them.
- Improving communications between the different stakeholder communities.
- Improving logbooks and other data-collection techniques.
- Conducting new research studies (e.g., turtle survivability and mitigation, line-weighting studies).
- Developing databases and websites to improve the organization and dissemination of information and provide educational materials to all necessary audiences.
- Improving communication and collaboration among agencies around the world that have drafted FAO national plans of action for seabirds, and mentoring countries that have not yet done so.
- Increasing the presence of representatives of interested NGOs on fishing boats.
- Organizing further conferences on the topic.

In addition, many participants, speaking as individuals or on behalf of a group, presented plans of action to the assembly, as follows:

CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR):

- Improve CCAMLR estimates of bycatch at regional to global levels and identify research gaps at regional levels.
- Encourage countries to actively address IUU fishing from national, regional and global levels.
- Institute seabird mitigation programs in member countries where they don't yet exist.

GUAM FISHERMEN COOPERATIVE:

Initiate a pilot project in the bigeye tuna longline fishery to address seabird and turtle bycatch issues. Specifically:

- Establish an advisory body that would include NMFS, NGOs, fishermen and scientists to review and analyze data on a quarterly basis and recommend changes to mitigation strategies on an ongoing basis.
- Set up an education and training program centered on the NMFS protected species course.
- Establish a comprehensive logbook that would embrace all the needs of stakeholders in the fishery.
- Evaluate or test known and emerging technologies for seabird and sea turtle bycatch mitigation.
- Promote monitoring by at-sea observers, VMS, or electronic means.
- Advocate and incorporate management regimes that would reward excellence and invoke developmental sanctions.

FISHERMEN WORKING WITH NOAA FISHERIES IN THE NORTHEAST DISTANT (NED) ATLANTIC WATERS:

Address the lack of technology to determine impacts of fishing and mitigation. Specifically:

- Lobby to convene a technical working group on satellite technology and develop an experimental design for implementation by June 2003 in the NED research program.
- Determine the effectiveness of mitigation measures already implemented, including line cutters, dehookers and other turtle handling-and-release techniques.
- Implement developed procedures for turtle handling and release by June 2003.
- Allow biological data collection by fishermen.
- Develop protocol for fishermen to administer antibiotics to injured turtles prior to release. Post research results at relevant websites.

NOAA FISHERIES HONOLULU LAB:

- Adopt the use of the ARC dehookers in all turtle mitigation research conducted with the Hawai'i-based longline fleet and urge adoption of this device as part of turtle handling-and-release protocols for the Hawai'i-based fishery.
- Promote Pacific-wide testing of circle hooks in the tuna pelagic longline fisheries and post research results on IFF website and other relevant websites.

GROUP FROM NEW ZEALAND:

Continue research and development on the weighted line for bottom longline fishing, which has produced highly positive results to date, and perfect its performance; also, expand the number of vessels that use this weighted line for trials.

PARTICIPANT FROM MEXICO:

- Disseminate, via a new website and other means, information on actions to solve the bycatch problem among scientists, fishermen and government agencies.
- Implement and test in my own fleet the mitigation practices described at the forum.
- Encourage other fishers to implement these practices once they have proven effective in our fleet.

GROUP FROM SCOTLAND:

Establish a working group to gather comprehensive information on bycatch and establish a website to educate diverse audiences.

UNIDENTIFIED PARTICIPANT:

- Help solicit interest and funds for a proposed global seabird bycatch database.
- Help draft a seabird bycatch proposal to be submitted to the APEC fisheries working group in March 2003.
- Assist in coordinating reports to COFI on the status of MPOA development.
- Coordinate distribution of a University of Washington Sea Grant Program outreach video to some 2,000 Alaska fishermen.
- Work with Canada on a seabird identification guide that would complement the existing North Pacific albatross guide.

FISHERIES SCIENTIST:

Contact individuals and agencies around the world that have drafted FAO national plans of action for seabirds to propose formation of an informal group to support their efforts and possibly develop a prototype national plan of action.

FORUM HIGH-QUALITY BIOLOGICAL RESEARCH TEAM:

In response to a priority request from representatives of the fishing industry, a group from the high-quality biological research team will pursue carrying out a study to quantify post-release survivorship of longline-hooked loggerhead turtles.

UNIDENTIFIED PARTICIPANT:

- Disseminate bird guides and a turtle guide being developed by the South Pacific. Commission to fishing vessels to assist crews with species identification for logbook reporting.
- Collaborate with fishers to write articles for the mainstream media and NGOs on the achievements of fishers in using mitigation methods to reduce seabird and turtle bycatch.

PARTICIPANT FROM NEW ZEALAND:

- Work to refine the code of practice to increase the minimum standards of bird mitigation currently used on vessels in New Zealand.
- Promote introductions of an inshore fleet to the Ling Longline Working Group and help them to develop a code of practice for their fishery.

AUSTRALIAN TUNA BOAT-OWNER:

- Work through boat-owners' association to gain assistance, support and funds to educate fishermen and increase the awareness of bycatch problems throughout the industry.
- Disseminate the information from IFF2 and encourage the use of all tools and devices to reduce mortalities of turtles and seabirds.
- Develop strong partnerships with the researchers and NGOs to support fishermen in finding solutions to bycatch problems.

REPRESENTATIVE OF NEW ZEALAND EDUCATIONAL ALLIANCE:

- Draw in representatives of fisheries that aren't yet participants in the alliance.
- Pursue joint projects with other countries that share albatrosses and petrels with New Zealand.

INAUGURAL GOLDEN ALBATROSS AWARD

Kitty Simonds, Executive Director of the WPRFMC, presented the inaugural "Golden Albatross Award," which recognizes individuals whose personal actions "raise the bar" for performance and commitment in reducing the bycatch of seabirds and/or sea turtles, and inspire others to do the same. John Bennett, a fisherman from New Zealand, was the inaugural recipient of the award. It was presented in recognition of his continual efforts to innovate and improve measures for seabird bycatch mitigation on the San Aotea II and motivate his crew, his fleet and forum participants by his example.

Closing Statement

2ND INTERNATIONAL FISHERS FORUM

HONOLULU, HAWAII ~ 2002

Closing Statement

SEAN MARTIN, HAWAII LONGLINE ASSOCIATION

Thank you for the opportunity to be the final speaker today. I promise to keep this short. From a fisherman's perspective, this has been a fascinating week. This meeting has brought together a unique group of individuals from a variety of different professions to look at how we can work together to minimize longline impacts on sea turtles and sea birds. We have covered a lot of ground in the four days we have been together. Not only the principal focus on existing or potential seabird and turtle mitigation methods, but also issues surrounding data collection, education and outreach, the obstacles to progress, international agreements, incentives for fishermen, and the use of modeling in the process of developing management options.

The global market for longline-caught fish will continue to grow. In my time in Hawai'i I have seen the state's longline fishery grow from a nearly moribund fishery in the early 1980s, with a handful of boats, to a fleet in excess of a hundred vessels a decade later. Following Hawai'i's lead, many of our Pacific Island neighbors have successfully developed their own longline fisheries. The continuity of these fisheries is especially critical for the Pacific Island nations since there are limited economic opportunities available to these small countries. On the Pacific Rim relatively new longline fisheries have also been established in countries such as China and Vietnam, while new marketing opportunities are being developed in Europe and North America.

Practical solutions for reducing seabird and turtle bycatch need to be developed to ensure that this expansion of longline fishing does not add to the already long list of impacts on these populations from man-made sources. Shutting down fisheries is not a solution. Because of the mobility of fishing fleets and the global nature of the seafood market, fleets will simply move to avoid closure or fleets elsewhere will take advantage of the market shortfall brought about by fishery closures. We have seen both of these responses to the closure of the Hawai'i swordfish fishery. Indeed, the volume of swordfish consumed in the United States has increased despite the closure of the Hawai'i fishery, with an increasing volume of imports from foreign fisheries. The net result of unilateral action such as in Hawai'i is that negative bycatch impacts are simply transferred from one fleet to another without any net benefit to either turtles or seabirds.

The global nature of seafood markets and the international nature of longline fisheries mean that our solutions to the negative impacts of longline bycatch have to be developed at the international level. As we have seen from this meeting, one of the keys to minimizing bycatch impacts to turtles and seabirds is documenting the bycatch-to-catch ratios in different fisheries. Armed with this we can make meaningful comparisons between fisheries and see where we need to concentrate our efforts. For this reason we have spent time at this meeting looking at the whole spectrum of issues concerning data collection and how these data can be improved.

We have also learned that many of the solutions for mitigating the impact of longline bycatch are proposed without complete understanding of their impacts, neither on the seabirds and turtles, nor on the target fishery. We have also absorbed the message that we need more learning tools that simulate a variety of impacts that result from management options and which will teach us how to think more systematically and ecologically about these issues.

Moreover, responsible fishing and sustainable fishery management must be linked with responsible seafood consumption. Everyone from fishermen to consumers has a responsibility to minimize negative bycatch impacts. It is likely that some of the incentives for longline fishermen to adopt mitigation measures will stem from market-driven solutions in the form of certification systems, consumer guidance and increased consumer awareness. Useful as these mechanisms are, however, we have to ensure that these well-intentioned initiatives are based on a scientific approach and solid data.

We also have recognized that securing international agreements to minimize negative bycatch impacts of longline fishing will likely be a lengthy process. The strong regulatory incentives for U.S. longline fishermen to develop and promote the use of mitigation measures such as the Endangered Species Act may be weaker or entirely absent in other countries. We also need to address the shortcomings of international agreements and legally binding instruments to make them more effective and to shorten response times for action.

More countries and longline fishermen participated in this second forum, as compared to IFF1. However, we are still missing participation by some of the major elements of the global longline fishing community. A prime objective for IFF3 must be to secure effective participation from all longline fishing nations and fishermen. We also need to ensure that concrete actions based on the recommendations of IFF2 are taken to resolve these issues. But most importantly, we need to stay focused on the larger goal of protecting the ecosystem and the targeted and non-targeted resources, and keep fishermen from becoming an endangered species.

Appendix 1 & 2

2ND INTERNATIONAL FISHERS FORUM · HONOLULU, HAWAII ~ 2002

Appendix 1:
Program

	November 18, 2002
2:00 – 6:00 p.m.	Registration Open, (Monday) Hawaii Convention Center, (313BC)

DAY 1:	November 19, 2002 (Tuesday)
7:00 a.m. – 8:00 a.m.	Registration / Continental Breakfast, Exhibit Room (313BC), Hosted be Rena International
8:00 a.m. – 8:30 a.m.	Plenary: Welcoming Address, Ceremony and Prayer (316ABC) Kitty Simonds, Executive Director, Western Pacific Regional Fishery Management Council
8:30 a.m. – 9:00 a.m.	Opening Address Ambassador Satya Nandan, Director General of International Seabed Authority
9:00 a.m. – 9:10 a.m.	Forum Structure, Goals and Social Events; Breakout Group Sessions - Objectives, Forum Convener
9:10 a.m. – 9:30 a.m.	Group Photo (Grand Staircase) Coffee/Tea Break Exhibit Room (313BC)
9:30 a.m. – 10:45 a.m.	Plenary: IFF1 Commitment Update Janice Molloy, Department of Conservation, New Zealand
10:45 a.m. – 12:00 noon	Plenary Overview: Seabird and Sea Turtle Biology, Distribution and Population Status Rosemary Gales, Tasmanian Parks and Wildlife Service Colin Limpus, Queensland Parks and Wildlife Department
12:00 noon – 1:00 p.m.	Lunch, Exhibit Room (313BC) Hosted by the Marine Conservation Action Fund
1:00 p.m. – 2:30 p.m.	Plenary Overview: Longline Fisheries and Data Collection Tim Park, Federated States of Micronesia Mike Bayle, Alaska Frontier Company Howard McElderry, Archipelago Marine Research Ltd.
2:30 p.m. - 2:40 p.m.	Refreshment Break Exhibit Room (313BC)
2:40 p.m. – 3:40 p.m.	Plenary Overview: Mitigation measures, data collection and research. Nigel Brothers, Tasmanian Parks and Wildlife Service Christopher Boggs, National Marine Fisheries Service Honolulu Laboratory
3:40 p.m. – 3:50 p.m.	Refreshment Break, Exhibit Room (313BC)
3:50 p.m. – 4:20 p.m.	Plenary Overview: Modeling Anthony Starfield, University of Minnesota
4:20 p.m. – 5:20 p.m.	Plenary Overview: International Agreements/National Approaches John Cooper, University of Cape Town Douglas Hykle, Convention on the Conservation of Migratory Species
5:30 p.m. – 8:00 p.m.	E Komo Mai Celebration, Exhibit Room (313BC)

DAY 2:	November 20, 2002 (Wednesday)
5:30 a.m. – 6:30 a.m.	Shuttle Service to the United Fishing Agency Auction
7:00 a.m. – 8:00 a.m.	Continental Breakfast, Exhibit Room (313BC) Hosted by Seafreeze, Ltd.
8:00 a.m. – 11:00 a.m.	Breakout Session I Breakout Groups 1. Seabird Mitigation and Research (316A Fishermen Only) 2. Sea Turtle Mitigation and Research (316B Open to All) 3. Data Collection (316C Open to All) 4. Education/Communication (313ABC Open to All)
9:30 a.m. – 10:30 a.m.	Refreshments Available in Exhibit Room (313BC)
11:00 a.m. – 12:00 noon	Lunch (On Own)

12:00noon – 3:00 p.m.	Breakout Session II Breakout Groups 1. Seabird Mitigation and Research (316A Open to All) 2. Sea Turtle Mitigation and Research (316B Fishermen Only) 3. Data Collection (316C Open to All) 4. Education/Communication (313ABC Open to All)
2:30 p.m. – 3:30 p.m.	Refreshments Available in Exhibit Room (313BC)
3:00 p.m. – 6:00 p.m.	Breakout Session III Breakout Groups 1. Seabird Mitigation and Research (316A Open to All) 2. Sea Turtle Mitigation and Research (316B Open to All) 3. Data Collection (316C Fishermen Only) 4. Education/Communication (313ABC Open to All)
6:30 p.m. – 8:30 p.m.	Hawaii Longline Association Tour of Longline Vessels Gordon Biersch Brewery & Restaurant, Aloha Tower

DAY 3:	November 21, 2002 (Thursday)
5:30 a.m. – 6:30 a.m.	Shuttle Service to the United Fishing Agency Auction
7:00 a.m. – 8:00 a.m.	Continental Breakfast, Exhibitor Room (313BC) Hosted by Department of Conservation, New Zealand
8:00 a.m. – 8:30 a.m.	Plenary Overview (316ABC): Forum Convener a. Reporting Key Results from Seabird and Sea Turtle Mitigation and Data Collection Breakout Sessions b. Summary of Comment Box Responses from Day One
8:30 a.m. – 8:45 a.m.	Refreshments Available in Exhibit Room (313BC)
8:45 a.m. – 11:45 a.m.	Breakout Session IV Breakout Groups 5. Obstacles, Lessons Learnt and the Way Forward (316A Open to All) (316B Open to All) (316C Fishermen Only) 6. International Agreements/National Approaches (304A Open to All) (304B Fishermen Only) 7. Modeling (301A, 301B Open to All) 8. Fishermen Incentives (303AB Open to All) (305AB Fishermen Only)
10:00 a.m. – 11:00 a.m.	Refreshments Available in Exhibit Room (313BC)
11:45 a.m. – 1:00 p.m.	Lunch (on own)
1:00 p.m. – 4:00 p.m.	Breakout Session V Breakout Groups 5. Obstacles, Lessons Learnt and the Way Forward (316A Open to All) (316B Fishermen Only) (316C Open to All) 6. International Agreements/National Approaches (304A Open to All) (304B Fishermen Only) 7. Modeling (301A, 301B Open to All) 8. Fishermen Incentives (303AB Open to All) (305AB Fishermen Only)
2:30 p.m. – 3:00 p.m.	Refreshment Break Exhibit Room (313BC)
6:00 p.m. – 9:00 p.m.	Luau - Waikiki Aquarium (Ticketed Event)

DAY 4:	November 22, 2002 (Friday)
5:30 a.m. – 6:30 a.m.	Shuttle Service to the United Fishing Agency Auction
7:30 a.m. – 8:30 a.m.	Continental Breakfast, Exhibit Room (313BC) Hosted by North Pacific Longline Association
8:30 a.m. – 9:00 a.m.	Plenary Overview (316ABC): Report on Fishermen Incentives, International Agreements and Modeling Breakout Sessions
9:00 a.m. – 9:30 a.m.	Plenary: William T. Hogarth, Assistant Administrator for Fisheries, NOAA
9:30 a.m. – 10:00 a.m.	Plenary: Martin Hall, Inter-American Tropical Tuna Commission
10:00 a.m. – 10:15 a.m.	Coffee/Tea Break Exhibit Room (313BC)
10:15 a.m. – 12:00 noon	Plenary: Mapping the Way Forward
12:00 noon – 2:00 p.m.	Lunch (Room 311) Hosted by Hawaii Longliners Association
2:00 p.m. – 3:15 p.m.	Plenary: continued
3:15 p.m. – 3:30 p.m.	Refreshment Break Exhibit Room (313BC)
3:30 p.m. – 4:30 p.m.	Plenary: Taking Action
4:30 p.m. – 5:30 p.m.	Closing Statement and Ceremony Jim Cook, Hawaii Longline Association

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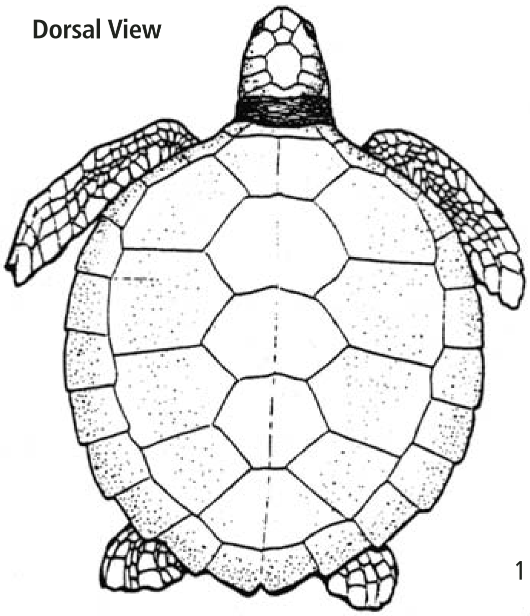
Appendix 3: **Sea Turtle Identification Guides**

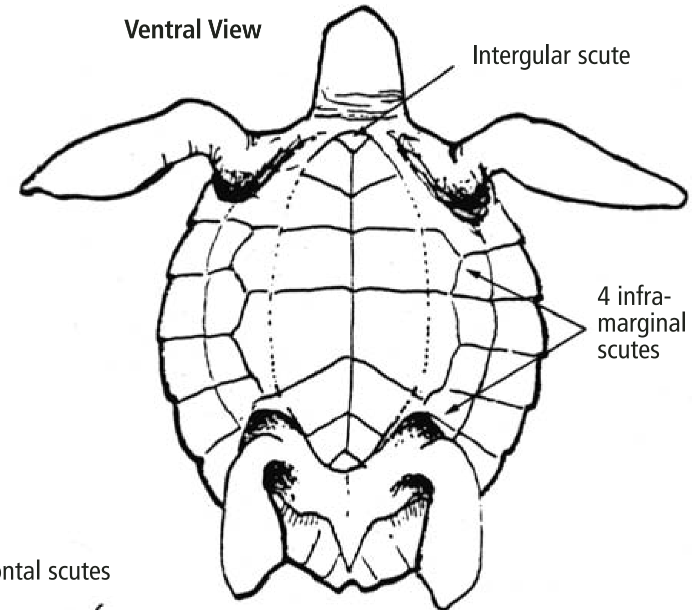
Flatback Turtle

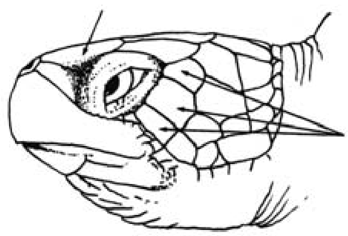
Natortor depressus

Dorsal View



Ventral View





Head

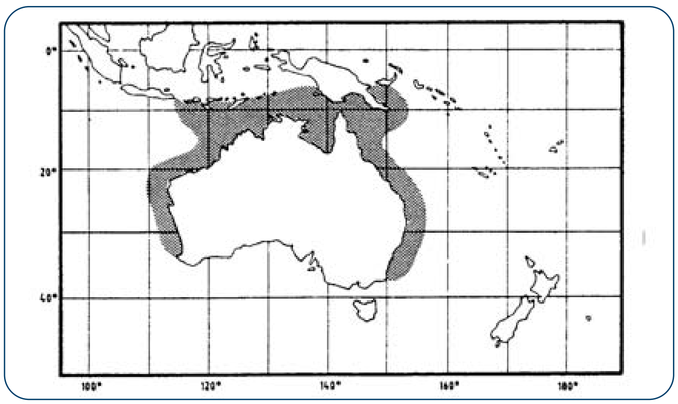
IUCN THREAT STATUS: vulnerable

Diagnostic Features:

- in the adult, the body is flat and the carapace smooth, nearly elliptical with upturned margins
- in subadults, the carapace rim is usually indented from the middle part backward
- 5 central scutes and 4 lateral scutes
- 4 pairs of lateral scutes
- 12 pairs of marginal scutes
- 4 pairs of poreless inframarginal scutes
- each flipper has a single visible claw

Habitat and Biology:

- has a very low emigration rate out from its major distribution area and tends not to go beyond the Australian continental shelf
- the peak of the nesting season varies from one place to another; in southeastern Queensland, the flatback nests only in the summer months, from November to January; in the northern beaches nesting occurs throughout the year with a peak between March and April; on Crab Island the main nesting period goes from August to October
- because of its restricted geographical distribution, the flatback turtle is the most vulnerable of all sea turtles to any change of habitat or to over-exploitation



Geographic range of the Flatback turtle

Geographical Distribution:

- the flatback turtle is confined to the waters of the Australian continental shelf
- it occurs commonly in shallow waters, especially in coastal areas along the main coral reefs and in the vicinity of continental islands
- single individuals have been reported from the south-eastern coasts of Papua/New Guinea

Nesting Grounds:

- nesting occurs along the northern coast of Australia, from Port Hedland in the west to Mon Repos in the east
- Crab Island is the most important rookery for the species
- other important nesting grounds include: Sir Edward Pellew Island; Delambre Island (located on the north-western shelf); Greenhill Island; Wild Duck and Avoid Islands; Peak Island; Curtis and Facing Islands; and on the continent, from Townsville to Mon Repos

Food and Feeding:

TROPHIC MODE: adults are carnivorous; unknown for hatchlings and juveniles

FOOD ITEMS: adults feed on sea cucumbers, benthic animals like hydroids, soft corals and mollusks, brown algae and squids

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; the eggs are eaten by introduced foxes. Dingos, rats, goannas and ghost crabs; hatchlings are vulnerable to terrestrial predators, especially from night herons and other birds; adults, principally females when landing to nest are easy prey of crocodiles.

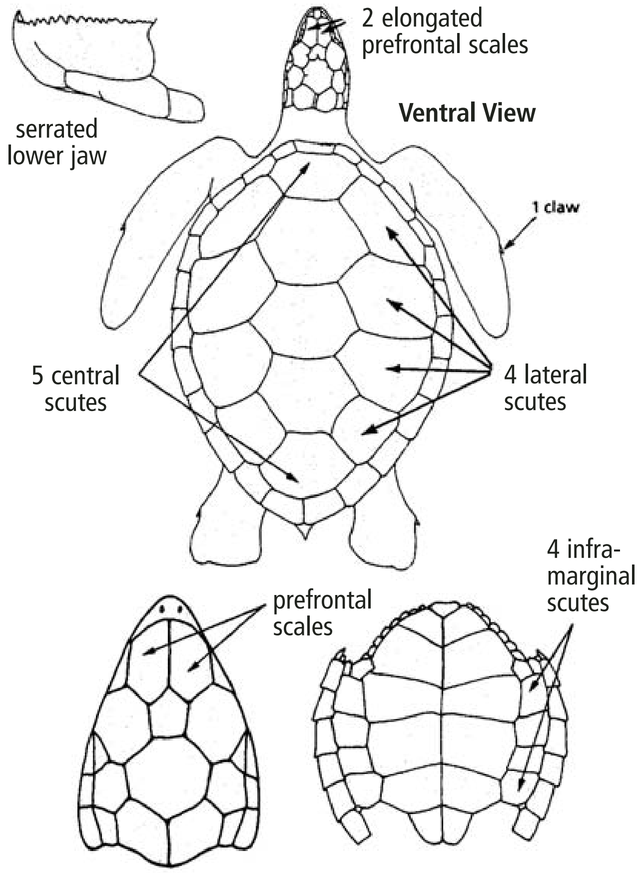
FACTORS INFLUENCING POPULATIONS: this turtle has never been favored as food by the aborigines or Europeans; a few turtles have been captured from the Crab Island rookery and sold to residents of Thursday Islands; the eggs are consumed by the residents of Bamaga and Thursday Islands who harvest them from Crab Island; the species is valued for subsistence use; incidental capture by prawn trawlers.

References:

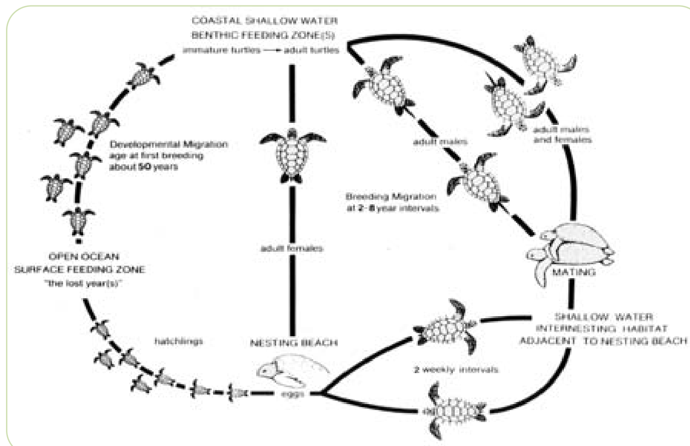
FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico;. A special thank you to Colin Limpus.

Green Turtle

Chelonia mydas



Dorsal View of Head **Ventral View**



General sea turtle life history strategy.

IUCN THREAT STATUS: Endangered

Diagnostic Features:

- body depressed in adults, carapace oval in dorsal view, its width about 88% of its length
- color varies from pale to dark and from plain color to brilliant combinations of yellow, brown and greenish tones; in juveniles, the scales of the head and upper sides of the flippers are fringed by a narrow, clear, yellowish margin that is lost with age
- 5 centrals, 4 pairs of laterals, and usually 12 pairs of marginals
- each flipper a single visible claw at the outer border
- 4 pairs of inframarginals
- head with usually one pair of elongated prefrontal scales and 4 postorbital scales at each side
- tomium of lower jaw serrated
- each flipper a single visible claw at the outer border

Habitat and Biology:

- mainly solitary nektonic animal that occasionally forms feeding aggregations in shallow water areas with abundant seagrass or algae

Geographical Distribution:

- widely distributed in tropical and subtropical waters, near continental coasts and around islands
- rare in temperature waters; like the Hawksbill, the green turtle is the most tropical of the marine turtles
- latitudinal range remains within the northern and southern limits of the 20°C. and follow the seasonal latitudinal changes of these limits

Nesting Grounds:

- southeast coast of Malaysia and offshore islands
- Sarawak, Satang and Talang, Islands
- Philippines (“Turtle Islands”, the Sulu Sea, Pulau Boaan, Baguan, Taganak, Bakkungan, Palawan)
- Australia (Lacepede Islands)
- Gulf of Carpentaria, Rayne Island, Pandora Cay, Capricorn Group, including heron Islands and bunker Group with Hoskyn Island
- nesting occurs on hundreds of islands in the central Pacific, including the Hawaiian Islands

Food and Feeding:

TROPHIC MODE: omnivorous, but primarily herbivorous; feed during the day time

FOOD ITEMS: seagrasses (*Zoostera, Thallasia, Cymodocea, Syringodium, Diplantera, Halodule* and *Halophila*); algae (*Gelidium, Gracillaria, Garacilliaropsis, Hypnea, Caulerpa,* etc..); less than 2% of green turtle diet is animal (sponges, bryozoan, crustaceans, sea urchins, molluscs and sea squirts)

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; groupers, snappers and jacks prey on juveniles.

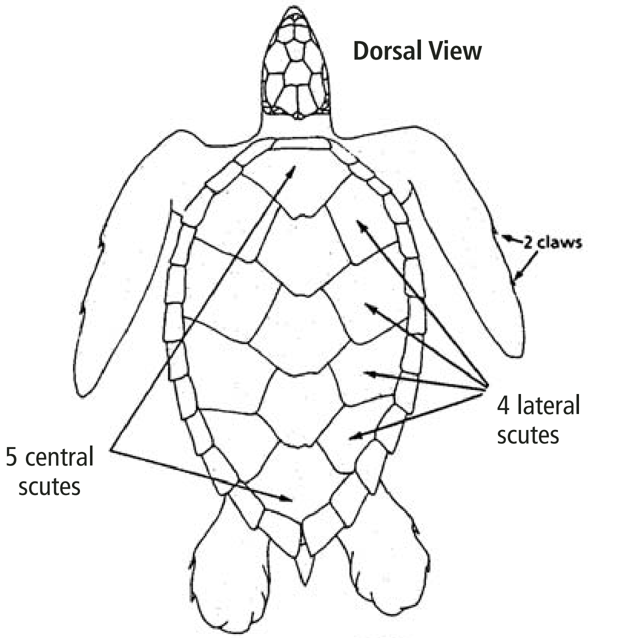
FACTORS INFLUENCING POPULATIONS: egg loss due to erosion or sea over washes; predation on and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks; predation by man; incidental catch in fisheries; entanglement in marine debris.

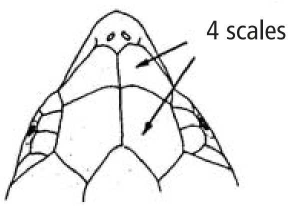
References:

FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico;. Photo K.Hopper A special thank you to Colin Limpus.

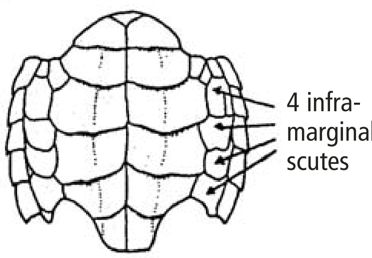
Hawksbill Turtle

Eretmochelys imbricata

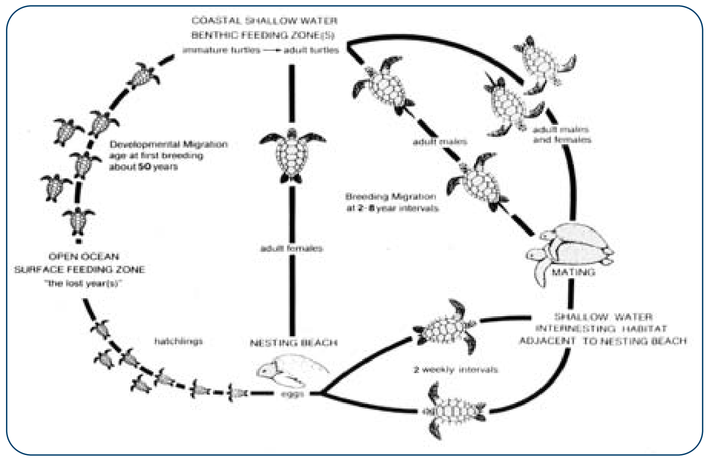




Dorsal View of Head



Ventral View



General sea turtle life history strategy.

IUCN THREAT STATUS: critical

Diagnostic Features:

- scutes are overlapping
- 5 central, 4 pairs of lateral and 11 pairs of marginal scutes
- 4 poreless inframarginal scutes
- each rear and fore flipper bears two claws on its anterior border
- 4 prefrontal scales on head
- hooked beak; not serrated on the cutting edge, but hooked at the tip

Habitat and Biology:

- live in clear, littoral waters of mainland and island shelves
- may migrate short or long distances between feeding and nesting beaches
- not observed in groups or flotillas
- hatchlings disappear for an unknown period and are again observed when approaching coastal shallow waters at sizes usually over 20 cm (SCL)
- populations usually have residential or non-migratory behavior
- in Hawaii peak nesting occurs from late July to early September
- females show nesting site fidelity; prefer steep beaches with coarse sand

Geographical Distribution:

- most tropical of all sea turtles
- nesting is in a more widespread pattern with very few major nesting places
- more common where reef formations are present
- also present in shallow waters with sea grass or algal meadows like lagoons and bays

Nesting Grounds:

- nest on islands and mainland of southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea, the Solomon Islands and Australia
- in Hawaii, Maui, Molokai and the Big Island of Hawaii

Food and Feeding:

TROPHIC MODE: carnivorous

FOOD ITEMS: highly variable; up to and around 10 cm (SCL) hawksbill apparently switches from nectonic to benthic feeding; nectonic – perhaps feeding on salps; benethic – feeding on corals, tunicates, algae, and sponges.

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; groupers, snappers and jacks prey on juveniles

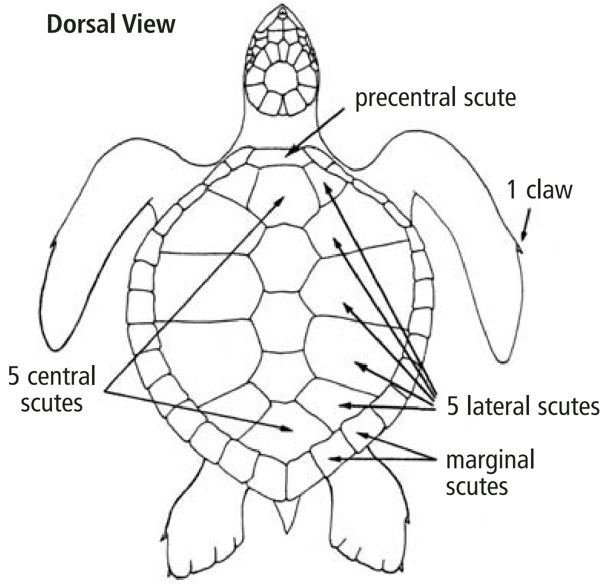
FACTORS INFLUENCING POPULATIONS: predation on eggs and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks; because of its occurrence around coral reefs, where big carnivore fishes remain in ambush, this turtle is continuously exposed to heavy predation; predation by man; incidental catch in fisheries; entanglement in marine debris.

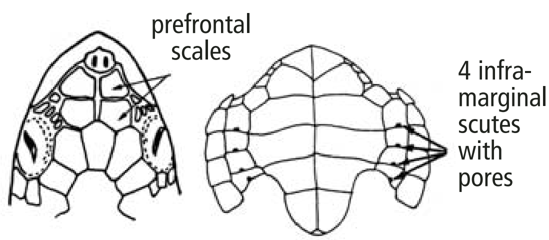
References:

FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico; photo by John Naughton. A special thank you to Colin Limpus.

Kemp's Ridley

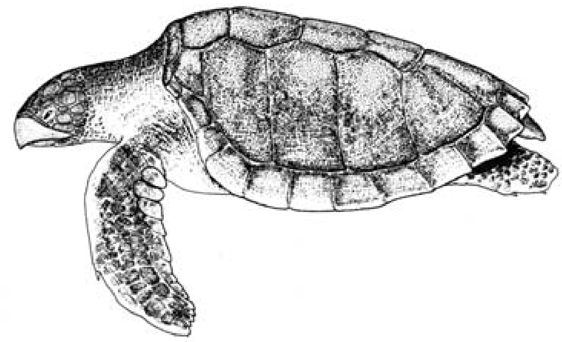
Lepidochelys kempii

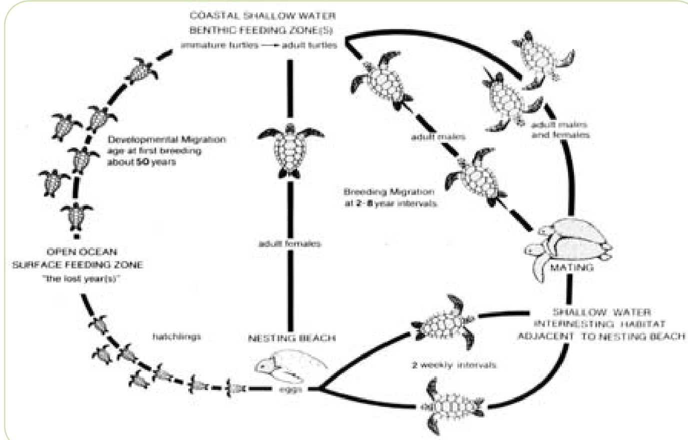




Dorsal View of Head

Ventral View





General sea turtle life history strategy.

IUCN THREAT STATUS: Critical

Diagnostic Features:

- smallest of the sea turtles
- when viewed from above the carapace has a nearly circular shape
- 5 central scutes and 5 lateral scutes, with the first one in contract with the precentral scute
- 12 pairs of marginal scutes
- 4 inframarginal scutes with pores
- carapace is usually clean and smooth
- front flippers usually with 1 claw; hatchlings show 2 claws
- rear flippers usually 1 or 2 claws
- in comparison to females, males have larger claws and a longer tail

Habitat and Biology:

- While in the Gulf of Mexico, the turtles usually inhabit sandy and muddy bottoms which are rich in crustaceans
- they travel near the coast
- they remain in the nesting grounds at least from April to the end of July although some will only stay a couple of months and are replaced by new individuals
- is the most conspicuous daytime nester
- usually mass-nesting takes place on windy days

Geographical Distribution:

- Adults usually occur only in the Gulf of Mexico but juveniles and immature individuals range between tropical and temperate coastal areas of the northwestern Atlantic ocean
- juveniles are frequently observed in bays, coastal lagoons and river mouths
- adults are present seasonally in places like the Louisiana coasts and Campeche Bank and converge on the Rancho Nuevo nesting ground each spring
- they may follow two major migratory routes: 1) northward to the Mississippi area, spread between Texas and Alabama; and, 2) southward to the Campeche Bank

Nesting Grounds:

- almost the entire population nests on a single beach, Rancho Nuevo, which is about 40 km in length on the west coast of the Gulf of Mexico

Food and Feeding:

TROPHIC MODE: carnivorous

FOOD ITEMS: the principal items in the diet of adults are crabs and shrimps, gastropods, clams, sea urchins, jellyfishes, squid eggs, fishes, vegetable fragments. They eat mainly in the daytime.

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; eggs are predated principally by coyotes, skunks, ghost crabs and ants; hatchlings are attached by the same predators as the eggs, and by seabirds, large pelagic fishes like tunas, mackerels, jacks, yellow tail, wahoo, barracudas, dolphin fish and sharks.

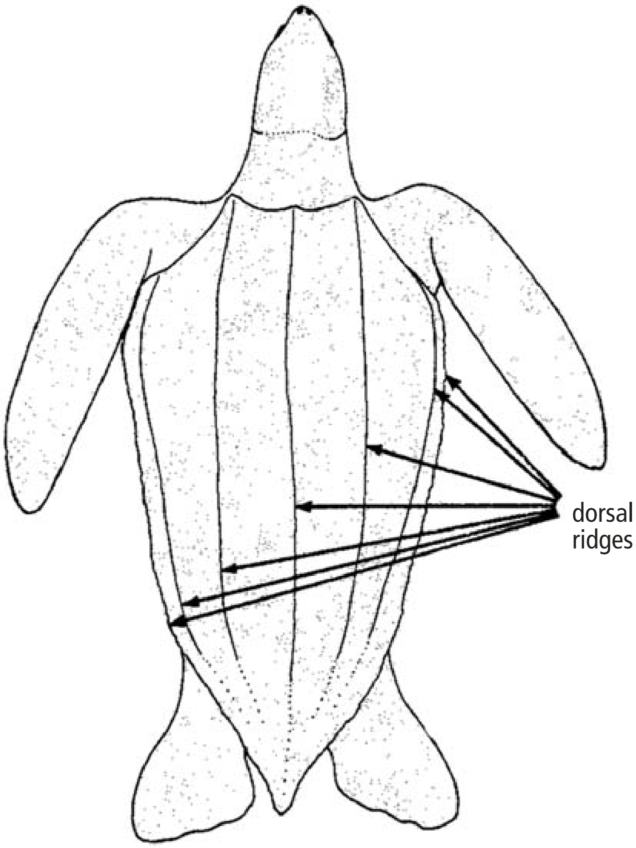
FACTORS INFLUENCING POPULATIONS: natural physical phenomena like hurricanes, storms, floods or dry weather on the nesting beaches; predation on and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks; cold stunning in northern grounds; strong currents carrying small turtles out of their normal range of dispersion; food scarcity; disease incidental catch in fisheries; entanglement in marine debris; oil pollution; impacts by speed boats; construction of barriers.

References:

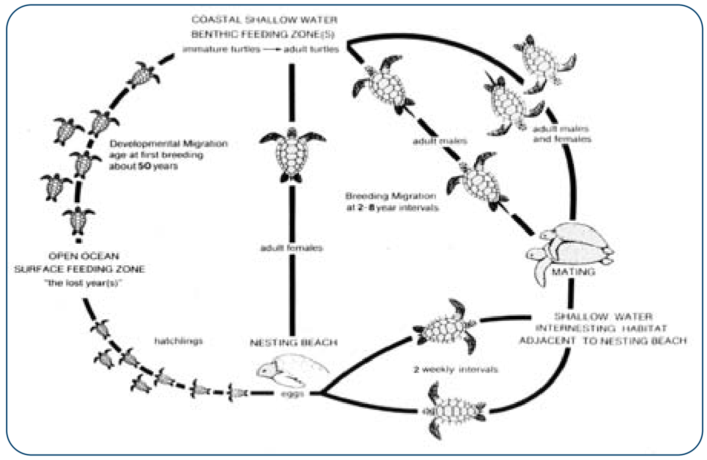
FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico;. A special thank you to Colin Limpus.

Leatherback Turtle

Dermochelys coriacea



Dorsal View



General sea turtle life history strategy.

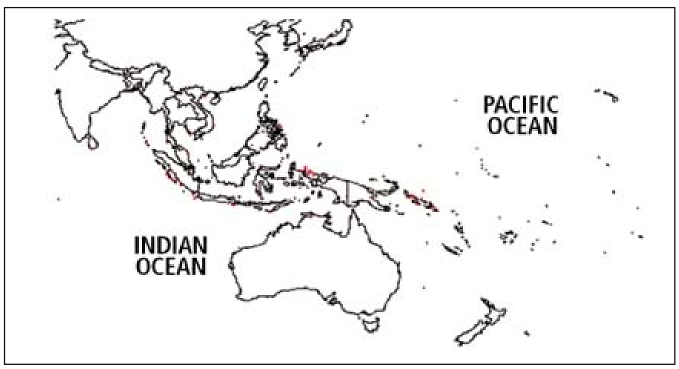
IUCN THREAT STATUS: Critical; population declining

Diagnostic Features:

- largest living reptile
- leathery, unscaled and keeled carapace
- 7 dorsal and 5 ventral longitu-dinal ridges
- beak is sharp edged but lacking crushing surfaces; upper jaw with two pointed cusps; lower jaw with a single pointed cen-tral hook that fits between the upper cusps
- fore flippers usually equal or exceed half the carapace length
- rear flippers connected by membrane to the tail
- dorsal side dark with scattered white blotches; pinkish blotches neck, shoulders and groin
- males are distinguished from females mainly by their long tail; females have a pink area on the crown of their head

Habitat and Biology:

- highly pelagic species that only approaches coastal waters during the nesting season
- seldom forms large aggregations
- frequently descends into deep waters and is physiologically well adapted to deep-diving
- rarely stop swimming, even at night; may swim more than 10,000 km in one year
- leatherback turtles are typically found in convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelago waters
- leatherback sightings peak in August near Monterey Bay and the Farallon Islands may represent a migration of turtles southward to Mexican beaches where they arrive in time for the October nesting



Leatherback turtle nesting sites in the southwestern Pacifc

Geographical Distribution:

- leatherback turtles are adapted to colder water than other sea turtles, and therefore are the most widely distributed of all sea turtles
- very little is known about the distribution of the hatchlings after they abandon the nests
- sighted circumglobally from latitudes 71°N to 42°S

Nesting Grounds:

- EASTERN PACIFIC – Michoacan, Mexico, nesting occurs from October to February or March of the following year
- WESTERN PACIFIC – in China, the season runs from may to June, in Irian Jaya from may to September, and in Australia from December to February, and on the Solomon Islands, nesting occurs from November to January

Food and Feeding:

TROPHIC MODE: carnivorous

FOOD ITEMS: adults feed on jellyfish (*Scyphomedusae*), tunicates and other epipelagic soft-bodied invertebrates; juvenile fishes and marine plants are ingested accidentally; feeding behavior is unknown but assumed to be similar to that of adults.

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; groupers, snappers and jacks prey on juveniles; bones of the leatherback turtle were recovered from the stomachs of killer whales (*Orcinus orca*).

FACTORS INFLUENCING POPULATIONS: egg loss due to erosion or sea overwashes; predation on and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks; predation by man; incidental catch in fisheries; entanglement in marine debris.

References:

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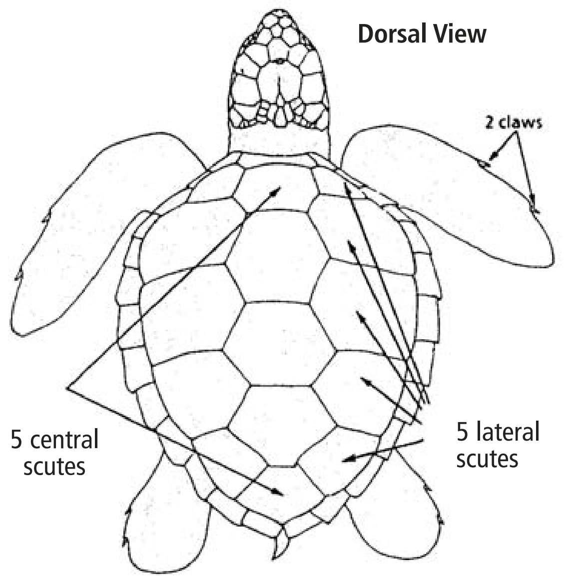
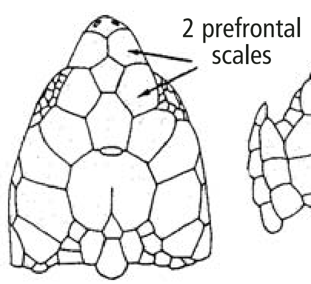
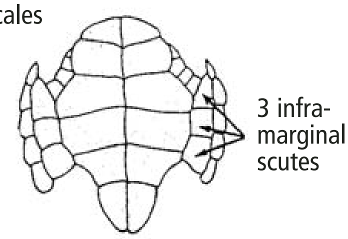
Loggerhead Turtle

Caretta caretta

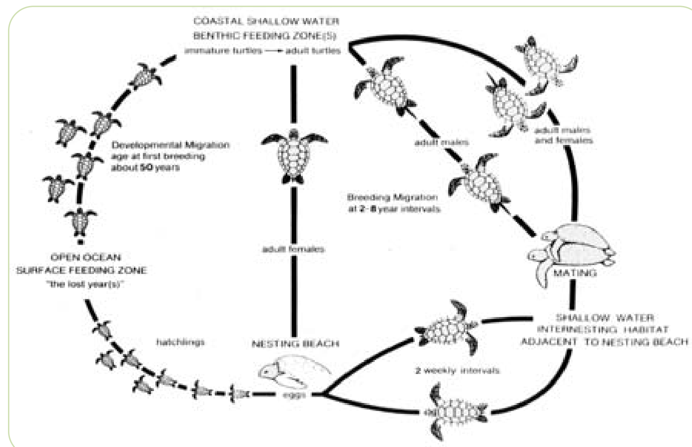




Dorsal View of Head



Ventral View



General sea turtle life history strategy.

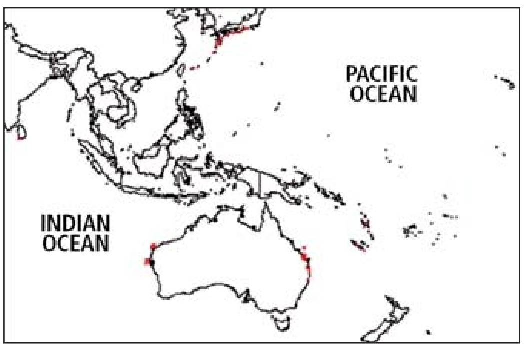
IUCN THREAT STATUS: endangered

Diagnostic Features:

- in dorsal view, heart shaped carapace
- dorsal reddish-brown coloration and yellow-creamy underneath
- 2 pairs of prefrontal scales and one inter-prefrontal scale
- horny beak that is comparatively thicker than in other sea turtles
- 5 central and lateral scutes, 12 or 13 pairs of marginals
- 3 pairs of inframarginal scutes which rarely have pores
- fore flippers with two visible claws; rear flippers with two or three claws

Habitat and Biology:

- primary habitat are the continental shores of warm seas, common in shallow waters
- tend to follow 17°C and 20°C sea surface isotherms when migrating
- only sea turtle that can nest successfully outside of the tropics but the surface temperature must be greater than 20°C
- form large aggregations just off of nesting beaches at the end of Spring, in Summer and at the beginning of Autumn
- often nesting beaches are also associated with underwater crevices in rocky or reef points where turtles remain throughout the reproductive season
- Hatchlings and juveniles forage in open ocean pelagic habitats while subadults and adults tend to forage in shallower waters over benthic hard- and soft-bottom habitats



Loggerhead Turtle breeding sites

Geographical Distribution:

- widely distributed in coastal tropical and subtropical waters, around some islands
- suspected that some loggerhead turtles undertake long migrations using warm currents
- groups of loggerhead turtles noted in open seas, e.g., thousands of juvenile loggerheads swimming westward off Gibralter (33°N, 14°W)
- an important spring and summer foraging area for juvenile, subadults and a few adults is along south Baja California, Mexico
- capable of living in a variety of environments for relatively long periods like brackish waters of coastal lagoons and river mouths
- can remain dormant during winter buried in muddy bottoms in moderately deep waters such as sounds, bays and estuaries, e.g., Cape Canaveral in Florida
- limit of distribution is waters of about 10°C
- if they encounter waters colder than 10°C, they may become stunned, drift helplessly and stranded on nearby shores

Nesting Grounds:

- Major nesting in the pacific is restricted to the western region, primarily in Japan and Australia.
- Mentioned but not quantified for waters of Sumatra, Borneo, Sabah, Philippines, Indochina, Malaysia and Thailand.

Food and Feeding:

TROPHIC MODE: Carnivorous (*molluscs-crustaceans*)

FOOD ITEMS: Wide range of food items with juveniles and migrating adults eating pelagic animals and subadults and adults eating principally benthic fauna. Hatchlings known to eat jellyfishes, Sargassum, and gastropods (*Diiacria, Litiopa*); large aggregations of juveniles forage off Baja California feeding on the small pelagic red lobsteret, *Pleuronocodes planipes*. Subadults and adults known to eat conchs, clams, crabs, shrimps, sea urchins, sponges, fishes, squids, octopuses. During migrations, loggerheads eat jellyfishes, pteropods, molluscs (*Janthina*), floating eat clusters, flying fishes, squids and lobsterets (*Galatheids*).

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; groupers, snappers and jacks prey on juveniles.

FACTORS INFLUENCING POPULATIONS: egg loss due to erosion or sea over washes; predation on and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks. Prone to bear epibiontic organisms like leeches, crabs and algae; predation by man; incidental catch in fisheries; entanglement in marine debris.

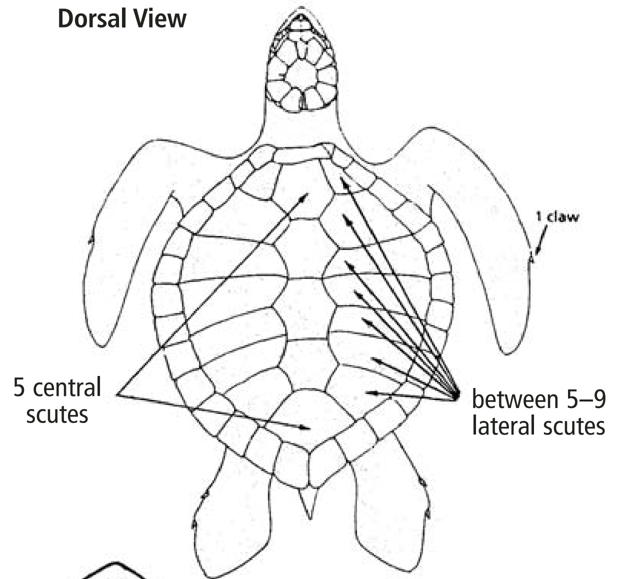
References:

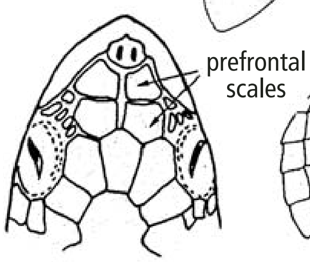
FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico;. A special thank you to Colin Limpus.

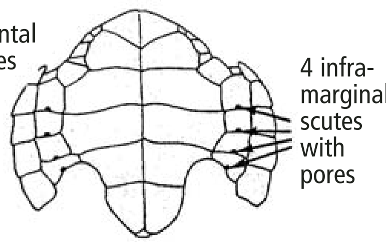
Olive Ridley

Lepidochelys olivacea

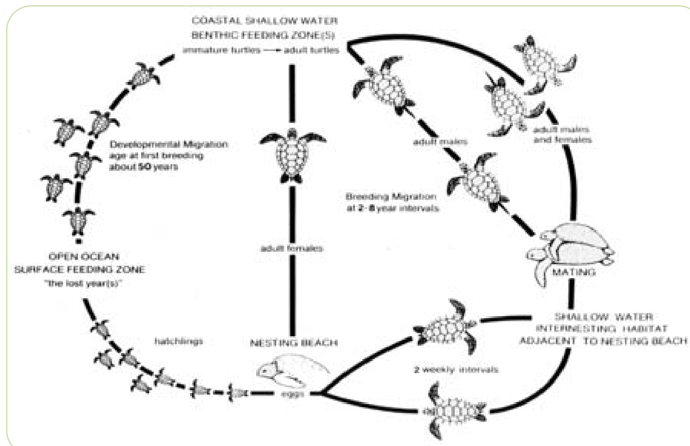
Dorsal View







Dorsal View of Head **Ventral View**



General sea turtle life history strategy.

IUCN THREAT STATUS: Endangered

Diagnostic Features:

- adults are plain olive-grey and creamy or whitish, with pale grey margins underneath
- carpace with 5 central scutes
- lateral scutes are often more than 5 pairs
- 12 pairs of marginal scutes
- 4 inframarginal scutes with pores
- head with 2 pairs of prefrontal scales
- fore flippers with one or two visible claws on the anterior border, and sometimes a third claw on the distal part; rear flippers also with two claws

Habitat and Biology:

- most abundant sea turtle
- turtles are often seen in large flotillas traveling between breeding and feeding grounds
- species is also seen in groups of thousands just in front of their nesting beaches at midday
- nesting takes place in synchronized aggregations called arribadas which result in huge egg loss due to females digging and laying on other nests

Geographical Distribution:

- pantropical species, living principally in the northern hemisphere, with the 20° C isotherms as its distributional boundaries
- rarely seen around oceanic islands
- very few observations on juvenile and immature olive ridley turtles
- suspected that oceanic currents are used by adults to travel between their different foraging and breeding grounds
- records of non-breeding olive ridleys outside the common range of the 20° C isotherms have occurred during El Niño phenomena

Nesting Grounds:

- principally in the Eastern Pacific Ocean from Mexico to Costa Rica, on the northeast coast of India (also in the Atlantic, in Suriname)
- other minor nesting sites are in Malaysia Thailand and Irian Jaya; a single nesting in 1985 on Maui, Hawaii

Food and Feeding:

TROPHIC MODE: facultative carnivore; capable of eating a single kind of food for long periods

FOOD ITEMS: 1982 study off Oaxaca, Mexico: males feed mainly on fishes (57%), salps (38%), crustaceans (2%), and mollucs (2%); females feed mainly on salps (58%), fishes (13%), molluscs (11%), algae (6%), crustaceans (6%), bryozoans (0.6%), seq squirts (0.1%)

Biological Interactions:

PREDATION: sharks are the principal predators for all size classes of turtles; groupers, snappers and jacks prey on juveniles.

FACTORS INFLUENCING POPULATIONS: high egg loss due to females digging and laying on other nests; predation on and hatchlings on the nesting beaches; predation of hatchlings and juveniles by marine birds and pelagic fishes, especially sharks; predation by man; incidental catch in fisheries (especially in near shore shrimp fishing off the Indian coast incidentally which is reported to kill 13,575 turtles in 1998); entanglement in marine debris.

References:

FAO Species Catalogue, Vol. II. Sea Turtles of the World: an annotated and illustrated catalogue of sea turtle species known to date; turtle illustrations by P. Lastrico;. A special thank you to Colin Limpus.

Appendix 4: **Seabird Identification Guides**

2ND INTERNATIONAL FISHERS FORUM

HONOLULU, HAWAII ~ 2002

Amsterdam Albatross

Diomedea amsterdamensis

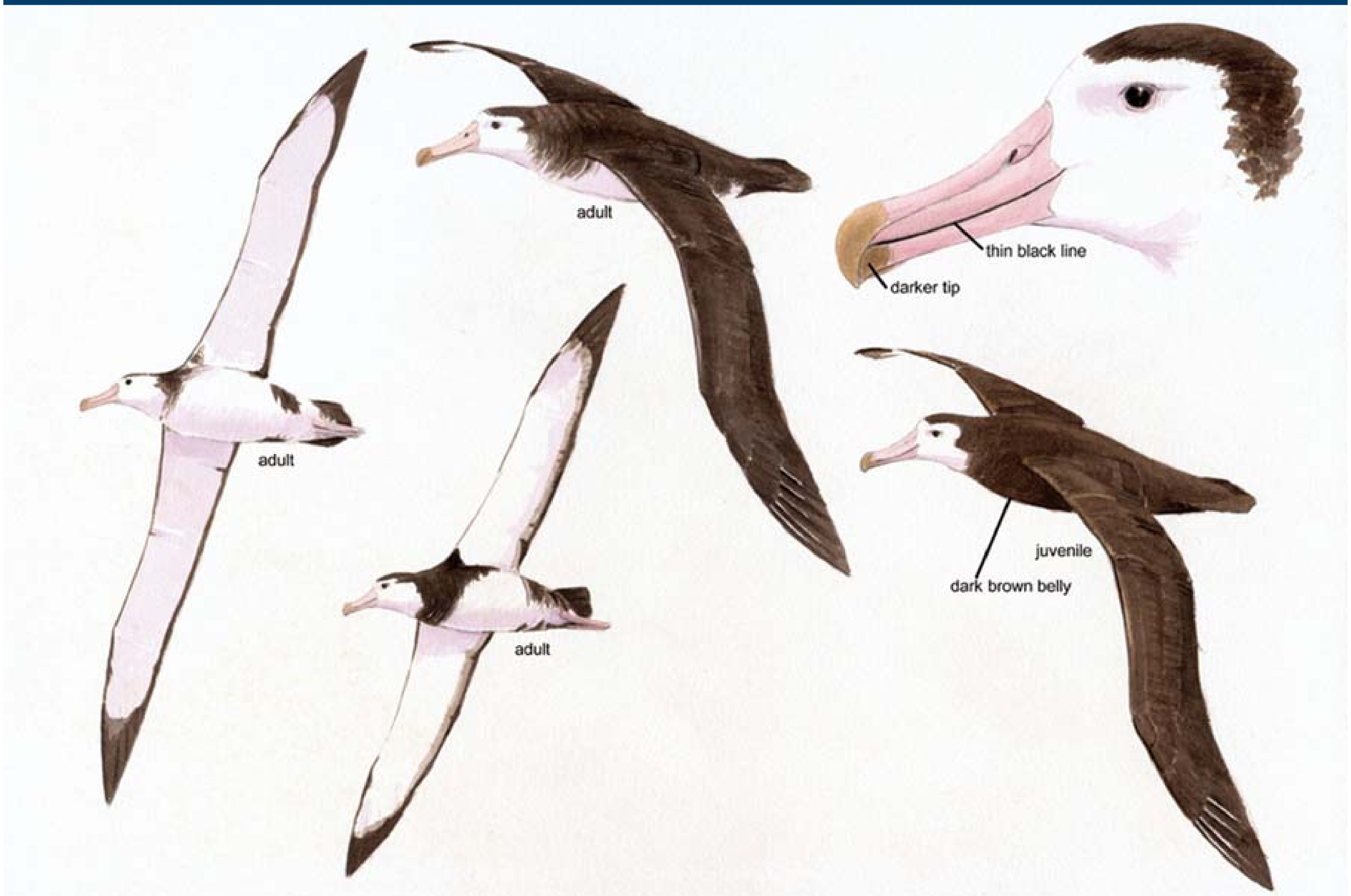


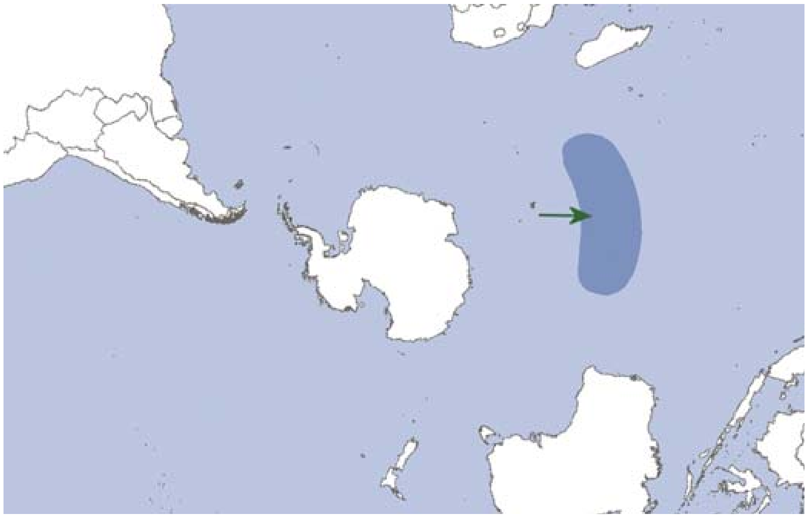
Illustration by Derek Onley

IUCN THREAT STATUS: Critical,population increasing

Identification:

WINGSPAN: 300 cm LENGTH: 110 cm BILL: 135-156 mm

Huge albatross with a large pale pink bill with a thin dark line on the cutting edge and a darker tip. Juveniles are dark brown with a white face and underwing. Underparts become whiter with age. Almost identical to darker plumaged Wandering, Tristan and Antipodes Albatrosses and only identifiable when black line and dark tip to bill are seen well.



Range and Population:

The Amsterdam Albatross breeds on the Plateau des Tourbières on Amsterdam Island (French Southern Territories) in the southern Indian Ocean. It has a total population of c.90 birds including 40 mature individuals, with c.13 pairs breeding annually, showing an increase since 1984, when the first census was carried out[8]. The population was probably formerly larger when its range was more extensive over the slopes of the island[8]. During the breeding season, birds forage both around Amsterdam Island and up to 2,200 km away in subtropical waters[9], but non-breeding dispersal is unknown, although possible sightings have been reported from Australia[3] and New Zealand[1].

Ecology:

Its exact diet is unknown, but probably consists of fish, squid and crustaceans. Breeding is biennial (when successful) and is restricted to the central plateau of the island at 500–600 m, where only one breeding group is known. Adult survival rate is 96–97% and estimated average life span 30–40 years[5,6].

Threats:

Degradation of breeding sites by introduced cattle has decreased the species range and population across the island[4]. Human disturbance is presumably also to blame[5]. Introduced predators are a major threat, particularly feral cats[4]. Interactions with longline fisheries around the island, in the 1970s and early 1980s, could also have contributed to a decline in the population[4].

Conservation:

Listed in Appendix I, Convention on Migratory Species (CMS). All birds are banded and the population is censused and monitored every year[7]. In 1987, the number of cattle was reduced and a fence erected to seal off part of the island. In 1992, a second fence was erected with the aim of providing complete protection for the high plateau from possible incursions by cattle[7].

Targets:

Continue detailed monitoring of the population. Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[2].

References:

1. Carboneras (1992b). **2.** J. Cooper and J.P. Croxall *in litt.* (2000). **3.** Environment Australia (1999). **4.** Inchausti and Weimerskirch (submitted). **5.** Jouventin (1994b). **6.** Jouventin *et al.* (1989). **7.** Micol and Jouventin (1995). **8.** Weimerskirch *et al.* (1997). **9.** H. Weimerskirch (unpublished data).

Antipodean Albatross

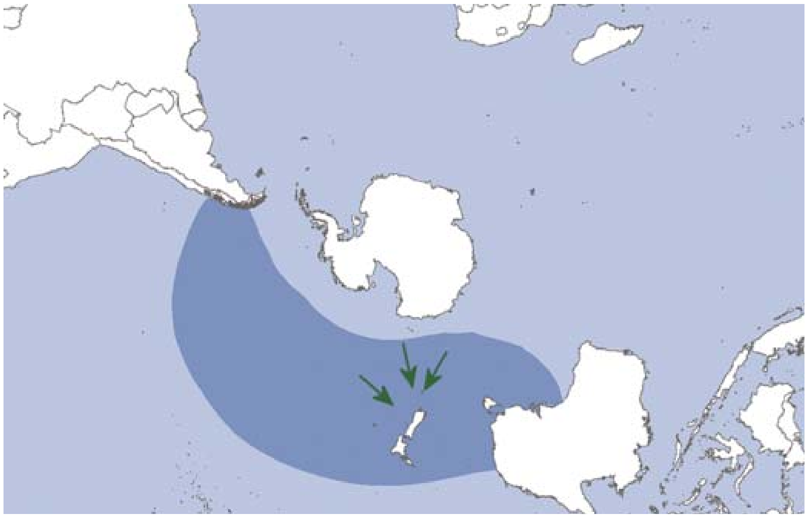
Diomedea antipodensis

IUCN THREAT STATUS: Vulnerable, population trend unknown

Identification:

WINGSPAN: 300 cm LENGTH: 110 cm BILL: 132-155 mm

Huge albatrosses with large, pale pink bills sometimes with slightly darker marks on tips. Juveniles are dark brown with a white face and underwing. Body and upperwing become whiter over many years resulting in a wide range of plumages. Tristan and Antipodes Albatrosses cannot be told apart, and are only distinguishable from Wandering Albatross by smaller size. Measure bill! Darker birds are like Amsterdam Albatross and can only be identified when the plainer pink bill is seen well, but watch out for the occasional darker marks on tip. Paler birds can look like Northern and Southern Royal Albatrosses but they usually have more dark markings on head, back and tail, and close up are distinguishable by plain pink bill.



Range and Population:

The Antipodean Albatross is endemic to New Zealand, breeding on Antipodes Island (4,635–5,757 pairs from several counts in the 1990s[10]), Campbell Island (a few pairs[3]), and the Auckland Islands group (Adams, Disappointment and Auckland), where five counts in the 1990s indicated a mean annual breeding population of 5,800. A transect count on a ridge on Adams Island repeated in 1973 and 1997 indicated a decline of 63%[11]. Birds disperse over the Tasman Sea and south Pacific Ocean east to coastal Chile[6]. Auckland Island birds also use the Southern Ocean[10]. Population: 40,000.

Ecology:

It nests from the coastline inland, on ridges, slopes and plateaus, usually in open or patchy vegetation, such as tussock grassland or shrubs. It feeds mostly on cephalopods and fish[4]. Breeding is biennial if successful[3]. On Adams Island, between 1991 and 1996, average productivity was 69%, and adult female survival was significantly lower than male adults[2].

Threats:

Between 1987 and 1992, this species was a significant bycatch in the longline tuna fishery in New Zealand waters. Female survival on the Auckland Islands is currently 2% lower than for males[11]. This may be because females disperse further north than the males[12], increasing their chance of interacting with longline fisheries in Australian and New Zealand waters. Pigs may be responsible for the near extirpation of the species on Auckland Island, and probably still take eggs and chicks, while feral cats may also kill some chicks[10].

Conservation:

Listed in Appendix II, Convention on Migratory Speices. Conservation efforts began in 1969, when the breeding population was first estimated on Antipodes. Many thousands of chicks have been banded, both on Antipodes and Adams Islands. Research focusing on foraging and non-breeding ranges is underway. By 1992, cattle and sheep had been eradicated from Campbell Island[10]. All islands are nature reserves and, in 1998, were declared part of a World Heritage Site.

Targets:

Census total breeding population for 3–4 consecutive years at 10-year intervals. Check all birds for bands during censuses for survival and recruitment measures. Develop mitigation devices/techniques to minimise fisheries bycatch. Eradicate pigs and cats from Auckland Island[10].

References:

1. Burg and Croxall (2000). **2.** Croxall and Gales (1998). **3.** Gales (1998). **4.** Marchant and Higgins (1990). **5.** Medway (1993). **6.** Nicholls *et al.* (1998). **7.** Nunn and Stanley (1998). **8.** Robertson and Nunn (1998). **9.** Robertson and Warham (1992). **10.** Taylor (2000). **11.** Walker and Elliot (in press). **12.** Walker *et al.* (1995).

Atlantic Yellow-nosed Albatross

Thalassarche chlororhynchos

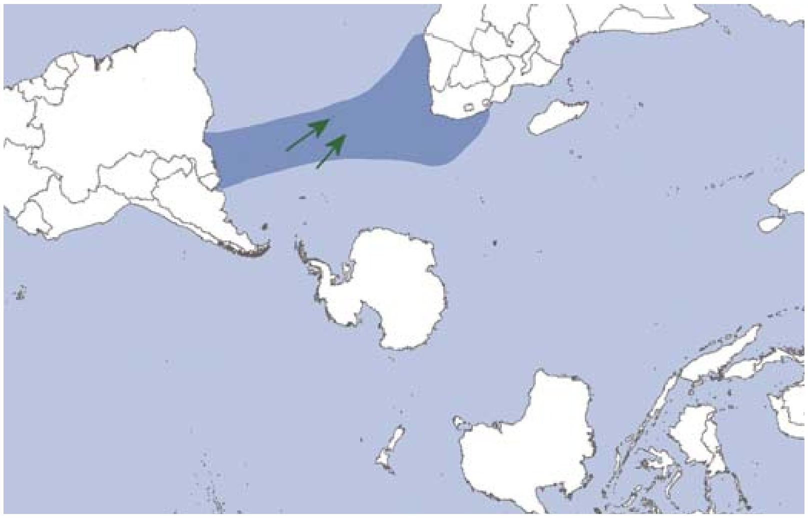
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population trend unknown

Identification:

WINGSPAN: 200 cm LENGTH: 76 cm BILL: 111-124 mm

Small, slim albatross with a white underwing thinly bordered with black. Adults have a black bill with a yellow stripe on top. Atlantic birds have a pale grey head with a large black patch in front of eye; Indian birds an almost white head with a smaller black patch. Juveniles of both have black bills, white heads and small eye patches and cannot be told apart. Adult Atlantic birds similar to Grey-headed and Buller's Albatrosses but have paler heads, more obvious eye patches, one yellow stripe on bill and thinner black line on leading edge of underwing. Young birds told from similar sized Black-browed, Campbell, Grey-headed and Buller's Albatrosses by white head, dark bill and white underwing thinly bordered with black. Compare also White-capped and Salvin's Albatrosses.



Range and Population:

The Atlantic Yellow-nosed Albatross breeds on Gough and all the islands in the Tristan da Cunha archipelago, Tristan da Cunha (to UK). Its total population was estimated at 27,000 to 46,000 breeding pairs in the 1970s, but with no recent reliable data[1]. The population on Inaccessible Island was estimated at 1,100 breeding pairs in 1988[2]. There is no information on trends for most populations but a small (<100 pairs) study population showed a significant decrease over 1982–1999[6]. In the non-breeding season it disperses throughout the South Atlantic Ocean, mainly between 45°S to 15°S, and has been recorded off the coast of Argentina, Brazil and the west coast of southern Africa[3].

Ecology:

Occasionally follows ships. Breeds colonially on cliffs of oceanic islands.

Threats:

There are reports of mortalities in longline fisheries, in particular an estimated mortality of at least 900 birds per annum off the coast of south-eastern Brazil, where it is known to be one of the commonest species attending longline boats[5]; it is also known to attend trawlers off the west coast of southern Africa[1,3,4].

Conservation:

If further information confirms that this species is suffering a continuing decline or a significant overall reduction, a classification of Vulnerable would be appropriate.

References:

1. Croxall and Gales (1998). **2.** Fraser *et al.* (1988). **3.** Harrison (1983). **4.** Olmos (1997). **5.** Olmos *et al.* (2000). **6.** Woehler *et al.* (2000).

Black-browed Albatross

Diomedea melanophris

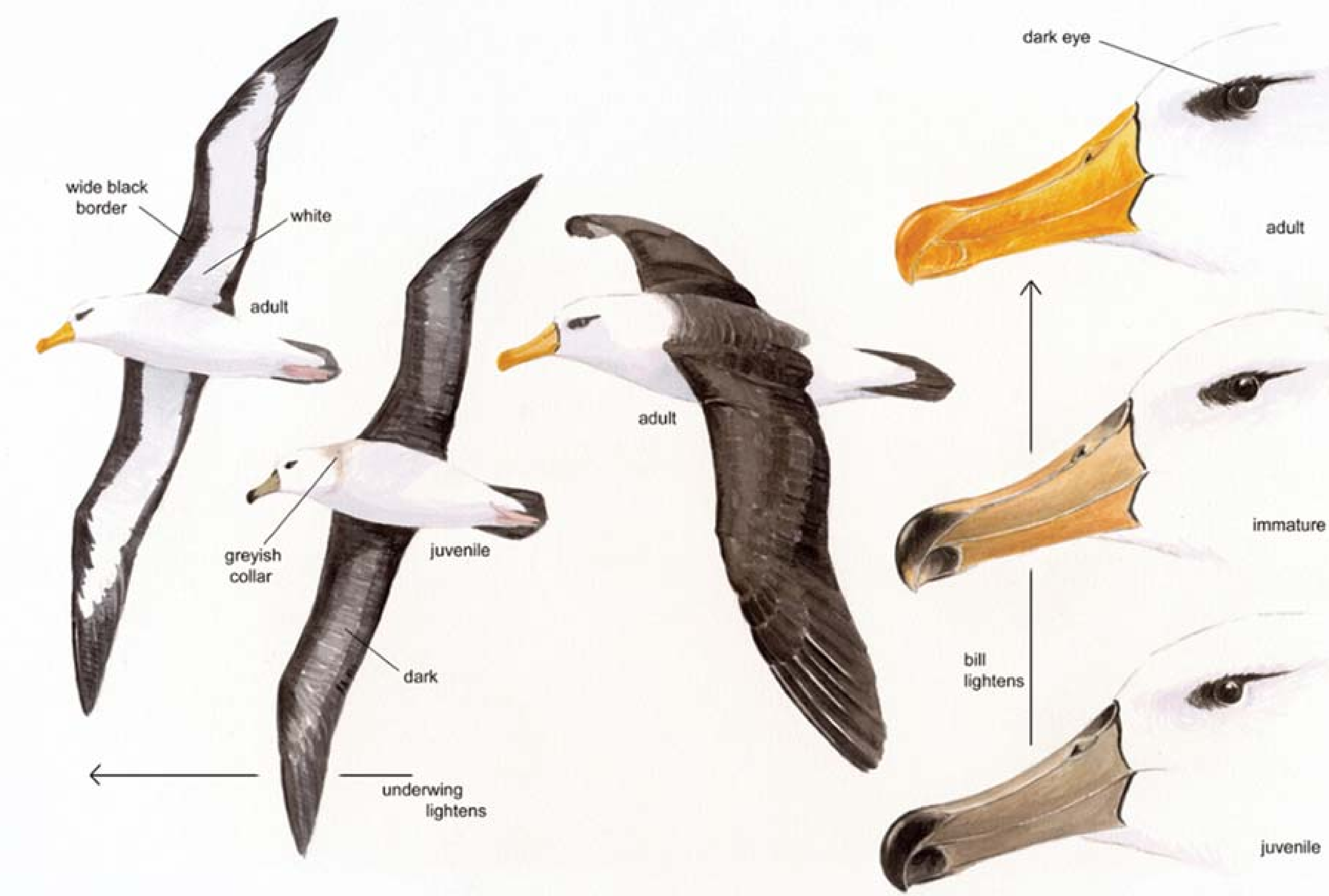


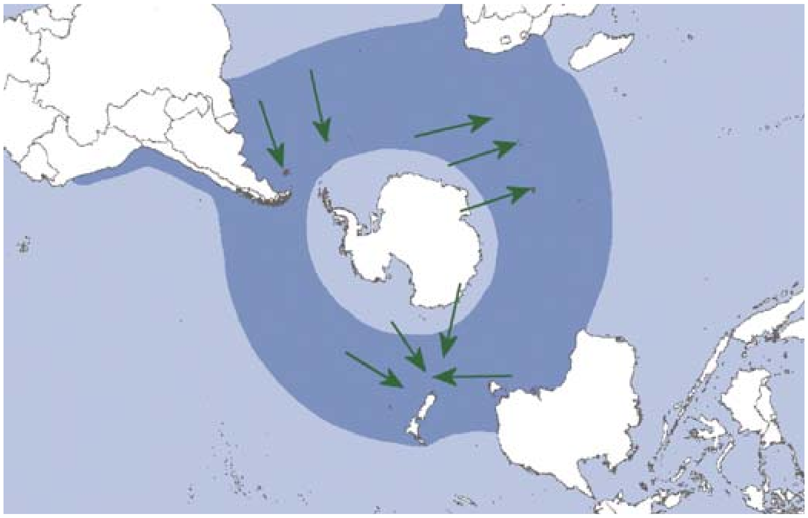
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population trend unknown

Identification:

WINGSPAN: 225 cm LENGTH: 88 cm BILL: 108-124 mm

Medium-sized black and white albatross. Adults have a white head, orange bill and broad black margins to white underwing. Young birds have variable smudgy markings on head, dull-coloured bills and dark underwings. Very similar to Campbell Albatross. Usually identifiable close up by dark eye. Young birds are very difficult to distinguish from young Grey-headed Albatrosses, but usually have paler bills with darker tips and whiter heads. Compare also Buller's and both Yellow-nosed Albatrosses.



Range and Population:

The Black-browed Albatross breeds on the Falkland Islands (to UK), Islas Diego Ramirez (Chile), South Georgia and the South Sandwich Islands (to UK), Crozet and Kerguelen Islands (French Southern Territories), Heard and McDonald Islands (to Australia), Macquarie island (Australia), and Campbell, Antipodes and Snares islands, New Zealand[1]. Its total breeding population is c.680,000 pairs, 80% at the Falkland Islands, 10% at South Georgia and 3% in Chile[1]. Populations at Bird Island (15% of the South Georgia total) and Kerguelen have declined by 35% since 1989/90 and 17% between 1978/79 and 1994/95, respectively[2,13]. Numbers at Diego Ramirez also decreased in the 1970s and 1980s[10]. Numbers in the Falklands apparently increased substantially during the 1980s[1,4], probably attributable to abundant offal and discards from trawl fisheries[12].

Ecology:

Habitual ship follower. Breeds in colonies located on grassy cliffs of oceanic islands. This is the most widespread and frequently encountered albatross.

Threats:

Counts of breeding adults suggest a strong possibility that populations may have sustained a substantial decline over the last few years[3,7]. These documented declines may be attributable to the development of new longline fisheries over much of the Patagonian Shelf, around South Georgia and off the southern African coast[8,9,11]. Indeed, it is one of the most frequently killed species in the Australian Fishing Zone[6], with up to 1,500 individuals killed per year on Japanese longliners between 1989 and 1995[5].

Conservation:

Recent (2000) census results suggest a strong possibility that populations may have sustained a substantial decline over the last few years which, if confirmed, would result in the species moving to Vulnerable status[3,7].

References:

1. Croxall and Gales (1998). **2.** Croxall *et al.* (1998). **3.** J.P. Croxall *in litt.* (2000). **4.** Gales (1998). **5.** Gales *et al.* (1998). **6.** R. Gales *in litt.* (1999). **7.** Huin (2000). **8.** Prince *et al.* (1998). **9.** Schiavini *et al.* (1998). **10.** Schlatter (1984). **11.** Stagi *et al.* (1998). **12.** Thompson and Riddy (1995). **13.** Weimerskirch and Jouventin (1998).

Black-footed Albatross

Phoebastria nigripes

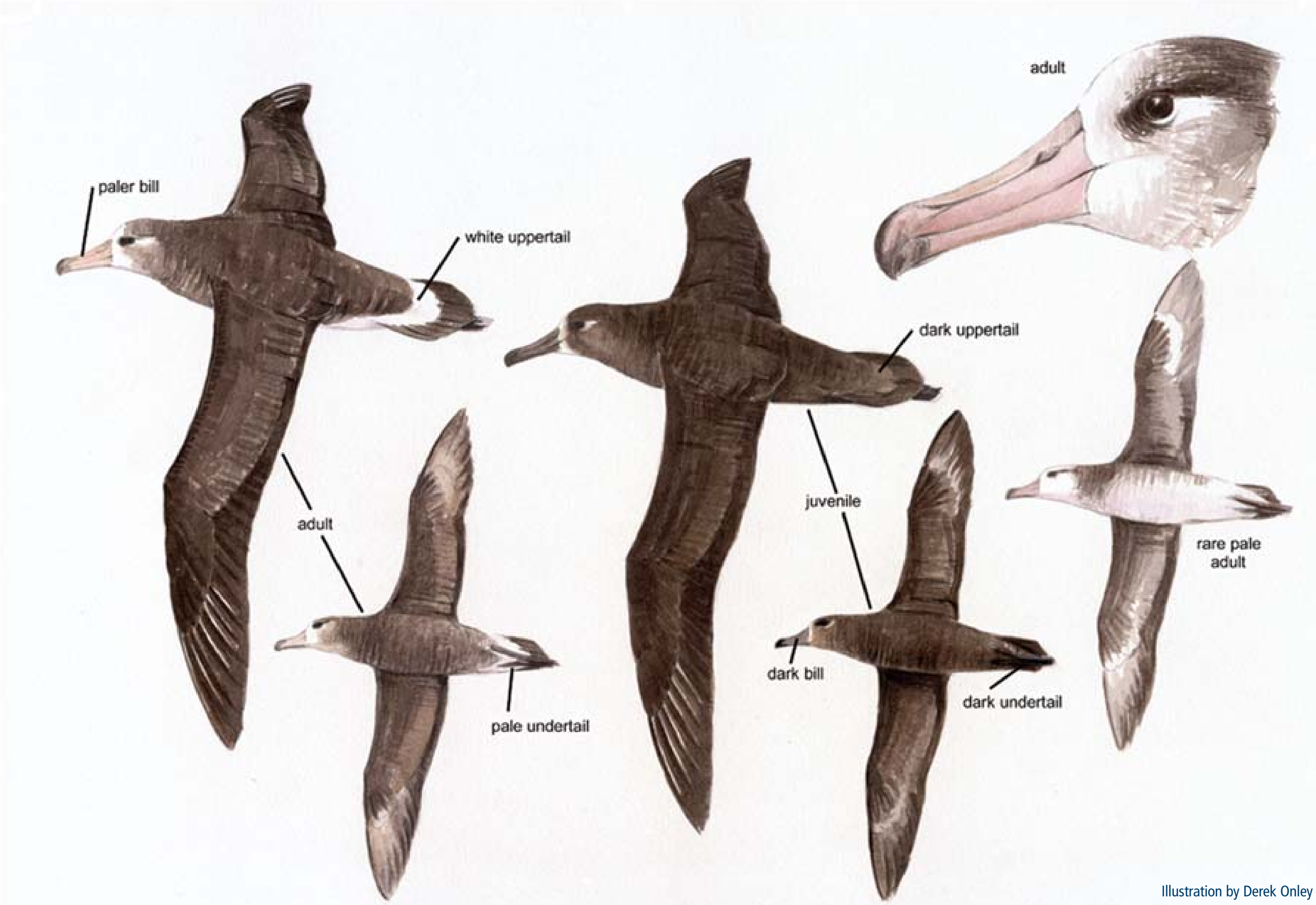


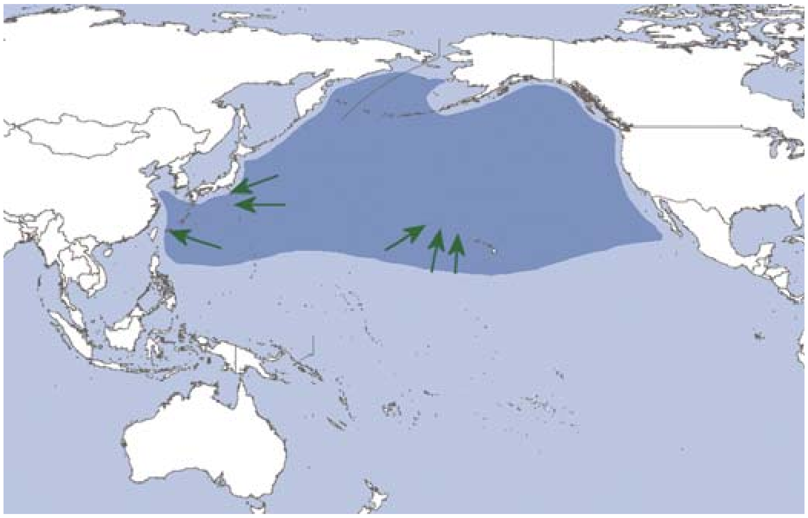
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 220 cm LENGTH: 81 cm BILL: 85-95 mm

Small, dark albatross with a pale patch at base of dark bill. Juveniles dark brown. Adults usually slightly paler, with white at base of upper and under tail. A few birds are much paler. Juveniles look like newly fledged dark billed Short-tailed Albatrosses but have pale feathers at base of shorter bill and different head and bill shapes.



Range and Population:

The Black-footed Albatross breeds on the Northwestern Hawaiian Islands (USA) and three outlying islands of Japan, colonies having been lost from other Pacific islands[3,14]. In 2000, the population was estimated at 109,000 breeding birds (278,000 total) at 12 localities, including c.23,000 and 20,500 pairs on Laysan and Midway Islands, respectively[4,13]. Although declines have been noted 1992–1999 trend data for Laysan, Midway and French Frigate Shoals (78% of breeding population) suggested stability[4]. However, the 2000 counts were lower than in 1999 and indicate a decline since 1995[13]. On Torishima, 20 chicks were reared in 1964, compared to 914 from 1,219 pairs in 1998[4]. The species disperses widely over the north Pacific Ocean, with occasional records in the Southern Hemisphere[2].

Ecology:

It breeds on beaches and slopes with little or no vegetation, and on short turf. It feeds mainly on fish, squid, flying fish ova and crustaceans[9], but also fish offal and human refuse[3]. Individuals do not breed until at least four years of age and generation time is at least 20 years[4].

Threats:

Until 1992, it suffered high mortality from interactions with squid fishing gear and drift-nets in the north Pacific[11]. Currently, it interacts with longline fisheries, with mortality thought to be at least 3,000 birds per year in US-based fisheries[5,7], possibly many more elsewhere[4]. Other threats include loss of nests to waves[5], pollution[1,12], introduced predators[10], oiling, plastic ingestion and volcanic eruption on Torishima[8].

Conservation:

Listed in Appendix II, Convention on Migratory Species. All Hawaiian breeding localities are part of the US National Wildlife Refuge system or State of Hawaii Seabird Sanctuaries. Nearly 80% of the breeding population is counted directly or sampled every year. Up to 100,000 birds are banded. All sites except one have been surveyed since 1991[5].

Targets:

Continue monitoring population trends and demographic parameters[6].

- Continue satellite-tracking studies to assess temporal and spatial overlap with longline fisheries[6].
- Adopt best-practice mitigating measures in all longline fisheries within the species' range.

References:

1. Auman *et al.* (1997). **2.** Carboneras (1992b). **3.** Cousins (1998). **4.** Cousins and Cooper 2000. **5.** Croxall and Gales (1998). **6.** R. Gales *in litt.* (1999). **7.** Gould and Hobbs (1993). **8.** Harrison, C. S. (1990). **9.** Harrison *et al.* (1983). **10.** Hasegawa (1984). **11.** Johnson *et al.* (1993). **12.** Jones *et al.* (1996). **13.** USFWS data *per* E. Flint *in litt.* (2000). **14.** Whittow (1993).

Buller's Albatross

Thalassarche bulleri

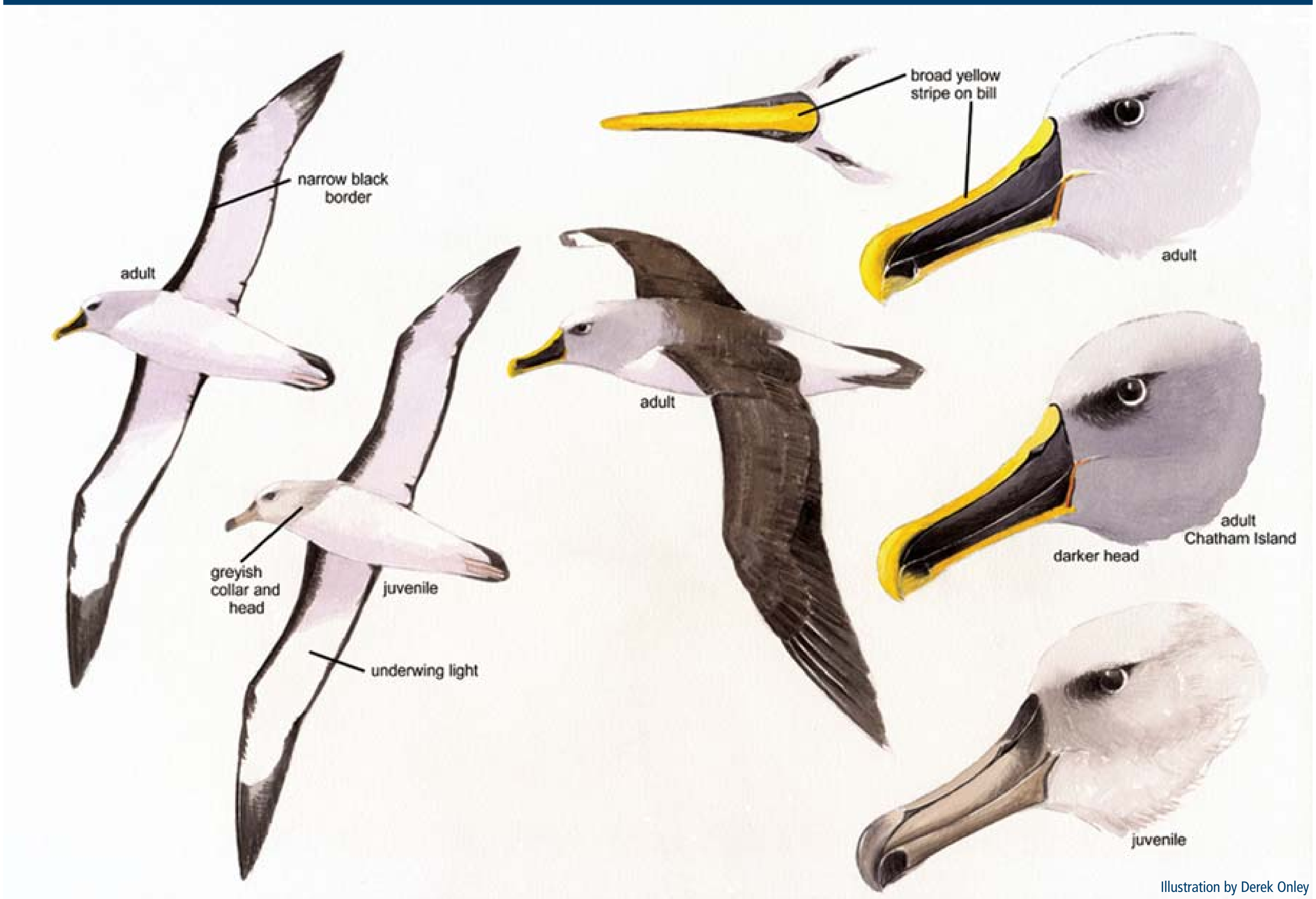


Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population stable

Identification:

WINGSPAN: 210 cm LENGTH: 79 cm BILL: 111-126 mm

Small albatross. Underwing white with a black border, slightly wider at leading edge. Adults have black bill, striped yellow top and bottom and pale grey heads, darker on Chatham I. birds. Young birds have dull colored bills and patchy grey heads. Adult told from similar Grey-headed Albatross by wider yellow stripe on top of bill and narrower black stripe on leading edge of underwing and from Atlantic Yellow-nosed Albatross by darker grey head, smaller black eye patch and two yellow stripes on bill. Young birds told from young Grey-headed, Black-browed and Campbell Albatrosses by white underwing with narrower black borders. See also Salvin's and Chatham Albatrosses.

Range and Population:

The Buller's Albatross is endemic to New Zealand. It breeds on the Snares (8,877 pairs) and Solander (2,625) Islands in the south[9], Forty-Fours (16,000) and Big and Little Sister (2,130) Islands in the Chatham Island group, and Rosemary Rock, Three Kings Islands (20) off North Island[3]. The population on Main Island (Snares) has almost doubled since 1969, but the rate of increase has declined in the 1990s. The population on Solander may have declined by 19% since 1985, or remained stable[9]. Birds disperse across the south Pacific Ocean to the west coast of South America[8,11]. Population estimate: 58,000 birds

Ecology:

It breeds in a variety of habitats including tussock and grass-covered cliffs, under forest canopy, grassy meadows and scrub[5]. It feeds mostly on squid, fish, krill, tunicates and octopuses[4,5]. On Little Sister, annual productivity 1994–1996 was 57–60% (to end of guard stage), and mean annual adult survival 1974–1995 was 93.5%[3].

Threats:

A severe storm in 1985 almost completely removed soil and vegetation from Sisters and Forty-Fours Islands. Although *T. bulleri* seems unaffected, further habitat degradation could result in population decreases, as has been predicted for Northern Royal Albatross *Diomedea sanfordi*[3]. It is one of the more common bycatch species in the longline tuna fishery in New Zealand waters, where all birds caught are adults[1,6]. It is also caught by squid trawlers in low numbers despite the banning of net-sonde cables in 1992[4,11]. Weka *Gallirallus australis* was introduced to Big Solander and may take eggs and chicks[11].

Conservation:

Listed in Appendix II, Conservation on Migratory Species. Long-term studies have been initiated in all main populations[11]. Most islands are legally protected, but all Chatham colonies are on private land.

Targets:

Complete an accurate census on Forty-Fours and Big Sister. Census all colonies for 2–4 consecutive years every 10 years, and Little Sister at least every five years. Develop mitigation devices/techniques to minimise fisheries bycatch. Establish observer coverage on fisheries east of the North Island and the Chathams.

- Eradicate *G. australis* from Big Solander Island. Obtain legal protection for Forty-Fours and Sisters Islands, and continued access for research[11].

References:

1. Bartle (2000b). **2.** Brooke (in prep.). **3.** Croxall and Gales (1998). **4.** Heather and Robertson (1997). **5.** Marchant and Higgins 1990). **6.** Murray *et al.* (1993). **7.** Robertson and Nunn (1998). **8.** Sagar and Weimerskirch (1996). **9.** Sagar *et al.* (1999b). **10.** P. Sagar *in litt.* (1999). **11.** Taylor (2000).

Campbell Albatross

Thalassarche impavida

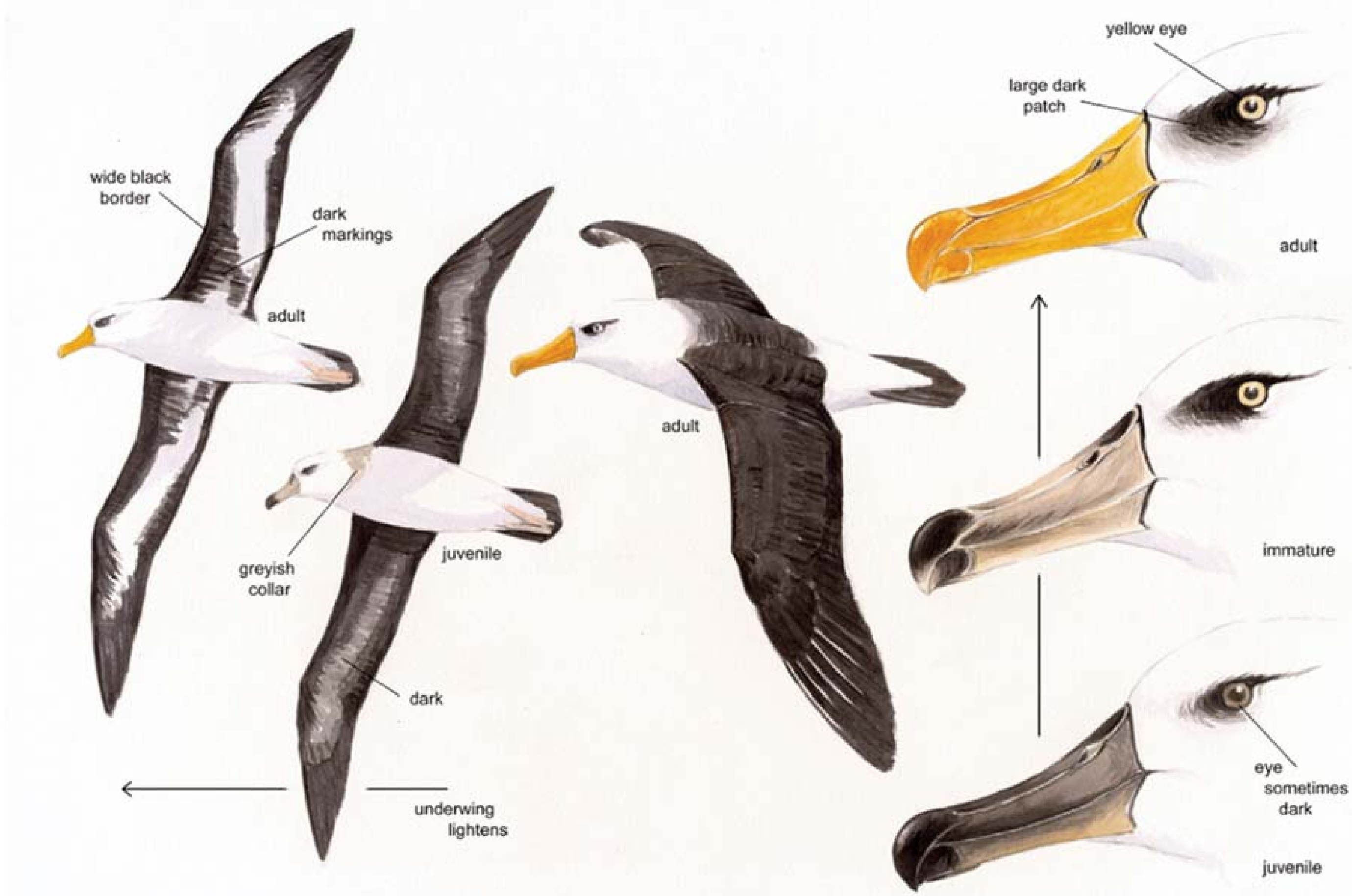


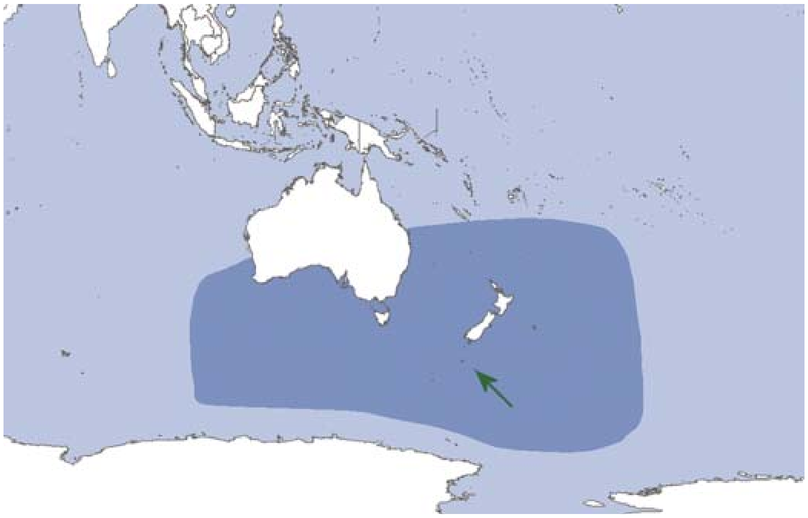
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population stable

Identification:

WINGSPAN: 220 cm LENGTH: 88 cm BILL: 105-118 mm

Medium-sized black and white albatross. Adults have a white head, orange bill and broad black margins to white underwing. Young birds have variable smudgy markings on head, dull-coloured bills and dark underwings. Very similar to Black-browed Albatross. Usually identifiable close up by yellow eye. Young birds are very similar to young Grey-headed Albatrosses. Identifiable close up by yellow eye, otherwise bill is slightly paler with a dark tip and head whiter. Compare also Buller's and both Yellow-nosed Albatrosses.



Range and Population:

The Campbell Albatross breeds only on the northern and western coastline of Campbell Island (111 km^2) and the tiny offshore islet, Jeanette Marie, New Zealand. The total population is between 19,000 and 26,000 breeding pairs[7]. Numbers decreased steeply between the 1970s and 1980s—one colony declined at a rate of 5.9% per year between 1966–1981, and 10.5% per year between 1981–1984. However, numbers have been either stable or increasing slightly since 1984[9]. It may be confined to southern Australian waters, the Tasman Sea and the South Pacific Ocean[1].

Ecology:

It nests on ledges and steep slopes covered in low native grasses, tussocks and mud[8]. It feeds mainly on krill and fish[4]. Mean annual productivity was 66% between 1984 and 1994. Mean adult survivorship was 94.5% between 1984 and 1995. Average age of first breeding is 10 years[9].

Threats:

Large numbers are caught by tuna longline vessels, mostly juveniles in New Zealand seas, but also adults in Australian waters[1,3,7]. The population decline coincided with the development of a large-scale fishery that peaked in New Zealand waters during 1971–1983. The present gradual increase in numbers may be due to a substantial decline in fishing effort since 1984[9]. However, during 1988–1995, it still comprised 11% of all the seabirds killed on tuna longlines in New Zealand waters and returned for identification[7], and 13% of all banded birds caught in Australian waters[2]. It is also attracted to offal discarded from trawlers, and is occasionally drowned in nets[3]. Brown rat present on Campbell Island, probably has little effect[7].

Conservation:

Listed in Appendix II, Convention on Migratory Species. The species was first studied in the 1940s. Feral sheep were eradicated from Campbell Island in 1991. Research includes studies on population dynamics, colony distribution, biology, diet and foraging[7]. The islands are a national nature reserve, and part of a World Heritage Site, declared in 1998.

Targets:

Complete ground census of colonies for three consecutive years every 10 years, and repeat photopoints at least every five years. Search intensively for banded birds in two consecutive years at five-year intervals. Complete research to clarify fisheries interactions.

- Develop mitigation devices/techniques to minimse fisheries bycatch. Eradicate rats from Campbell Island[7].

References:

1. Croxall and Gales (1998). **2.** Gales *et al.* (1998). **3.** Heather and Robertson (1997). **4.** Marchant and Higgins (1990). **5.** Nunn *et al.* (1996). **6.** Robertson and Nunn (1998). **7.** Taylor (2000). **8.** G.A. Taylor *in litt.* (1999). **9.** Waugh *et al.* (1999).

Chatham Island Albatross

Thalassarche eremita

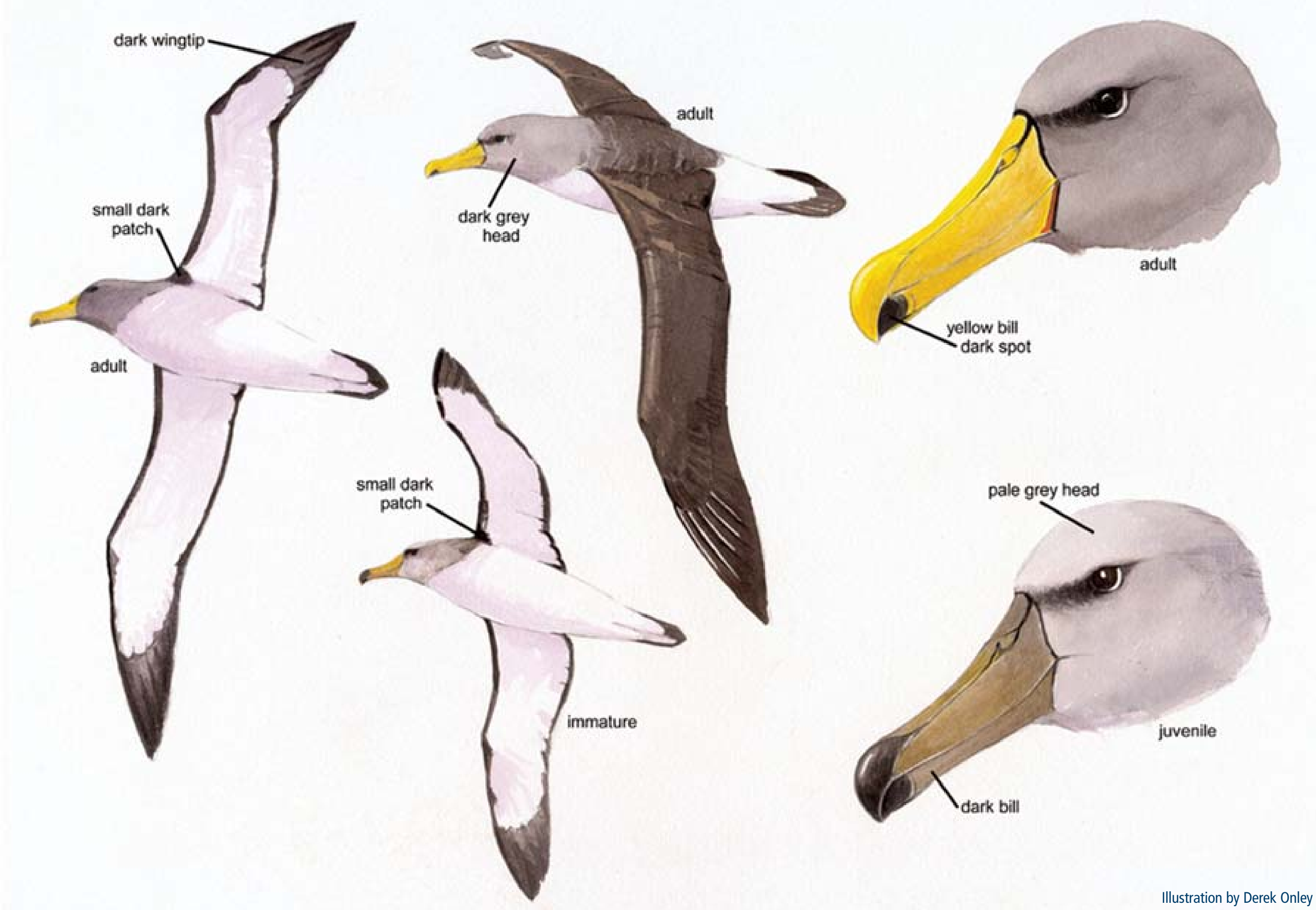


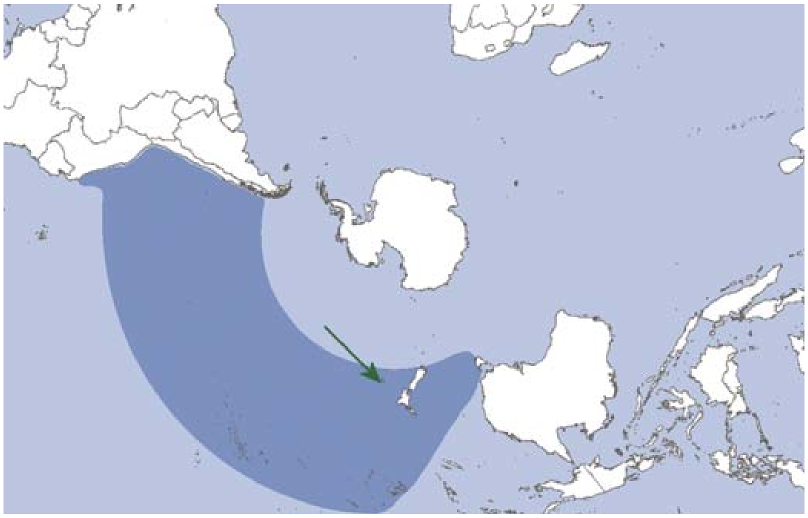
Illustration by Derek Onley

IUCN THREAT STATUS: Critical, population stable

Identification:

WINGSPAN: 220 cm LENGTH: 90 cm BILL: 113-130 mm

Medium large albatross. White underwing has dark wingtip, narrow black border and small dark patch at base of leading edge. Adult easily identified by yellow bill and dark grey head. Young birds have dark bills that lighten over several years and very variable patchy grey heads. They can be told from young White-capped Albatrosses by darker tip to underwing but are probably indistinguishable from young Salvin's Albatross unless bills show some adult coloring. Larger than Black-browed, Campbell, Buller's, Grey-headed and both Yellow-nosed Albatrosses with a different underwing pattern.



Range and Population:

The Chatham Island Albatross breeds only on The Pyramid, a large rock stack in the Chatham Islands, New Zealand. Aerial photographs indicated that the breeding population was between 3,200 and 4,200 pairs[2], but a ground count in 1999–2000 revealed 5,333 occupied sites[8]. Satellite tracking (1997–1999) and other observations indicate that it disperses within the south Pacific Ocean west to Tasmania and east to Chile and Peru. Most of April–July is spent in Peruvian coastal waters north to 6°S[8]. Population estimate: 10,000 – 11,000 birds.

Ecology:

It usually nests on rocky ledges and steep slopes. It feeds mostly on cephalopods and fish[3]. An estimated 1,200–1,500 chicks fledged each year between 1993 and 1995, and 2,100 were banded[2].

Threats:

Since 1985, a significant reduction in the extent and condition of vegetation on the islet occurred due to extreme storms, and soil was severely reduced. As a result, there is an increased probability of nest collapse due to reduced moisture retention (as has happened to Northern Royal Albatross *Diomedea sanfordi* on the Sisters and Forty-Fours Islands)[2]. Since 1998, there has been some improvement in soil and vegetation cover[8]. Some parts of the colony that have been exposed to some of the more recent storms, 1992–1999, have had very low productivity[2], although overall c.60% of nests hatched young between 1997–2000[8]. The only confirmed individual caught by a tuna longliner was reported in 1997, and a further nine were caught by a research vessel and demersal longliners fishing for ling. Birds also attend trawlers off both the east and west coast of New Zealand. Three banded or transmitter birds have been reported as caught by coastal longline fisheries in Chile and Peru, 1995–1999[8]. Illegal harvesting of chicks may occur annually[1], and though suggested numbers are small, this may have some effect on the population[6].

Conservation:

Listed in Appendix II, Convention on Migratory Species. In 1995, detailed population studies were commenced. The islet is privately owned[6].

Targets:

Continue accurate ground census over three consecutive years. Repeat census at five-year intervals.

- Correlate aerial and ground counts. Resolve issue of chick harvesting with local community. Obtain legal protection for The Pyramid[6]. Develop mitigation devices/techniques to minimise fisheries bycatch, particularly for longliners[7].

References:

1. B. D. Bell and D. Bell *in litt.* (1999). **2.** Croxall and Gales (1998). **3.** Marchant and Higgins (1990). **4.** Nunn *et al.* (1996). **5.** Robertson and Nunn (1998). **6.** Taylor (2000). **7.** B. Weeber *in litt.* (2000). **8.** C.J.R. Robertson *in litt.* (2000).

Grey-headed Albatross

Thalassarche chrysostoma

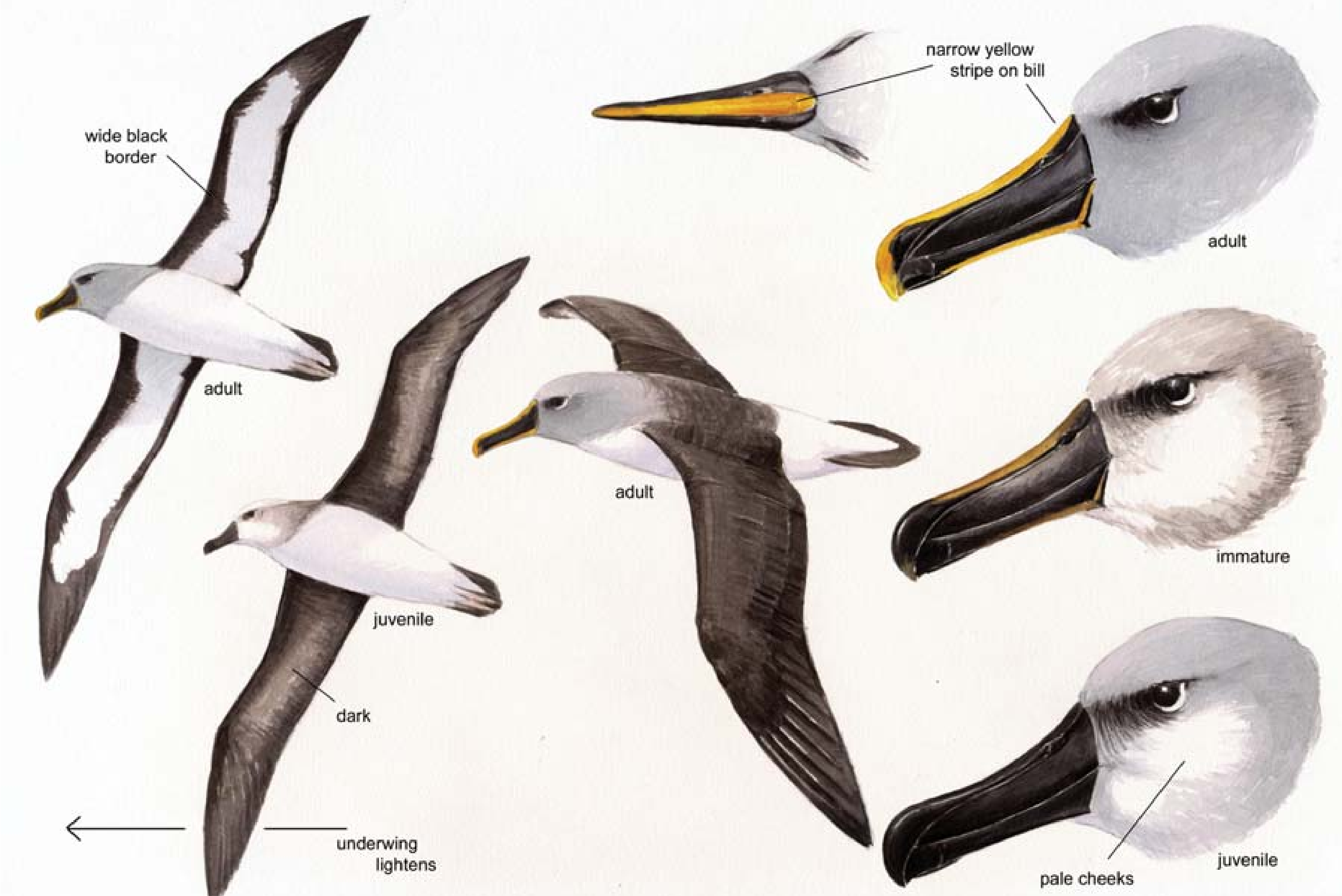


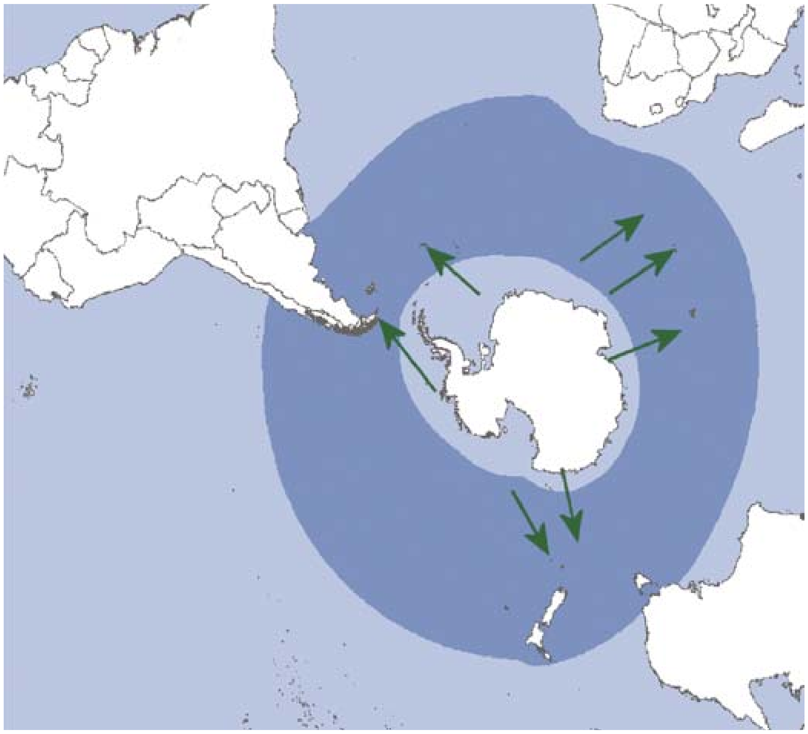
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 220 cm LENGTH: 81 cm BILL: 102-120 mm

Smaller albatross. Adults have black bill striped yellow top and bottom, grey heads and white underwing bordered with black, broadly so on leading edge. Young birds have dark bills, patchy grey heads, often with pale cheeks and dark underwings. Adults told from similar Buller's Albatross by narrower yellow stripe on top of bill and wider black stripe on leading edge of underwing, and from Atlantic Yellow-nosed by much darker grey head, broader black leading edge to underwing and two yellow stripes on bill. Young birds are very difficult to tell apart from young Black-browed and Campbell Albatrosses but usually have darker bills, more grey on head and unlike Campbell Albatross, dark eyes. See also Salvin's and Chatham Albatrosses.



Range and Population:

The Grey-headed Albatross breeds on Islas Diego Ramirez (Chile), South Georgia (to UK), Prince Edward and Marion Islands (South Africa), Crozet Islands, Kerguelen Islands (French Southern Territories), Macquarie Island (Australia) and Campbell Island (New Zealand). At Bird Island, the population (15% of South Georgia population which is 56% of total) has declined 19–29% since 1975–1976[5], and recruitment rates of juveniles have dropped from 38% to 5%[6,11]. At Marion, the population (7% of total) has declined at 0.7% per year until 1992, after which it increased slightly[5]. At Campbell, the population (7% of total) has declined since the 1940s, with three colonies declining by 79–87%[13]. It is likely that other populations are also decreasing, particularly at Diego Ramirez (11% of total)[5]. Its range at sea while breeding lies largely within or south of the Antarctic Polar Frontal Zone[12,15], but it then disperses widely in all the southern oceans. Population estimate: 25,000 birds

Ecology:

It breeds biennially on steep slopes or cliffs, generally with tussock-grass. It feeds mainly on cephalopods and fish, but also crustaceans and carrion, and lampreys are locally important[10,15]. It actively scavenges baits[9].

Threats:

In Australian waters, up to c.400 individuals (>80% juvenile) were killed annually in 1989–1995 by Japanese longliners[5,8]. In the Indian Ocean, illegal or unregulated fishing for Patagonian toothfish *Dissostichus eleginoides* killed an estimated 10,000–20,000 albatrosses (mainly this species) in 1997 and 1998[1,2]. At Campbell, the long-term decline appears to be caused by environmental factors, possibly rising sea-surface temperatures resulting in food shortages, but longline fisheries may also contribute[14].

Conservation:

Listed in Appendix II, Convention on Migratory Species. Population monitoring and foraging studies are being undertaken at South Georgia, Diego Ramirez, Marion, Macquarie and Campbell Islands. Macquarie and Campbell are World Heritage Sites and the Prince Edward Islands are a Special Nature Reserve.

Targets:

Continue existing monitoring and commence at little-known sites[3,7]. Satellite-track birds from Campbell to investigate possible causes of decline[9]. Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[4].

References:

1. CCAMLR (1997). **2.** CCAMLR (1998). **3.** J. Cooper *in litt.* (1999). **4.** J. Cooper and J.P. Croxall *in litt.* (2000). **5.** Croxall and Gales (1998). **6.** Croxall *et al.* (1998). **7.** Environment Australia (1999). **8.** Gales *et al.* (1998). **9.** R. Gales *in litt.* (1999). **10.** Prince (1980). **11.** Prince *et al.* (1994). **12.** Prince *et al.* (1998). **13.** Taylor (2000). **14.** Waugh *et al.* (1999). **15.** J. Xavier (unpublished data).

Indian Yellow-nosed Albatross

Thalassarche carteri

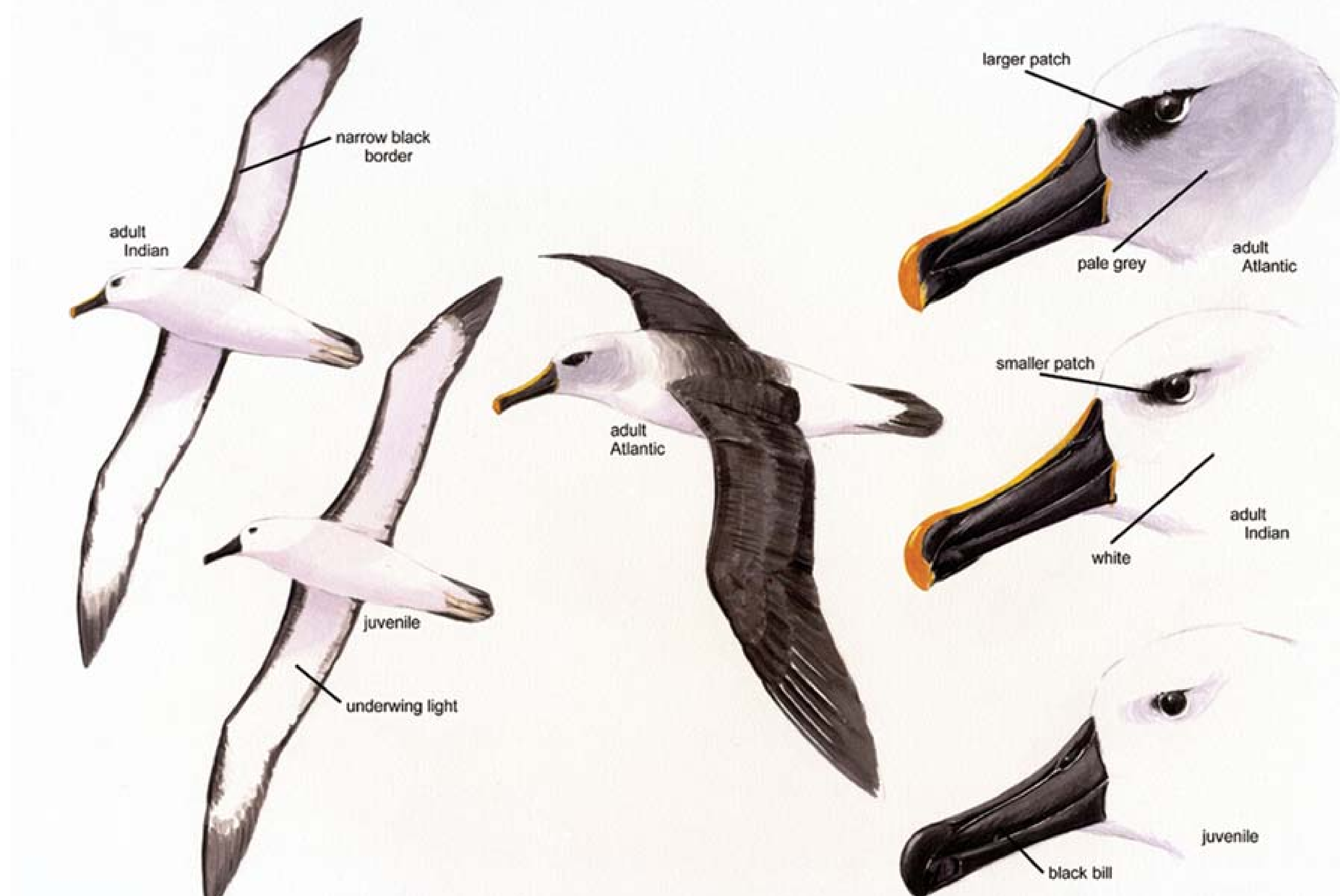


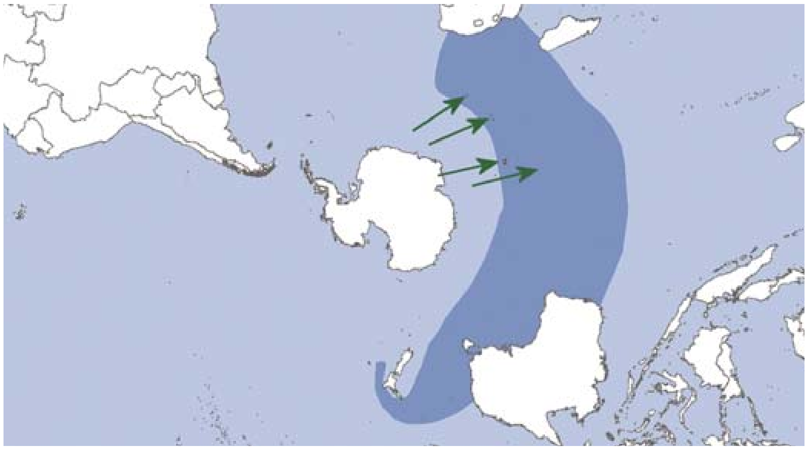
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 200 cm LENGTH: 76 cm BILL: 111-124 mm

Small, slim albatross with a white underwing thinly bordered with black. Adults have a black bill with a yellow stripe on top. Atlantic birds have a pale grey head with a large black patch in front of eye; Indian birds an almost white head with a smaller black patch. Juveniles of both have black bills, white heads and small eye patches and cannot be told apart. Adult Atlantic birds similar to Grey-headed and Buller's Albatrosses but have paler heads, more obvious eye patches, one yellow stripe on bill and thinner black line on leading edge of underwing. Young birds told from similar sized Black-browed, Campbell, Grey-headed and Buller's Albatrosses by white head, dark bill and white underwing thinly bordered with black. Compare also White-capped and Salvin's Albatrosses.



Range and Population:

The Indian Yellow-nosed Albatross breeds on Prince Edward Island (South Africa), Crozet Islands, Kerguelen Islands, Amsterdam and St Paul Islands (French Southern Territories). The population has been estimated at c.36,500 pairs, corresponding to 165,000–185,000 individuals of all age classes[4]. Amsterdam Island is the main breeding site (28,000 pairs in 1998[9]) but a decline of at least 36% has been observed there since 1984, due to increased adult mortality and poor recruitment[8]. Outside the breeding season, it disperses throughout the Indian Ocean and is frequently observed off south-western Australia and extends east to the Tasman Sea and north-eastern New Zealand[5].

Ecology:

It feeds mainly on fish, crustaceans and cephalopods[2]. It breeds annually, either solitarily or in loose groups, on slopes or cliffs, typically in bare, rocky areas but sometimes in tussock-grass and ferns[1]. Birds do not breed until 9–11 years old[1].

Threats:

Interactions with longline fisheries in the Australian region, particularly off south-western Australia, could account for observed decreases given that up to 600 may be killed annually, comprising mainly adults in the winter months and immatures during the summer fishing season[4,8]. During the breeding season, it also comes into contact with tuna longliners in subtropical waters[8], and birds (mostly adult males) have been taken by Patagonian toothfish *Dissostichus eleginoides* longliners in the vicinity of the Prince Edward Islands[7]. Other threats on Amsterdam are a disease that kills up to 95% of chicks in some colonies in some years[8] and introduced predators, such as brown rat *Rattus norvegicus* and feral cats[6].

Conservation:

Listed in Appendix II, Convention on Migratory Species (CMS). Population monitoring and foraging studies are being undertaken at Amsterdam Island. The Prince Edward Islands are a Special Nature Reserve.

Targets:

- Conduct further studies to determine the cause of decline in the Amsterdam population and monitor trends at other locations[8], notably Prince Edward and Crozet Islands.
- Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[3].

References:

1. Carboneras (1992b). **2.** Cherel and Klages (1998). **3.** J. Cooper and J.P. Croxall *in litt.* (2000). **4.** Gales (1998). **5.** Harrison (1983). **6.** Jouventin (1994a). **7.** Ryan and Boix-Hinzen (1999). **8.** Weimerskirch and Jouventin (1998). **9.** H. Weimerskirch (unpublished data).

Laysan Albatross

Phoebastria immutabilis

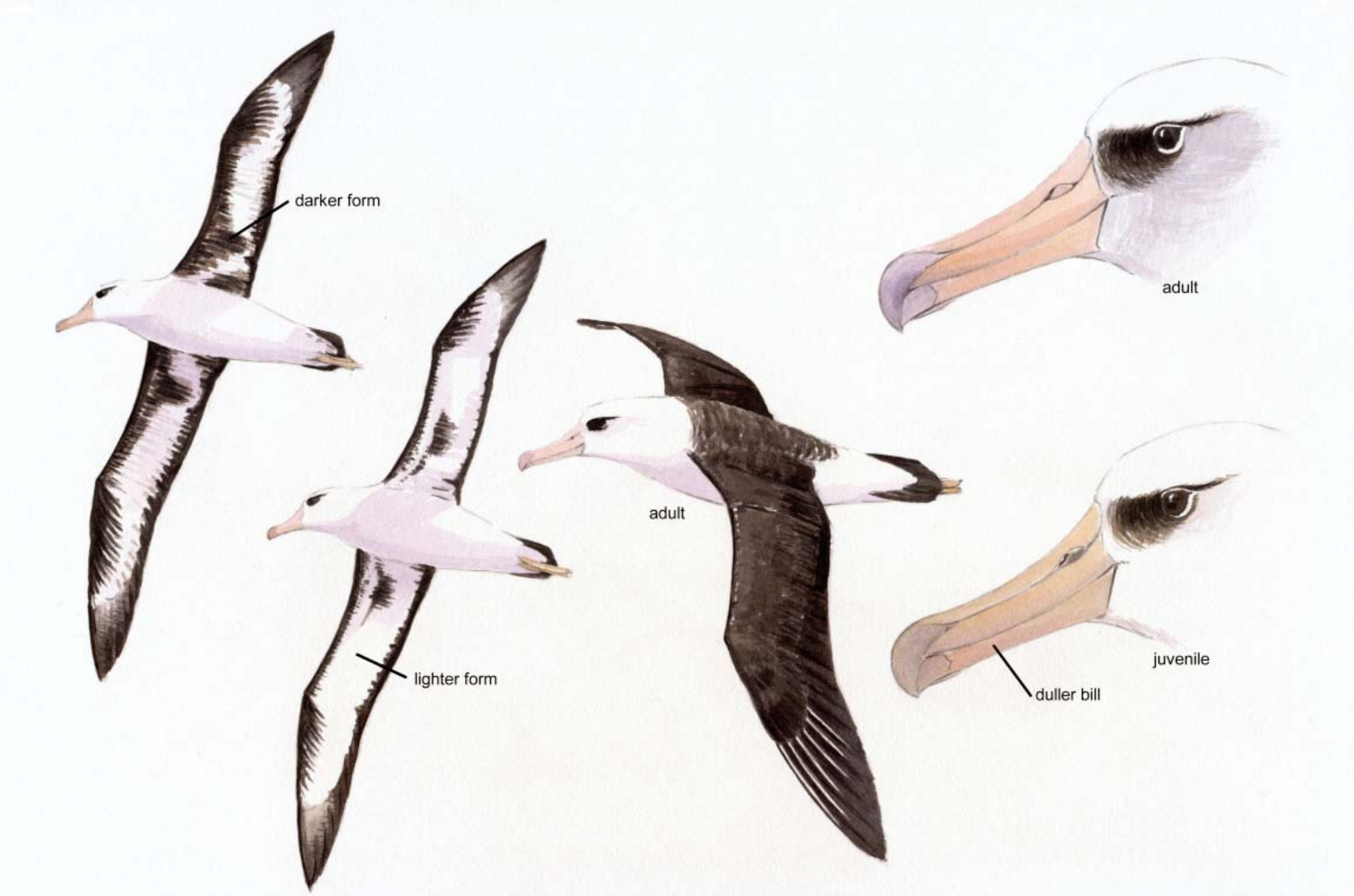


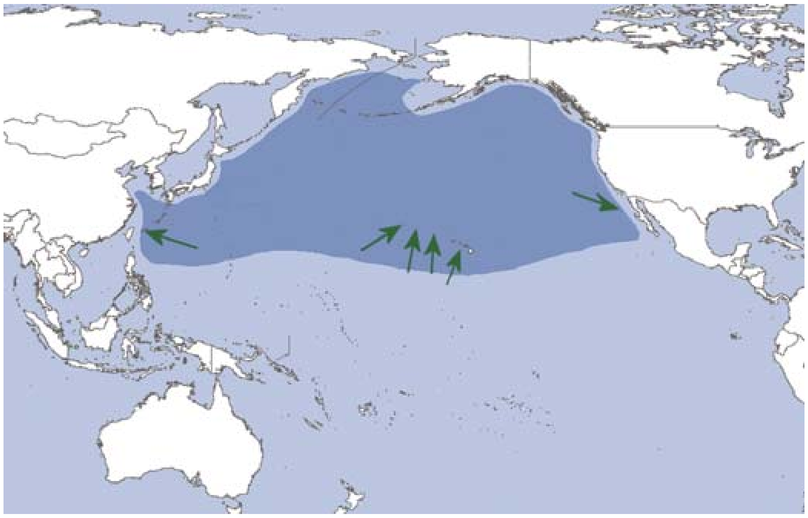
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population declining

Identification:

WINGSPAN: 220 cm LENGTH: 80 cm BILL: approx. 85-110 mm

Small black and white albatross with dark upperwing, back and tail, white body and head, and black eye patch. Some variation in amount of dark on white underwing. Adult bill is pink with a bluish tip. Juvenile bill slightly duller. Bill color similar to Short-tailed Albatross but smaller, head whiter with dark eye patch and completely dark upperwing and back. Occurs very rarely in South Pacific where bluish-tipped pink bill distinguishes it from similar plumages of Black-browed, Campbell, Indian and Atlantic Yellow-nosed Albatrosses.



Range and Population:

Laysan albatrosses range throughout the North Pacific between 20°N and 58°N latitude. Knowledge of their distribution comes primarily from reports of encounters with banded birds, from scientific transects, and from observations. The Laysan is common in the Gulf of Alaska, the Aleutian Islands and Bering Sea. In addition, more Laysan sightings are being reported on the California coast, perhaps due to the relatively new colony in Mexico. The species occurs off the East Coast of Japan[1]. Whereas the great majority of pelagic encounters of Laysan albatross have come from west of the 180º meridian[3]. It is estimated that before the feather hunters reached Marcus Island, the island had a population of one million Laysan albatrosses (Rice and Kenyon 1962). Feather hunters also raided Laysan albatross colonies in the NWHI taking at least 300,000 birds from Laysan Island in 1909 (Dill and Bryan 1912). The current world population of breeding Laysan albatrosses has moderately recovered to an estimated 2.4 million, with 558,415 breeding pairs in 15 colonies

Ecology:

It breeds colonially on oceanic islands.
It feeds mainly on fish, squid, flying fish ova and crustaceans, but also follows ships and feeds on fish offal and human refuse[2].

Threats:

Only two direct counts (i.e., a count of every bird seen during a complete survey of an island or a portion of an island) have been completed on Midway Atoll, one in 1991 (427,556 breeding pairs) and the second in 1996 (387,854 breeding pairs). The results from these counts suggest that the population has decreased by at least 10% in five years. Given that Midway Atoll is the largest colony for the species, concern should be raised by this finding.

Conservation:

The threat of accidental mortality by long-lines and the noted dramatic population declines could lead the species to receive a vulnerable conservation status.

References:

1. H. Hasegawa (1978). **2.** Harrison *et al.* (1983). **3.** Robbins and Rice (1974).

Light-mantled Sooty Albatross

Phoebetria palpebrata

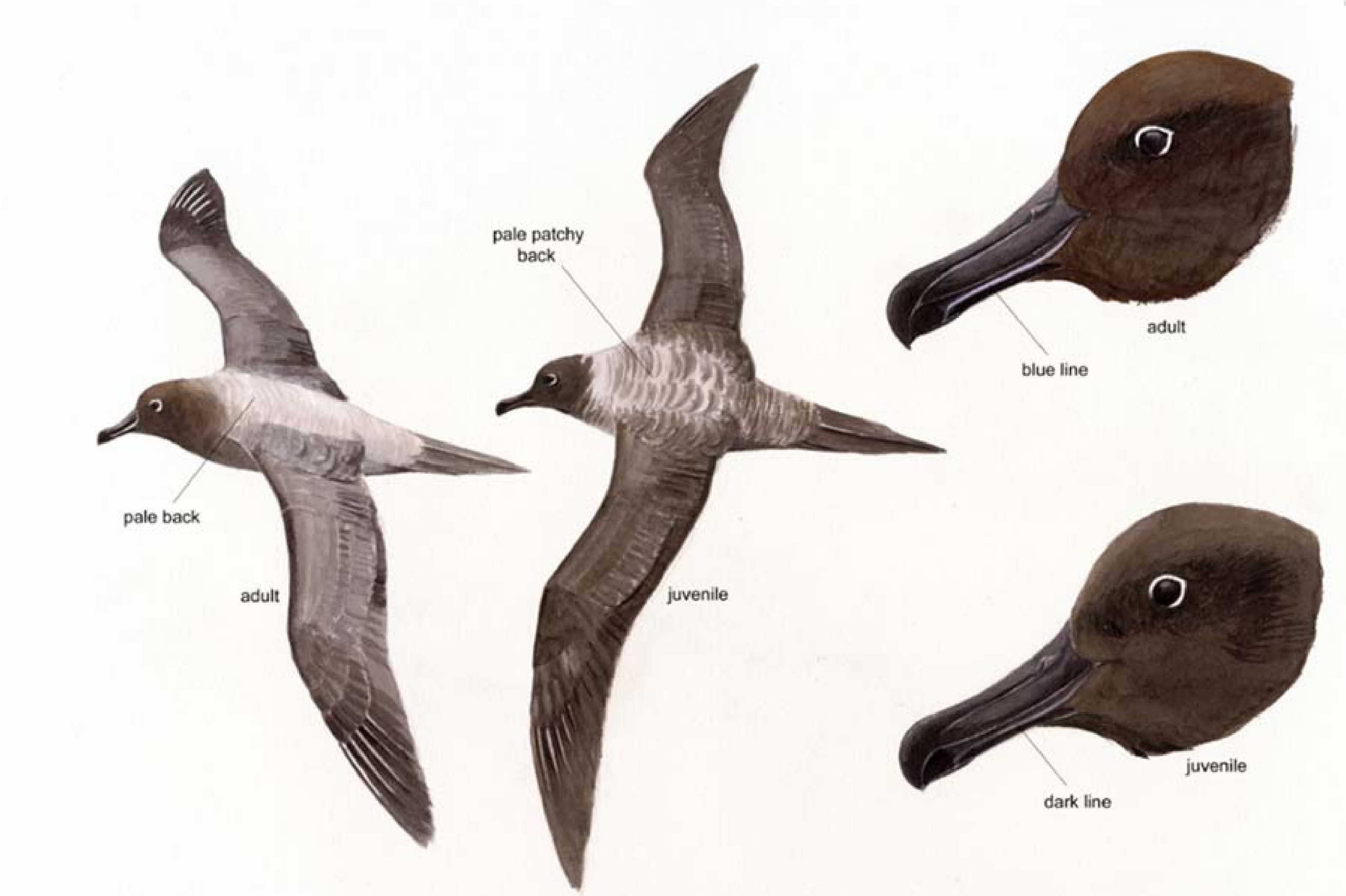


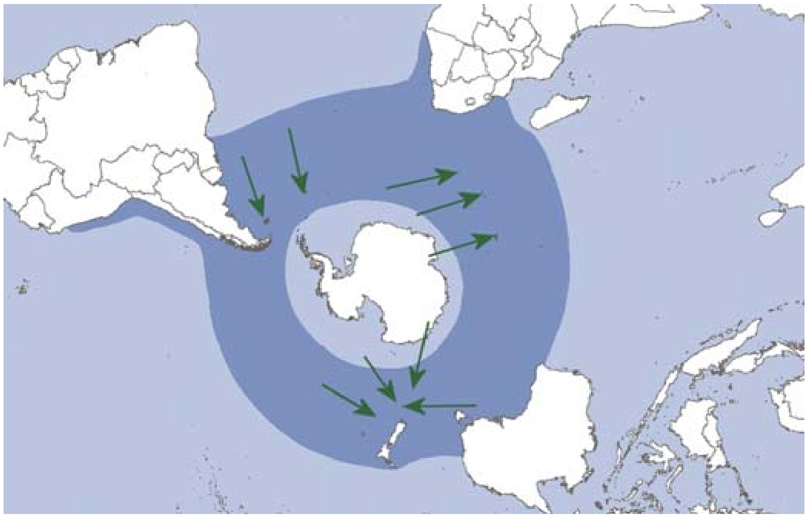
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population trend unknown

Identification:

WINGSPAN: 215 cm LENGTH: 84 cm BILL: 98-113 mm

Medium-sized, dark grey-brown albatross with a pointed, wedge-shaped tail and a paler silvery-grey back, often mottled in juveniles. Adult bills are black with a thin bluish line. Juvenile bills completely dark. Similar to Sooty Albatross. All ages distinguishable by paler back. Adults, close up, by bluish line on bill.



Range and Population:

The Light-mantled Sooty Albatross breeds on South Georgia (to UK), Prince Edward and Marion islands (South Africa), Amsterdam, St Paul, Crozet and Kerguelen islands (French Southern Territories), Heard Island (Heard and MacDonald Islands (to Australia)), Macquarie Island (Australia), and Auckland, Campbell and Antipodes islands (New Zealand). The total annual breeding population is estimated at 19,000–24,000 pairs, equivalent to 58,000 individuals in this biennially breeding species[1,4]. Population trends remain largely unknown: on Possession Island (Crozet), there has been a decline of 13% in 15 years[5] while, on Marion, there has been an increase of 66% in eight years[2]—however, this change may reflect better count effort rather than real change[3].

Ecology:

Breeds colonially on grassy cliffs of oceanic islands. The species tends to follow ships.

Threats:

Recent reports from New Zealand, Australia and Japan indicate that it is regularly caught by the tuna-longline fisheries, though few observers are present on vessels in the high seas, and numbers of birds caught may be under-reported[4]. There is also concern over longline interactions in the illegal or unregulated Patagonian toothfish *Dissostichus eleginoides* fishery in the Southern Ocean. Introduced predators are present at some of the New Zealand colonies, and may affect breeding success and colony distribution[4].

Conservation:

Further information may require this species to be upgraded to Vulnerable. Listed in Appendix II, Convention on Migratory Species.

References:

1. Croxall and Gales (1998). **2.** Marine and Coastal Management (unpublished data). **3.** P. Ryan *in litt.* (1999). **4.** Taylor (2000). **5.** Weimerskirch and Jouventin (1998).

Northern Royal Albatross

Diomedea sanfordi

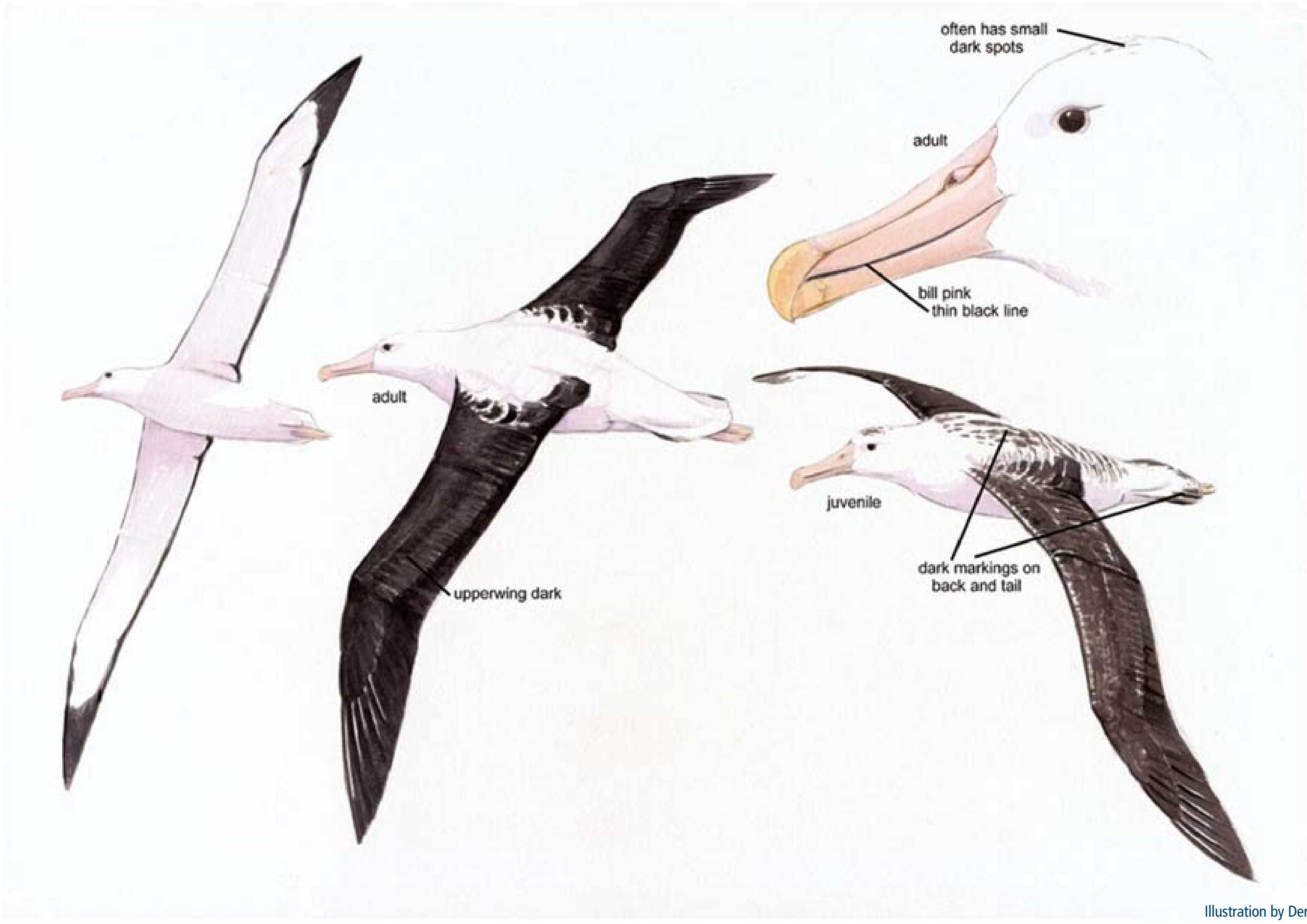


Illustration by Derek Onley

IUCN THREAT STATUS: Endangered, population declining

Identification:

WINGSPAN: 320 cm LENGTH: 115 cm BILL: 154-172 mm

Huge black and white albatross with a large pale pink bill that has a thin black line along cutting edge. Juveniles have dark upperwings, white underwings, and white body with dark marks on top of head, back, and tip of tail. Body becomes whiter over several years. Upperwings remain dark. Similar to paler plumages of Wandering, Tristan and Antipodes Albatrosses but body usually whiter and upperwings more uniformly dark. Separable close up by black line on bill. Adult difficult to tell from young dark-winged Southern Royal Albatross but those with small dark spots on head and dark tip to tail are likely to be Northern. Juveniles inseparable.

Range and Population:

The Northern Royal Albatross breeds on Forty-Fours, Big and Little Sister Islands (Chatham Islands), Taiaroa Head (Otago Peninsula, South Island) and Enderby Island (Auckland Islands), New Zealand. The Chatham Islands population (99% of the total) is 6,500–7,000 pairs. In 1995, 27 breeding pairs were present at Taiaroa Head, including five hybrids (with Southern Royal Albatross *D. epomophora*)[1,7]. Two birds have hybridised on Enderby Island. It makes circumpolar movements in the Southern Oceans[5]. Total estimated population: 13,000 birds.

Ecology:

It usually nests on the flat summits of tiny islands which formerly had herbfields[8]. It feeds mainly on squid taken from the surface, but fish, crustacea and salps are also taken[2]. First breeding occurs between 8–10 years of age[1]. At Taiaroa Head, the mean age of breeding birds is c.20 years[4]. Mean annual adult survival is 94.6–95.3%[1].

Threats:

In 1985, a storm hit the breeding sites on the Chathams, reducing soil cover and destroying all vegetation[4]—since then, nests have been built with stones, or eggs laid on bare rock[7]. As a result, mean annual productivity has plummeted to 8% (1990–1996) on the Forty-Fours, and 18% over all three islands[4], due to egg breakage, high temperatures and flooding in temporary pools[7]. In addition, a reduction in mean egg-shell thickness of 20+%, and an increased incidence of chicks dead in the shell has been recorded in the last 20 years, but does not appear to be caused by contaminants[7]. At Taiaroa Head, stoat *Mustela erminea* and cats can take eggs and chicks[1]. Mortality due to longline fishing activities may be a future threat to this species[1,7].

Conservation:

CMS Appendix II. All populations are annually monitored[1]. Population data from Taiaroa Head is the most complete for any seabird species in New Zealand[7]. Predator control during the breeding season results in comparatively high mean annual productivity[1]. Animal husbandry techniques have been developed from work with this colony. Feral cattle, rabbits and mice have been eradicated from Enderby Island[7]. Taiaroa Head and Enderby Island are nature reserves.

Targets:

Continue to census Chatham populations annually using aerial photography. Continue intensive management of Taiaroa Head colony. Band further cohorts of chicks from all colonies. Obtain legal protection for Forty-Fours and Sisters Islands, and continued access for research[7].

References:

1. Croxall and Gales (1998). **2.** Heather and Robertson (1997). **3.** Nunn *et al.* (1996). **4.** Robertson (1998). **5.** Robertson and Nicholls (2000) **6.** Robertson and Nunn (1998). **7.** Taylor (2000). **8.** G.A. Taylor *in litt.* (1999).

Salvin's Albatross

Thalassarche salvini

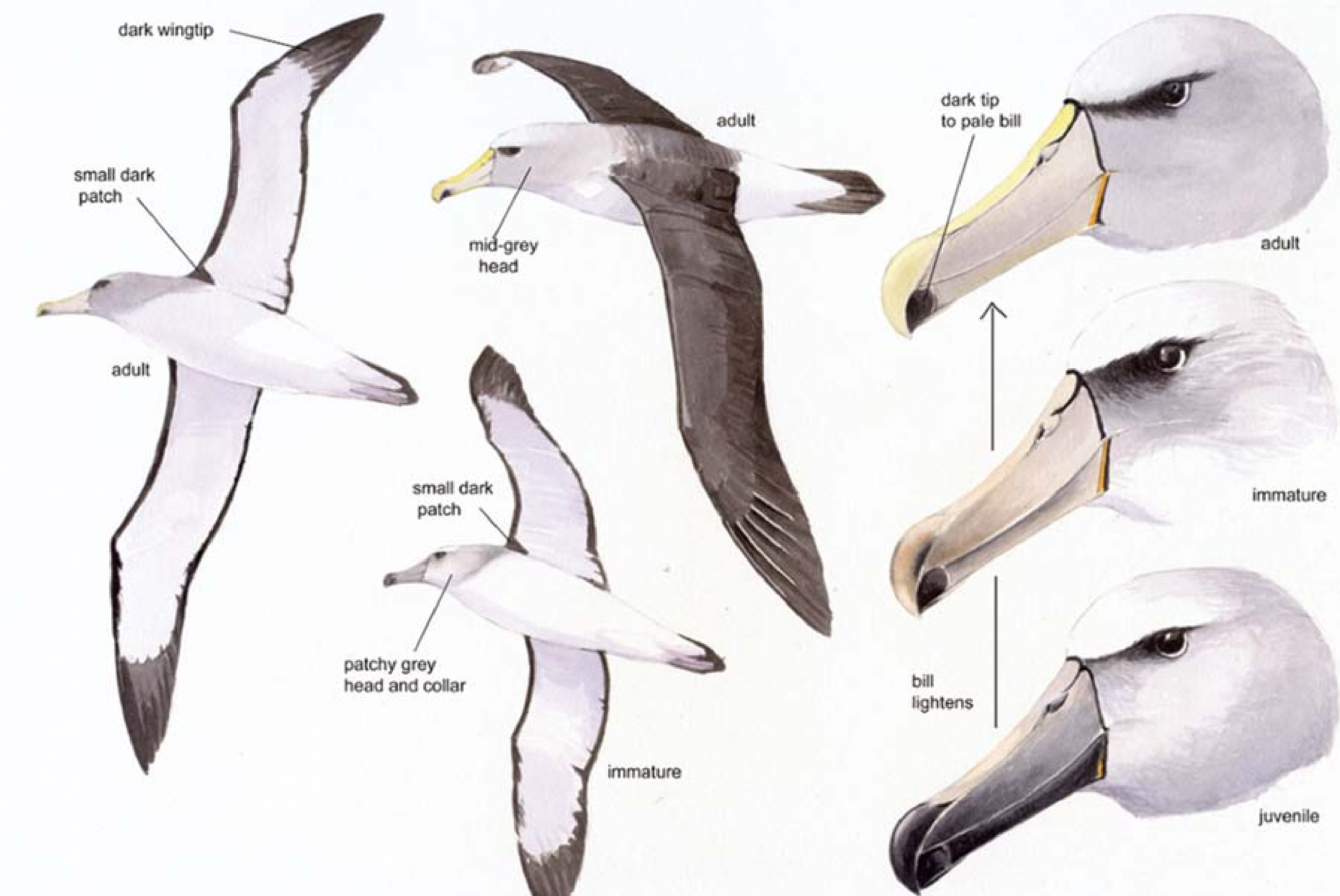


Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population stable

Identification:

WINGSPAN: 250 cm LENGTH: 90 cm BILL: 123-135 mm

Large albatross. White underwing has dark wingtip, narrow black border and small dark patch at base of leading edge. Adult has pale grey and yellowish bill with a dark spot on tip, and a pale grey head. Young birds have dark bills that lighten over several years and very variable amounts of patchy grey on the head. Adult bill can look like bill of young White-capped Albatross so identify by smoothly grey head and darker tip of underwing. Use darker underwing to tell young birds from young White-capped Albatrosses. Young birds probably indistinguishable from young Chatham Albatross unless bills show some adult colours. Larger than Black-browed, Campbell, Buller's, Grey-headed and both Yellow-nosed Albatrosses with a different underwing pattern.

Range and Population:

The Salvin's albatross breeds on the Bounty Islands (nine islands and islets), Western Chain (Snares Islands), and possibly The Pyramid (Chatham Islands), New Zealand[3,8] and has bred at least once on Ile des Pingouins (Crozet Islands, French Southern Territories). In 1978, the population on the Bounty Islands (99% of total) was estimated at 76,000 breeding pairs[7] and, in 1998, at 30,750[1,2]. Both estimates were based on counts on Proclamation Island and aerial photographs of all other islands[2,7], but census methods differed, making comparisons difficult. In 1984, the population on the three Western Chain islets was estimated at less than 650 pairs. In 1995, two empty nests on The Pyramid were occupied. In the 1980s, four pairs were recorded on Ile des Pingouins[8]. It ranges widely through the Southern, south Pacific and Indian Oceans[3,8] and large numbers of birds are found along the Peru Current[8]. Estimated population: 62,700 birds.

Ecology:

It breeds mostly on small, bare rocks[3]. It feeds mainly on cephalopods and fish[4].

Threats:

No introduced predators are present on the islands, but it is particularly vulnerable to extreme weather events. Small numbers are caught on tuna longliners in New Zealand waters, but it may also be exposed to long-line operations elsewhere in the Southern Ocean. Gradual ocean warming, resulting in changes in food availability, could pose a threat (cf. Rockhopper Penguin *Eudyptes chrysocome* and Erect-crested penguin *E. sclateri*)[8].

Conservation:

CMS Appendix II. In 1985, 1,000 fledglings were banded[3], but only one has been recovered[9]. In 1995/1996, a long-term population study was initiated on the Snares population[8]. All islands are nature reserves, except for The Pyramid which is privately-owned. In 1998, the Snares and Bounty Islands were declared part of a World Heritage Site.

Targets:

Census all the Bounty Islands intensively for baseline population estimates. Census two islands in the Bounty and Snares Islands for two consecutive years at 10-year intervals. Obtain information from South African and South American observer programmes on bycatch levels. Develop mitigation devices/ techniques to minimise fisheries bycatch[8].

References:

1. A.M. Booth *in litt.* (1999). **2.** Clark *et al.* (1998). **3.** Croxall and Gales (1998). **4.** Marchant and Higgins (1990). **5.** Nunn *et al.* (1996). **6.** Robertson and Nunn (1998). **7.** Robertson and van Tets (1982). **8.** Taylor (2000). **9.** G.A. Taylor *in litt.* (2000).

Short-tailed Albatross

Phoebastria albatrus

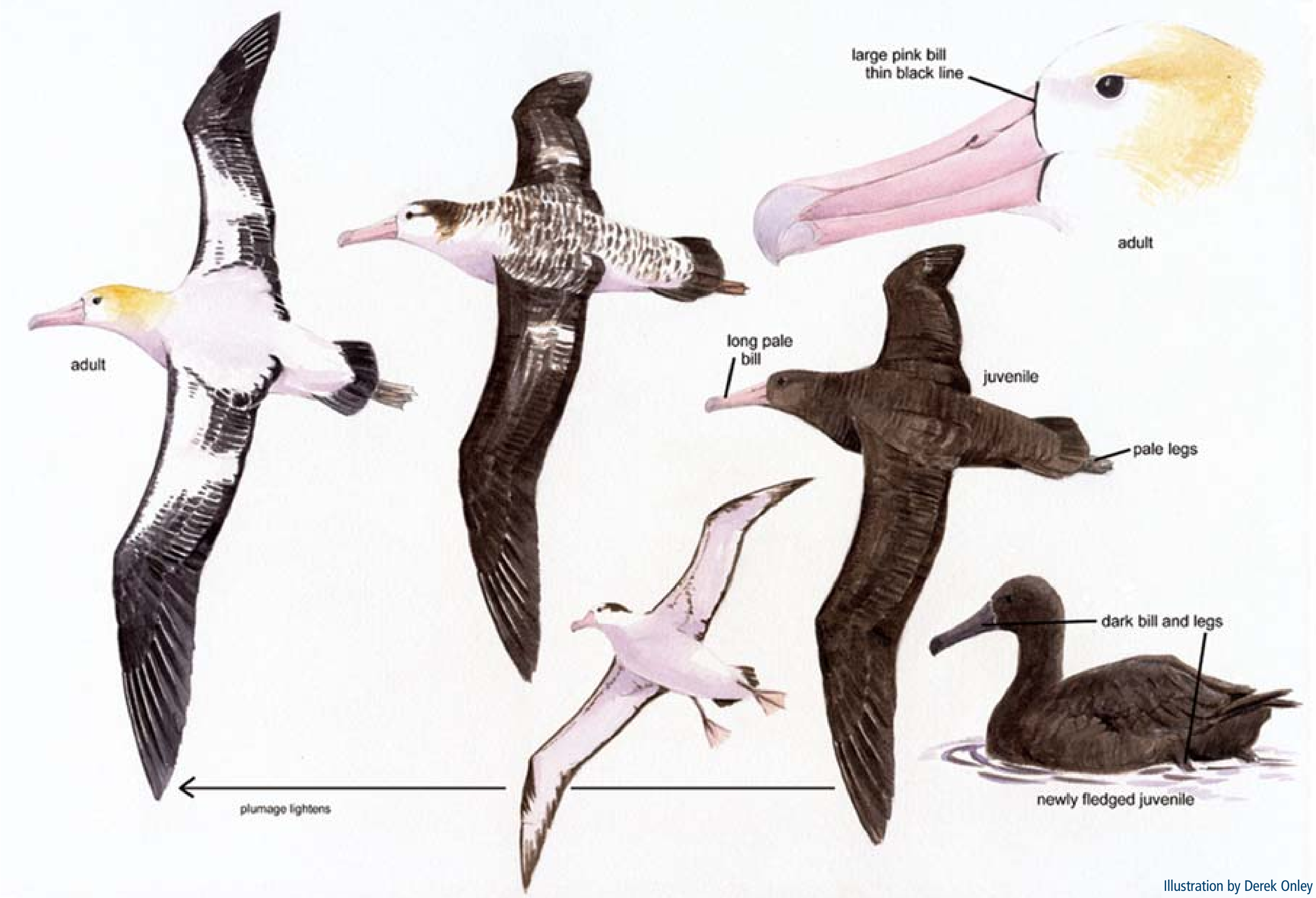


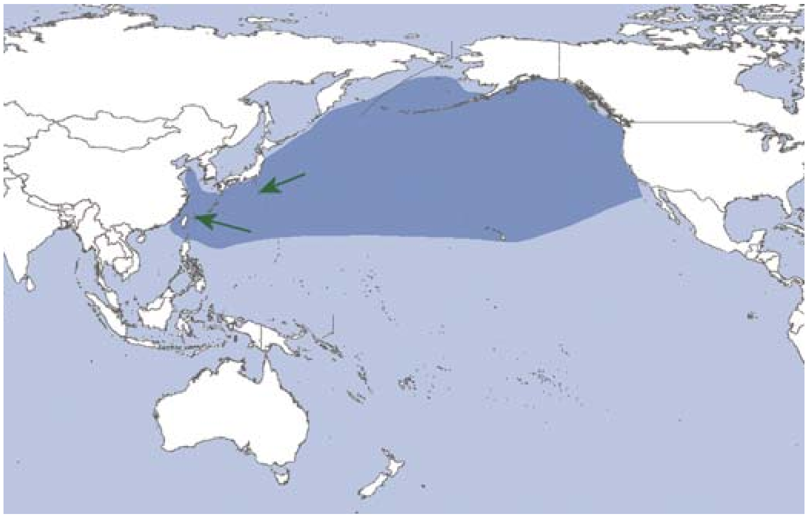
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population increasing

Identification:

WINGSPAN: 210 cm   LENGTH: 89 cm   BILL: 120-130 mm

Medium-sized albatross. Juveniles are entirely brownish-black and become whiter over many years resulting in a wide range of plumages. Dark young birds can be told from similar Black-footed Albatross by pink bill except for newly-fledged juveniles which have dark grey bills. Look for dark feathers at base of bill, long bill and differently shaped head and bill. Older whiter birds are never as neatly black and white as Laysan Albatross: dark-winged birds have patchy brown heads and white-headed birds patchy black and white wings. Check also southern hemisphere Wandering, Tristan, Antipodes and Amsterdam Albatrosses – just in case!



Range and Population:

The short-tailed albatross breeds on Torishima and the Senkaku Islands, Japan. It historically bred on several additional Japanese islands and islands off Taiwan[1]. Its marine range covers most of the northern Pacific Ocean and there are some records in the Sea of Okhotsk, but it has not recently been found in the Sea of Japan. Outside the breeding season, it has been recorded along the coasts of eastern Russia, South Korea, China and Taiwan, and Alaska and the Hawaiian Islands, USA. It declined dramatically during the 19th and 20th centuries and was believed extinct by the 1940s, until its rediscovery in the 1950s[3]. The current population is estimated at c.1,200 individuals[2], with slightly more than 1,000 birds on Torishima and 100–150 birds estimated on Minamijima.

Ecology:

For nesting, it seems to prefer level, open areas by steep cliffs, adjacent to tall clumps of the grass *Miscanthus sinensis*. It feeds mainly on squid and has been recorded following ships to feed on scraps and fish offal.

Threats:

Its historical decline was caused by exploitation. Today, the key threats are mortality caused by fisheries and the instability of soil on its main breeding site. With the majority of the population breeding at a single site, it is vulnerable to natural disasters, such as volcanic eruptions. Introduced predators are a potential threat.

Conservation:

CITES Appendix I. CMS Appendix I. It is legally protected in Japan and the USA. Torishima has been established as a National Wildlife Protection Area. In 1981–1982, native plants were transplanted into the Torishima nesting colony, in order to stabilise the nesting habitat and the nest structures. This has enhanced breeding success, with over 60% of eggs now resulting in fledged young. Decoys have been used to attract birds to nest at another site on Torishima and the first pair started breeding at this new site in November 1995. Almost all birds on Torishima are banded.

Targets:

Promote measures designed to protect this species from entanglement in fishing nets and prevent mortality from longline fisheries. Study the possibility of attracting it to breed at former colonies. Promote conservation measures for the population in the Senkaku Islands.

References:

1. H. Hasegawa (1979). **2.** H. Hasegawa (1997). **3.** W.L. N. Tickell (1973).

Sooty Albatross

Phoebetria fusca

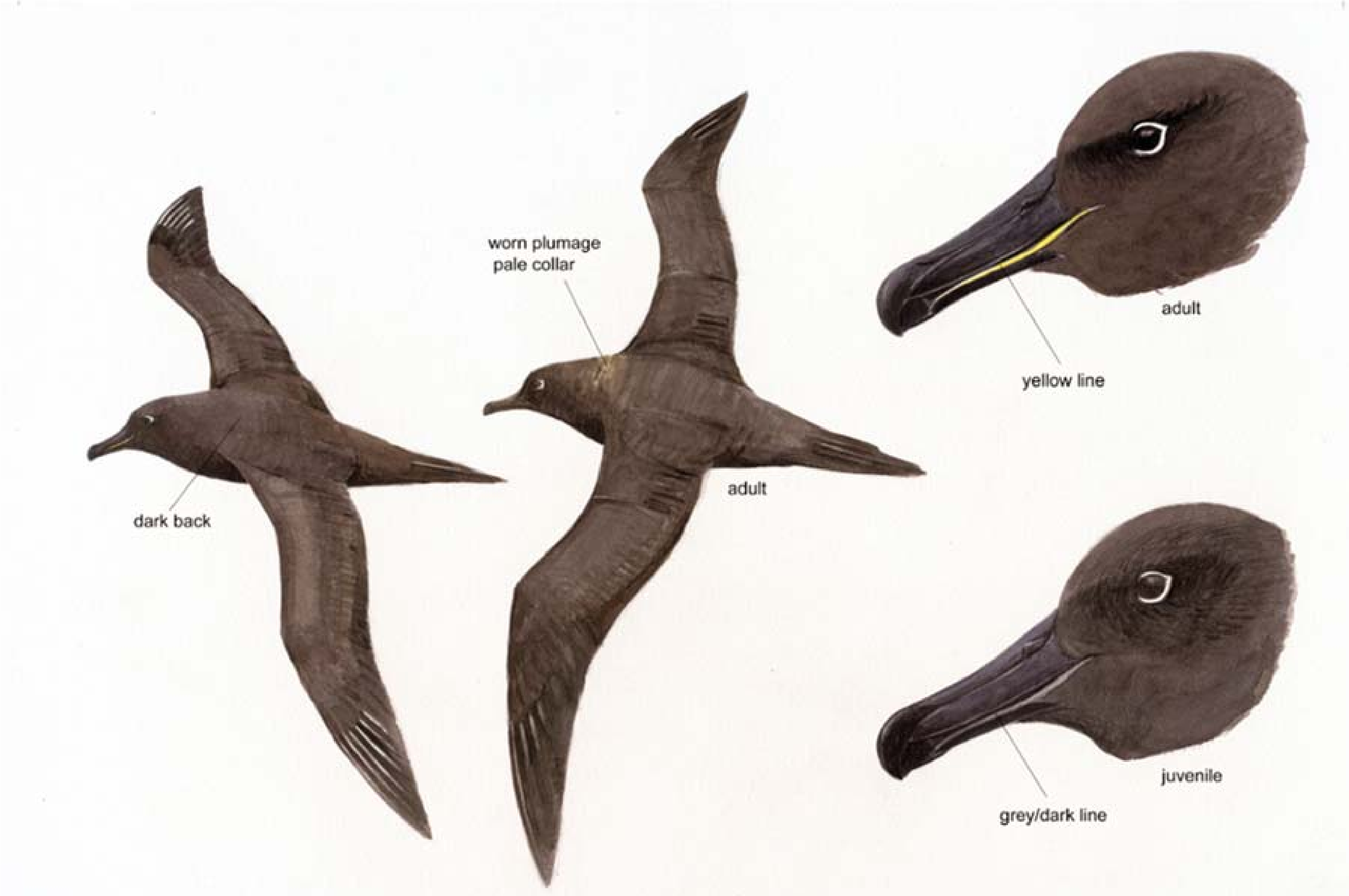


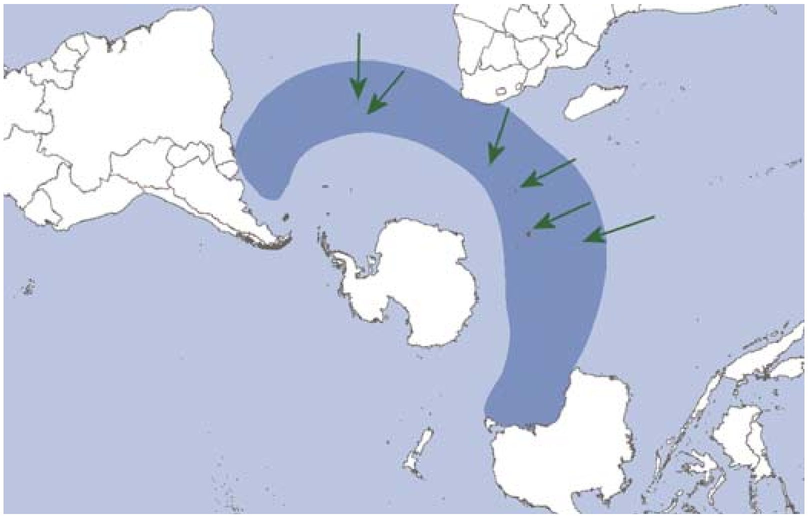
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 205 cm LENGTH: 85 cm BILL: 100-120 mm

Medium-sized, very dark, sooty-brown albatross with a pointed, wedge-shaped tail. Adult bills are black with a thin yellow line. Juvenile bills completely dark. Similar to Light-mantled Sooty Albatross. All ages distinguishable by dark back. Adults, close up, by yellow line on bill.



Range and Population:

The Sooty Albatross breeds on islands in the South Atlantic and Indian Oceans. The total annual breeding population is estimated at 12,500–19,000 pairs, equivalent to a total breeding population of c.42,000 individuals[5] as breeding is almost wholly biennial. Estimates of pairs are: 5,000–10,000 on Gough Island, 4,125–5,250 in the Tristan da Cunha group, both Tristan da Cunha (to UK), 1,539 on Prince Edward and Marion Islands (South Africa)[8], 2,620 on the Crozet Islands, less than five on Kerguelen Island, and 300–400 on Amsterdam Island (all French Southern Territories)[1]. On Possession Island (Crozet), the population declined by 58% between 1980 and 1995[10]. On Marion, the population declined by 25% between 1990 and 1998[8]. The species forages in subtropical waters both during and outside the breeding season[10].

Ecology:

It feeds on cephalopods, fish, crustaceans and carrion, occasionally following fishing vessels[2]. It breeds in loose colonies of up to 50–60 nests on cliffs or steep slopes[7]. In the French Southern Territories, the average age at first breeding is 12.7 years, annual adult survival is 89.9%, and juvenile survival is 22.4%[10] (lower than required for a stable population).

Threats:

Both adults and juveniles are killed on Japanese longlines set inside and beyond the Australian Fishing Zone[6]. However, only one bird (of 1,500 examined) is known to have been killed by vessels with observers in the Prince Edward fishery[9]. Introduced predators on Kerguelen and Amsterdam may have a significant effect on breeding success. The harvest of chicks and adults on Tristan is banned and illegal poaching is now probably very rare[9].

Conservation:

Listed in Appendix II, Convention on Migratory Species (CMS). Population monitoring and foraging studies are being undertaken at Possession, Amsterdam and Marion. The species is protected in Tristan da Cunha[3,9]. Gough is a World Heritage Site and the Prince Edward Islands are a Special Nature Reserve.

Targets:

Continue monitoring and research. Survey the population at other key sites, notably Gough and Tristan da Cunha. Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[4].

References:

1. Carboneras (1992b). **2.** Cherel and Klages (1998). **3.** J. Cooper *in litt.* (1999). **4.** J. Cooper and J.P. Croxall *in litt.* (2000). **5.** Croxall and Gales (1998). **6.** Gales *et al.* (1998). **7.** Marchant and Higgins (1990). **8.** Marine and Coastal Management (unpublished data). **9.** P.G. Ryan *in litt.* (1999). **10.** Weimerskirch and Jouventin (1998).

Southern Royal Albatross

Diomedea epomophora

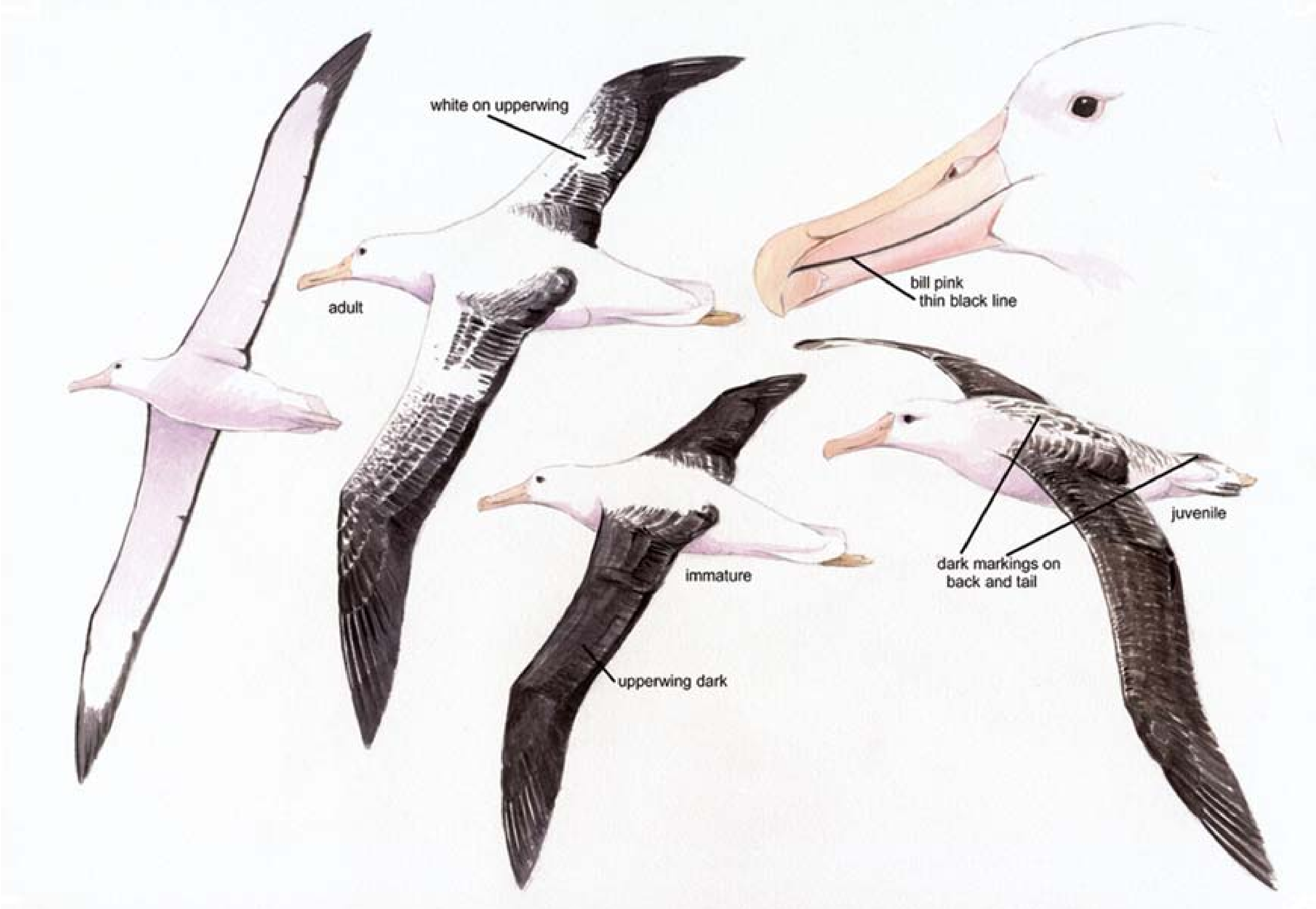


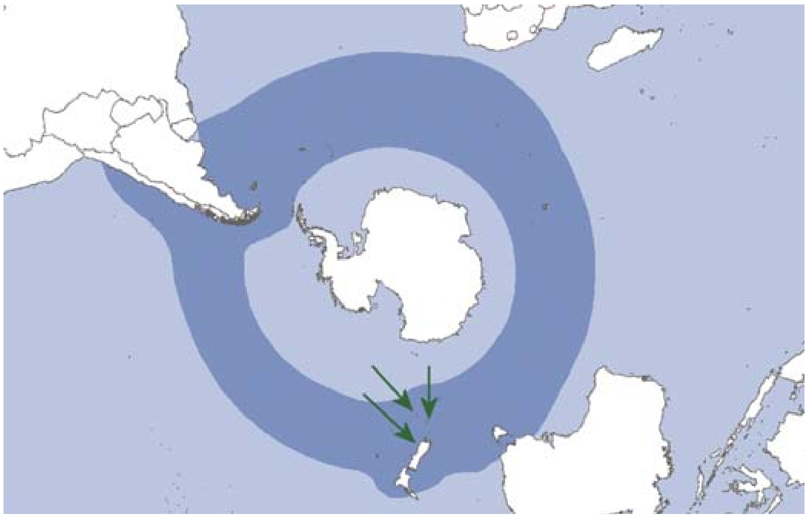
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population stable

Identification:

WINGSPAN: 350 cm LENGTH: 115 cm BILL: 165-190 mm

Huge black and white albatross with a large pale pink bill that has a thin black line along cutting edge. Juveniles have dark upperwings, white underwings, and white body with variable dark marks on top of head, back, and tip of tail. Body and upperwings become whiter over several years. Similar to paler plumages of Wandering, Tristan and Antipodes Albatrosses but body usually whiter and separable close up by black line on bill. White on upperwing separates adults from Northern Royal Albatross. Dark winged young birds are very similar to Northern Royal Albatross, but those with whiter bodies and tail and no spots on head are likely to be this species.



Range and Population:

The Southern Royal Albatross breeds on Adams, Enderby and Auckland Islands (Auckland Islands group), Campbell Island, and on Taiaroa Head (Otago Peninsula, South Island), New Zealand. The Campbell population (99% of the total) is estimated at 8,200–8,600 breeding pairs. Numbers have apparently increased since the mid-1980s, but may have levelled off[6]. In 1995, 55 pairs were present on Enderby, and c.20 on Auckland and Adams Islands combined[1]. No pure-bred *D. epomophora* are present at Taiaroa Head[2,6]. The species may circumnavigate the Southern Ocean after breeding[1], but is most commonly recorded in New Zealand and South American waters[3]. Population estimate: 28,000 birds.

Ecology:

It breeds in sheltered places, generally on flat ground, on headlands, ridges, gullies and plateaus[2,3]. It feeds primarily on squid, supplemented by fish, crustacea and salps, mostly taking food from the surface[2]. Breeding is biennial if a chick is successfully reared.

Threats:

Humans and introduced mammals caused massive reductions in all populations, extirpating the Enderby and Auckland Islands populations by the late 1800s[2]. Pigs and cats still take eggs and chicks on Auckland Island. Brown rat *Rattus norvegicus* takes chicks on Campbell, but the problem is unlikely to be significant. On Campbell and Enderby, *Dracophyllum* scrub is spreading, possibly due to climatic warming, and may reduce breeding habitat. It is frequently caught by Japanese longliners in the high seas and small numbers are killed in fisheries in New Zealand waters and off south-western Australia and Tasmania[6].

Conservation:

Listed in Appendix II, Convention on Migratory Species. Cattle and sheep have been removed from Campbell, and cattle, rabbits and mice have been eradicated from Enderby. Almost 36,000 birds have been banded on Campbell since the 1960s. Two study areas on Campbell are monitored annually[6]. All islands are nature reserves and, in 1998, were declared a World Heritage Site.

Targets:

Census the Campbell and Enderby colonies at 10-year intervals. Check for leg bands during censuses for data on survival and recruitment. Monitor vegetation change on Campbell and Enderby and assess its effect on habitat availability. Develop mitigation devices/techniques to minimise fisheries bycatch. Eradicate rats from Campbell Island. Eradicate pigs and cats from Auckland Island[6].

References:

1. Croxall and Gales (1998). **2.** Heather and Robertson (1997). **3.** Marchant and Higgins (1990). **4.** Nunn *et al.* (1996). **5.** Robertson and Nunn (1998). **6.** Taylor (2000).

Tristan Albatross

Diomedea dabbenena

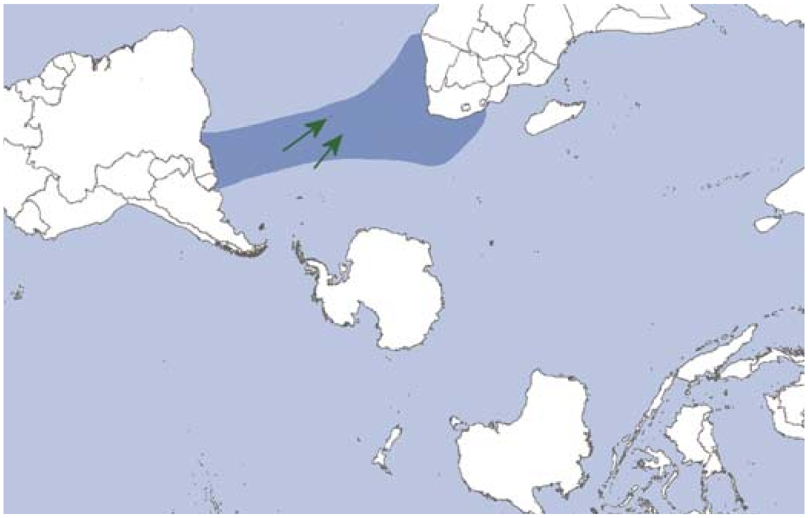
Illustration by Derek Onley

IUCN THREAT STATUS: Endangered, population declining

Identification:

WINGSPAN: 300 cm LENGTH: 110 cm BILL: 132-155 mm

Huge albatrosses with large, pale pink bills sometimes with slightly darker marks on tips. Juveniles are dark brown with a white face and underwing. Body and upperwing become whiter over many years resulting in a wide range of plumages. Tristan and Antipodes Albatrosses cannot be told apart, and are only distinguishable from Wandering Albatross by smaller size. Measure bill! Darker birds are like Amsterdam Albatross and can only be identified when the plainer pink bill is seen well, but watch out for the occasional darker marks on tip. Paler birds can look like Northern and Southern Royal Albatrosses but they usually have more dark markings on head, back and tail, and close up are distinguishable by plain pink bill.



Range and Population:

The Tristan Albatross is essentially restricted when breeding to Gough Island, Tristan da Cunha (to UK), having become extinct on Tristan (though birds were seen prospecting in 1999[14]), with 2–3 pairs on Inaccessible[6]. In 1979–1981, the annual breeding population on Gough was estimated at c.1,000 pairs[6], in 1999, 1,129 chicks were counted suggesting 1,500 pairs, equivalent to a total population of 9,000 individuals[14] for this biennially breeding species. Outside the breeding season, it disperses to South Atlantic and South African waters, with numerous recent records from Brazilian waters[8,9] and one from Australia[14], suggesting that birds may occasionally disperse into the Indian Ocean. Estimated Population: 9,000 birds.

Ecology:

It nests at 400–700 m (rarely to 300 m), primarily in wet heath[14]. It feeds on cephalopods and fish[3], and probably follows ships and trawlers for offal and galley refuse.

Threats:

On Inaccessible, its decline was probably owing to predation by feral pigs and humans[7,12]. The failure to recover is unclear, but may be because young birds get stuck in thick vegetation[12,13]. On Tristan, its extirpation was probably the result of human exploitation[3], although predation by rats may have been a factor[7]. On Gough, storms have caused peat slips, burying and killing nesting adults, though this is probably a very rare event[11]. The main threat probably comes from interactions with longline fisheries with a high proportion of "Wandering"; Albatross bycatch in southern Brazilian waters being this species[8,9], including recoveries of a few birds banded at Gough[3,6].

Conservation:

Listed in Appendix II, Convention on Migratory Species. On Tristan, a programme to eradicate cats was successful in the 1970s. Gough is a nature reserve and World Heritage Site and is uninhabited apart from a meteorological station[2].

Targets:

Survey the population on Gough in consecutive years[13].

- Confirm taxonomic status and publish morphometric data[5].
- Research at-sea distribution and foraging behaviour[4].
- Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[5].
- Use decoys to assist re-establishment of birds on Tristan, and to attract birds to Long Ridge on Inaccessible to avoid risks of entrapment in vegetation[13].

References:

1. T. Burg and T. Neves (unpublished data). **2.** Cooper and Ryan (1994). **3.** J. Cooper *in litt.* (1999). **4.** J. Cooper *in litt.* (2000). **5.** J.Cooper and J.P. Croxall *in litt.* (2000). **6.** Croxall and Gales (1998). **7.** Fraser *et al.* (1988). **8.** Neves *et al.* (2000). **9.** Olmos *et al.* (2000). **10.** Robertson and Nunn (1998). **11.** Ryan (1993). **12.** Ryan *et al.* (1990). **13.** P. G. Ryan *in litt.* (1999). **14.** P.G. Ryan *in litt.* (2000).

Wandering Albatross

Diomedea exulans

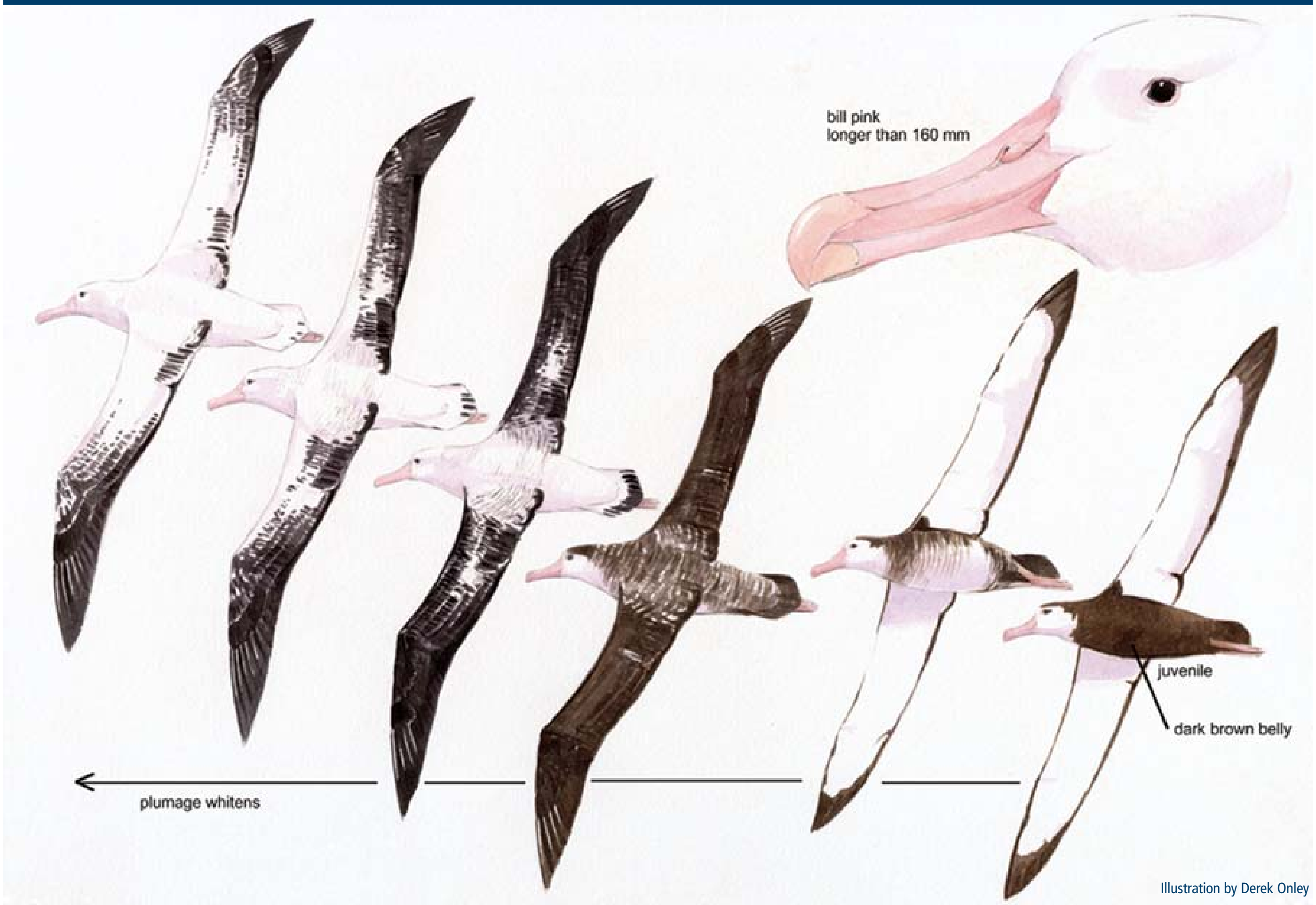


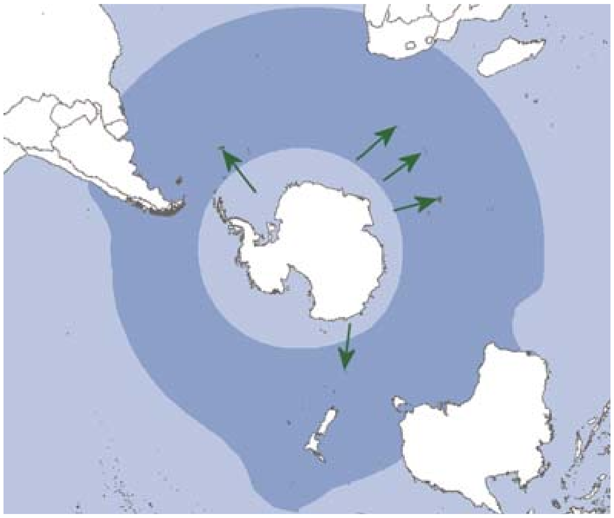
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 330 cm LENGTH: 115 cm BILL: 160-180 mm

Huge albatross with a large, pale pink bill. Juveniles are dark brown with a white face and underwing. Body and upperwing become whiter over many years resulting in a wide range of plumages. Slightly larger but very similar to Tristan and Antipodes Albatrosses and usually impossible to tell apart, but can be separated by measuring bills. Darker birds look like Amsterdam Albatross and can only be distinguished if plain unmarked pink bill is seen well. Paler birds can look like Northern and Southern Royal Albatrosses, but they usually have more dark markings on head, back and tail, and close up are distinguishable by plain pink bill.



Range and Population:

The Wandering Albatross breeds on South Georgia (to UK), Prince Edward and Marion Islands (South Africa), Crozet Islands, Kerguelen Islands (French Southern Territories) and Macquarie Island (Australia). The total annual breeding population is estimated at 8,500 pairs, equivalent to c.28,000 mature individuals[6] in this biennially breeding species. Data from Bird Island (South Georgia) and Possession Island (Crozet, together comprising 30% of the world population) indicate steady (1% over 20 years) to steady-to-steep (1–7% per annum during the 1970s and 1980s) declines respectively[6]. On Bird Island, a 10% per annum decrease in post-fledging survival rate has occurred and a 2–3% per annum decrease in adult survival rate[7]. On Possession, the population has increased at 4% per annum since 1986[10]. The species disperses widely in all the southern oceans.

Ecology:

It nests in open or patchy vegetation near exposed ridges or hillocks[2]. It does not reach maturity until 9–11 years and the estimated average life span is 30–40 years[2]. It feeds mainly on cephalopods and fish, often following ships, feeding on offal and galley refuse[2,3].

Threats:

It is the most aggressive seabird attending fishing vessels and is highly susceptible to being drowned after striking at baited hooks[7]. The South Georgia population may be most at risk from longline fisheries in the southern Atlantic and Indo–Pacific Oceans, whereas the Crozet population is more vulnerable in the Indian Ocean and Australian region. The Macquarie population was plundered by sealers, but recovered in the early 20th century only to collapse again, this decline also attributed to longline fisheries[8].

Conservation:

Listed in Appendix II, Convention on Migratory Species (CMS). Population monitoring and foraging studies are being undertaken at South Georgia, Marion, Crozet, Kerguelen and Macquarie. Recent signs of recovery of the Crozet and Marion populations have been ascribed to reduced fishing effort and relocation of fisheries away from foraging grounds[4,10]. Most breeding sites are reserves and Macquarie is a World Heritage Site.

Targets:

Continue monitoring and research programmes at all sites. Promote adoption of best-practice mitigation measures in all fisheries within the species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[5].

References:

1. Burg and Croxall (2000). **2.** Carboneras (1992b). **3.** Cherel and Klages (1998). **4.** J. Cooper *in litt.* (2000). **5.** J. Cooper and J.P. Croxall *in litt.* (2000). **6.** Croxall and Gales (1998). **7.** Gales *et al.* (1998). **8.** de la Mare and Kerry (1994). **9.** Robertson and Nunn (1998). **10.** Weimerskirch *et al.* (1997).

Waved Albatross

Phoebastria irrorata

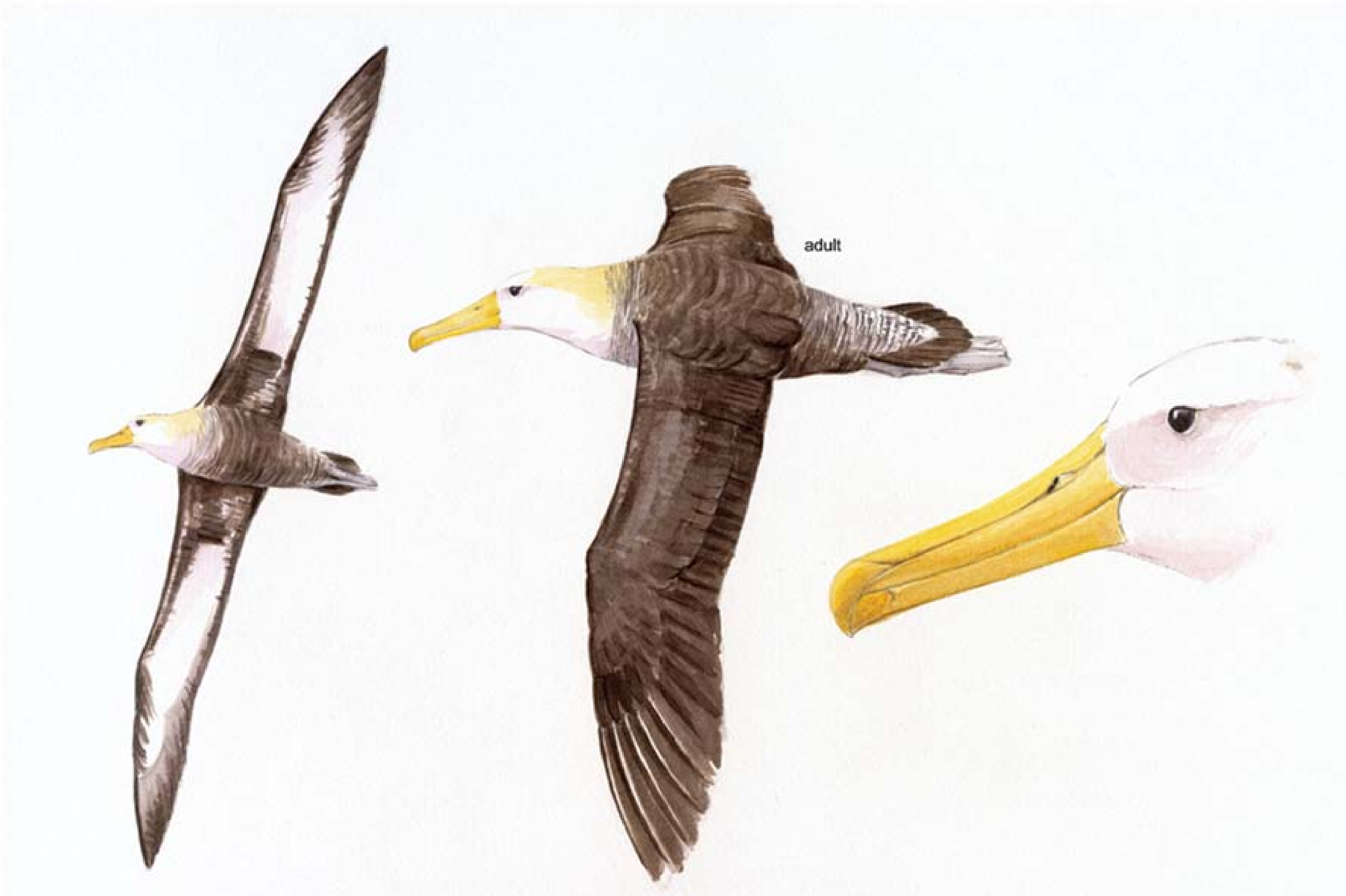


Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population increasing

Identification:

WINGSPAN: 230 cm LENGTH: 90 cm BILL: approx 120 mm

Medium-large albatross with brown upperwing, back and tail, finely barred body and long yellowish bill. Young birds have white heads, adults' heads are golden buff. Unlikely to be confused with anything!

Range and Population:

The Waved Albatross breeds on south Española Island in the Galápagos Islands, and Isla de la Plata off Manabí province, Ecuador[3]. On Española, the breeding population is apparently increasing, estimated at c.12,000 pairs in 1970–1971 and 15,600–18,200 pairs in 1994[3,4]. Breeding no longer occurs at two inland sites, perhaps through redistribution to the coast[1,4]. On Isla de la Plata, it probably numbers fewer than 10–20 pairs[1], and long-term data are too sketchy to assess population trends[3]. Breeding adults travel to the Peruvian upwelling region to feed[1]. In the non-breeding season, birds move mainly east and south-east into the waters of the Ecuadorian and Peruvian continental shelf[1,8]. Population estimate: 31,200 – 36,400 birds.

Ecology:

It nests in colonies on sparsely vegetated areas with lava surrounded by boulders. It feeds on squid, fish and crustaceans[6], but recent studies have shown that scavenging food items that other species (such as cetaceans and boobies) have disgorged may be an important feeding strategy[1,7]. Birds breed from 5–6 years of age[4].

Threats:

Around the Galápagos Islands, the transition from traditional to more modern fishing techniques such as longlining may seriously threaten this species, given its tendency to scavenge[7]. Longline fishing operations along the Peruvian and Ecuadorian coasts also threaten the species[5,9]. The population on Isla de la Plata is threatened from nest-predation by rats and cats, as well as illegal collection of eggs and young[2]. Movement of eggs by parents (frequently resulting in death of the egg) and mass desertions of eggs are yet to be fully explained[1].

Conservation:

Listed in Appendix II, Convention on Migratory Species. Española is part of the Galápagos National Park and Marine Reserve and, in 1979, the islands were declared a World Heritage Site. Española is well protected and has no alien fauna (goats having been eradicated in 1978[1]), and tourism is well regulated[2]. Isla de la Plata is part of Machalilla National Park, but is insufficiently protected[2].

Targets:

- Census the breeding population regularly and establish a baseline to ascertain trends.
- Evaluate the threat of longlining[1].
- Adopt best-practice mitigating measures in all longline fisheries within the species's range.
- Improve protection for the Isla de la Plata colony.

References:

1. Anderson and Cruz (1998). **2.** Carboneras (1992b). **3.** Croxall and Gales (1998). **4.** Douglas (1998). **5.** Guillén *et al.* (2000). **6.** Harris (1973). **7.** Merlen (1996). **8.** Tickell (1996). **9.** H. Vargas and F. Cruz *in litt.* (2000).

White-capped Albatross

Thalassarche cauta

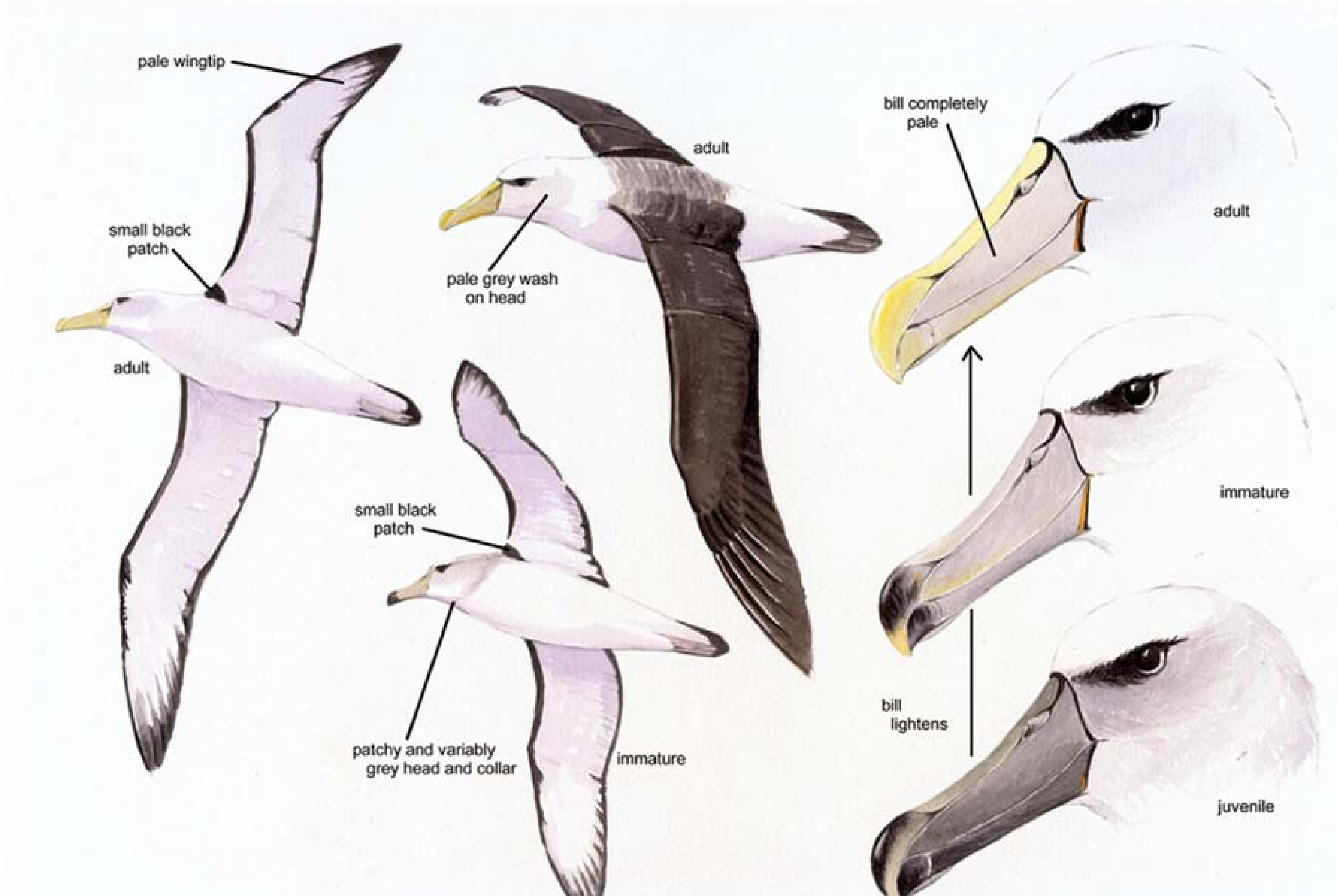


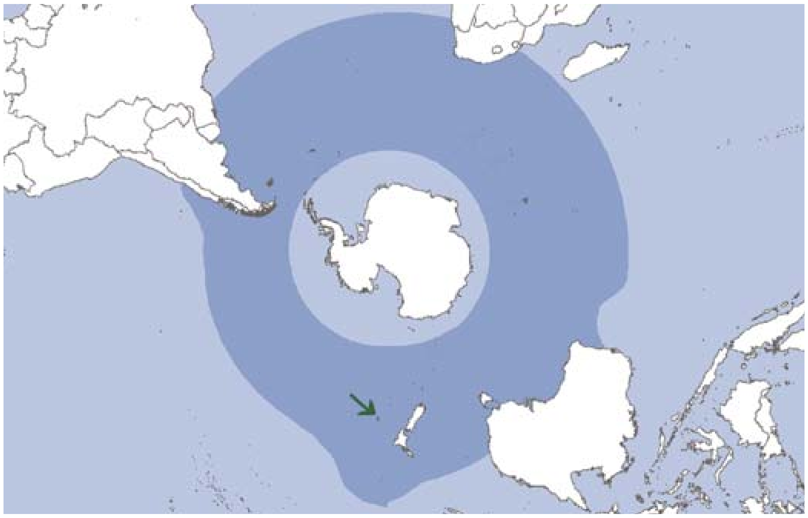
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population trend unknown

Identification:

WINGSPAN: 255 cm LENGTH: 99 cm BILL: 122-141 mm

Large albatross. White underwing has pale wingtip, narrow black border and small black patch at base of leading edge. Adult has pale grey and yellow bill and barely noticeable grey wash on white head. Young birds have dark bills that lighten over several years and very variable amounts of patchy grey on head. Pale bill and white head separate adults from adult Salvin's and Chatham Albatrosses but young birds are similar and are best identified by paler tip to underwing. Larger than Black-browed, Campbell, Buller's, Grey-headed and both Yellow-nosed Albatrosses with a different underwing pattern.



Range and Population:

The White-capped Albatross breeds at Disappointment, Auckland and Adams islands (Auckland Islands group), Bollon's Island (Antipodes Islands group), and Forty-Fours Island (Chatham Islands group), New Zealand. The main population exists on Disappointment Island (c.95% of total). Aerial and ground photos of this colony between 1972 and 1994 indicate that the population of 70,000–80,000 breeding pairs has not changed in extent. Breeding pair estimates for other islands are: Auckland, 3,000; Adams, 100; Bollon's[1], c.100[6]; and one pair on the Forty-Fours[1]. The species may disperse into the Southern, Pacific and Atlantic Oceans[4].

Ecology:

Colonies are densely packed[4]. Breeding sites are on peat-covered steep slopes and cliff edges which are densely vegetated. The nest is usually a solid column of mud and vegetation. One egg is laid in late November, and chicks probably fledge in July–August[8]. Diet is primarily squid, with fish (mainly mackerel and redbait), krill and salps. Offal and bait from fishing boats is also taken[5,4,3].

Threats:

Until the 1980s, when trawling methods were modified, the squid trawl fishery near the Auckland Islands killed a large number of birds—2,300 in 1990 alone. All birds caught were adults. It is also the most commonly killed albatross on tuna longliners in New Zealand, comprising 15% of all returns for autopsy between 1988 and 1997[7]. On Auckland Island, birds have become restricted to breeding areas inaccessible to introduced pigs. Nesting area was significantly reduced between 1972–1982, due to pig interference[1,7]. Feral cats may also take small numbers of chicks[7].

Conservation:

Work with the Disappointment Island colony began in 1972, primarily for census purposes. All islands are nature reserves, and are part of a World Heritage Site, except for Forty-Fours which is privately owned.

References:

1. Croxall and Gales (1998) **2.** Gales (1998) **3.** R. Gales in litt. (1999) **4.** Heather and Robertson (1997) **5.** Marchant and Higgins (1990) **6.** Nunn *et al.* (1996) **7.** Taylor (1999) **8.** G.A. Taylor *in litt.* (1999) **9.** Tennyson et al. (1998)

Northern Fulmar

Fulmarus glacialis

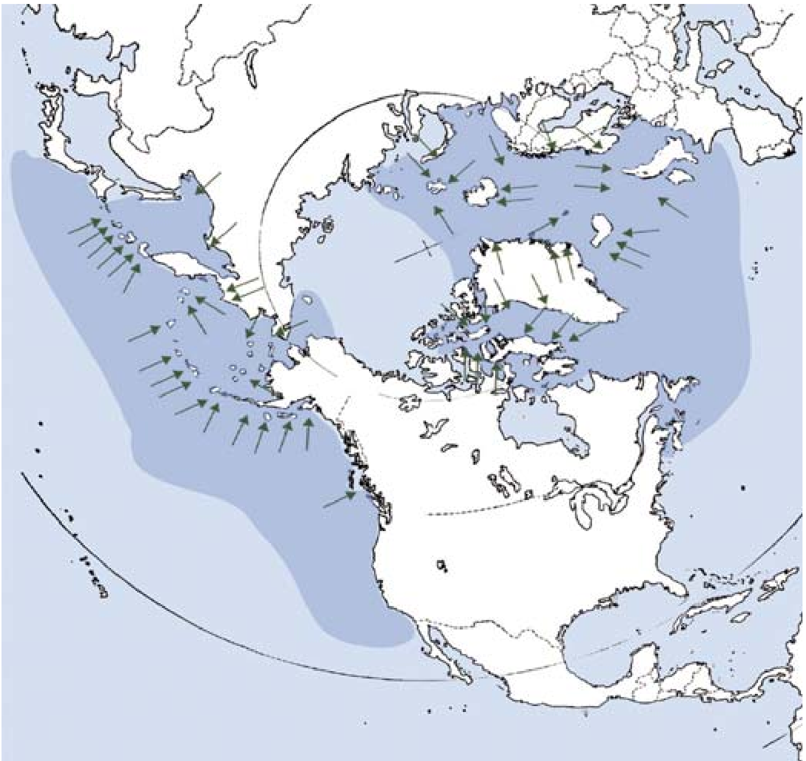
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 105 cm LENGTH: 48 cm BILL: 36-44 mm

Medium-sized stocky, short-billed petrel with a wide variety of plumages. Most birds are white with pale grey upperwing and small dark eye patch, or entirely dusky bluish grey. Pacific birds are more variable, whiter birds can have patchy dark markings and darker birds can be almost black. Pale birds can look like gulls but have short thick bill with nasal tubes on top and pale patch towards end of straight, stiffly held wings. Dark and patchy birds can resemble all sorts of petrels and shearwaters but can be told apart with practice by shape especially of short bill and thick neck.



Range and Population:

Breeds in Pacific from Kurile Is north to Cape Stoletiya (Chukotski), and east from Iona Island (Sea of Okhotsk) along the Commander & Aleutian Islands to Triangle Island (off Vancouver Island). Total breeding population in Pacific <4 million, most in colonies of <50,000. Based on counts at some small colonies, the overall population trend is stable or upward[5]. Fulmars breed in Canada from Baffin Bay south to Newfoundland (360,000 pairs[1]) and in Europe, including Greenland and Jan Mayen (2,900,000 pairs[4]). Counts at the largest Atlantic colonies lack precision, particularly for Iceland and the Faroes. Further south in the Atlantic a dramatic increase (now slowed) in population and range has occurred over 150 years. They now breed abundantly (< 450,000 pairs[7]) on the sea cliffs of Europe, south to Brittany. Total population estimate: 3.2 million breeding in Atlantic, and 4 million in Pacific.

Ecology:

Breeds annually May-September, migrating in winter to temperate northern waters. Eats small fish, squid, crustacea and fish offal by night and day, often feeding around trawlers. Temperate Atlantic fulmars eat offal more commonly than arctic or Alaskan birds[2,5]. Average age at first breeding 8 years, with subsequent annual survival of 0.97[5].

Threats:

Nests mainly on sea-cliffs, secure from predators. Few drowned in Japanese North Pacific salmon drift-nets because they are primarily surface-feeders (2000 annually, 1981-845). Alaskan sablefish vessels also catch 5-15,000 per year[6]. Atlantic longliners from Norway, Iceland and the Faeroes catch an estimated 50 -100,000 annually[3]. Longline mortality has probably caused some population declines.

Conservation:

Protected in Alaska, Canada, Russia and the EU. Little information on population sizes and trends in Greenland, Iceland and the Faeroes, where young birds and eggs are harvested. Populations decline rapidly where adults are shot on nesting cliffs or at sea. Most demographic data comes from protected populations in Britain and Alaska.

References:

1. Brown and Nettleship (1984). **2.** Cramp and Simmons (1977). **3.** Dunn and Steel (2001). **4.** Hagemeijer and Blair, eds. (1997)
5. Hatch (1993). **6.** Melvin *et al.* (2001). **7.** Tasker in press.

Black Petrel

Procellaria parkinsoni

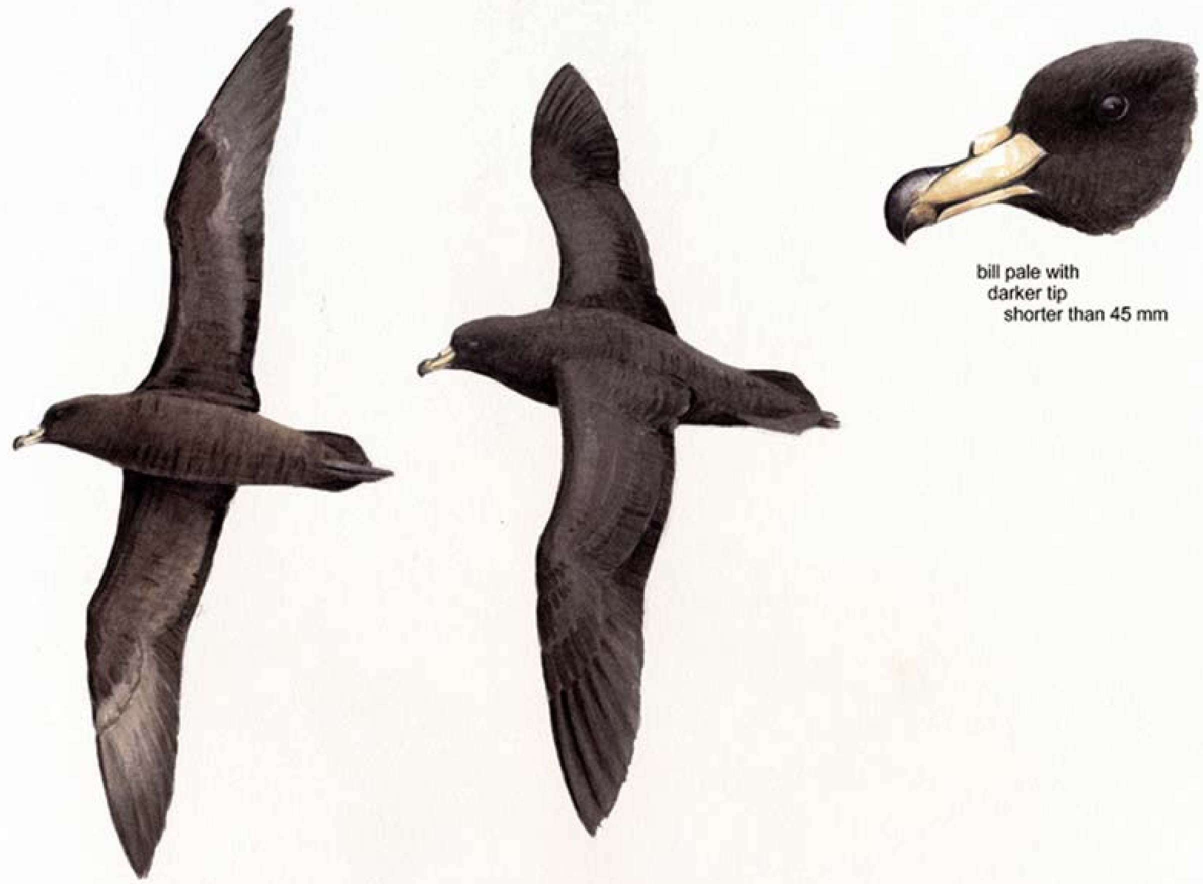


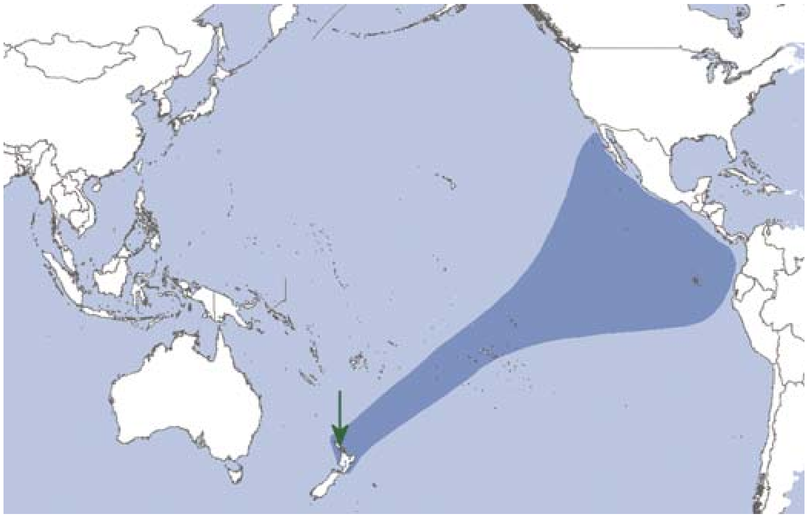
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population stable

Identification:

WINGSPAN: 115 cm LENGTH: 46 cm BILL: 39 – 44 mm

Medium-sized brownish-black petrel with pale, dark-tipped bill. Smaller and slimmer than Westland, White-chinned and Spectacled Petrels but still very difficult to tell apart at a distance. Close up, dark-tipped bill distinguishes it from White-chinned, and lack of white markings on head from Spectacled. Smaller and more lightly built than Westland with small differences in bill shape, but difficult to distinguish without practice. Measure bill! Flesh-footed Shearwater (not included here) has pink feet. See also dark Wedge-tailed, Sooty and Short-tailed Shearwaters.



Range and Population:

The Black Petrel breeds on Little and Great Barrier Islands, New Zealand, where the total population is c.10,000 birds[5]. It once bred in the North and south-west South Islands, but had disappeared from the mainland by the 1960s. On Little Barrier, it was abundant in the late 1800s but, although it is slowly increasing, now numbers only c.100 pairs. On Great Barrier, it may be stable, and numbers at least 2,500 pairs[3,5]. It migrates to the eastern Pacific Ocean between the Galápagos Islands, southern Mexico and northern Peru[1]. Population estimate: 5,000 individuals.

Ecology:

It nests in virgin podocarp and mixed broadleaf forest above 500 m. On the mainland, it reportedly bred up to 1,200 m, mostly in tall forest, but also in tussock grasslands[3]. Its diet consists of squid, fish, crustaceans and marine invertebrates. It can begin breeding at six years of age[1].

Threats:

Introduced cats cause minor interference on Great Barrier, but decimated the Little Barrier population, killing up to 100% of fledglings in some years[2], and taking adults. Pacific rat *Rattus exulans* is present on both islands but has little effect. Black rat *R. rattus*, stray dogs and feral pigs may also be a threat on Great Barrier. The species is a common scavenger of fishing boat waste, and is caught by commercial longliners in New Zealand waters, and may be at greater risk during migration to the east Pacific off Ecuador and Peru where it is a near-obligate associate of small crustaceans[4]. Birds have been caught on longlines in this region. El Niño fluctuations may also affect the population in this zone[5,6].

Conservation:

CMS Appendix II. Cats were eradicated on Little Barrier Island by 1980. Between 1986 and 1990, 249 fledglings were transferred from Great Barrier to Little Barrier in an attempt to boost population size. Follow-up monitoring indicates mixed results[5]. The colony on Little Barrier is monitored every breeding season to assess breeding success[1]. A long-term population study was initiated on Great Barrier in 1996[5].

Targets:

Complete an accurate census of both islands. Monitor Great Barrier study populations annually to determine trends, and assess breeding success. Follow-up reports of mainland breeding sites. Develop mitigation devices/techniques to minimise fisheries bycatch[5]. Continue and expand control at Great Barrier if monitoring indicates that any predators are causing a population decline[5,7]. Eradicate rats from Little Barrier[5].

References:

1. Heather and Robertson (1997). **2.** Imber (1987). **3.** Marchant and Higgins (1990). **4.** Pitman and Ballance (1992). **5.** Taylor (2000). **6.** G.A. Taylor *in litt.* (1999). **7.** B. Weeber *in litt.* (2000).

Grey Petrel

Procellaria cinerea

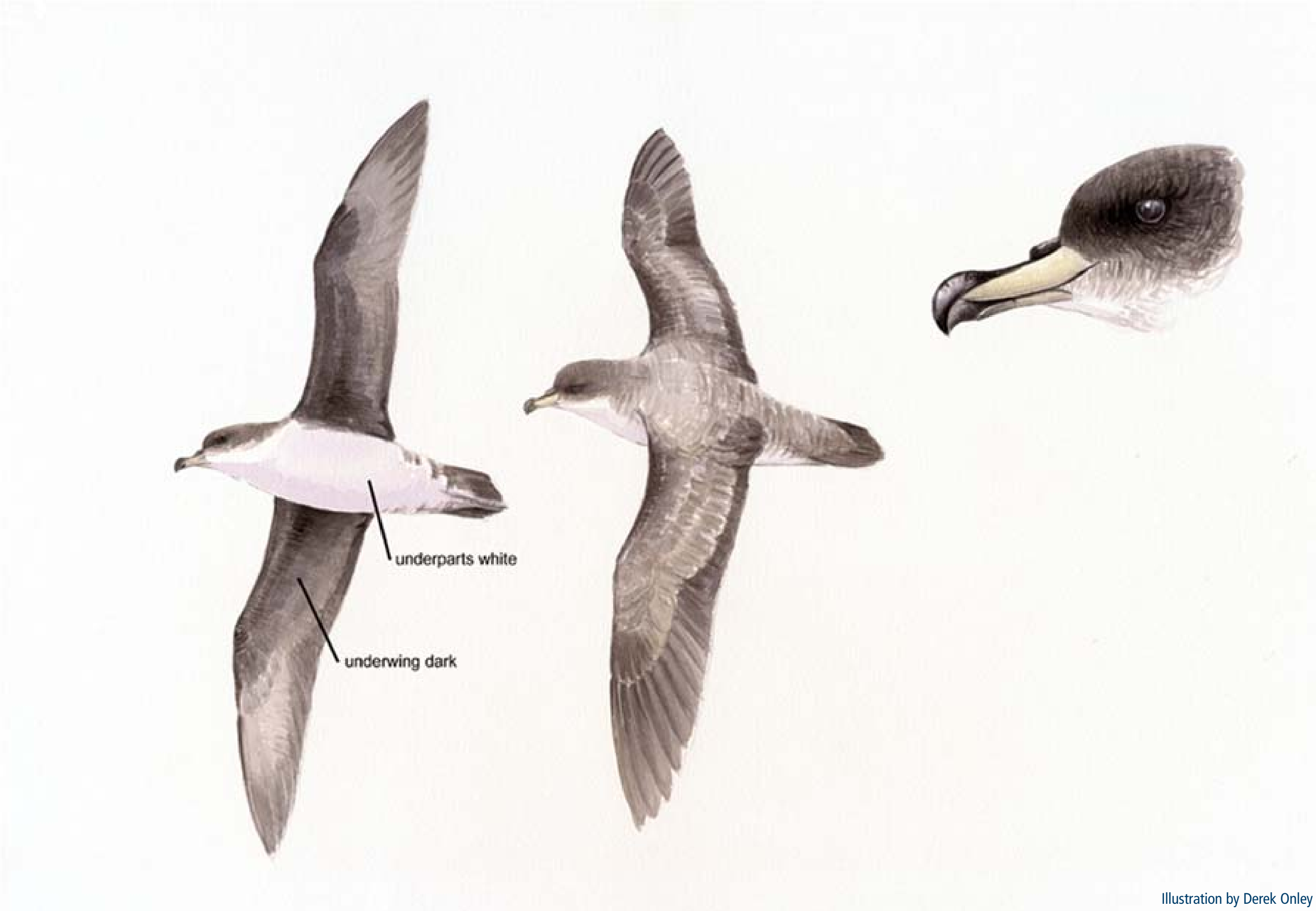


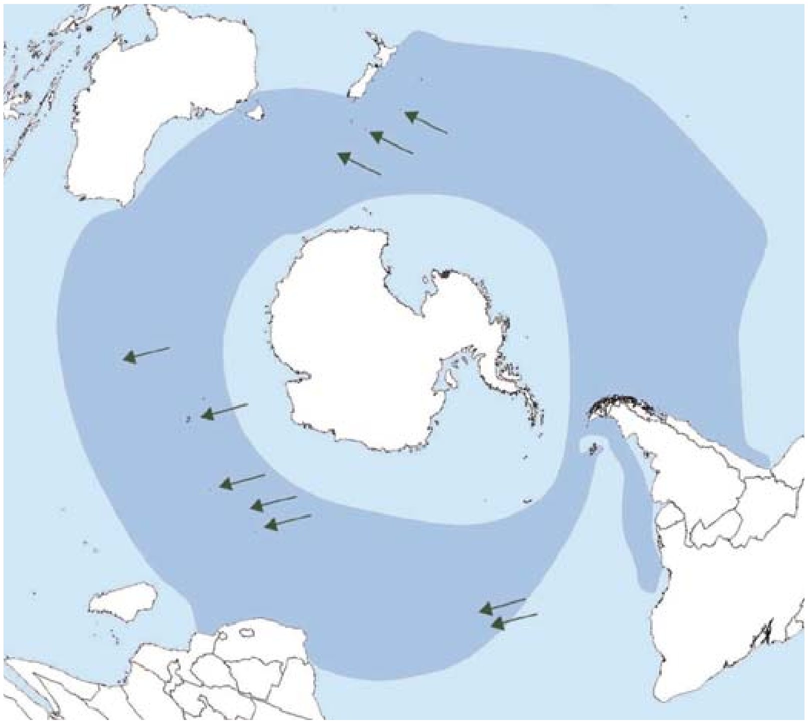
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 120 cm LENGTH: 48 cm BILL: 42-50 mm

A medium-large petrel. Soft grey above and white underneath except for dark underwing. Similar only to White-headed Petrel (not included here), but has a greyer top to head and a yellowish darker bill with a dark tip.



Range and Population:

Nests at Tristan da Cunha (50-100 pairs)[8], Gough (possibly 100,000 pairs)[8], Prince Edward and Marion Is (1000 pairs)[6], Crozet (1000 pairs)[6], Kerguelen (5000-10,000 pairs)[6], Amsterdam I. (10 pairs)[9], Macquarie (unknown), Campbell (100 pairs)[10] and Antipodes Is (32,000-73,000 pairs)[3]. Size of world population unclear: although hundreds of thousands estimated at Gough[8], this is probably exaggerated[2], as their burrows appear to be only sparsely scattered[5]. Distributed throughout the open waters of the Southern Ocean south of 30ºS, extending north to 18ºS off Brazil[11]. Abundant in the S. Pacific east of Antipodes Is across to Chile, off Argentina and Brazil in winter, and east of the Greenwich Meridian across the S. Atlantic south of Africa and into the Indian Ocean[11].

Ecology:

Breeds annually in winter, March-November. Grey Petrels forage in offshore subantarctic waters taking pelagic cephalopods, fish and crustacea[6]. Follows ships and feeds around fishing vessel, diving to depths of at least 10 meters[2].

Threats:

In New Zealand, the southern bluefin tuna longline fishery kills more Grey Petrels than any other seabird. An estimated c.45,000 have been caught there in the last 20 years[2], and the selective mortality of adult females could be having an undue impact on the breeding population[1,7]. Longline deaths have also been recorded in Australia, and large numbers of Grey Petrels are caught in international waters in the Indian Ocean[2]. Introduced predators on the breeding islands are a further serious threat, for example, cats and *Rattus rattus* on Crozet, Kerguelen and Macquarie Is, and cats and *R. norvegicus* on Amsterdam I.

Conservation:

Grey Petrels have suffered historic declines on several islands, and could now be under threat from southern bluefin tuna longlining in winter. Bones indicate that Amsterdam I. once supported one of the world's largest colonies, prior to introduction of rats and cats[12]. More information on population trends and demography is urgently needed. BirdLife International currently rank Grey Petrels as A2d,e (Near-threatened).

References:

1. Bartle (1990). **2.** S. Bartle *in litt.* (2000). **3.** N. P. Brothers *per* S. Garnett *in litt.* (2000). **4.** Carboneras (1992d). **5.** Huyser *et al.* (1999). **6.** Imber (1983). **7.** Murray *et al.* (1993). **8.** Richardson (1984). **9.** J.-C. Stahl *per* S. Bartle *in litt.* (2000). **10.** Taylor (2000). **11.** Worthy and Jouventin (1999). **12.** Marchant and Higgins (1990)

Northern Giant Petrel

Macronectes halli

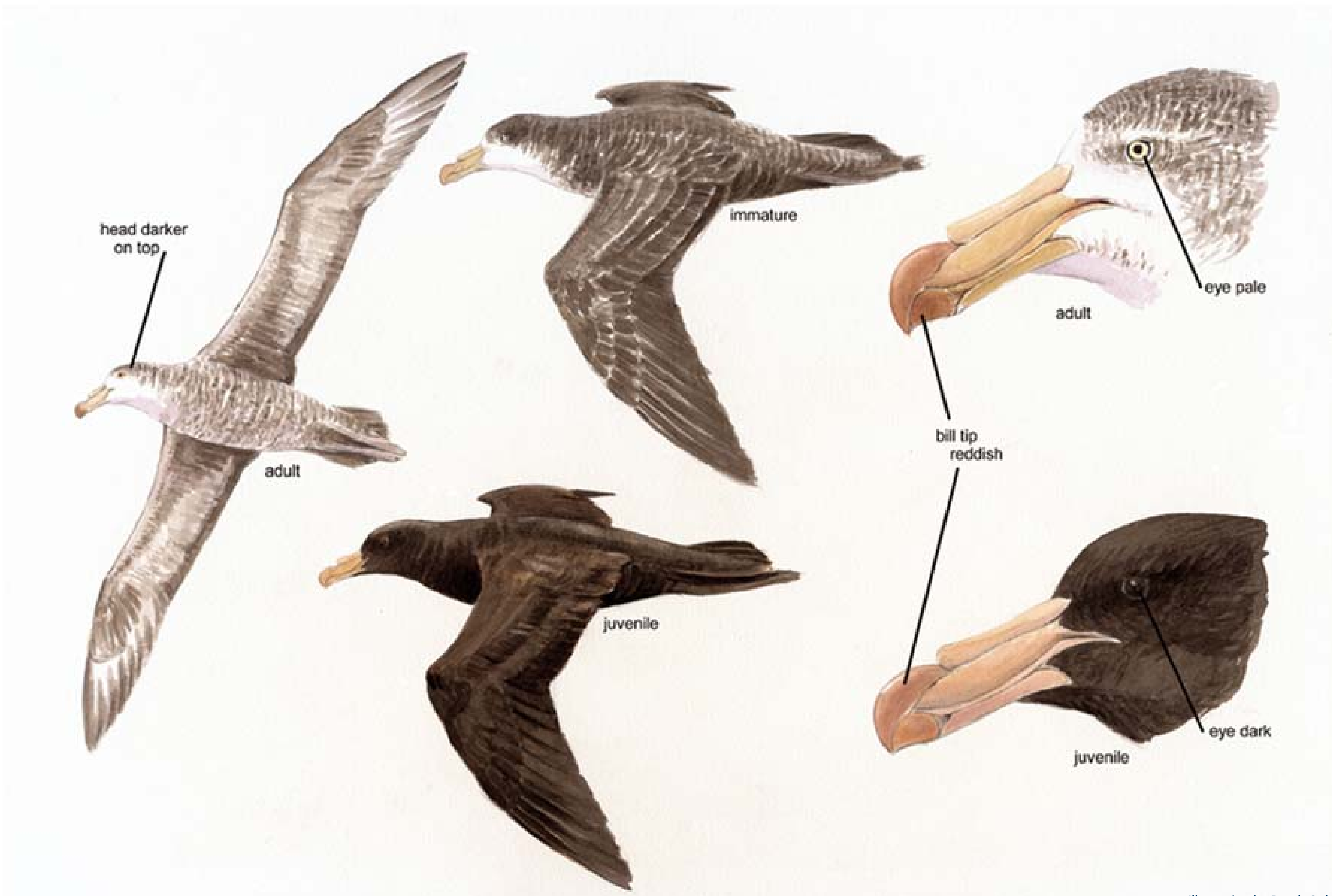


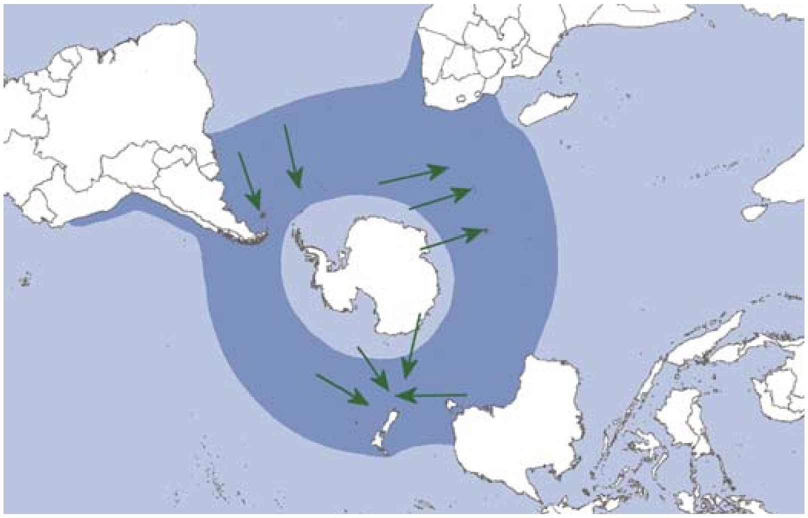
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, population trend unknown

Identification:

WINGSPAN: 190 cm LENGTH: 87 cm BILL: 85 - 110 mm

Very large petrel, the size of a small albatross, with a heavy, bulbous, pinkish bill, tipped reddish. Sooty-black juveniles become paler with age, passing through a variety of plumages. Very like Southern Giant Petrel. Distinguishable close up by reddish tip to bill (except for the few young birds with entirely pinkish bills) and paler eyes of adults. Not separable at a distance when these features cannot be seen.



Range and Population:

The Northern Giant Petrel breeds at South Georgia (to UK), Prince Edward Islands (South Africa), Crozet and Kerguelen islands (French Southern Territories), Macquarie Island (Australia), Auckland, Campbell, Antipodes and Chatham islands and, historically, on islets off Stewart Island (New Zealand). The world population in the 1980s was estimated at c.8,600 pairs[4]; a more recent estimate (late 1990s) is 11,500 pairs, an apparent increase of 34%[5] though this may be the result of better monitoring. There has been a c.30% increase in the large South Georgia population, similar increases at Marion, possible increases at Prince Edward and stable populations at Macquarie[7]. The Possession Island (Crozet) population, which decreased between the 1980s and 1992, is now increasing[1,6].

Ecology:

Its less colonial breeding habit makes it less sensitive to human disturbance than the threatened Southern Giant-petrel *M. giganteus*.

Threats:

It is at risk from mortality through longline fishing for Patagonian toothfish *Dissostichus eleginoides*—2,000–4,000 giant-petrels were estimated killed by illegal or unregulated fishing in the Indian Ocean sector of the Southern Ocean in 1997–1998[2,3]. Noted increases in the population probably reflect greater availability of carrion from expanding populations of fur seals *Arctocephalus gazella* and *A. tropicalis* and increased waste from commercial fishing operations[5].

Conservation:

The threat of accidental mortality by longlines, in combination with habitat loss due to fur seal expansion, could lead to decreases in the near future. Listed in Appendix II, Convention on Migratory Species.

References:

1. Bretagnolle *et al.* (1991). **2.** CCAMLR (1997). **3.** CCAMLR (1998). **4.** Hunter (1985). **5.** Patterson *et al.* (in press). **6.** H. Weimerskirch (unpublished data). **7.** Woehler and Croxall (1999 [1997]).

Southern Giant Petrel

Macronectes giganteus

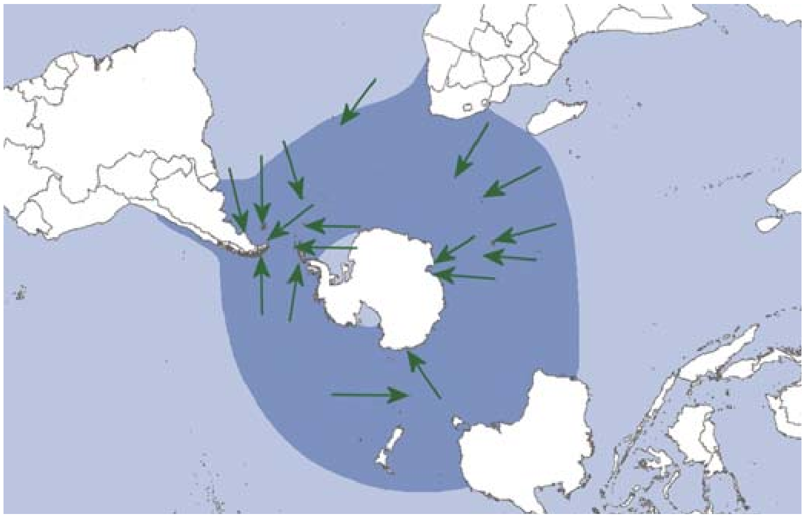
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 195 cm   LENGTH: 87 cm   BILL: 85-103 mm

Very large petrel, the size of a small albatross, with a heavy, bulbous, pinkish-yellow bill, tipped greenish. Sooty-black juveniles become paler with age, passing through a variety of plumages. Very like Northern Giant Petrel. Distinguishable close up by greenish tip to bill (except for the few young birds with completely pinkish bills). Otherwise difficult to separate, but birds with white heads and darker underparts are likely be to Southerns. Rarer white form is unmistakable.



Range and Population:

The Southern Giant Petrel breeds on Diego Ramirez and Isla Noir (Chile), Staten Island and islands off Chubut Province (Argentina), the Falkland Islands (to UK), South Georgia and the South Sandwich Islands (to UK), the South Orkney and South Shetland Islands, at islands near the Antarctic Continent and Peninsula, Gough Island (Tristan da Cunha (to UK)), Prince Edward Islands (South Africa), Crozet Islands, Kerguelen Islands (French Southern Territories), Heard Island (Heard and McDonald Islands [to Autralia]), Macquarie Island (Australia), and at four localities on the Antarctic Continent including Terre Adélie[1,5,6]. In the 1980s, the population was estimated at 38,000 pairs[10], declining 18% to 31,000 pairs in the late 1990s[12]. Populations at Heard and Macquarie declined 50% between the 1960s and late 1980s[14]. Many Antarctic peninsula populations decreased to the mid-1980s (e.g. >50% at Signy)[11], though some have since stabilised. The population at Terre Adélie declined from c.80 pairs in the 1960s to 10–15 pairs in 2000[1]. Other colonies have remained stable or increased, e.g. at South Georgia and Possession Island (Crozet)[11]. Post breeding dispersal is extensive. Juveniles make substantial migration[9]. Population estimate: 62,000 birds.

Ecology:

It nests in loose colonies on grassy or bare ground. Average age of first breeding is c.10 years, and mean adult annual survival at South Georgia is 90%[8]. It feeds on carcasses, cephalopods, krill, offal, discarded fish and refuse from ships, often feeding near trawlers and longliners[7].

Threats:

A total of 2,000–4,000 giant-petrels were estimated killed in illegal or unregulated Southern Ocean longline fisheries for Patagonian toothfish *Dissostichus eleginoides* in 1997–1998[2,3]. Decreases have also been attributed to reductions in southern elephant seal *Mirounga leonina* (an important source of carrion), human disturbance and persecution[8,13].

Conservation:

CMS Appendix II. It is monitored at South Georgia, Marion, Crozet and Macquarie Islands, and at Terre Adélie. Several breeding islands are nature reserves; Gough and Macquarie are World Heritage Sites.

Targets:

Continue monitoring. Conduct surveys of major breeding sites. Minimise disturbance at breeding sites. Research movements and migration. Promote adoption of best-practice mitigation measures in all fisheries within its range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[4].

References:

1. V. Bretagnolle *in litt.* (2000). **2.** CCAMLR (1997). **3.** CCAMLR (1998). **4.** J. Cooper and J.P. Croxall *in litt.* (2000). **5.** Gales *et al.* (1998). **6.** Harrison (1983). **7.** Hunter (1983). **8.** Hunter (1984a). **9.** Hunter (1984b). **10.** Hunter (1985). **11.** Patterson *et al.* (in press). **12.** Rootes (1988). **13.** P.G. Ryan *in litt.* (1999). **14.** Woehler (1991).

Spectacled Petrel

Procellaria conspicillata

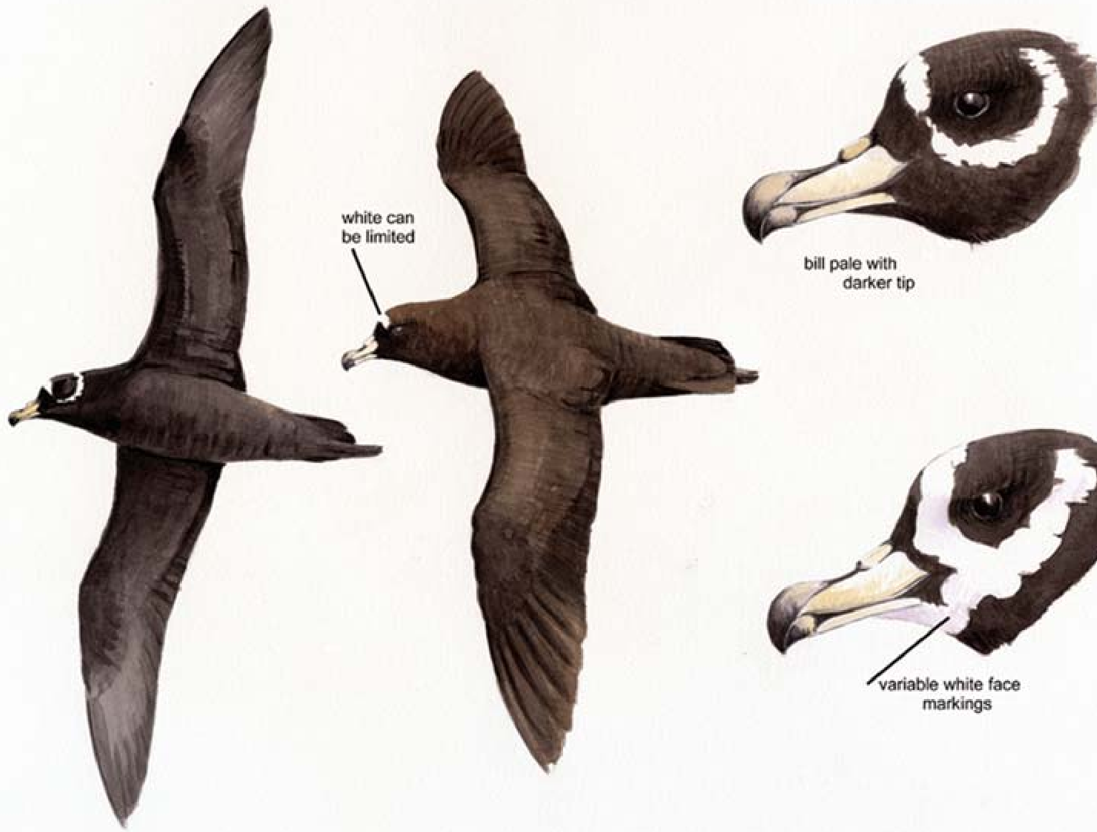


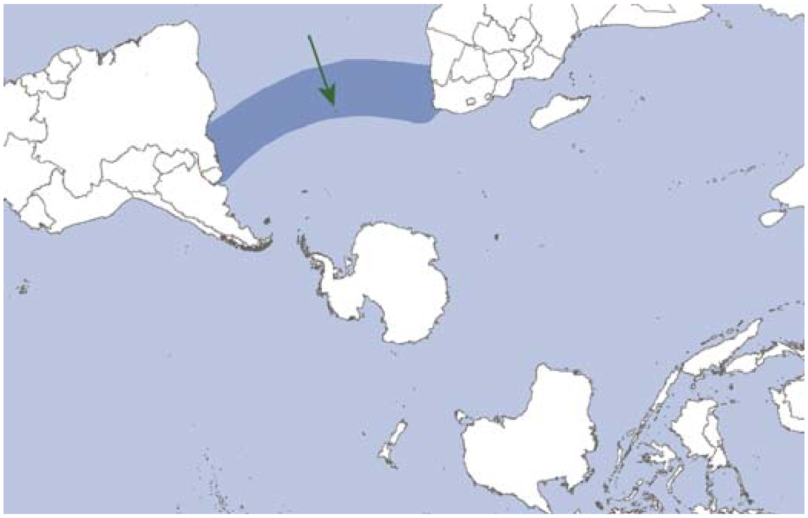
Illustration by Derek Onley

IUCN THREAT STATUS: Critical, population declining

Identification:

WINGSPAN: 135 cm LENGTH: 55 cm BILL: 49 - 55 mm

Large brownish-black petrel with variable white markings on head and pale bill with darker tip. Easily identified when head markings can be seen, but some birds have very little white. Otherwise very difficult to tell from Westland, White-chinned and Black Petrels. Flesh-footed Shearwater (not included here) has pink feet. See also dark Wedge-tailed, Sooty and Short-tailed Shearwaters.



Range and Population:

The Spectacled Petrel breeds only on the high western plateau of Inaccessible Island, Tristan da Cunha (to UK). In 1949–1950, the population was estimated to be at least 100 pairs, probably considerably more[9]. In 1982–1983, it was estimated at c.1,000 pairs[5,10]. In 1999, 6,000–7,500 burrows were counted (c.60% occupied), but failures prior to this stage and the presence of non-breeders confound an accurate population estimate[11]. Most birds disperse to the waters off southern Brazil outside the breeding season, with small numbers recorded off the west coast of southern Africa. In the 19th century, it may have occurred throughout the Indian Ocean, possibly breeding at Amsterdam Island (French Southern Territories), and was also collected at sea off Australia[4,10].

Ecology:

It feeds on cephalopods, decapod crustaceans and small fish[6]. It breeds in wet heath above 380 m[12]. Burrows are along the banks of river valleys[5] and in adjacent marshy areas[13].

Threats:

Feral pigs may have caused the apparent extirpation of *Procellaria* petrels from Amsterdam Island and may have had an impact on Inaccessible in the late 19th and early 20th centuries[5,10]. Southern Skua *Catharacta antarctica* is a natural predator, particularly of fledglings[12], and there is a permanent risk of colonisation by mammalian predators, particularly black rat *Rattus rattus* from Tristan. However, the greatest threat comes from interactions with longline fisheries, given estimates of more than 200 killed annually off southern Brazil during the late 1980s and early 1990s[10], revised to c.700 annually more recently[8].

Conservation:

CMS Appendix II. Inaccessible is a nature reserve and, although Tristan Islanders retain the right to collect driftwood and guano, other access is restricted[1].

Targets:

Conduct repeat surveys of breeding population[10]. Promote adoption of best-practice mitigation measures in all fisheries within species's range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[3]. Minimise the risk of colonisation by introduced species through strict controls of visits and promoting awareness of dangers of inter-island transfers[12]. Nominate Inaccessible for World Heritage Site status[2].

References:

1. Cooper *et al.* (1995). **2.** J. Cooper *in litt.* (1999). **3.** J. Cooper and J.P. Croxall *in litt.* (2000). **4.** Enticott and O'Connell (1985). **5.** Fraser *et al.* (1988). **6.** Hagen (1952). **7.** G.B. Nunn and P.G. Ryan (unpublished data). **8.** Olmos *et al.* (2000). **9.** Rowan *et al.* (1951). **10.** Ryan (1998). **11.** Ryan and Moloney (in press). **12.** P.G. Ryan *in litt.* (1999). **13.** P.G. Ryan *in litt.* (2000).

Westland Petrel

Procellaria westlandica

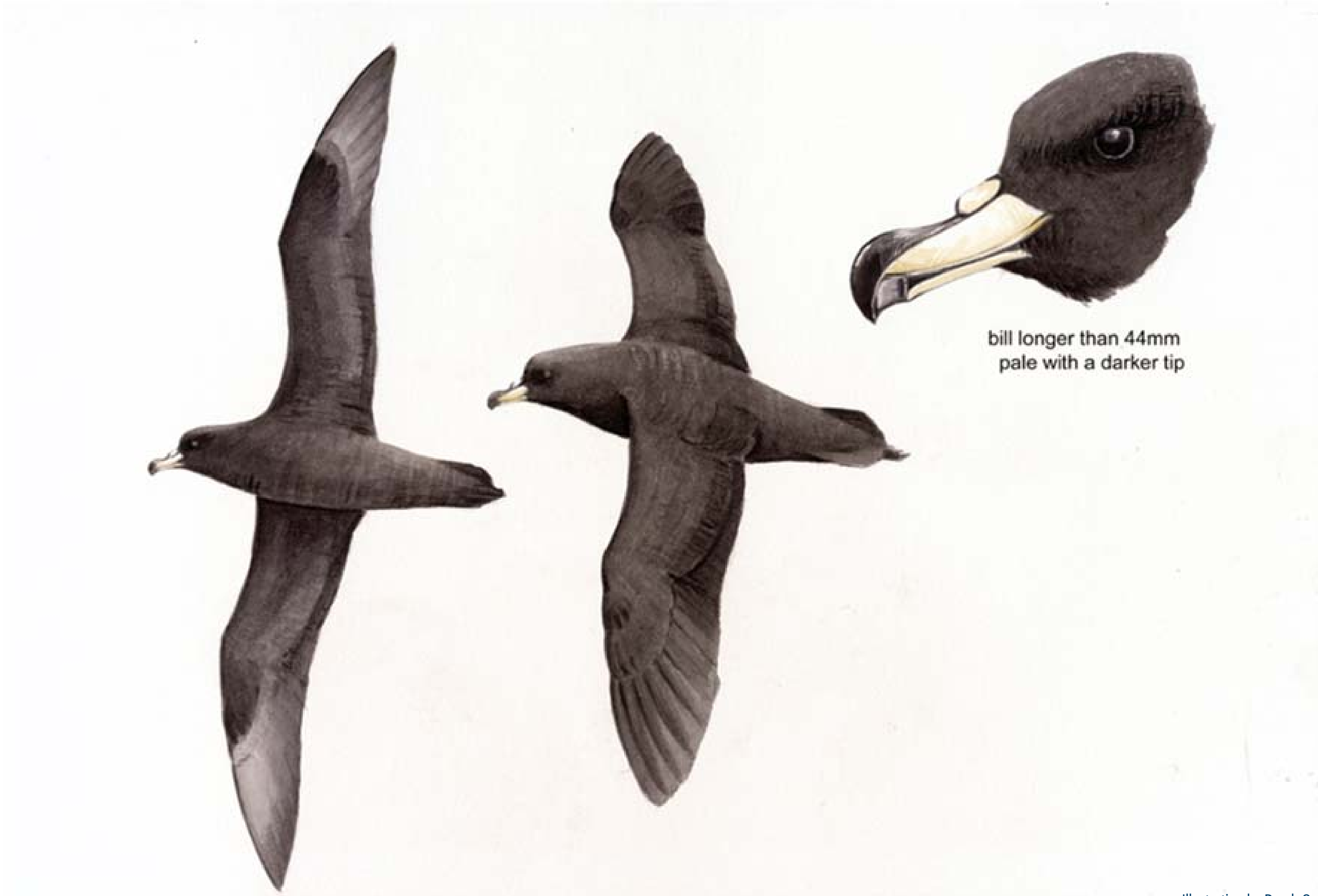


Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern, stable population trend

Identification:

WINGSPAN: 140 cm LENGTH: 50 cm BILL: 45 - 49 mm

Large brownish-black petrel with pale, dark-tipped, bill. Difficult to tell at a distance from White-chinned, Spectacled and Black Petrels. Close up distinguishable from White-chinned by dark tip to bill, and Spectacled by lack of white marks on head. Larger and more heavily built than Black Petrel, with small differences in bill shape, but difficult to distinguish without practice. Measure bill! Flesh-footed Shearwater (not included here) has pink feet. See also dark Wedge-tailed, Sooty and Short-tailed Shearwaters.

Range:

The Westland petrel breeds in the coastal foothills at Punakaiki, South Island, New Zealand[1]. In 1958, the population was estimated at 3,000–6,000 birds, in 1972, 6,000–10,000 birds, and in 1982, 1,000–5,000 pairs[4]. In 1974, however, only 818 occupied burrows were located[1]. Recent estimates put the total population at less than 20,000 birds, and c.2,000 pairs[3,5]. It migrates in summer to central Pacific and eastern New Zealand waters, and off South America[4].

Ecology:

It nests in colonies on densely forested hills between 20–250 m. Burrows are usually concentrated in areas where the ground is relatively open, and where take-off areas are close by. Juveniles return to the colony as young as five years, but the minimum age of first breeding is 12[4]. Fisheries waste is an important dietary component, perhaps forming more than half of solid food eaten during the hoki fishing season[2].

Threats:

Introduced mammals prey on eggs, chicks and adults, trample burrows, and contribute to the erosion of subcolonies[1,4,5,6]. Mining and agriculture have destroyed some available habitat. Birds are occasionally killed by flying into power pylons, and are attracted to lights and noisy machinery at dawn and dusk[5]. It is a bycatch species of tuna longliners in New Zealand and Australia[3]. Birds regularly follow commercial trawlers and may be killed when nets are hauled[5].

Action:

CMS Appendix II. The breeding site is within the Paparoa National Park. A proposal to designate the colonies as the Westland Petrel Special Area was approved in 1999, and will restrict public access. A long-term study has been in place since 1969, covering social organisation, behaviour, breeding biology and aspects of population dynamics. Predator and herbivore control has been carried out in the main breeding colonies since 1990[5].

Targets:

Census all burrows every 10 years. Continue annual monitoring of study burrows, and band chicks and adults. Identify and minimise hazards to birds flying to and from the colony. Continue sustained predator control and monitoring of nests to identify predation events, and respond accordingly. Commence sustained control of browsing mammals, particularly goats and possums. Fence colony boundaries to exclude stock[5].

References:

1. Best and Owen (1976). **2.** Freeman (1998). **3.** Heather and Robertson (1997). **4.** Marchant and Higgins (1990). **5.** Taylor (2000). **6.** A. J. D. Tennyson *in litt.* (1994).

White-chinned Petrel

Procellaria aequinoctialis

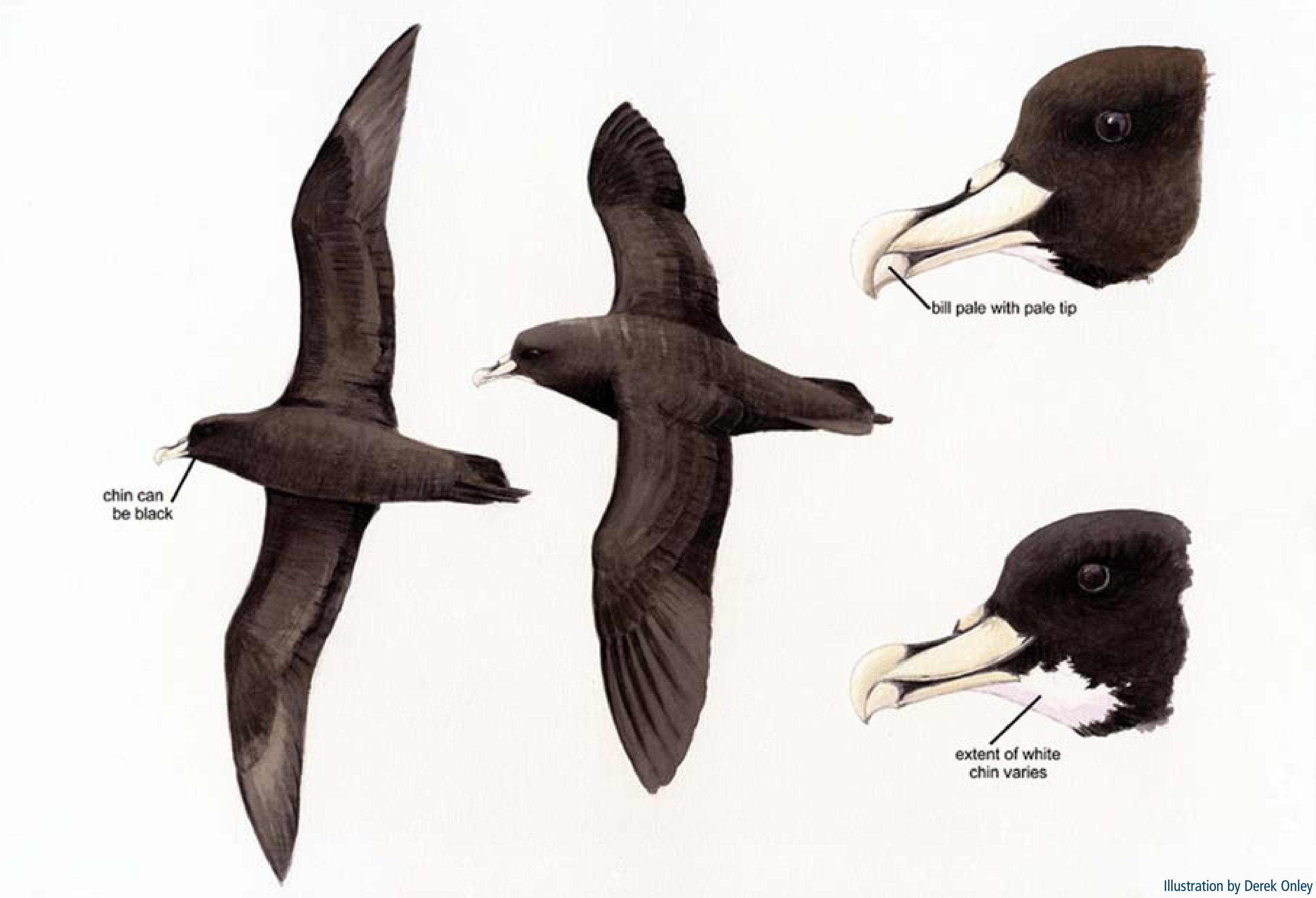


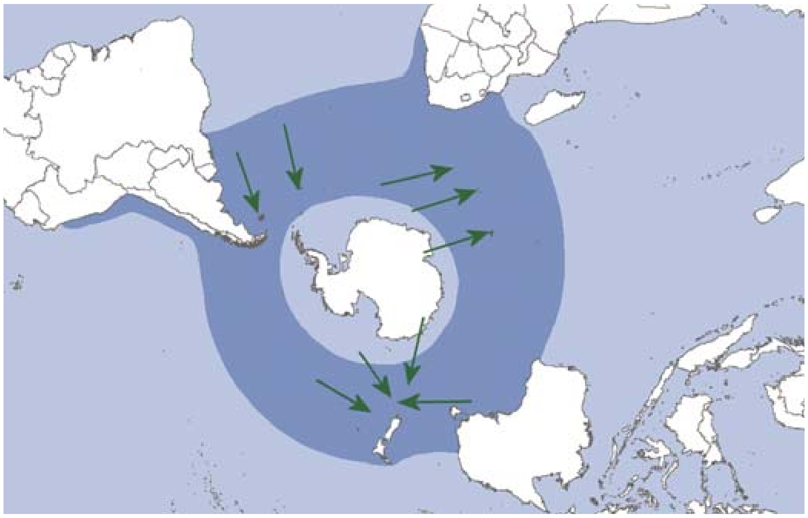
Illustration by Derek Onley

IUCN THREAT STATUS: Vulnerable, population declining

Identification:

WINGSPAN: 140 cm LENGTH: 55 cm BILL: 47 - 56 mm

Large brownish-black petrel with a pale bill. Easily identified when pale-tipped bill can be seen. Otherwise difficult to tell from Westland, Spectacled and Black Petrels. Extent of white on chin varies and can be absent and is not very helpful for identification. Flesh-footed Shearwater (not included here) has pink feet. See also dark Wedge-tailed, Sooty and Short-tailed Shearwaters.



Range and Population:

The White-chinned Petrel breeds on the Falkland Islands (to UK), South Georgia (to UK), Prince Edward Islands (South Africa), Crozet Islands, Kerguelen Islands (French Southern Territories), Auckland, Campbell and Antipodes Islands (New Zealand), and possibly Macquarie Island (Australia). Its population is estimated at c.2,000,000 pairs on South Georgia[7], many tens of thousands on Crozet[9], 100,000–300,000 pairs on Kerguelen[12] and at least c.100,000 on Disappointment (Auckland) and the Antipodes[11]. On Bird Island (South Georgia), it decreased by 28% over 20 years[3], while in Prydz Bay (Antarctica), birds at sea decreased by 86% during 1981–1993[14]. It forages north to the subtropics and south to the pack-ice edge off Antarctica[2,13], and disperses widely in all southern oceans[7]. Estimated population: 5,000,000 birds.

Ecology:

It feeds on cephalopods, crustaceans and fish[2].

Threats:

It is one of the commonest species attending longline fishing trawlers off south-eastern Brazil during winter[10] and constitutes virtually all the recorded seabird bycatch from the South African hake fishery[1]. In the Atlantic and Indian Oceans, several hundred are killed annually in the regulated fishery for Patagonian toothfish *Dissostichus eleginoides*. A further 31,000–111,000 and 50,000–89,000 seabirds in 1997 and 1998 respectively were estimated killed in the illegal fishery, c.80% *P. aequinoctialis*[4,5]. In the Australian Fishing Zone, more than 800 are potentially killed annually[8] and, in New Zealand, it is the second most common petrel caught on longlines[11]. Rats are significant predators at some breeding sites, such as Crozet and South Georgia, where breeding habitat is extensively degraded due to erosion by expanding populations of Antarctic fur seal *Arctocephalus gazella*[3].

Conservation:

Listed in Appendix II, Convention on Migratory Species. Population monitoring and foraging ecology studies are being undertaken at South Georgia, Crozet and Prince Edward. Several breeding sites are in protected areas.

Targets:

Continue and extend monitoring studies. Where feasible, eliminate alien predators from breeding islands. Promote adoption of best-practice mitigation measures in all fisheries within the species' range, particularly via existing and proposed intergovernmental mechanisms under auspices of CCAMLR, CMS and FAO[6].

References:

1. Barnes *et al.* (1997). **2.** Berrow *et al.* (1999). **3.** Berrow *et al.* (in press). **4.** CCAMLR (1997). **5.** CCAMLR (1998). **6.** J. Cooper and J.P. Croxall *in litt.* (2000). **7.** Croxall *et al.* (1984). **8.** Gales *et al.* (1998). **9.** Jouventin *et al.* (1984). **10.** Olmos (1997). **11.** G.A. Taylor *in litt.* (1999). **12.** Weimerskirch *et al.* (1989). **13.** Weimerskirch *et al.* (1999). **14.** Woehler (1996).

Cory's Shearwater

Calonectris diomedea

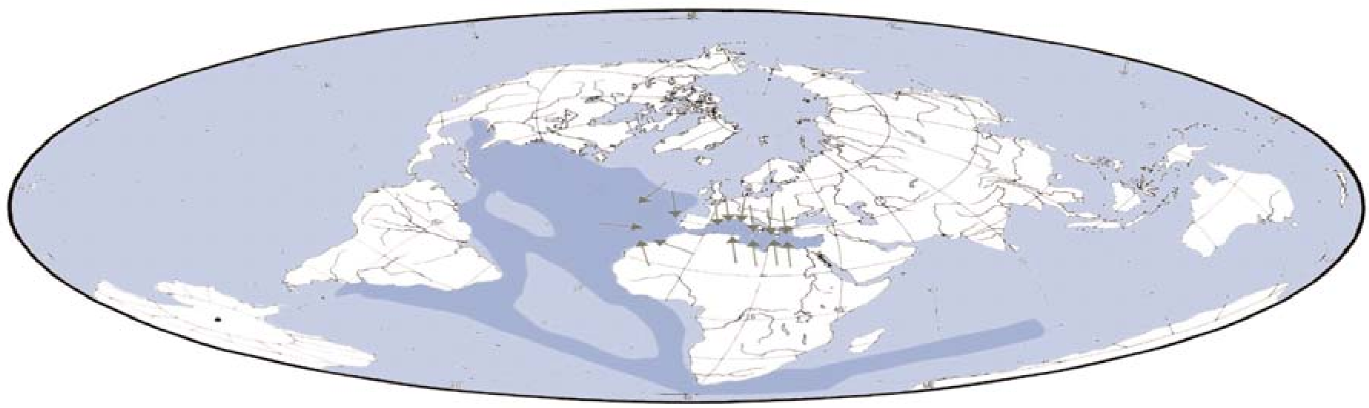
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 110 cm   LENGTH: 46 cm   BILL: 45-62 mm

A large broad-winged shearwater with a large, pale yellow, dark-tipped bill. Pale greyish–brown upperparts merging into white underparts. White underwing with dark border. Told from similar Great Shearwater by yellow bill, whiter underwing and belly and smudgy sides to head. More heavily built than pale Wedge-tailed Shearwater with shorter, squarer-ended tail and yellow bill.



Range and Population:

Breeds annually, May–November. Two subspecies, distinguishable at sea. *C. d. diomedea* breeds on islands throughout the Mediterranean (>26,000 pairs[3]) *C. d. borealis* breeds on Azores (50,000–90,000 pairs[4]), Madeira, Salvage (13,000 pairs[5]), Canary (1000s pairs), and Berlengas Is. Has increased in number on several islands in recent years[5]. Total population estimate: over 800,000 birds. Breeds in Northern Hemisphere and migrates south. *C. d. diomedea* migrates out of the Mediterranean and down the west African coast into southern African waters. From November to May they occur off southern Africa 24–40°S. *C. d. borealis* breeds on eastern Atlantic islands and migrates down the east coast of South America and across into the Indian Ocean. From November to May occurs in the SW Atlantic to 48°S. From December–March also across SW Indian Ocean, between 34–42ºS, to Amsterdam I.

Ecology:

Feeds on fish, cephalopods, and crustacea[2], mostly obtained over shelf waters and ocean fronts. Follows ships and feeds around trawlers[3]. Mean annual adult survival 92.7%, with 32.8% of young birds surviving to breed[6].

Threats:

Dives frequently to at least 2m[(2)], and has been recorded in the North Atlantic taking tuna lures[1]. Mortality on tuna longlines in the Atlantic is believed to be responsible for depressed mean annual adult survival[6]. Adults and eggs taken from breeding islands in large numbers in 1960s resulted in rapid population declines in many places[2]. This has now reversed[6], as the result of protection of the birds and some islands. Rat predation reduces breeding success on Corsica, but rats are now controlled there.

Conservation:

Long-term demographic studies have been made of Cory's Shearwaters at several sites. The best-known population is that on the Salvage Islands (Portugal), studied since 1963, and intensively since 1978 by Mougin and co-workers. Long-term studies of the Mediterranean subspecies have been made on Corsica and other islands, and have now commenced on the Azores Is.

References:

1. Berrow (1993). **2.** Cramp et al. (1977). **3.** Marchant and Higgins (1990). **4.** Monteiro *et al.* (1996). **5.** Mougin *et al.* (1996). **6.** Mougin *et al.* (2000).

Great Shearwater

Puffinus gravis

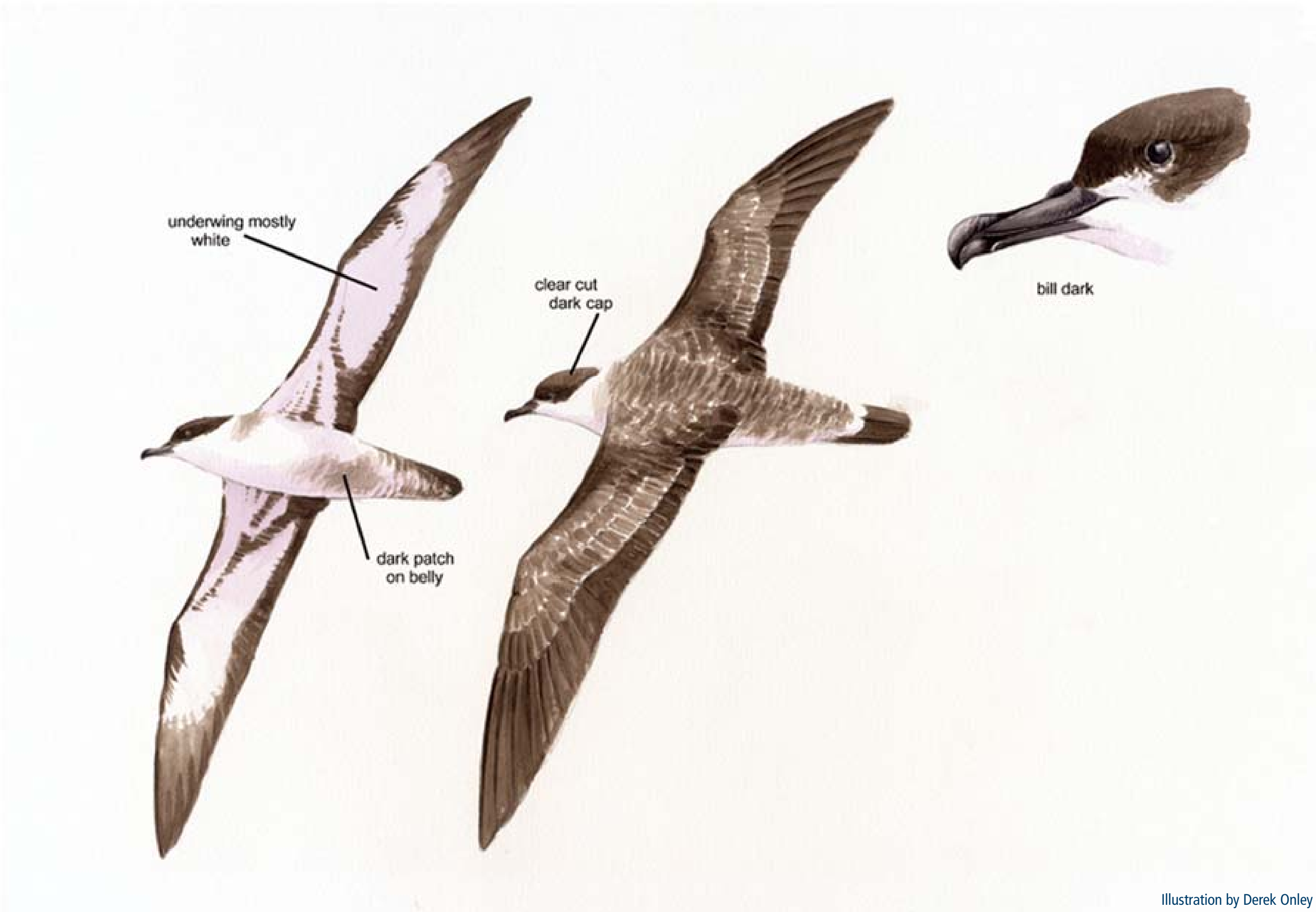


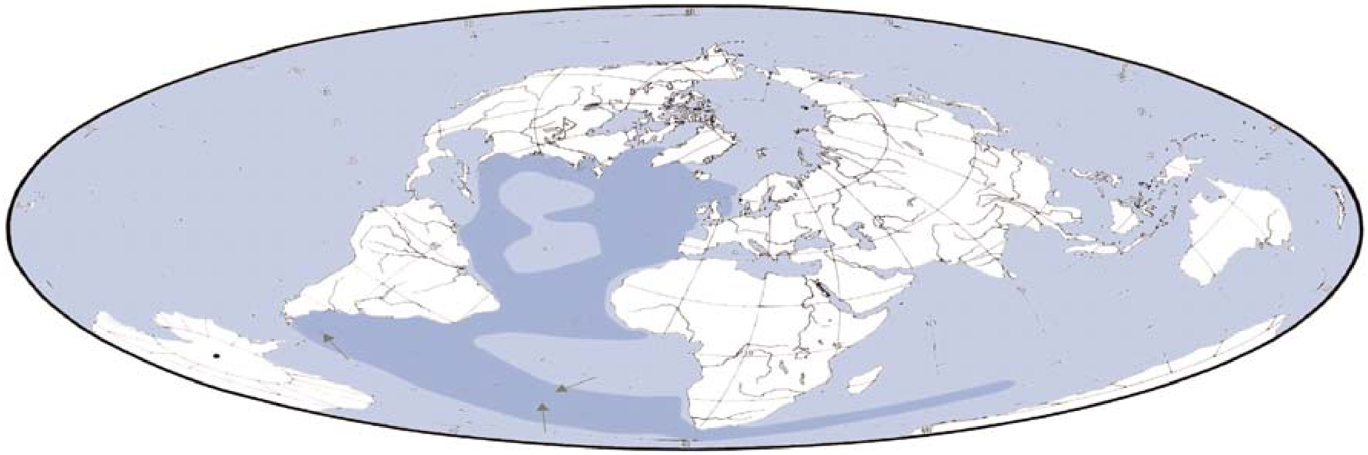
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 110 cm LENGTH: 47 cm BILL: 43-50 mm

A large shearwater with a dark bill. Brown upperparts with white band across base of tail, white collar, and dark brown, well-defined cap. White underparts with a smudgy and often hard to see brownish patch on belly. Dark-bordered white underwing with variable dark marks. Dark bill, clear-cut dark cap and dark marks on underparts and underwing distinguish it from Cory's Shearwater.



Range and Population :

Breeds annually from November–April. Breeds on Nightingale Island (2 million pairs) and Inaccessible Island (2 million pairs) in the Tristan da Cunha group, on Gough (600,000–3 million pairs) and the Falkland Islands (100 pairs)[5]. Populations historically stable[3], but increasing since 1950s[5]. Total population estimate: 10 million birds. In southern summer mostly in South Atlantic 38–52ºS, with a few north to 32ºS off Brazil and south as far as 55ºS. Smaller numbers occur around southern Africa to 54ºS. In autumn, Great Shearwaters spread east into the Indian Ocean between 39–45ºS across to Kerguelen (65ºE). In winter most migrate to North Atlantic, but a few stay in the south throughout the year (J-C Stahl)[2].

Ecology:

Feeds on fish, cephalopods and crustaceans, obtained with frequent, shallow dives, mostly by day. Occurs mainly in (sometimes very large) flocks[1]. Will follow ships and feed around trawlers and fishing vessels[2].

Threats:

Exterminated on Tristan da Cunha Island by introduced predators, but a small colony has re-established[3]. An estimated 40-70,000 birds have been annually harvested on nearby Nightingale Island by islanders from Tristan da Cunha since 1930s, with no apparent influence on population size, even though adults as well as chicks have been taken[3]. No data on mortality in fisheries, but high mortalities of Great Shearwaters are likely in the high seas drift-net fishery in the Tristan da Cunha area by Taiwanese and other vessels, as described by Ryan & Cooper[4].

Conservation:

No populations are being monitored to provide demographic data, but Gough Island and Inaccessible Island are now nature reserves. Maintenance of the predator-free status of Nightingale, Inaccessible and Gough Island is the most essential requirement to maintain the Great Shearwater population. There are no wharves or permanent mooring facilities at these islands.

References:

1. Cramp et al. (1977). **2.** Marchant and Higgins (1990). **3.** Richardson (1984).
4. Ryan and Cooper (1991). **5.** Ryan and Moloney (2000).

Short-tailed Shearwater

Puffinus tenuirostris

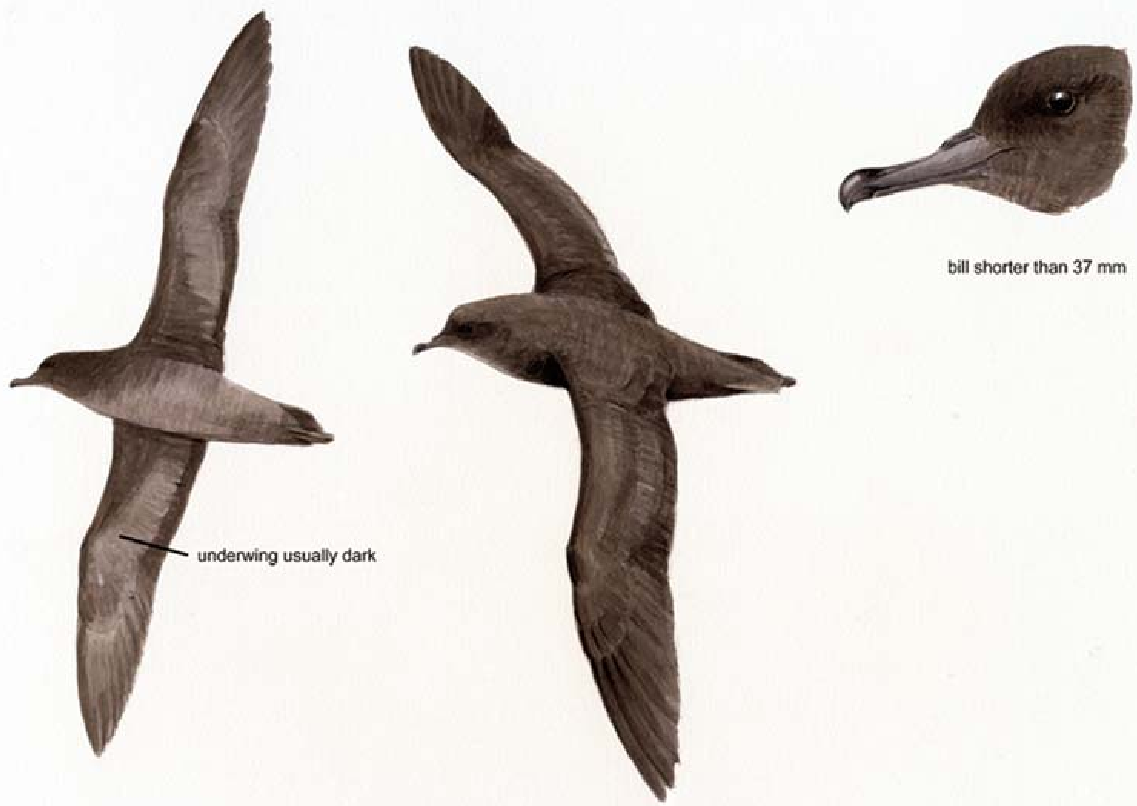


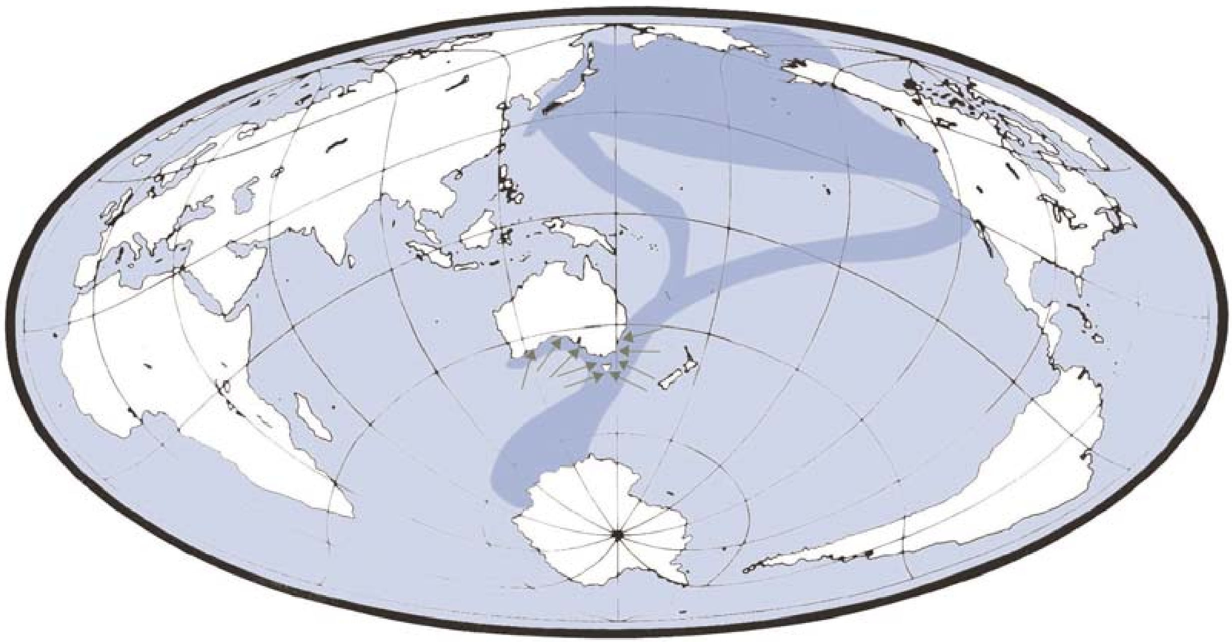
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 95 cm LENGTH: 42 cm BILL: 29-35 mm

Medium-sized, blackish-brown shearwater with narrow stiff-looking wings and shortish tail. Underwing usually dark, very rarely paler. Bill thin and dark grey. Fast gliding flight with brief bursts of rapid wingbeats. Slightly smaller but very similar to Sooty Shearwater, usually distinguishable by dark underwing. Measure bill! Flesh-footed Shearwater (not included here) is broader winged and has a pale dark-tipped bill. See also dark Wedge-tailed Shearwater, Spectacled, Black, White-chinned and Westland Petrels.



Range and Population :

In summer and autumn, ranges south of Australia to 65ºS and through the South Indian Ocean west to 60ºE. In winter, most migrate to the North Pacific. Breeds on many islands off Australia, especially off the southeast coast; including Tasmania (6.8 million pairs) Victoria (2.2 million pairs); New South Wales (24,000 pairs). Numbers apparently stable or increasing[2]. Total population estimate: 23 million.

Ecology:

Breeds annually, November-April in burrows on offshore islands. Feeds on small fish, cephalopods and crustacea (mostly euphausiids and amphipods) seized from surface or from dives to 20m[2]. Sometimes feeds around trawlers.

Threats:

An estimated 100,000±10,000 per year were killed in North Pacific drift net fisheries 1978-92[1]. No recent data are available on mortality in Australian or North Pacific fisheries.

Conservation:

The North Pacific high-seas gill net fisheries are now closed. Human harvesting of young birds continues on islands off Tasmania, where 220,000 birds were harvested in 1994[3]. Detailed information on demography available from a long-term (since 1947) monitoring programme on Fisher Island, Tasmania, and from other islands in Bass Strait.

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Sooty Shearwater

Puffinus griseus

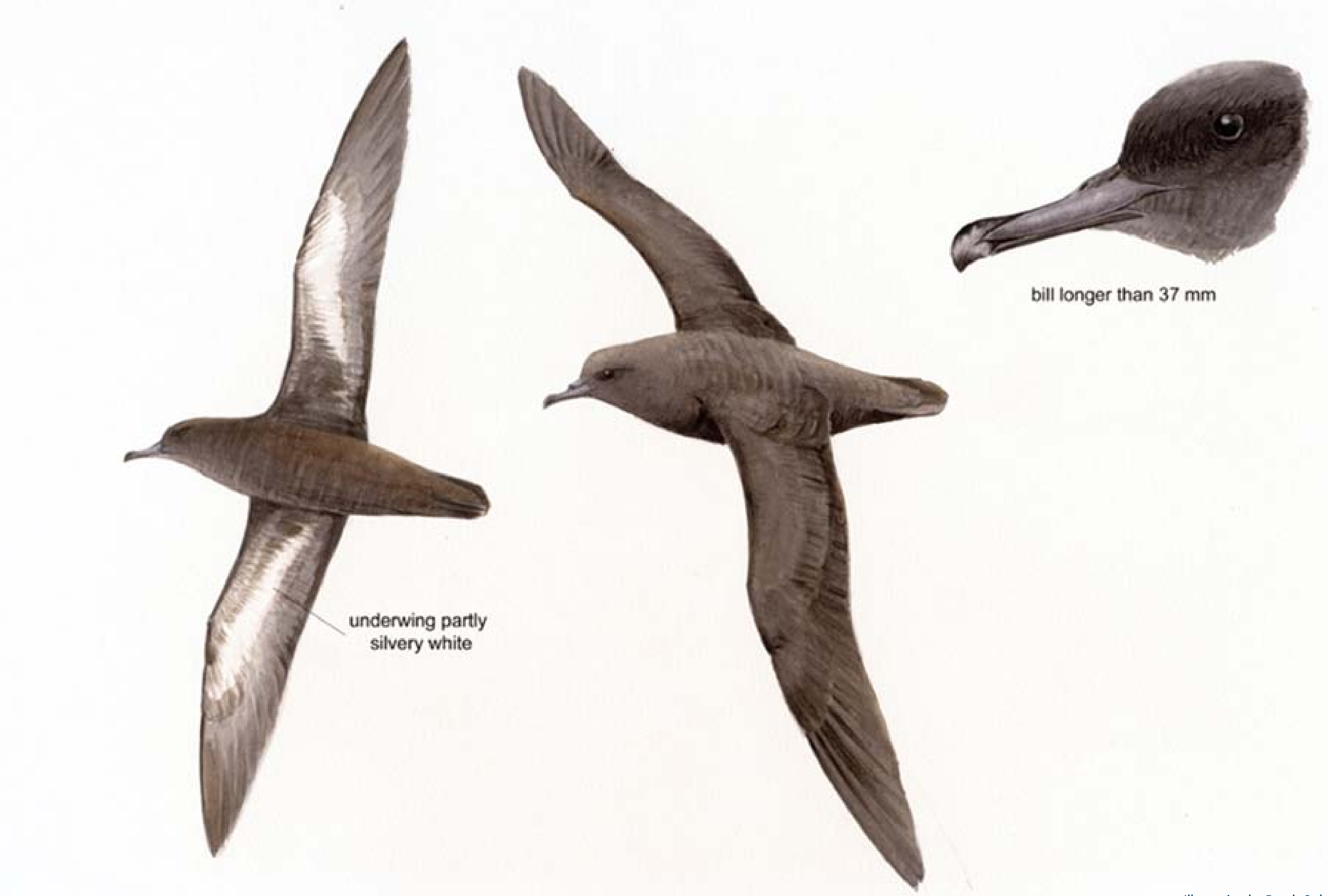


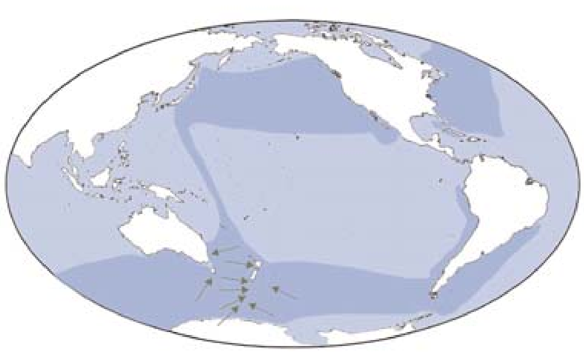
Illustration by Derek Onley

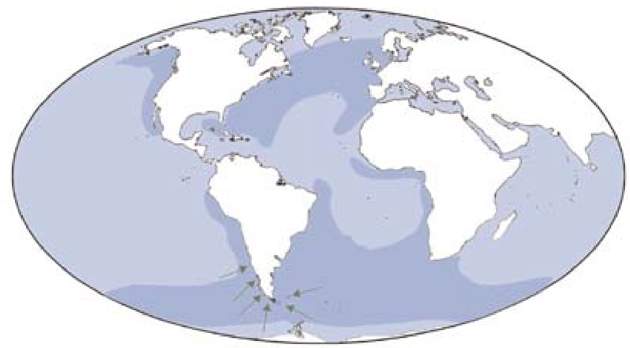
IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 105 cm LENGTH: 44 cm BILL: 39 - 46 mm

Medium-sized, blackish-brown shearwater with narrow stiff-looking wings and shortish tail. Underwing partly silvery-white. Fast gliding flight with brief bursts of rapid wingbeats. Slightly larger but very similar to Short-tailed Shearwater, usually distinguishable by white on underwing. Measure bill! Flesh-footed Shearwater (not included here) is broader winged and has a pale dark-tipped bill. See also dark Wedge-tailed Shearwater, Spectacled, Black, White-chinned and Westland Petrels.





Range and Population :

Main breeding areas – (1) in the New Zealand region, on offshore islands (> 2 million pairs), Snares Islands (2.75 million pairs), Campbell, Auckland (1000 pairs), and Macquarie (1800 pairs) Islands. (2) on islands of S. Chile and Cape Horn (>10,000 pairs), and on the Falkland Islands (10,000+ pairs). A few (3) in Australia – New South Wales (300 pairs) and Tasmania (>1000 pairs) [7, 11]. Numbers declining in North Pacific and in the New Zealand area, perhaps by 64% between 1961 and 1999[10, 15,17]. Total population estimate: 23 million.

Ecology:

Breeds annually, November–April. In summer common in seas around New Zealand, south-eastern Australia, and South America from 34–67°S, commonest over shelves. In autumn moves into the Pacific north to 5°S off Ecuador, and into the SE Indian Ocean to 60°E south of Kerguelen (49°S). In winter most migrate to the North Pacific and North Atlantic. On return, common south of 45°S off Argentina and Africa. A few in the Southern Ocean in all months. Follow ships and feeds around trawlers. Frequently dives to depths of 40–67m[19].

Threats:

Sooty Shearwaters among the most-frequently killed seabirds in global fisheries. Observed Japanese, Taiwanese and Korean high-seas drift nets in the North Pacific killed an estimated 427,000 ± 312,000 Sooty Shearwaters yearly between 1978 and 1992. The worst-case scenario for this fishery was that up to 1.16 million Sooty Shearwaters were caught annually. More recently, in large-scale coastal gill net fisheries from British Columbia to Alaska, over 63% of seabirds caught were Sooty Shearwaters[8]. Sooty Shearwaters, occasionally in high numbers, are caught in coastal gill nets in New Zealand [6,16]. Few Sooty Shearwaters are caught on tuna longlines in Australian and New Zealand seas[2,3,6,9], but several thousand are killed in trawl fisheries every year[1,4,5,12,13,14].

Conservation:

New Zealand and Australian subantarctic islands are fully protected as World Heritage sites although rat and cat predation remains as a problem on Macquarie. Predation by introduced mammals may be a problem in Chile. In southern New Zealand, Maori harvest about 250,000 young birds for food every year[18].

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Wedge-tailed Shearwater

Puffinus pacificus

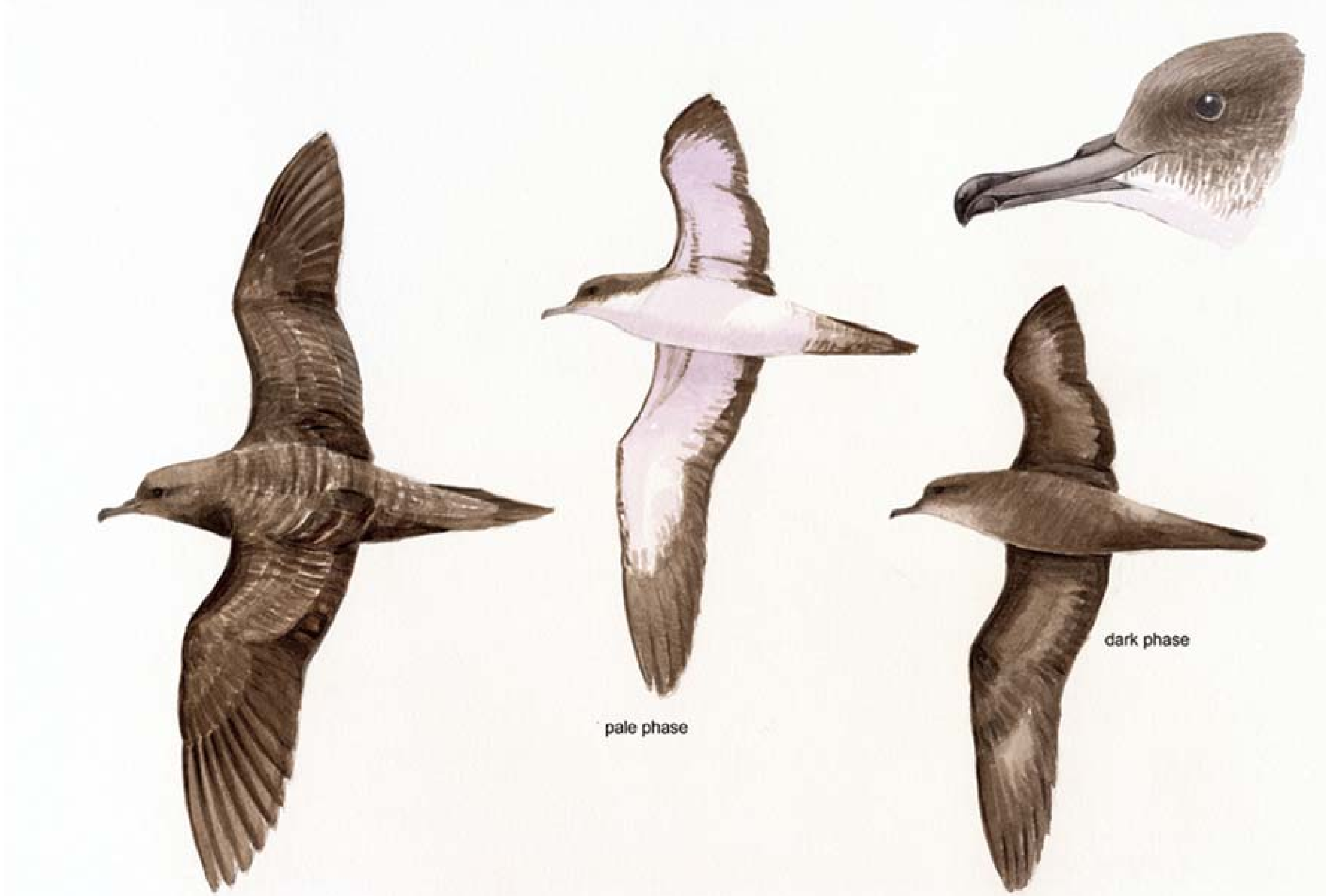


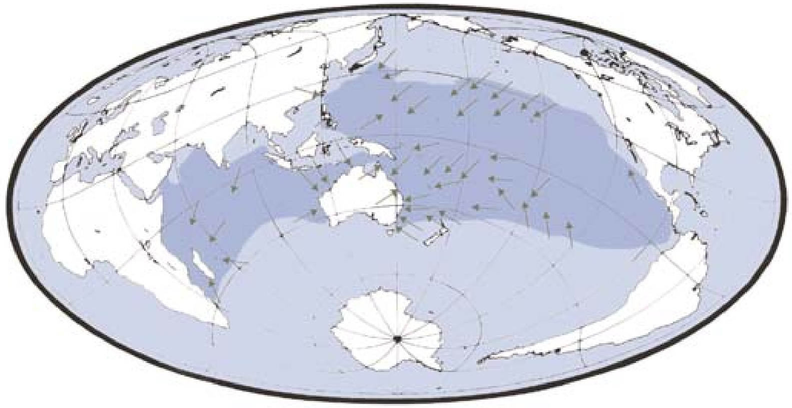
Illustration by Derek Onley

IUCN THREAT STATUS: lower risk – least concern

Identification:

WINGSPAN: 100 cm   LENGTH: 43 cm   BILL:. 36-42 mm

Wedge-tailed Shearwaters are entirely brown, except for North Pacific colonies (90% with whitish underparts), and Western Australia and Mexico (c.30% whitish).[7, 10, 2]. Medium-large, slender shearwater with a pointed tail and thin dark bill. Dark birds entirely greyish-brown. Pale birds have dark upperparts merging into whiter underparts. Slighter build with a dark bill and pointed tail distinguish pale birds from Cory's Shearwater. Dark birds are broader winged and longer tailed than Sooty and Short-tailed Shearwaters. See also pale-billed White-chinned, Westland and Black Petrels



Range and Population :

The most abundant shearwater in warm waters. Breeds on Hawaiian (Kure south to Johnston & Phoenix Is – 572,000 pairs)[4,8], Bonin, Iwo Jima, Marcus and Marshall Is (12,000+ pairs), and Revillagigedos[4]. Also on hundreds of islands from Pescadores (Taiwan Strait) and east Australia across to Henderson I. Abundant on islands off Queensland (over 100,000 pairs[9]), Norfolk (100,000+ pairs), Lord Howe (60,000 pairs) and Kermadecs (55,000 pairs[6]). Scattered across the Central Pacific (Solomon, New Caledonia, Vanuatu, Fiji, Niue, Tuvalu, Tonga, Tuvalu, Tokelau, Samoa, Austral, Society, and Marquesas). Largely sedentary except for Australian birds migrating into the Philippine Sea[10]. In Indian Ocean breeds from Madagascar to Seychelles & Chagos Archipelago. Largest populations (over 10,000 pairs) on Mascarene, Amirante and Seychelles. None on Aldabra and Christmas : few on Cocos-Keeling[10]. On 80 islets off Western Australia from Ashmore Reef to Rottnest I. (colonies fewer than 10,000 pairs except for Pelsaert, 81,400 pairs[3]). Migrates into tropical North Indian Ocean in winter[10]. Total population estimate: 5 million.

Ecology:

Normally breeds annually in summer, but almost all year in the tropics[8]. Nests in burrows at low altitudes on islands and coral cays. Mostly feeds in flocks – sometimes several thousand; often with other seabirds. Diet mostly small fish and cephalopods caught by surface-seizing by day. Tuna, dolphins and porpoises important in chasing prey[1].

Threats:

Level of harvest for food for humans on Pacific and Indian Ocean islands is considered sustainable[5]. Declines on Johnston Atoll, Jarvis, Howland, Midway and the Mariana Is are caused by habitat changes and the introduction of mammals[4]. There is also mortality in gill-net fisheries[4].

Conservation:

The key is protection of colonies from habitat modification and introductions. Where islands are protected (e.g. Cousin I, Seychelles; Australia; Kermadec & Laysan I.), rapid recovery in numbers has occurred. But where they are not protected (e.g. Islas Revillagigedo) a downward trend towards extinction is evident[4]. Fisheries mortality does not seem important at present.

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