8 Working with Fishers to Reduce By-catches

(by Martin A. Hall)

Fifty years ago, when the oceans’ stocks of fish were thought to be inexhaustible, there were no so-called ‘by-catches’. Marine scientists studying fisheries were mostly limited to the monitoring of landings, and they developed the methods used in fisheries science from this perspective. Discards and by-catches were not part of the equation. By-catches in the context of this chapter mean dead discards; and because discarding happens at sea, land-based monitors could not see this component of the fishing process. What were the consequences of this very incomplete picture?

For species that were the targets of fisheries, when there were discards of undersized individuals, or high grading, etc., there was an additional unaccounted harvest of the population. The figures used to determine how populations were doing were therefore incorrect, and underestimated impacts.

For non-target species, there were several issues, but one of the biggest problems seemed to be when by-catches involved low productivity species mixed in with the higher productivity target species. For example, a tuna that begins to reproduce at 1.5 years of age, and may produce 100,000,000 eggs per year cannot be compared with a dolphin that begins to reproduce at age 10, and can only produce one calf every second year. When dolphins, sea turtles or seabirds, are taken in fisheries targeting tunas, anchovies, squids, etc., the level of fishing that could be sustainable for the target species is far greater than what the by-catch species can sustain. The dilemma is therefore to reduce fishing to the level that is adequate for the by-catch species, or to try to break the coupling of the target and by-catch species via selective fishing.
At sea, fishers were facing this by-catch issue from their own perspective. Seabirds taking bait from hooks were reducing fishing opportunities; the fact that once in a while some would get caught on a hook added to the aggravation because the bird had to be removed. By-catches of fish species increased the work on deck in order to discard unwanted individuals. Some of the by-catch species are also popular among fishers (although those species that take bait or target species are seldom popular), and this brings an additional incentive to avoid incidental mortality of such species.

The first attempts to improve selectivity in fishing gears were simple changes in mesh size, with the objective of releasing smaller individuals from the net and retaining only those individuals of desired sizes. But during the 1950s and 1960s, more scientists and technicians started going out to sea frequently, and other impacts became known. Two very different issues related to by-catch took prominence. One of them was the potential utilisation of the by-catch from shrimp trawls. Here by-catch was considered an issue of wastage, a problem of protein harvested but not consumed and many studies, particularly in tropical areas, discussed the potential utilisation of that by-catch. The other issue was the realisation by the public of the large incidental mortalities of dolphins in the tuna purse-seine fishery in the eastern Pacific. When the public knew that some very charismatic species were being killed in large numbers by this fishery, reaction came swiftly. What followed were attempts by the industry’s participants to ‘sweep the issue under a huge carpet’, denying the existence of the problem, or trying to argue that the mortalities were sustainable, under a naive belief that the mortality of a ‘few hundred thousand dolphins,’ even if it were deemed sustainable, could be accepted by the public. Years of lobbying and developing political connections by industry, amounted to little in the face of this new movement that scared and confused the industry. The conflict was quite bitter, and by-catch became a dominant issue in the management of the tuna fishery. Other by-catch cases soon followed, involving charismatic components of the ecosystem (sea turtles and seabirds), as well as other cases, involving not-so-charismatic species (such as sharks, juvenile fish, etc.).

To reduce by-catches, we always have two options: ‘fish less or fish better’. The option of fishing less, that at the extreme, leads to banning some fishing gear or practices entirely, is frequently preferred by some sectors, but very rarely by the fishing community. Given the social and economic situations of many countries, it is unlikely that they would accept the economic impacts, and especially the social costs, caused by increased unemployment. So for them, the preferred option to reduce by-catch is usually to find ways to ‘fish better’. To achieve this goal, we need to find ways to encourage the fishers’ cooperation and participation in the process. This is a necessary step because: (i) fishers know more
about fishing than anybody else; (ii) fishers produce practical solutions, as the case-studies in this chapter will show, whilst academics produce diagnoses, but seldom practical solutions; and (iii) because modifying the behaviour of fishers at sea is frequently part of the solutions, they must be engaged in the process, rather than forced into it.

In this chapter we provide a variety of case-studies that illustrate the evolution of fishers, environmental advocates, fisheries managers and others, in dealing with by-catch issues. What we have learnt from these pioneer experiences should prove useful in facing future by-catch problems. These case studies offer a variety of views in different fisheries, regions and conditions that should help inform anyone trying to implement a program to reduce by-catches in fisheries. It is by no means a complete picture, and efforts such as those of TAMAR in Brazil, Karumbe in Uruguay, Parrish and Melvin in the Pacific Northwest and Alaska, and those of Kennelly and Broadhurst in Australia, should be examined for how to successfully integrate fishers, scientists and managers in dealing with by-catch issues. In this chapter, we have elected to concentrate on fisheries and by-catch issues concerning seabirds, turtles and dolphins – i.e., the charismatic by-catch issues. Other chapters in this book concentrate more on the non-charismatic by-catches associated with trawling, dredging and hooking.

Our focus here is not on the legal, engineering or scientific aspects of by-catch issues, but on the development of constructive and responsive interfaces between fishers, technicians, scientists and managers to succeed in dealing with by-catch problems. We have not tried to homogenise the contents of these case-studies: the voices of the storytellers have been respected and personality and cultural differences have been retained. Most people working with fishers on by-catch issues are good communicators, and there is little point in second-guessing the style and language of their choice.

8.2 Case Study 1 – Learning to Work with Fishers after Twenty Years in the Eastern Pacific Fisheries: The Tuna-dolphin Case

(by Martin A. Hall)

Almost 20 years ago, a young Latin American boat owner, Mr. Carlos Arbelaez, with a fleet of several purse-seiners in his stable, walked into my office. He had seen once again the gory videos of dolphins rolling down a purse-seine net. It was the same shot that had been shown over and over on different TV channels and programs. He realised the impact the video would have on the public and, in spite of the doubts many people in the
industry had about the authenticity of the video (a strange boat that had been inactive for years, with a clueless and callous captain and crew, etc.), we felt that it would be a waste of time to question the images. The behaviour of the crew shown in the video was very far from ‘typical’ behaviour on the boats, as shown in years of scientific observer records, but it was not impossible that a crew like that existed. Dolphin mortality was happening, and the figures were quite high (high being defined not in a population-sense but in a public-perception sense, where numbers have a psychological value). He asked me what we could do to reduce mortality, and I knew he meant business.

Over the previous months, we had been studying our observer data, and we had identified a number of factors that were affecting the level of dolphin mortality during fishing operations. There were environmental and mechanical factors, the availability of gear and its condition, etc. But the skill, experience, and motivation of captains and crews played a major role, as shown by differences in the performance of similar vessels operating in more or less the same areas with similar gear. The willingness of owners to provide their vessels with the right gear and equipment was also important. Approximately 20% of the vessels caused close to 80% of the mortality of dolphins.

However, it was not just technology that was leading to high dolphin mortality. The effect of individual differences among fishers was also significant. In fact, the performance of Carlos’ fleet was the worst of the eastern Pacific. Captains that were new to the fishery on dolphins were trying to grasp the new techniques and equipment, and that learning was costly. When I showed Carlos the statistics for his fleet, and compared those to data for the other fleets, he was shocked, and right then and there he decided to do something about it. Several of his boats were at sea, and the captains that rotated with those at sea were in Basque country, but he put his money where his mouth was. He called everyone in, and told me I had 3 days to show them how to lower dolphin mortalities. Very few boat owners would have made that decision; it was a combination of the belief that something needed to be done, with some trust that we may be able to produce a change, and the economic courage to put up a considerable sum of money to back those beliefs. In less than 3 years, that fleet had the lowest dolphin mortality rates of all those operating in the eastern Pacific and in 12 years, the incidental mortality of dolphins for the whole international fleet had been cut to 1% of the original level. After that first effort, we have been organising workshops for tuna fishers for almost 20 years. This is the story of how we learned to work with the fishers, and how they learned to work with us.
Role playing

Can you really put yourself in somebody else’s shoes? We had to show people who spent most of their time at sea the way their activity was being portrayed, and therefore perceived, by the public. We had to explain to them that, even though the dolphins were not in danger of extinction, the public response was strong enough to create a need for the industry to respond to mitigate the problem.

We had to decide how to use this opportunity to communicate with them in a very effective way.

The first thing we did was to show them all the videos seen on TV newscasts and documentaries, newspaper clippings, magazine articles, flyers and pamphlets. Even though they complained bitterly at the way they were being portrayed, they understood.

Round 1 finished with the acknowledgement that they had to face the problem, and an awareness of the possible consequences of not doing so. Nobody could promise them a solution if things changed, but it was quite obvious that only a major change could give them a fighting chance to keep their jobs and their industry in operation.

Fishers need to understand the problem they are facing, and believe in the proposed solutions. In this case, it was believing in their own ability to change the impact of the fishery. We showed them that some boats were doing very well in reducing dolphin mortality, and those vessels had no significant differences from the others in equipment or in their productivity.

Round 2 began with putting together the necessary building blocks, by firstly providing the fishers with an introduction to the species involved – in this case, the dolphins and the tunas. A lot of judgment is required to decide what they need to know – what could be helpful for them to understand these aspects of the ecology and behaviour of tunas and dolphins that are important and perhaps even to anticipate the circumstances that lead to incidental captures. They don’t need to become biologists, and the person in charge of the presentation is not there to show off how much he/she knows. No jargon, no Latin names, no complicated sentences. Clear, useful information and concepts, briefly and well explained. Why state the obvious? Because many people seem to have a major difficulty communicating directly. For many, scientific training results in an increasing inability to convey concepts without a heavy load of jargon.

The next component of the discussion with the fishers was an understanding of what we know about the factors that cause or increase by-catches. These ranged from environmental factors (e.g., strong currents), to gear and operational factors (e.g., execution of release manoeuvres, availability of rescue equipment, etc.), and the skill and motivation of captains and crews. Parallel to the identification of each problem, we
developed the responses that had originated from the fishers themselves over the years. This review of factors causing by-catch was an excellent opportunity to bring to the table their individual experiences and perceptions in sometimes heated discussions. This was an excellent learning time for everyone.

We also discussed the performance of the fleet and, in private with each captain, their individual performances. In the highly-competitive environment of this tuna fleet, looking bad in front of their peers is something fishers would all like to avoid. At the same time, their understanding that a few captains were responsible for the image of the entire fleet and the majority of the problem was very useful to build a management model based on recognising those differences. The captains were always strong supporters of management schemes that separated ‘good’ from ‘bad’ fishers.

For over 10 years now, the fleet has operated with an overall dolphin mortality limit, but that limit is divided by the number of participating vessels, and each vessel receives an individual dolphin mortality limit for a year. If a vessel’s limit is exceeded, it has to stop setting on dolphins for the rest of the year. Fishers always liked this scheme, because they didn’t want to be the victims of others’ lack of skill or motivation. Individual responsibility in management is an excellent concept when it is feasible; it is fair and equitable, and with time it results in a selective process for better captains and crews. Most of the captains who were involved in the higher-mortality trips are now gone from the fishery. When the boat owners realised that the better captains were not only those that filled the boats quickly, but that did so without compromising the fate of the vessel with carelessness about dolphins, the changes happened.

To reduce conflicts, we also clarified the role of observers, and finished by presenting to the fishers the problems we are still trying to solve, and asked for their impressions and suggestions, plus criticisms about the way we are proposing to work. And we listen. Sometimes there are simpler ways to achieve the same ends; sometimes the proposed solutions have unintended consequences. Once the workshops started, many fisheries authorities decided to follow our model, and today these workshops organised by the IATTC or by national dolphin program staff take place several times a year, in different countries and ports.

At the end of the workshops, private meetings are held with the fishing captains present to review their records of performance. Very frequently, the reasons for poor performances become evident from these records. Gear availability and use, problems with release manoeuvres, and risk-taking tendencies, are all described one-on-one. You don’t want to embarrass proud and very independent people, as these fishers are, but you need to show them why their performances are below par. Sometimes, they may share their ‘score’ with others, but it remains their choice to do so. Their
competitive instincts are heightened by the interactions with their peers, which often consist of using a sense of humour as a pointed stick, to jab at those bringing problems to the others. This is a male society; there are no women captains in the eastern Pacific. In many cases the ports are far away from the captains’ homes, and all their contacts are limited to a small world composed of captains, navigators, deck bosses, boat owners and the staffs of the national fisheries agencies and the IATTC. The social networks in which these fishers work are quite limited in membership, but they are crucial in the formation of opinions.

At the workshops, we emphasise the issues for which we have no answers yet, (e.g., by-catches of other species) and we ask them to start thinking about those problems. We usually show them gear changes and innovations from other fisheries that are of potential interest in our fishery, which may later be tested and introduced, and seek their views. The communication among fishers from different regions is quite weak, and we try to remedy that by serving as a channel for those ideas. As an example of this, we have started showing the fishers the sorting grids developed in the Norwegian mackerel and saithe fisheries to release smaller fishes alive, and those used in Canada to release smaller salmon. This is always accompanied with questions about their perception of the usefulness of those ideas in the tuna fishery.

Acknowledgement of the good performers is as important as identification of those responsible for most of the problems. Each year, the captains with the best performance in reducing dolphin mortality are recognised. We make sure to highlight the examples of leadership, responsibility and consistency among the captains.

8.3 Case Study 2 – Sea Turtles, Longlines, and the Artisanal Fisheries of the Eastern Pacific

(by Martin A. Hall)

The critical condition of several of the populations of leatherback turtles in the Pacific Ocean led to an increasing level of concern in the late 1900s and early 2000s. In spite of years of nest-protection programs, and the implementation of Turtle Excluder Device (TED) programs, the populations continued to decline. By-catch in fisheries was considered to be one of the reasons, if not the main reason, for the decline. Information was scarce, and clearly insufficient to assess the level of mortality caused by coastal gillnets, industrial and artisanal longliners, etc., in a rigorous way. In any case, longline fisheries were in the sights of many who thought that the only way to save the turtles was a moratorium on all fisheries that
contributed to the decline in their populations. We started drawing the attention of governments and industry leaders to this crisis, and the International Fishers Forum II, held in Hawaii in 2002, was a great opportunity to show them the problems and possible solutions, and to identify a global effort that was developing to save both the turtles and the fisheries involved.

The more visionary and better informed sector of the industry was persuaded by a technical advisor, Ingro. Guillermo Morán who attended that Forum, that it was in their best interests to face the problem, and work at finding a solution that could ensure the survival of their industry. But the good intentions of the industry needed an echo in the government, and the Under Secretary of Fisheries of Ecuador at the time, Mrs. Lucia De Genna, had the vision to see the problem, and more importantly, the courage to go forward. Why courage? Because every time that a fishery is opened to scrutiny for any reason, its fishing practices and their impacts become exposed, and some of them may cause negative reactions from the public, managers, etc. Very seldom has openness been rewarded. Governments and cooperatives of fishers, were keenly aware of the potential impact for their economies and employment levels. Hundreds of thousands of workers depend on longlining for their livelihood, and they are already in marginal economic and social situations, with very few options available to them. Pressure was clearly evident to find a solution that would allow the survival of the industry, and keep the fishers employed. This was one of the main ingredients that led to action.

When the IATTC received a request from the Under Secretary of Fisheries Resources of Ecuador, strongly supported by the Association of Exporters and the National Federation of Fishers Cooperatives of Ecuador, it became necessary to search for solutions, and for a strategy to implement them. Researchers from NOAA had been testing a wider type of hook, a circle hook, that reduced sea turtle mortality in two ways: (i) by reducing hooking rates, and (ii) by changing the way the turtles are hooked, increasing the survival of the turtles that did get hooked. The hooks also did not reduce the catch rates of the target species, and in some cases even increased catch rates.

It seemed that changing the type of hook was a reasonable thing to do, so the next problem faced was the development of an implementation strategy. The necessary steps were:

1. Show that the circle hooks are an effective way of reducing sea turtle mortality.
2. Show the fishers that they can continue making a living with the new technology, i.e., that the catch rates with circle hooks would be at least equivalent to current levels with conventional J hooks.
3. Make sure that the adoption of the circle hooks was economically viable.

Since you can’t expect a fisher to agree to change the basic fishing instrument based on experiments performed in other fisheries and regions, it became obvious that they needed to test the hooks in their own fishing conditions; in their boats, with their baits, in their fishing grounds, etc.

The decision was to facilitate these tests by providing the circle hooks free of charge, and inviting the fishers to compare the new hooks with the old ones in comparative trials. We obtained the very willing cooperation of the NOAA authorities and researchers, of the Western Pacific Regional Fishery Management Council (WPRFMC), and of the World Wildlife Fund (WWF), to develop a program to begin these tests. We offered the fishers the opportunity to exchange some of their hooks for the new ones free of charge. After testing them for a trip or two, they had the option to undo the exchange, return the circle hooks and recover their J hooks. With these same partners (NOAA, WPRFMC, IATTC, and WWF), with the addition of the Overseas Fishery Cooperation Foundation (OFCF) from Japan, with contributions from The Ocean Conservancy, and Defenders of Wildlife-Mexico, and with the participation and support from government fisheries agencies in all countries, national conservation organisations, and national industry and fish workers organisations, the program has rapidly expanded to all countries operating in the eastern Pacific.

The key issues in this process were:

- fishers’ participation was voluntary, after they were explained the situation and the reasons to join the program;
- the hook exchange was partial, so we reduced the risk involved;
- the exchange was free, but the operation was not a charity;
- fishing effort was not increased;
- the results were monitored through an observer program, and made available to all fishers;
- instruments and technical training to reduce mortality of hooked turtles were provided to the fishers.

The program was introduced using workshops, modelled from our experience with the tuna fleet outlined earlier in this chapter. We explained what was needed, why, and the way we were proposing to go about it.

After the experiments were begun, we followed up with frequent contacts with the fishers to assess the performance of the hooks, and the difficulties they caused. We learned about the difficulties for baiting and storage posed by the use of hooks of different sizes and shapes on the same line, and we helped find options to reduce these difficulties. We also worked
with them in finding the right hook with respect to size, design and materials. For circle hooks, there are different materials and designs available. When hooks rusted quickly, or when there was some breakage of hooks, they were replaced by other types, brands or materials. Following their evaluations, we explored the various options available, and settled on one that could help the turtles without harming the fishers’ catches.

Solutions were not imposed, but were developed with their active participation. Frequent contacts are needed to keep the flow of information going both ways: we received their feedback and suggestions for adaptations of the program, and we provided them with the results for the whole group of vessels involved in the work.

During the communication process with the fishers, we gathered a host of ideas about possible ways to reduce sea turtle mortality. For example, seeing the tendency of the turtles to approach the float, and become entangled near them, they suggested replacing the lines connecting the float and the line by cable, or stiffer materials, changing the colour of the floats, using fewer floats, etc. We are currently in the process of setting up these experiments.

In the case of artisanal fish workers, their organisations are an important point of contact, and we have had the support, and the presence in workshops of the leaders of FENACOPEC (Ecuador’s National Federation of Fishers’ Cooperatives) and later in Peru of the sister organisation, the Frente Integrado Unico de Pescadores Artesanales del Peru (FIUPAP). A message presented by the government’s fisheries authorities, industry, exporters, environmentalists, scientists, and their own elected leaders, has much more power to influence people than the isolated effort from any one of these sectors.

At the same time that we recognise the major role of the fish workers’ organisations, we have to remember that in many cases a large proportion of fishers do not belong to any organisation. This means that our efforts should not be channelled exclusively through them, but must also include the participation of independent groups and individuals.

Another important difference with respect to tuna captains was that the roles of the family unit and of the community were very important. While the men are concerned with the day-to-day needs and problems of their operations, the women in these families are the ones interacting with fish buyers, governments and other sectors, and they understand well the impact that different market problems could have. They are also operating on a longer time-horizon that the men, more concerned with the continuity of the day-to-day operations, and they will be the reminders, in the future, of what needs to be done. In these fishing communities, social interactions are important, and the size of the social networks is much larger than in the tuna fleet. First of all, large families frequently inhabit the same village,
and they frequently function as a unit for the purposes of communication, formation of opinion, etc. Children begin to go to sea when they are 10 or 11 years old, during school holidays, and they can also be vehicles for change. Programs targeting schools in fishing villages could have much more rapid effects than are often seen in programs of environmental education directed to the public at large, which are prolonged, difficult to evaluate, and slow in bringing change.

The leadership of these fishing communities is different than the leadership of the fish workers’ organisations. The former leaders, who are frequently women, have a significant power in the group, and their endorsement of the work is very valuable. They also have a clear perspective that the problem cannot be solved by only a few of them. Unless everyone contributes his or her share of the solution, the problem won’t go away; a few careless fishers may cause the defeat of the efforts of the rest of the community – and we can offer them the example of the tuna-dolphin case outlined earlier to illustrate that.

Of course, the sea turtle by-catch issue is only one of the issues faced by the fish workers’ sector on this region, and we should not lose sight of the other social and economic factors that affect these communities. A strong and active fish workers’ sector is in critical need for sustainable fisheries management, and we should use every opportunity to contribute to the achievement of this larger goal. To work with fishers we need to understand and respect their organisations, and to reach out to those not belonging to them. As the fish workers are the first victims of poor fisheries management, we should empower them to become more like the custodians of the resources they harvest.

The success of the above approach resulted in an expansion of the program to cover practically all countries from the Pacific coast of America from Mexico to Peru, and the welcome addition of the support and collaboration of many other organisations from all sectors. In each country, government agencies, local environmental organisations, and industry sectors, are participating in the activities. A network of scientists and managers has also been created, linked through the common support of the NOAA and IATTC scientific staffs, and of the WWF national and regional offices involved (Peru, Colombia, Central America and Mexico) that coordinate the implementation of the program with the respective fisheries agencies. The process is built on two basic, simple premises: (i) nobody wants to kill sea turtles, nor drive them to extinction, and (ii) nobody wants to put fishers out of work. With a common ground, and building trust among the participants, we are hoping to put together a different model to face conservation problems; a model based on cooperation, in which the resources and motivations of all the sectors are brought together.
8.4 Case Study 3 – The Tori Pole in the Japanese Longline Fishery

(by Hideki Nakano and Shelley Clarke)

8.4.1 Introduction

Seabird interactions with fishing gear resulting in inadvertent by-catch and mortality occur in several Japanese longline fisheries. One of these is the Japanese southern bluefin tuna fishery operating in sub-Antarctic waters, mainly in the Indian Ocean. Fishing vessels are approximately 400 tonnes in capacity and 50 m in length, with crews of 20 to 25 usually comprised of Japanese officers and non-Japanese deck crew and seamen. Seabird by-catch, consisting mainly of 20 species of albatross, is a major issue in these fishing grounds. Given concerns raised by several conservation organisations and Japanese authorities regarding incidental catches of seabirds in longline fisheries by various nations, Japan is committed to objectively and scientifically analysing the impact of its longline fisheries under a basic policy of encouraging fishers to develop creative solutions to by-catch issues. A method for reducing seabird by-catch by employing bird scaring lines, called ‘tori’ (Japanese for ‘bird’) poles, was originally implemented by Japanese fishers and has been required by the Convention for the Conservation of Southern Bluefin Tuna (CCSBT) for all longline vessels since 1991. It is believed that this device reduces the level of seabird by-catch by approximately one third.

Seabird by-catch is also an issue in the North Pacific Ocean. Of the three species of albatrosses occurring in this area, Laysan and Black-footed albatrosses comprise the majority of the by-catch. Vessels operating here can be categorised into coastal, offshore and distant water fleets. Coastal fishing vessels are less than 10 tonnes, have crews of 1 to 3, and are at sea for less than 1 week. Offshore fishing vessels are between 10 and 120 MT, have crews of less than 10 and are at sea for periods ranging from 1 week to 1 month. Their fishing grounds are located west of the international date line. Distant water longline fishing vessels are larger than 120 tonnes, have crews of 15–20, are at sea for periods of two to three months, and may range farther from Japan than the offshore vessels. Nearly all of the crews in the coastal and offshore fleets are Japanese but in the distant water fleet, most crews are non-Japanese with the exception of a few officers. When officers and crew are of different nationalities, not only do problems of communication and education regarding mitigation measures for sea birds arise, but also in such situations there is often a different perspective on fishing operations. In particular, previous traditions of passing knowledge
and skill from more experienced crew members to newcomers are broken as foreign crew members are not seen as apprentices. Instead, foreign crews are considered a necessity to continue operations when economic conditions preclude the attraction of Japanese workers.

8.4.2 The Tori Pole Solution

Although it is not known who first invented the tori pole, it has been documented that a Japanese fishing master working in the southern bluefin tuna fishing grounds was deploying the device as early as 1988. The tori-pole system involves a solid line towed from a pole installed at the stern of the fishing vessel, equipped with a curtain of streamers and bird-avoidance tapes, aimed at deterring seabirds from taking baited hooks. Since albatrosses have poor in-flight manoeuvrability, their feeding behaviour is disrupted when obstacles are set above the area where baited hooks are cast onto the water surface. The tori pole was initially designed to prevent seabirds from stealing fish from baited longline hooks and therefore increase the catch of target species, as well as minimise seabird interference with line retrieval. In addition to these objectives, some fishers may have welcomed the tori pole because they believe that seabirds are an incarnation of the gods and that seabirds indicate good fishing grounds, therefore avoiding the killing of seabirds will bring good luck. For these reasons, the tori pole conformed perfectly to fishers’ own interests and thus spread on its own accord throughout the fishery. It was subsequently adopted as a regulatory requirement under the CCSBT as a means of protecting and conserving seabirds, but it is important to recognise that for Japanese fishers, it was not originally intended specifically for that purpose.

8.4.3 Remaining Problems with Seabird By-catch

The implementation of the tori pole in the southern bluefin tuna fishing grounds has been highly successful because it reduced seabird by-catch by one third. Nevertheless, by-catch in this fishery still results in the mortality of seabirds and thus further by-catch reduction is desirable. It has been documented in field trials that other by-catch reduction methods, such as making bait less viable using a harmless blue dye, can be even more effective than the tori pole. However, the introduction of blue-dyed bait faces some obstacles in acceptance and implementation. Firstly, although the cost of the blue dye is low, the crew cannot dye the bait themselves on deck due to the rough weather conditions of sub-Antarctic waters and it is thus necessary to order pre-dyed bait from suppliers, primarily located in China and Vietnam. At present there is insufficient demand for blue-dyed bait to
make its cost competitive with standard baits. Fishers are accustomed to changing bait suppliers frequently in order to achieve cost savings, and therefore the additional effort required in acquiring blue-dyed bait is seen as both an additional expense and an inconvenience. The key issue in promoting the use of blue-dyed bait will be to change bait market dynamics so that demand for blue-dyed bait increases, resulting in greater availability and lower prices.

Other potential mitigation measures include weighting of branch lines, setting lines underwater, avoiding disposal of offal from the vessels during line setting, using automatic bait-casting machines and properly thawed bait, setting lines at night, using water-jet devices, and setting from the side of the vessels. These techniques have undergone various types of testing and implementation, and have been shown to have different degrees of effectiveness and acceptability to fishers.

Japanese longline vessels in the North Pacific do not employ the tori pole widely despite its proven effectiveness and acceptance in the southern ocean. There are several reasons for this. The most apparent is that there is a relatively lower abundance of threatened seabirds such as albatrosses in the North Pacific compared to the South Pacific and as yet there is no mandate for tori pole usage, nor any other seabird by-catch mitigation measures in the North Pacific. Furthermore, fishers have resisted calls for voluntary implementation saying that the design of the tori pole would need to be scaled down for use on the smaller vessels employed in the coastal and offshore longline fleets, which conduct most of the Japanese fishing operations in the North Pacific. In addition to the re-scaling of the device’s design, simultaneous operation of the tori pole, and setting and retrieval of longline gear, poses a significant challenge due to the smaller crew size in these fleets. Impediments to widespread adoption of blue-dyed bait also exist in the North Pacific. Onboard dyeing may be possible in some cases but the purchase of pre-dyed bait from suppliers is likely to be preferable given operational constraints such as deck space and crew size. Since Japanese longliners in the North Pacific use domestic suppliers and may prefer to maintain long-standing supplier contracts, different market incentives may be required to influence the availability of blue-dyed bait for North Pacific fleets.

8.4.4 Characteristics of the Japanese Situation

One of the strengths of the Japanese political system is its ability to act quickly to achieve resolution of problems that are raised. However, the range of possible actions that can be taken by government in response to by-catch issues is limited due to its historical relationship with the fishing
industry. As a traditionally coast-oriented nation, many decades ago, Japan evolved a system of fishing rights management based on mutual agreements between communities. In later years, as the central government grew stronger, its role was limited to adjusting these agreements as necessary rather than regulating with a firm hand. Japan’s heavy reliance on coastal resources, in combination with rapid population growth, also created a need for distant water fishing activities to meet food requirements much earlier than in other countries. As a result, fishing communities have maintained a strong sense of independence and self-governance and the government usually considers it best that new policies be initiated by the fishing community itself.

The maintenance of this historical system during the development of modern Japan has also resulted in a strong hierarchical structuring of the fishing community and its various interest groups. The fishing sector is characterised by a number of industry organisations which serve as channels of information to fishers. While such organisations may facilitate dissemination of information, the large number of layers between government or scientific staff and the fishers themselves can prevent direct communication. In one way, this may result in fishers failing to appreciate international conservation concerns due to no direct experience with such issues, compounded by cultural or language differences, and a lack of attention by the Japanese media to conservation topics. On the other hand, the situation may hinder the recognition of fishers’ own innovations by government and the rewarding of such innovations with incentives.

In recent years, the Japanese fishing industry feels it has suffered from a number of negative influences. As certain fisheries have closed (for example the drift net fisheries in the early 1990s) some fishers have converted to other gear types, but many now find their new fisheries are under pressure from a combination of over-capacity and limited resources. In many cases, foreign lobby groups are seen as contributing to fishers’ hardships and thus the fishing industry may be reluctant to share information freely. As described above, many vessels are now crewed by a combination of Japanese officers and non-Japanese workers in order to reduce operating costs. Nevertheless, some of these vessels are managing only to cover basic costs and are not otherwise profitable, hence such vessels are unwilling to make any significant investment in by-catch mitigation gear or training.

8.4.5 Outlook and Conclusion

It is likely that several factors, working in concert, will be necessary to resolve seabird by-catch issues in Japanese longline fisheries. Current initiatives by government and scientists to provide educational materials to
fishing industry organisations in the form of laminated panels, booklets, posters and educational videos should be continued. While fishing industry representatives are responsive to these initiatives, other efforts to directly contact fishers through educational and feedback sessions in fishing ports should also be pursued.

Despite an expected increase in awareness of conservation issues, the response of the fishing sector is likely to continue to be based on economic factors. In this sense, the ongoing, gradual reform of the fishing industry through both vessel de-commissioning and the inevitable discontinuance of unprofitable operations will result in a fleet that should be able to absorb the costs of by-catch mitigation. However, further economic incentives may be necessary to subsidise by-catch mitigation, at least in the initial stages of implementation. This could take the form of government-sponsored research into tori pole re-sizing for the North Pacific or stimulating the market for blue-dyed bait.

In parallel, it is essential to continue by-catch research activities. Although most technical aspects of reducing by-catch are already well understood, further work to facilitate implementation of existing techniques by specific fleets may be required, for example improving methods for side setting of lines or new dyeing methods for bait. In addition, it is necessary to study the by-catch situation in various fleets and areas in order to identify which operations are most likely to benefit from mitigation measures.

Ultimately, successful solutions will not be achieved by top-down decision-making in Japanese fishing fleets. Mitigation measures which are effective and easy to implement, and which will diffuse through the fishery by means of the fishers themselves, provide the best hope for achieving by-catch mitigation targets while maintaining economically viable longline fisheries.

This case study has illustrated:

- The tori pole mitigation method was implemented independently by Japanese fishers in response to their own desire to reduce seabird by-catch;
- Barriers to implementation of the tori pole in other fisheries stem from important structural and economic differences in operations;
- The Japanese Government is working to distribute educational materials and sponsoring mitigation research, but does not have a history of strong intervention in fishing operations; and
- Fishers may respond most favourably to low- or no-cost measures proposed by the industry itself, particularly when incentives are provided by Government.
8.5 Case Study 4 – Southern Seabird Solutions: Conservation Through Cooperation

(by Simon Thomas and Janice Molloy)

To spread news, find a gossip; to spread new behaviour, find a role-model.

The Southern Seabird Solutions Trust developed from a workshop in Nelson, New Zealand in July 2002 that incorporated fishers and fishing company representatives, government departments, environmental NGOs and seabird researchers.

The timing was certainly right in terms of engaging the interest of fishing companies because the killing of 312 white-chinned petrels by a king-clip auto-liner seven months earlier had gained the attention of the New Zealand public and politicians. The issues of seabird by-catch and mitigation had been known about and worked on in industry circles for a long time. But this incident, and the political interest it generated, suddenly made progress more urgent. In addition to this, forward-thinking industry participants at the Nelson workshop realised that seabird kills in other parts of the world – by other fisheries – might affect them if seabird breeding populations on New Zealand’s offshore islands fell as a result. Tough measures would be introduced for vessels fishing in our waters to safeguard these seabirds if this happened. As most of these seabirds actually spend much of their lives in other parts of the world, working with Southern Africa, South America and Australia was seen as critical.

Having something at stake helped engage companies, fishers and the wider industry. They could agree something needed to be done, and that it needed to happen out on the water – where both the problems and solutions lay.

It was decided that there was a need to accelerate the transfer of ‘seabird-smart’ attitudes and behaviours amongst the skippers and crews in a fishing fleet. Doing this required the trust and co-operation of all parties – government agencies, environmental NGOs and, above all others, fishers and fishing companies. And, surprisingly, this trustful attitude came quite readily.

All involved in the Southern Seabird Solutions group saw the issue as solvable and as something they needed to work together on. And while there were not infrequent tensions between these various parties in other areas of fisheries management, we all ‘left our swords at the door’ when we came together for Southern Seabird Solutions meetings.

Engendering this trustful and cooperative approach between our partners has been the cornerstone of the group’s success.

Most of Southern Seabird Solutions projects involve fishers, simply because fishers are most receptive to new ideas from their peers. For
instance, the group has carried out two skipper-exchange projects to date, one between Chile and New Zealand and the other between New Zealand and Reunion Island. Both have had excellent outcomes. In the Chilean exchange, the skipper returned home motivated to continue spreading good practice in his own fleets. He has attended workshops around Chile talking about his experiences in New Zealand and describing the measures he observed being used. In the Reunion Island exchange, the whole fleet has begun using a new weighted longline that sinks the line quickly out of the diving range of seabirds.

Both fishers and companies need to feel good about themselves, and about their adoption of ‘seabird-smart’ fishing techniques. Like everyone, they like to be seen as ‘good citizens’. So with the help of environmental NGOs and government agencies, the Southern Seabirds group has helped industry mitigation efforts and successes to be celebrated publicly through the general news media, as well as through seafood trade publications.

The Southern Seabirds group focused much of its efforts during its first three years on this communication of successes; and most particularly communicating these successes within industry circles. Monthly stories were carried in the *Seafood New Zealand* magazine that celebrated role-model skippers, new ‘seabird-smart’ fishing technologies and information on the birds themselves. The stories had a huge effect in building and maintaining support from across the fishing community and wider industry.

A classic example of the effect of these was the reception that a new seabird mitigation advisory officer (a fisher himself) got when visiting a fleet he had never had contact with previously. He found the skippers all read *Seafood New Zealand* magazine, and knew who he was, and about the concept of ‘seabird-smart’ fishing. They welcomed him aboard their vessels and were eager to have him help them improve the ways they fished.

We have found this role of seabird mitigation advisory officer crucial in spreading attitudinal and behavioural change across a fleet, particularly amongst inshore fleets that may have many small vessels. And as the previous example illustrates, we found targeted communications materials that support their work helped accelerate the progress an advisory officer makes with a fleet. We found that fishers can also more easily stand in the shoes of another fisher and know how to communicate the message in a way that is meaningful. So the group has always aimed at fisher-to-fisher communication.

We recently ran workshops at different ports in northern New Zealand, aimed at inshore longliners, and hosted by their local fish-receiving shed. We brought several role-model fishers from other fleets to talk at these, as well as an environmental representative with knowledge of seabirds and their conservation. Part of our purpose was to thank fishers for their efforts to date and to encourage them to continue using seabird-smart fishing
practices. The workshops were all held in the local bars, which ensured good attendance. Participants were given T-shirts with the group’s logo and catch phrase ‘Conservation through Cooperation’; the venues and the T-shirts helped create an atmosphere of receptiveness.

Other fisher-to-fisher work included the production of a ‘seabird-smart’ fishing video. This was hosted and narrated by a fisher, and largely featured skippers and vessel managers from different fleets talking about the issue. The video proved hugely popular, with copies being distributed free amongst New Zealand fleets. The video has since been translated into Spanish and a special introduction added from the Chilean fisher involved in the skipper-exchange programme.

A critical factor in the success of Southern Seabird Solutions has been developing a goal that everyone can agree on and work towards. In addition, gathering this initially loose coalition of interest groups under a name and governance structure has resulted in a cohesion and identity that members are proud to be part of. The main limiting factor to date has been securing enough resources to undertake the many additional projects we have lined up.

In summary, the key elements of success of Southern Seabird Solutions have been good timing in terms of the public profile of the issue, developing a common goal, patience, a no-surprises approach, behaviours that engender trust, use of fishers as role models and messengers, and public acknowledgement of the efforts of fishers through the media. We have had a high level of engagement from longline fleets, but have yet to achieve this with the New Zealand large-scale trawl fleets or with recreational fishers, both of whom catch seabirds. These fisheries will be among our next priorities.

8.6 Case Study 5 – Networks, Knowledge and Communication: An Integrated Approach to Empowering Fishers to Reduce Turtle By-catch

(by Hoyt Peckham, Johath Laudino-Santillán, and Wallace J. Nichols)

In August 2002, Anselmo Ruiz-Camacho, a halibut fisher from Baja California Sur, Mexico, asked, ‘How can loggerhead turtles possibly be endangered? I caught thirty in my nets this morning.’ We were astonished. We had come to Puerto Lopez Mateos, a small fishing village on the Pacific coast of Baja California Sur to study sea turtles, but not dead ones. ‘Thirty?’ we asked, hoping we had misunderstood his heavily accented Spanish. ‘Thirty,’ he confirmed. ‘All but two dead.’

We spent the next few days offshore with Anselmo hand-catchng turtles, and during that time we did our best to help him answer the question
for himself. We explained how loggerheads in the North Pacific only nest in Japan and, drawing maps in the sand, we explained that they swim across the Pacific as juveniles to feed their way to maturity in the rich waters of Baja California Sur (BCS; Fig. 8.1). He protested, saying he and his friends frequently catch loggerheads in summer, that one guy caught seventy in a single day, so how, really, could they be endangered? Together we looked over graphs of nesting trends from Japan. Fewer than 1500 loggerheads had nested in the North Pacific the winter before, and nesting had declined 50 to 80% over the past decade (Kamezaki et al. 2003).

Anselmo’s question was painfully ironic but not unusual; we’ve heard the same question from dozens of other fishers along his coastline. Despite local perceptions, there are now few loggerheads in the Pacific, and they are declining rapidly (Kamezaki et al. 2003). Those few left appear to be numerous to Anselmo and his fellow fishers because they regularly aggregate at unusually high densities off the Baja California peninsula. We interviewed these fishers at length and conducted surveys along a 50 km shoreline to gauge the extent and identify the cause of local turtle by-catch. Local gillnetters catch an average of four turtles per week during their four month halibut season. Most turtles are caught dead, and fishers throw the

![Pacific Ocean map with insets of Baja California Peninsula and Bahia de Ulloa](image)

**Fig. 8.1.** Pacific Ocean. Inset: Bahia de Ulloa
majority of carcasses overboard after disentangling them. Somewhere be-tween thirty to seventy *pangas* (6 to 9 m outboard-powered skiffs) fish bot-tom-set gillnets and longlines out of Puerto Lopez Mateos, Anselmo’s homeport.

Extrapolating from these data we came to understand that by-catch along Anselmo’s coast is one of the most significant known sources of loggerhead mortality in the entire North Pacific (Peckham et al. 2004). We realised that the future of loggerheads in the North Pacific lies heavily in the hands of Anselmo and other Baja California Sur fishers. Our objectives thus became clear: (i) to empower the people of this coast to answer Anselmo’s question for themselves; and (ii) to partner with them to develop practical by-catch solutions.

We began with what we knew was working – personal conversations and shared experiences. Anselmo quickly grasped the reality of the by-catch problem, and he acted on it. He and his wife and four sons adopted one of the turtles we captured together and helped us fit her with a satellite transmitter and release her. They named her Esperanza (‘Hope’ in English) and avidly tracked her movements via regular updates we faxed and emailed them (Fig. 8.2). Anselmo left the fishery the following summer in

*Fig. 8.2. Family with the loggerhead turtles they helped to catch, fit with a satellite transmitter, release and track*
part to avoid catching sea turtles, and he became a spokesman for reducing turtle by-catch. We partnered with other fishers in other towns along the BCS coast and explored, through group discussions, the full costs of by-catch such as time and resources lost to disentangling turtles and repairing damaged nets. We found that once fishers appreciate the Pacific-wide impact and true costs of their local by-catch, they usually strive to reduce and eliminate that by-catch. The challenge, then, was to scale-up this success.

8.6.1 Conservation Mosaic

Based on this modest success, we began implementing a conservation mosaic strategy (Nichols 2003). The mosaic consists of three approaches to achieving conservation, each informed by an established literature and differing degrees of proven effectiveness. The novelty of the mosaic lies in strategic integration of these approaches: (i) building a conservation network of fishers, students, teachers, activists, researchers, managers and other coastal people; (ii) drawing on these partnerships to derive new knowledge to develop locally practical solutions; and (iii) communication of this knowledge in resonant and appropriate ways to avoid by-catch and foster a sustainable ethic (Fig. 8.3).

![Conservation Mosaic](image_url)

**Fig. 8.3.** Schematic of the conservation mosaic. Overlap of the three spheres of action reflects their integration.
8.6.1.1 Community Conservation Networks

Clearly, our team doesn’t have the time or resources to reach every last fisher along the vast, isolated Baja California Sur coast. But the Grupo Tortuguero, an emerging community conservation network, does (Pesenti et al. 2005). Networks are decentralised, non-hierarchical, diverse and resilient (Barabasi 2002). As such, they are ideal for addressing widespread problems and creating the social change needed to address by-catch issues in isolated fishing villages.

We build local conservation capacity by partnering with fishers like Anselmo directly, by engaging local women’s and youth groups and by offering internships for local students. These conservation leaders are empowered and connected through workshops, regional meetings and international conferences. By interacting with colleagues from other towns, regions and countries, these leaders’ perspectives are broadened so that they appreciate the global impact of local by-catch and learn ways to avoid it. This conservation network serves as a new social fabric that fosters and facilitates a culture of marine conservation. Among other awareness-raising initiatives to date, we have brought Spanish-speaking Japanese biologists to Baja California fishing communities. When Japanese experts share their firsthand experience of declines in nesting turtles, local leaders increasingly appreciate the importance of protecting juvenile loggerheads in their waters (Fig. 8.4). These leaders then become the local spokespeople for reducing by-catch, sharing the problem and working towards solutions with their families, friends and neighbours.

Fig. 8.4. Mizuno Kojiro (centre), a Spanish speaking Japanese biologist, shares the decline in nesting turtles he and his colleagues are witnessing in Japan through school outreach and fishers’ workshops
8.6.1.2 Co-constructing Knowledge

Ecological research on turtles has been used to reduce by-catch in numerous fisheries through modification of both fishing gear (e.g., use of turtle excluder devices in shrimp trawling; Crowder et al. 1994) and practices (e.g., deeper setting of longlines; Polovina et al. 2003). Developing such solutions requires detailed knowledge of the fisheries involved and the ecology of affected species (Hall et al. 2000). Involving fishers in conservation planning can result in better solutions that account for fishers’ needs and incorporate their vast local knowledge while protecting imperiled populations. Moreover, fishers’ investment in the conservation process can increase subsequent adoption of conservation solutions (Nichols 2003; Santora 2003). This last point is especially important along isolated coasts such as the Baja California peninsula where enforcement is scarce and adoption of conservation solutions is largely up to fishers.

Drawing on the relationships described above, we formed a task force of local fishers, managers, community members and conservation biologists to: (i) elucidate turtle diving and feeding behaviour; (ii) collect data on stranding rates and mortalities; and (iii) experiment in modifying gillnet design and deployment. Local fishers are thus learning firsthand both the conservation process and the status of loggerhead turtles while helping to generate new knowledge such as data on turtle diets, diving and movement that are credible both locally and in scientific circles (Fig. 8.5).

![Fig. 8.5.](image)

**Fig. 8.5.** Alejandro Camacho and Victor de la Toba carry a loggerhead they have fitted with a satellite transmitter to their boat for release. Despite having accidentally caught thousands of loggerheads over his thirty year career, this was the first turtle Alejandro released alive.
The task force is combining local ecological knowledge with these data to develop practical solutions. For instance, tracking indicates that turtles are utilising fine-scale foraging hotspots. Fishers are enthusiastic that they might be able to reduce by-catch by avoiding these local hotspots. In this way fishers’ personal participation in deriving new ecological data and combining them with their local knowledge directly empowers them to conserve sea turtles.

### 8.6.1.3 Communication and Outreach

The emerging field of community-based social marketing guides our communication and outreach initiatives (MacKenzie-Mohr and Smith 1999; Jacobson 1999). The social marketing approach consists of a four-step process: (i) local attitudes and behaviours are assessed; (ii) a range of media and events are evaluated for their effectiveness; (iii) outreach campaigns are designed to inform and engage all fishers and their families; and (iv) the effectiveness of campaign components are measured in terms of changes in local attitudes and behaviours (Delgado 2005).

According to these precepts, our team designs and continually refines a suite of outreach initiatives to convey our core message of empowerment: specifically that BCS fishers and families hold the fate of the Pacific loggerhead in their hands. Informative workshops for fishers and curriculum enrichment for schoolchildren convey the facts about by-catch behind the message. To supplement these experiences across whole communities, Grupo Tortuguero offers a range of locally resonant media including comic books, children’s books, neighbourhood murals, informative brochures and local radio programming. Public events such as regional festivals, sports competitions and puppet shows are offered to celebrate sea turtles as natural treasures to be cherished and protected. Moreover, the network is working closely with ecotour operators to explore the feasibility of offshore turtle tours. Because loggerhead and olive ridley turtles aggregate in certain areas at extraordinarily high abundance, offshore trips could offer unprecedented experiences with foraging turtles for ecotourists and alternatives to gillnetting for boatmen. In all of these ways, fishers and their families are informed, engaged and empowered to protect sea turtles and the ecosystems they inhabit.

### 8.6.2 Success to Date

As a result of their personal participation in this research and their recognition of the Pacific-wide impacts of their local by-catch, the fishers of Puerto López Mateos, BCS declared the loggerhead high-use area off their
coast a ‘Fishermen’s Turtle Reserve’ in February 2006, thus self-limiting turtle by-catch in this region. In this way fishers’ personal participation in deriving new ecological data from their local knowledge directly empowered them to effect conservation change. Currently, the fishers of Puerto López Mateos are seeking federal legislation to officially protect their reserve.

The novelty and strength of this approach has yielded a conservation constituency among fishers and their families characterised by local pride, empowerment and stewardship. Three years into this 5 year initiative, preliminary results indicate decreased turtle by-catch and poaching, changes in local attitude and an emerging ‘sea ethic’. Enforcement agents from PROFEPA, SAGARPA and local councils are pursuing turtle violations that in the past were ignored. Increasing numbers of fishers are self-enforcing turtle protection amongst themselves and between and within their cooperatives. Fishers, students and their families are celebrating sea turtles through festivals, artwork and music. All of this translates into turtles saved and steps toward the recovery of turtle populations. Finally, there are indications that this emerging ‘sea ethic,’ borne by people’s increasing interest in turtle conservation, is leading them to manage fisheries such as lobster and abalone more sustainably, an unexpected but welcome result.

8.6.3 Summary: Global Impacts of Small-scale Fishing

Small-scale fisheries such as the one described herein are ubiquitous to the coastal waters of developing nations. Because small-scale fishers are often unlicensed, their boats are usually unregistered and their catch and by-catch are rarely quantified. This means that the impact of these fisheries has gone virtually unnoticed. But as this case study shows, by-catch in these fisheries may jeopardise both fishers’ livelihoods and endangered species as much as, and perhaps more than, any other fishing sector.

Because regulation and enforcement of such fisheries is often lacking and/or ineffective, conservation can therefore depend almost entirely on small-scale fishers’ direct participation. Our collective challenge then is to empower small-scale fishers around the world to conserve shared marine resources. We suggest that our conservation model could be employed in other regions to build grassroots constituencies among fishers and their families characterised by local pride, empowerment and stewardship to conserve marine species and their ecosystems.
8.7 Case Study 6 – Working with Hawaii-based Longline Fishers to Abate Fisheries By-catch

(by Eric Gilman, Jim Cook and Sean Martin)

8.7.1 Introduction

Hawaii-based pelagic longline fisheries are faced with strong incentives to reduce by-catches of sensitive species, including sea turtles and albatrosses. Here we highlight several approaches, some effective, others not, to engage Hawaiian longliners in getting directly involved in trying to abate fisheries by-catch.

In 2004, there were 125 active Hawaii-based longline tuna and swordfish vessels, which made 1,338 trips, setting about 32 million hooks. Table 8.1 summarises target species catch-per-unit-of-effort for the combined Hawaii-based longline tuna and swordfish fisheries from 1999 to 2004. In 2004, the Hawaiian longline fisheries landed approximately 8,200 tonnes and generated ex-vessel revenues estimated at US$ 42.6 million with tuna (Thunnus spp.) the dominant components of landings.

Because of concerns over turtle interactions, the Hawaii-based longline swordfish fishery was closed for over two years and is now subject to strict management measures. Measures include prescribed use of large circle hooks and fish bait, restricted annual effort, caps on turtle captures, 100% onboard observer coverage, required possession and use of specialised turtle de-hooking equipment and mandatory attendance of annual protected

Table 8.1 Hawaii pelagic longline tuna and swordfish fisheries catch-per-unit-of-effort (CPUE), number of fish per 1,000 hooks, 1999 – 2004 (U.S. National Marine Fisheries Service Pacific Islands Regional Office unpublished data, March 2005).

<table>
<thead>
<tr>
<th>Year</th>
<th>Tuna CPUE</th>
<th>Sharks CPUE</th>
<th>Billfish CPUE</th>
<th>Other CPUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>9.21</td>
<td>4.59</td>
<td>3.9</td>
<td>4.8</td>
</tr>
<tr>
<td>2000</td>
<td>8.18</td>
<td>3.91</td>
<td>2.88</td>
<td>4.8</td>
</tr>
<tr>
<td>2001</td>
<td>8.64</td>
<td>2.1</td>
<td>1.61</td>
<td>4.21</td>
</tr>
<tr>
<td>2002</td>
<td>7.48</td>
<td>1.87</td>
<td>0.98</td>
<td>4.27</td>
</tr>
<tr>
<td>2003</td>
<td>6.33</td>
<td>2.32</td>
<td>1.77</td>
<td>4.58</td>
</tr>
<tr>
<td>2004</td>
<td>6.42</td>
<td>2.34</td>
<td>1.24</td>
<td>5.49</td>
</tr>
</tbody>
</table>

*a mahimahi, moonfish, oilfish, pomfret, wahoo*
species workshops by vessel operators and owners. If seasonal limits on turtle interactions are reached, the fishery is closed for the year, and if a threshold is exceeded, federal resource management agencies consult to determine if additional restrictions on the fishery are warranted. Furthermore, the Hawaiian longline swordfish and tuna fleets are each authorised to take annually, through injury or mortality, only one endangered short-tailed albatross. If more than one short-tailed albatross is observed to interact with gear of the Hawaiian longline tuna or swordfish fleet in a single year, resource management agencies consult to determine if the fleet should be required to employ additional seabird avoidance measures.

Tens of Laysan and black-footed albatrosses are now annually captured by the fleet, down from thousands that were caught before the fleet was required to employ seabird avoidance methods and restrictions on swordfish fishing effort. The fleet has not had any observed captures of short-tailed albatrosses. Since June 2001, management authorities have required the Hawaiian longline tuna and swordfish fleets to use a number of measures intended to reduce seabird by-catch, including weighted branch lines, thawed and dyed bait, offal discards, and night setting in certain geographical areas for certain components of the fleet. Interactions between the fleet and false killer whales is another issue that has received recent attention. While there have been claims that this is causing population-level effects, in reality, there is little understanding of the status and trends of false killer whale populations nor of the consequence of interactions with longline gear.

8.7.2 Litigation

Over the past five years, there have been numerous lawsuits filed against the United States fishery management authority by environmental organisations and the Hawaii Longline Association over the by-catch of sea turtles, seabirds and whales by Hawaii-based longline fisheries. There have been a number of positive results from the litigation, but overall we believe that this has not been a wise long-term approach or efficient use of money, time, or energy to address fisheries by-catch.

There was little attention paid to reduce by-catch of sea turtles in the Hawaiian longline fisheries since the fisheries inception until the litigation began in 2000 (which aimed to close the fisheries) brought about substantial improvements involving changes in fishing gear, fishing practices and
methods to handle and release caught turtles. Turtle by-catch levels are now much lower than in the past, and turtles are being released with less injury and a greater chance of survival.

Another positive result of the litigation was increased cohesiveness of Hawaii Longline Association members. The numerous ethnic groups comprising the fishery came together to counter efforts to eliminate their source of livelihood and denigrate the reputation of the Hawaiian longline fisheries. The industry is now in a much better position to represent their interests.

However, even after substantial improvements were adopted by fishery management authorities and the longline industry, the litigation continued, as some environmental groups continued to pursue their goal of permanently closing the fishery. The result was that the fishers became bitter, were much less receptive to collaborating with outside groups, and lost the drive to pursue voluntary initiatives to innovate new by-catch solutions, which might also be exportable to longline fleets internationally. Other environmental groups, that had a goal of reducing fisheries by-catch and reducing this source of turtle mortality by working with fishers, had a much harder time gaining industry’s trust to work with them as a result of the actions of the groups that were working to close the fishery. In fact, the efforts to close the Hawaiian fleet may have actually increased turtle and bird mortality: During a four-year closure of the Hawaii longline swordfish fishery due to concerns over by-catch of sea turtles, swordfish supply to the United States marketplace traditionally met by the Hawaiian fleet was replaced by imports from foreign longline fleets, including fleets from Mexico, Panama, Costa Rica, and South Africa, which have substantially higher ratios of sea turtle captures to unit weight of swordfish catch and less stringent or no measures to manage seabird by-catch. Groups that wanted to pursue collaborative work with the Hawaiian longline fleet to make the Hawaiian fleet a model fishery, and to export identified solutions internationally, were frustrated by the misplaced efforts to close the Hawaiian fisheries.

The Hawaii Longline Association spent over $US 1.6 million and innumerable staff hours over the past five years as a result of involvement in this litigation. If this money, plus the funds spent by the United States Government and environmental groups on the litigation, had instead been used to conduct research to find effective and commercially viable solutions in the Hawaiian fleet and abroad, this might have saved many more turtles’ lives.

As we will describe next, collaborative, industry-led research has been effective at reducing seabird by-catch in Hawaiian longline fisheries and
substantially more progress has been made to find effective and practical solutions to seabird by-catch than turtle by-catch in Hawaiian pelagic longline gear, without litigation as a motive, and at a cost an order of magnitude lower than that spent on law suits.

8.7.3 Collaborative Research and Commercial Demonstrations to Reduce By-catch

Between 1999 and 2003, the Hawaii Longline Association collaborated with fishery management authorities and an environmental organisation to conduct three experiments and commercial demonstrations of various strategies (blue-dyed bait, towed buoy, offal discards, streamer line, underwater setting chute, and side setting) to reduce seabird by-catch in longline gear (Fig. 8.6). The United States Western Pacific Regional Fishery Management Council was the driving force behind the initial experiment, and researcher Brian McNamara was an excellent choice, as he quickly gained the trust of Hawaii longline fishers who worked with him to make the initial trials of various seabird avoidance methods a success. Two subsequent cooperative experiments were initiated by Eric Gilman, a scientist initially employed by an environmental organisation called the National Audubon Society and later a new organisation called the Blue Ocean Institute, who took the initiative to approach industry and fishery managers to work together to plan, fund and implement the project. Hawaii Longline Association representatives Sean Martin, Jim Cook, and Scott Barrows; Western Pacific Regional Fishery Management Council director Kitty Simonds; and United States National Marine Fisheries Service scientist Dr. Chris Boggs, joined the team to plan and implement the cooperative research project. Nigel Brothers, a consultant recently retired from the Tasmania Parks and Wildlife Service, Australia, joined the team and was key to securing the eventual success of these two latter experiments. Nigel’s extensive experience working on longline vessels around the world, understanding of albatross behaviour, approach to working with fishers, stubbornness and perseverance to find effective and viable solutions to seabird by-catch, greatly contributed to the success of these experiments.

From these experiments we determined that several seabird by-catch avoidance methods are capable of nearly eliminating bird captures in longline fisheries when effectively employed. Our industry-led experiments focused on identifying the most effective seabird by-catch abatement methods that are also economically viable and practical. Fishery management authorities recently amended regulations on measures for the Hawaii longline fleet to reduce seabird by-catch based on results from this most recent research.
Longline fishers are some of the most qualified people to develop and improve seabird by-catch mitigation techniques. They have a large repository of knowledge and information related to by-catch, which can be tapped to contribute to finding effective and practical solutions. This has been demonstrated by the successful research initiatives in Hawaii and elsewhere. Mitigation methods that effectively avoid seabirds, do not reduce fishing efficiency, or better yet, increase fishing efficiency and provide operational benefits, have the highest chance of being accepted by industry. The longline association became an active participant to address seabird by-catch problems by instituting and participating in research and commercial demonstrations and supporting adoption of regulations based on the best available science before restrictions, embargoes and possible closures were imposed on the fleet. This bottom-up approach fostered a sense of industry ownership for effective seabird mitigation methods, and
resulted in high compliance with the resulting rules mandating the use of seabird avoidance methods. By being directly involved in the development and testing of seabird avoidance methods, Hawaii longline fishers developed a sense of ownership for these tools and now support their required use.

8.7.4 Economic Viability, Practicality and Enforceability Considerations in Research Designs

The experiments on techniques to reduce seabird by-catch in the Hawaii-based longline fisheries provide an example of how research can be designed to collect information on economic viability, practicality and enforceability. Analysing differences in the effects of alternative seabird avoidance methods on bait retention, hook setting rates and catch-per-unit-of-effort of targeted fish; operational benefits and costs; time and money to adopt and employ; and enforceability is of great interest to industry, fishery management authorities and other stakeholders.

Given the political context and management frameworks of the majority of the world’s longline fisheries, there is a need to focus on the commercial viability of by-catch reduction methods in order to catalyse changes in fishing methods and gear and regulatory measures that will abate longline by-catch. To resolve global fisheries by-catch problems, there is a need to identify and institute the broad use of methods that not only have the capacity to minimise by-catch of sensitive species, but which are also practical and convenient and provide crew with incentives to employ them consistently and effectively. That is, it is critical to account for economic and social values of longline fisheries to achieve changes that abate by-catch.

For instance, because the loss of bait to seabirds and concomitant reductions in the catch of fish can be significant, the use of seabird avoidance measures is expected to lead to cost savings for longline fisheries. However, most longline fleets do not employ effective seabird avoidance methods despite the availability of effective methods that also increase fishing efficiency (Brothers et al. 1999a; Gilman 2001; FAO 2003). Reasons for this may be: (i) low industry awareness of the availability, effectiveness and practicality of these methods; (ii) few national fishery management authorities manage interactions between seabirds and longline vessels or require employment of effective seabird avoidance methods (Brothers et al. 1999a; BirdLife International 2003; FAO 2003; Gilman and Freifeld 2003); and (iii) lack of a sufficiently strong economic incentive for industry to change long-standing fishing practices. Recognising that this context also applies to many global commercial marine fisheries, maximising industry’s sense of ownership for using effective by-catch avoidance measures and providing industry with incentives for voluntary compliance
are needed. Commercial fishing industries respond best to economic incentives and disincentives (Gilman et al. 2002). By-catch mitigation methods that increase fishing efficiency and have operational benefits have the best chance of being accepted by industry. Eco-labeling and certification programs can also provide industry with strong market-based and social incentives to meet criteria to be certified as a sustainable fishery, including the employment of effective by-catch reduction methods, but requires adequate marketing of the label to make it economically viable for industry to participate (Gilman et al. 2002). Additionally, if regulations requiring the use of by-catch avoidance methods are effectively enforced and carry sufficient economic consequences for noncompliance, broad industry compliance can be achieved.

8.7.5 Outreach, Capacity-building and Disseminating the Lessons Learnt

The Hawaii longline association, in partnership with fishery management authorities and environmental conservation groups, has produced a number of educational materials on methods to abate fisheries by-catch. These include a poster (Fig. 8.7) and pamphlet on side setting to reduce seabird by-catch, a poster on best practices to handle and release incidentally caught seabirds in longline gear and methods to reduce seabird capture, and a booklet on methods to reduce sea turtle by-catch in pelagic longline gear and practices to handle and release captured turtles. The Hawaii Longline Association is also able to disseminate lessons learnt from experiments and commercial demonstrations and learn from by-catch research in other fisheries through participation in, and providing financial support for, conferences such as the International Fishers Forum series.

The Hawaii Longline Association is working with management authorities and the Blue Ocean Institute to implement a dockside technical assistance program for longline vessels to convert deck designs from the conventional setting position from the stern, to the side of the vessel to reduce seabird by-catch. Deck conversion requires considering the deck position for setting, selection of main line shooter hinges and hydraulics, line pullers, motor and mounting plate design for starboard setting, and the design, construction and installation of a bird curtain. Technical assistance is also available to captains and crew on best fishing practices for setting from the new position, including timing for clipping branch lines to the main line and practices for throwing baited hooks.
Fig. 8.7. Educational poster on the method and benefits of side setting, which has been shown to minimise seabird by-catch in Hawaiian pelagic longline gear.
These education and outreach programs are an investment to bring about changes in behaviour and attitudes by having an industry that is better informed of prescribed fisheries by-catch avoidance methods, and, in some cases, operational benefits from employing these techniques. Showcasing the results of industry-led research to abate fisheries by-catch also has the benefit of broadly disseminating the results so that the effective methodology can be replicated in other fleets worldwide and ineffective components can be improved.

8.7.6 One Fleet Pilot Project

The Hawaii Longline Association worked with an environmental organisation and fishery management authorities to examine the state of knowledge of employing fleet communication programs to reduce fisheries by-catch, and is now planning to institute a pilot program to reduce by-catch of sea turtles and albatrosses. Instituting a fleet communication system to report near real-time observations of by-catch hotspots enables a commercial fishery to operate as a coordinated ‘One Fleet’ to substantially reduce fleet-wide capture of protected by-catch species, including fish, seabirds, sea turtles and marine mammals. This benefits the by-catch species, reduces waste, can provide economic benefits to industry by reducing the risk of exceeding government-established seasonal by-catch thresholds, and can avoid possible future declines in target species catch resulting from by-catch of juvenile and undersized individuals. We analysed case-studies of fleet communication programs in three United States fisheries; the North Atlantic longline swordfish fishery; the North Pacific and Alaska trawl fishery; and the Alaska demersal longline fishery. Available information from these case-studies supports the inference that they have substantially reduced fisheries by-catch and provided large economic benefits that outweigh relatively nominal operational costs.

It is not yet known how likely it is that the Hawaii longline swordfish and tuna fleets will annually exceed seasonal sea turtle by-catch limits. This makes it difficult to assess if economic benefits from instituting a ‘One Fleet’ protocol, resulting from enabling the fleet to operate for a longer time period, will outweigh the economic costs from managing the fleet communication program. Furthermore, it may not be possible to determine definitively the effect of instituting the fleet communication program on sea turtle and seabird by-catch rates, due to the lack of a suitable control for comparison. Historical by-catch rates would not provide a suitable comparison because the fleet is now using different methods designed to minimise seabird and sea turtle by-catch. Furthermore, comparison of by-catch rates from different time periods can be confounded by
numerous variables, including weather, seabird and turtle behaviour, fishing practices, location of fishing grounds and consistency in observer methods. However, if some of the Hawaii longline vessels opted not to participate in the fleet communication program, a comparison of by-catch rates of participating and non-participating vessels could provide an understanding of the effect on by-catch rates from this single factor, assuming that there are no other substantial differences between the two categories of vessels. This was possible for the Alaska demersal longline fisheries fleet communication program. Non-monetary benefits to the Hawaii longline industry from instituting a ‘One Fleet’ program to reduce turtle and bird by-catch could be substantial, such as from positive media coverage and other values not described by established financial indicators.

8.7.7 Conclusions

In Hawaii and elsewhere, we have seen that fishers are some of the most qualified people to develop and improve by-catch avoidance strategies. Fishers have a large repository of knowledge and information related to by-catch, which can be tapped to contribute to finding effective and practical solutions. Mitigation methods that effectively avoid by-catch, do not reduce fishing efficiency, or better yet, increase fishing efficiency and provide operational benefits, have the greatest chance of being accepted by industry. Fishers and fishery associations need to become active participants to address by-catch problems by being involved in research and commercial demonstrations, implementing best practices, and supporting adoption of regulations based on the best available science before restrictions, embargos and possible closures are imposed on them.

Most countries have a low degree of political will to address fisheries by-catch problems and, as is the case in Hawaii, have scarce resources for enforcement of by-catch management measures. Few national fishery management authorities have frameworks to manage interactions between sensitive by-catch species and fishing vessels and many do not require employment of effective by-catch avoidance methods. A bottom-up approach that fosters a sense of industry ownership for effective by-catch mitigation methods, and concomitant compliance with requirements for using by-catch avoidance methods are needed in these countries.

While the effectiveness of this approach to address fisheries by-catch is broadly recognised, there has been far too little funding allocated for cooperative research and commercial demonstrations to find solutions to sea turtle, seabird and other by-catch problems in longline gear. In the United States, this may be a result of the government’s fear of being sued if they propose to conduct or fund experiments in United States fisheries that
result in injury to protected resources, even though these experiments will potentially result in substantial reductions in mortality of these species when best practices are identified and spread to multiple fisheries. Some United States fishery management authorities are funding experiments to test technical measures to reduce sea turtle by-catch in longline fisheries abroad, in part, to avoid problems with trying to receive permits and risk being sued by conducting the research in domestic fisheries. But too little research is being supported, there is insufficient coordination resulting in duplicative efforts and solutions found abroad may not be relevant to domestic fisheries. The amount of research being conducted is too small, research needs to occur in individual fisheries to find solutions that we can have confidence will work in our fisheries, and the agencies designing the experiments need to do more to tap into fishers’ knowledge to identify new promising strategies.

8.7.8 Acknowledgements

The impetus for preparing this case-study came from insights derived during three years of research on methods to reduce seabird by-catch in Hawaii pelagic longline fisheries. We are grateful for input from Jerry Ray, Barry Woods, George Ching, Kelly Malakai, and Beverly Ray, captain and crew of the F.V. Katy Mary, Nigel Brothers, a consultant from Australia, Dr. Chris Boggs and Donald Kobayashi of NOAA Fisheries, and Kitty Simonds and Paul Dalzell of the Western Pacific Regional Fishery Management Council.

8.8 Case Study 7 – Seabird By-catch Mitigation: The Southern Ocean (CCAMLR) Experience

(by J.P. Croxall, K. Rivera and C.A. Moreno)

8.8.1 The Problem

Decreases in albatross populations at sub-Antarctic islands became evident in the mid-1980s, particularly at South Georgia and Iles Crozet where the longest sets of annual population counts were derived (Croxall et al. 1990, Jouventin and Weimerskirch 1990, Prince et al. 1994) (Fig. 8.8). Three sets of observations and data linked these population declines to incidental mortality associated with longline fisheries and thus brought the issue to widespread attention, including that of fishery management organisations:
1. Analysis (in 1989) of the 81 recoveries (from 20,000 banded) of wandering albatrosses (*Diomedea exulans*) from South Georgia, indicated that fisheries, particularly those using longline gear, were the main cause of this mortality (Croxall and Prince 1990).

2. Direct estimates (in 1988) of albatross by-catch rates on vessels using longlines to catch southern bluefin tuna (*Thunnus maccocyti*) in the Tasman Sea (Brothers 1991), indicated that, even with rates of < 0.5 birds per thousand hooks, the total annual albatross by-catch from tuna longline fishing could easily exceed 40,000.

**Fig. 8.8.** Changes in population size of albatrosses in study colonies at Bird Island, South Georgia (BAS unpublished data), (A) wandering albatross (whole island counts), (B) grey-headed albatross (Colony E) and (C) black-browed albatross (Colony H)
8.8.2 The Context

The commercial harvesting of Antarctic marine living resources had followed a familiar pattern of prospecting, exploitation and over-exploitation. By the late 1970s, just two centuries after the discovery of the region’s resources, most, if not all, populations of Antarctic fur seal (*Arctocephalus gazelle*), several species of great whale and marbled rock cod (*Notothenia rossii*) were commercially unviable and nearly biologically extinct. Fisheries were switching to Antarctic icefish (*Champsocephalus gunnari*) (already over-exploited by 1980) and Antarctic krill (*Euphausia superba*). There was an overriding fear that not only would recently protected whale populations fail to recover, but that other species dependent on krill and its associated food chain would be affected by its harvesting.

Therefore, in 1977, the contracting parties to the Antarctic Treaty, who had been successful in depoliticising governance and promoting scientific collaboration in respect of the Antarctic Continent, started to negotiate an international convention, primarily to prevent over-exploitation of marine resources, especially Antarctic krill. The resulting CCAMLR Convention, signed in 1980 and in force since 1982, applies to the whole Southern Ocean south of the Antarctic Polar Front – an area of 32 million km² (see Fig. 8.9). The marine living resources involved in the Convention include all species in the Convention Area other than whales and seals, for which there were existing Conventions. The CCAMLR Convention was the first in the marine environment to try to combine the requirements of sustainable harvesting with adequate protection for non-target species potentially affected by harvesting. In fact, in three of its fundamental principles, it was foreshadowing, by at least a decade, the widespread adoption of the

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3. Direct observations (1991) of albatross and petrel by-catch on vessels fishing for Patagonian toothfish (*Dissostichus eleginoides*) using longlines around South Georgia, suggested that over 3500 petrels (including more than 1000 albatrosses) could be killed annually in this fishery in this region (Dalziell and de Poorter 1993). This longline fishery started in 1989.

In 1991 the above observations were brought to the attention of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), the management authority responsible for regulating fishing in the Southern Ocean and within whose boundaries many of the most affected albatross populations breed (e.g., at South Georgia, Iles Crozet, Kerguelen and Prince Edward Islands).
precautionary principle and the need for ecosystem-based approaches to the management of marine systems. Thus, Article II of the CCAMLR Convention contains the requirements:

1. to balance the needs of sustainable harvesting with those of conservation; and
2. to provide protection for dependent and related species, coupled with the restoration of depleted stocks and populations;
3. to avoid changes that are potentially irreversible within two to three decades.

In 1991 the situation for CCAMLR was that, given the population dynamics of albatrosses, their population decreases were of a magnitude potentially irreversible within two to three decades. However, the main cause of these changes likely reflected events in adjacent waters that were not under the jurisdiction of CCAMLR. Nevertheless, by allowing longline fishing in the knowledge that potentially high levels of albatross by-catch were likely, CCAMLR was clearly not acting in the precautionary manner prescribed under its Convention.
8.8.3 Tackling the Problem

As a result of the above situation, CCAMLR, through the representatives of its 24 member states, at meetings of its Working Group on Fish Stock Assessment, Scientific Committee and Commission started the process of developing mechanisms for regulating by-catch in longline fisheries (including initially acquiring data and information to enable it to do this). A timetable indicating the evolution and development of this process is set out in Table 8.2.

Lest progress be thought to be exceptionally slow, it should be noted, first, that measures legally binding on all members of CCAMLR (e.g., as conservation measures) must be adopted by consensus. Second, once sufficient data

Table 8.2 Milestones in the development of effective mitigation measures to prevent seabird by-catch in longline fisheries in the CCAMLR Convention Area

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>CCAMLR Convention comes into force.</td>
</tr>
<tr>
<td>1986</td>
<td>Reports of incidental mortality required.</td>
</tr>
<tr>
<td>1989</td>
<td>Longline fishing for Patagonian toothfish starts (around South Georgia); incidental mortality becomes a CCAMLR agenda item.</td>
</tr>
<tr>
<td>1990</td>
<td>First unofficial report of seabird by-catch; reporting forms on incidental mortality data and formats agreed as part of a Conservation Measure.</td>
</tr>
<tr>
<td>1991</td>
<td>First direct observations of seabird by-catch; first Conservation Measure on mitigation of incidental mortality of seabirds.</td>
</tr>
<tr>
<td>1993</td>
<td>Working Group on Incidental Mortality Associated with Longline Fishing established (first meeting in 1994).</td>
</tr>
<tr>
<td>1993</td>
<td>International scientific observers required on all (four) vessels longline fishing in the South Georgia area.</td>
</tr>
<tr>
<td>1994</td>
<td>First outreach materials to fishers and fishery managers and approaches to other RFMOs.</td>
</tr>
<tr>
<td>1995</td>
<td>Closed season for longline fishing for toothfish (1 August to end February) to assist reducing incidental mortality of seabirds.</td>
</tr>
<tr>
<td>1996</td>
<td>First (autoline) vessels achieve full compliance with all mitigation measures for seabird by-catch (Conservation Measure 29).</td>
</tr>
<tr>
<td>1997</td>
<td>Closed fishing season extended by two weeks (to 15 April).</td>
</tr>
</tbody>
</table>
were obtained to assess the magnitude of the problem, steady progress was made. Some of the main positive outcomes of the process set out in Table 8.2 are summarised below.

1. **By-catch reduced:** Once a full range of mitigation measures (Table 8.3), including a closed season, were imposed and monitored effectively, seabird by-catch numbers and rates at South Georgia (statistical subarea 48.3; see Fig. 8.8) were reduced ten-fold within a single year (Table 8.4).

<table>
<thead>
<tr>
<th>Action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>No offal discharge</td>
<td>Avoid attracting birds</td>
</tr>
<tr>
<td>Streamer lines</td>
<td>Keep birds away from sinking longline</td>
</tr>
<tr>
<td>Weighted lines</td>
<td>Sink lines too fast for birds to access</td>
</tr>
<tr>
<td>Night setting</td>
<td>Albatrosses are diurnal</td>
</tr>
<tr>
<td>Closed seasons</td>
<td>Protect birds when breeding</td>
</tr>
<tr>
<td>Scientific observers on every vessel</td>
<td></td>
</tr>
</tbody>
</table>
1. **Improvements to mitigation**: Improved ability at using and managing the technical mitigation methods (streamer lines, line weighting, offal discharge) soon produced further by-catch reduction at South Georgia by ten-fold again over the next 2 years – with rates stabilising thereafter.

Reductions were slower to achieve in the Indian Ocean (where closed seasons were not implemented) but, ultimately, similar proportionate reductions were achieved in the areas around the Prince Edward Islands (part of statistical subareas 58.6 and 58.7; see Fig. 8.9). Years of minor increases in by-catches (e.g., 2004) could be clearly associated with a drop in the standard of implementation of the technical mitigation measures (CCAMLR 2004).

Even the recent massive by-catches of white-chinned petrels *Procellaria aequinoctialis* (about 25,000 birds over years 2002 and 2003 combined) in French-managed fisheries in the Indian Ocean proved susceptible to implementation of the technical mitigation measures used elsewhere, reducing by-catch by 75% in one season (2004) (Fig. 8.10). Clearly streamer lines, line weighting and associated best practice with discharge of offal can produce major improvements in by-catch quite independently of those achieved by closing areas to fishing during the breeding season of seabirds.

2. **Use of the precautionary approach – Seabird by-catch limits**: Management of seabird by-catch in CCAMLR’s new and exploratory fisheries (i.e., starting longline fishing in a new statistical subarea or division) has been exemplary in terms of adopting a precautionary approach, particularly in defining by-catch risk levels and attendant

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**Table 8.4** Total estimated seabird by-catch and by-catch rate (birds per thousand hooks) in longline fisheries for toothfish *Dissostichus* spp. in the CCAMLR Convention Area (source: CCAMLR 2004).

<table>
<thead>
<tr>
<th>Subarea</th>
<th>Year</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>South Georgia (Subarea 48.3)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated by-catch</td>
<td></td>
<td>5755</td>
<td>640</td>
<td>210</td>
<td>21</td>
<td>30</td>
<td>27</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>By-catch rate</td>
<td></td>
<td>0.23</td>
<td>0.032</td>
<td>0.013</td>
<td>0.002</td>
<td>0.002</td>
<td>0.0015</td>
<td>0.00003</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Indian Ocean (Subarea 58.6, 58.7)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated by-catch</td>
<td></td>
<td>834</td>
<td>528</td>
<td>156</td>
<td>516</td>
<td>199</td>
<td>0</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>By-catch rate</td>
<td></td>
<td>0.52</td>
<td>0.194</td>
<td>0.034</td>
<td>0.046</td>
<td>0.018</td>
<td>0</td>
<td>0.003</td>
<td>0.025</td>
</tr>
<tr>
<td><strong>Ross Sea (Subarea 88.1, 88.2)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated by-catch</td>
<td></td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>By-catch rate</td>
<td></td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
Area-specific mitigation requirements and management actions (see CCAMLR 2004, Table 7.17). So far all regulations have been strictly observed with no, or almost no, seabird by-catch whatsoever. Furthermore, regulated relaxation of mitigation requirements (subject to seabird by-catch limits) have also been entirely successful at avoiding by-catch.

3. Adaptive management: Mechanisms for the stepwise removal of some mitigation requirements (e.g., closed seasons), consequent on complete compliance with the necessary mitigation measures have been agreed and implementation has either commenced and/or the preconditions met. However, greater relaxation of these regulations (e.g., allowing longline fisheries to operate with technical measures alone in the highest risk by-catch areas during the main seabird breeding season), may prove to be quite challenging, especially for avoiding by-catch of white-chinned petrels and for operations involving the Spanish system of longline fishing.

4. Easier methods for fishers: Development of new methods which are easier and more effective for fishers to use (e.g., longlines with integrated weight) are enabling autoline vessels to fish with greater freedom and efficiency than hitherto.

### 8.8.4 Drivers and Obstacles

Here we summarise those factors which, in our opinion, had the greatest positive or negative effects on the speed of progress and success of outcomes in this case study. Several of them may still be powerful influences on future developments.
8.8.4.1 Positive Influences

1. Placement of independent scientific observers on vessels.
2. Creation of a formal working group which comprised all stakeholder constituencies – fishers, fishery managers, fishery scientists, technical experts, seabird biologists – to analyse and assess data and to provide advice. In CCAMLR, this was the working group on Incidental Mortality Associated with Fishing (IMAF).
3. Collaborative research into practical solutions involving fishing companies and scientists and supported by governments.
4. High value of fishery so that the initial introduction of mitigation measures were neither disproportionately costly nor powerful disincentives to continue to participate in the fishery.
5. Relative geographical restriction of the toothfish fishery, which simplified management especially by coastal states around sub-Antarctic islands.
6. Vessel compliance with by-catch reduction measures and reporting requirements are fishery permit conditions.
7. Increasing recognition of the CCAMLR process and recommendations as ‘role models’ leading to the uptake of CCAMLR-style seabird avoidance measures in other parts of the world.

8.8.4.2 Negative Influences

1. Traditional commercial and operational secrecy at the start of a new fishery.
2. Remoteness of the region and resulting difficulty of policing in respect of Illegal, Unregulated and Unreported (IUU) fishing.
3. The Spanish system of longlining made simplifying mitigation measures (such as integrated weighting for autoliners) very difficult.
4. Lack of ability to test scientifically the contribution that each of the different mitigation measures makes to overall by-catch reduction. Consequent difficulty in proposing best practice combinations for new areas, circumstances, vessels, etc.
5. Closed seasons, although effective at reducing local by-catch rates, risk displacing fishing to other areas where management and mitigation may be much less effective.

8.8.5 Next Steps

The main challenges for CCAMLR within its Convention Area relate to: (i) further reducing seabird by-catch in the French Economic Exclusion Zone, and (ii) eliminating IUU fishing and its attendant by-catch.
However, now most by-catch of Convention Area seabirds occurs in adjacent regions. In this regard, CCAMLR needs to:

1. Collaborate with adjacent Regional Fishery Management Organisations (RFMOs), especially IOTC, ICCAT, CCSBT and the new Indian Ocean RFMOs, to ensure that seabird by-catch (especially of birds breeding in the Convention Area) is eliminated or minimised by the use of a suite of measures similar to those employed by CCAMLR.

2. Assist the development by such RFMOs of expert groups to advise on collection and analysis of by-catch data and on potential practical solutions to by-catch problems. Obtaining advice from, or participation of, experts with experience of the CCAMLR IMAF group could assist these RFMOs share and exchange information and assist with the transfer and uptake of the effective ways that CCAMLR has reduced seabird by-catch.

3. Work with relevant CCAMLR members to ensure that their vessels operating in high seas areas adjacent to the Convention Area are employing mitigation measures as effective as those required within the Convention Area.

4. Promote and assist the development of mitigation methods that operate effectively without comprehensive reporting, monitoring and compliance, such as further development and implementation of underwater setting devices and integrated line weighting.

5. For states into whose waters CCAMLR seabirds migrate (especially Argentina, Australia, Chile, New Zealand and South Africa), ensure that domestic legislation with respect to mitigation is as effective as that required by CCAMLR.

6. Work with relevant CCAMLR members to ensure that successful mitigation by their vessels of seabird by-catch in the CCAMLR area is complemented by equally successful mitigation by these and other vessels in their domestic fisheries (and, indeed, wherever their vessels participate in fisheries where there are risks of seabird by-catch).

7. Develop improvements to the Spanish system of longline fishing, particularly to enable simplification of the implementation of mitigation measures.

8. Reduce by-catch in appropriate parts of the French EEZ to levels comparable to the rest of the Convention Area.

9. Continue close monitoring of CCAMLR fisheries to ensure full compliance with conservation measures and prevent increases in by-catch (as seen in 2004).

10. Support and promote initiatives by industry, governments, and RFMOs to combat IUU.
8.9 Summary and Conclusions

(by Stephen J. Hall)

The stories told in the preceding case-studies in this chapter describe how changes in the behaviour of individuals and institutions have occurred in the face of various by-catch issues. It also describes how these changes have delivered conservation benefits that contributed to the long-term sustainability of fisheries. Each story is unique, and shows with varying degrees of emphasis some of the key factors that have led to successful outcomes. Behind this uniqueness, however, there are common threads that point to general lessons about how to get fishers to change their behaviour. The purpose of this section of this chapter is to draw those threads together.

Before drawing lessons about how change occurs among fishers and how to support it, it is worth considering how fishing differs from other industries. Its distinctiveness comes, not only from the technical peculiarities of fishing, but also from the socio-economic contexts in which fishing occurs. The public’s empathy with some by-catch species, property and access rights regimes and the cultural perspectives associated with fishing are all important. These and other issues combine to make fishing different from other industries. While admitting these differences, however, there is a strong case for arguing that, when thinking about how change occurs, it is the similarities between these stories and those elsewhere that are most important. It is from those similarities that we can draw general lessons.

In drawing general lessons about change among fishers, however, we must also recognise the huge volume of literature on change management that fills the shelves of business school libraries and book shops. This literature provides a plethora of frameworks and models for describing and understanding change, each of which has strengths and weaknesses. To these I add my own, synthesised from multiple sources, which treats change from the perspective of those whose behaviour one is seeking to influence. Given this huge literature on change management, one could view anything newly written as merely packaging ‘old wine in new bottles’.

8.8.6 Acknowledgements

We thank all our colleagues in the CCAMLR Working Group on Incidental Mortality Associated with Fishing for their exemplary collaboration over the last decade. We thank the many other individuals who have facilitated scientific and management research and action on this topic, particularly in the Southern Ocean.
I would argue, however, that context matters. Given the peculiarities of the fishing sector noted above, I hope that placing the key features of the case-studies in this chapter into a common framework will be informative and useful.

### 8.9.1 A Change Model

Drawing on the work of Kotter (1990), Senge (1990) and many others, the model for change developed here is built around three concepts. (i) where individuals, communities or institutions are on a continuum that reflects readiness for change; (ii) the leadership actions needed to cause change at each point on the continuum; and (iii) the drivers that deliver those leadership actions within the context of fisheries (Fig. 8.11).

In essence, the model argues that to get fishers to move from denial to commitment, one must first apply pressure for change by providing information. One must then find champions for change among fishers to help move the industry through the phase of resistance to one of exploration in which innovation and learning among fishers predominates. Accepted solutions developed during the innovation and learning period then become widely adopted through peer pressure mechanisms. These then take individuals beyond the exploration phase to commitment so that improved approaches become accepted practice.

Below I examine the validity of this model using the stories presented in this chapter.

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**Fig. 8.11. A change model**
8.9.1.1 Applying Pressure and Finding Champions

Pressure for change can, of course, come from various sources, but a common thread in many of the stories told here is how public opinion, framed by media attention, has catalysed action by fishers. The leadership action needed during the early phase of change is to provide information that will alter opinions – and no agent does this better than the popular press. Adverse media attention and the consequent socio-political pressure have been powerful stimuli for action. The gory videos of dolphin deaths in the tuna seines (Case-study 1) and the media attention to the death of 312 white chinned petrels by an auto-liner in New Zealand (Case-study 4) are good examples. Before fishers will start acting, someone usually needs to make a fuss.

But, although the press have proved important, it would be wrong to suggest that information provided by others does not also play a role. This role can be especially important when fishers’ interpretation of personal experiences run contrary to the messages they are hearing elsewhere. An excellent example of this comes from Peckham et al. (Case-study 5) where fishers’ perceptions from high turtle catches worked against the message that they were endangering populations. Here patient explanation about how turtles aggregate in fishing areas and information about the bigger picture had an important role to play in persuading fishers of the need for change. Combining this with information on individual turtle movements from satellite tracking, which no doubt created an emotional connection between fishers and the turtles, was especially powerful. But even when media attention is high, or when other information channels are effective, it almost always needs the initiative of key individuals to get fishers moving.

Champions usually need to emerge early in the story, even when threats to the fishery from litigation or market forces are clear. One important role that these individuals seem to play is in helping others understand that ‘perception is often reality’. It often takes an insider to persuade others that, even if the media has distorted an issue, it is the public and government’s perception of the truth that will affect their business. Although the most obvious examples of such champions in the case-studies tend to be men, one should not forget the role played by women. In their role as marketers of fish, they are often more aware of how markets can change with external pressure and can play a key influencing role (see Case-study 2).

As our model implies, finding champions is not only important for persuading others about the need for change. We also need them to lead the way in finding solutions. Thomas and Molloy (Case-study 4) are most clear on this matter: ‘Picking respected and committed fishers as role-models to champion behaviour change is a cornerstone of the Southern
Seabird Solutions approach. With such champions on-board the shift to a learning-and-innovation-cycle can take place.

8.9.1.2 Fostering Innovation and Learning

A fishing master developed tori poles to reduce seabird by-catch in the Japanese long-line fishery, as early as 1988. Tuna fishers devised new manoeuvres to avoid catching dolphins. Hawaiian long-liners helped refine hook technologies to reduce turtle capture. If there is one lesson above all others that comes from the chapters presented here, it is that we need to involve fishers in solving the technical problems of reducing by-catch. This is important for two reasons: first, technical solutions will get better faster; and second, engaging fishers in testing and refining innovations helps these innovations gain acceptance.

While accepting the value of developing a learning and innovation cycle within the fishery is non-controversial (see Hall and Mainprize 2004, for review), the best way to achieve it is unclear. In many respects, the best approach will depend on the particular setting. However, one general lesson is that researchers and extension workers often have a key catalytic role to play by promoting knowledge-sharing and stimulating learning and innovation. Engaging fishers in this cycle is especially important in remote areas where there is limited enforcement capacity and adopting new approaches rests solely in the hands of fishers (Peckham et al., Case-study 5).

One good example of the catalytic role played by extension agents is the ‘skipper exchange program’ described by Thomas and Molloy (Case-study 4). This approach provides an excellent vehicle, not only for sharing ideas and best-practice solutions, but also for recognising and rewarding champions. A testament to its power is that one visit from a New Zealand skipper led to the wholesale adoption of new weighted longlines by the Reunion fleet in Chile. Other models for sharing knowledge and stimulating innovation abound.

While the virtues of the learning and innovation cycle are clear, it is also important to recognise the costs of its absence. The crewing of Japanese vessels with foreign nationals illustrate this point (Nakano and Clarke, Case-study 3). Because foreigners are not seen as apprentices, the Japanese fishers do not pass on skills in by-catch mitigation. As a result, a culture of innovation does not develop. Strong social hierarchies within Japanese fishing communities also appear to inhibit both acceptance of the need for change and the learning and innovation needed to find solutions.
8.9.1.3 From Peer Pressure to Accepted Practice

As a cycle of learning and innovation develops and the number of fishers involved increases, it is reasonable to suppose that a sense of mutual accountability for improving should also develop. Recognition of the need for such accountability often seems to form early in the change process with the realisation that the poor performance of a few boats could affect everyone. Accepting such accountability usually appears much later, however, when there is general buy-in by the majority, and instruments are in place to monitor and report individual performance.

Such monitoring stimulates two change drivers, both of which amount to a form of peer pressure. The first is that it helps create internal pressures in competitive individuals who want to improve to be better than their peers. The key to tapping into that competitive streak is collecting data on performance and sharing those data in suitable ways. Experiences in the tuna fleets of the eastern Pacific point the way to best-practice in this regard. Fleet performance statistics are shared and there is private feedback on individual performance, combined with discussion and coaching on how to improve.

The second change driver comes from the external pressures imposed by peers who expect others to ‘pull their weight’. This pressure can come in subtle (and possibly less subtle!) social interactions. It may then be a short step from here to creating legislative or management instruments such as individual or fleet by-catch quotas, or by-catch hot-spot reporting systems, that essentially serve to normalise procedures and make them recognised practice.

8.9.2 Conclusions

I hope the model described here provides a useful way to think about these case-studies and helps give further insights into how change in fisheries occurs. I also hope that this model, or something like it, will be used in discussions with the players involved in a fishery to help promote change. I base this hope on the premise the more fishers, NGOs, legislators, and others understand the bigger picture of what is happening, the greater their engagement and the more informed are their decisions.

One example of where discussion of the change model itself could be useful is for gaining agreement on where a particular fishery is on its journey and on the leadership actions that are most suitable for moving it forward. Getting agreement on this could, for example, avoid continued litigation or harping on the need for change when such actions could be counter-productive and slow or even halt progress. The situation faced by Seabird Solutions in New Zealand seems to be an example of this
problem (Thomas and Molloy, Case-study 4). The success of such discussions depends of course on the key players having negotiable positions, something that is by no means guaranteed. This appears to be the problem in Hawaii, for example, where continued litigation to close the fishery completely is stalling the introduction of further improvements (Gilman et al., Case-study 6).

The stories presented in this chapter are highly varied and describe fisheries at different stages along a continuum of change. While it is tempting to highlight deficiencies, it is important to remember that the common theme running through all of them is success. To greater or lesser degrees, they describe initiatives that are reducing by-catch and making fisheries more ecologically sustainable. What is especially encouraging is some fisheries seem to have reached the normative stage, and have fully institutionalised a set of improved practices. For fisheries that have reached this stage, the time may well be right to loop back to start another round of improvement.

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