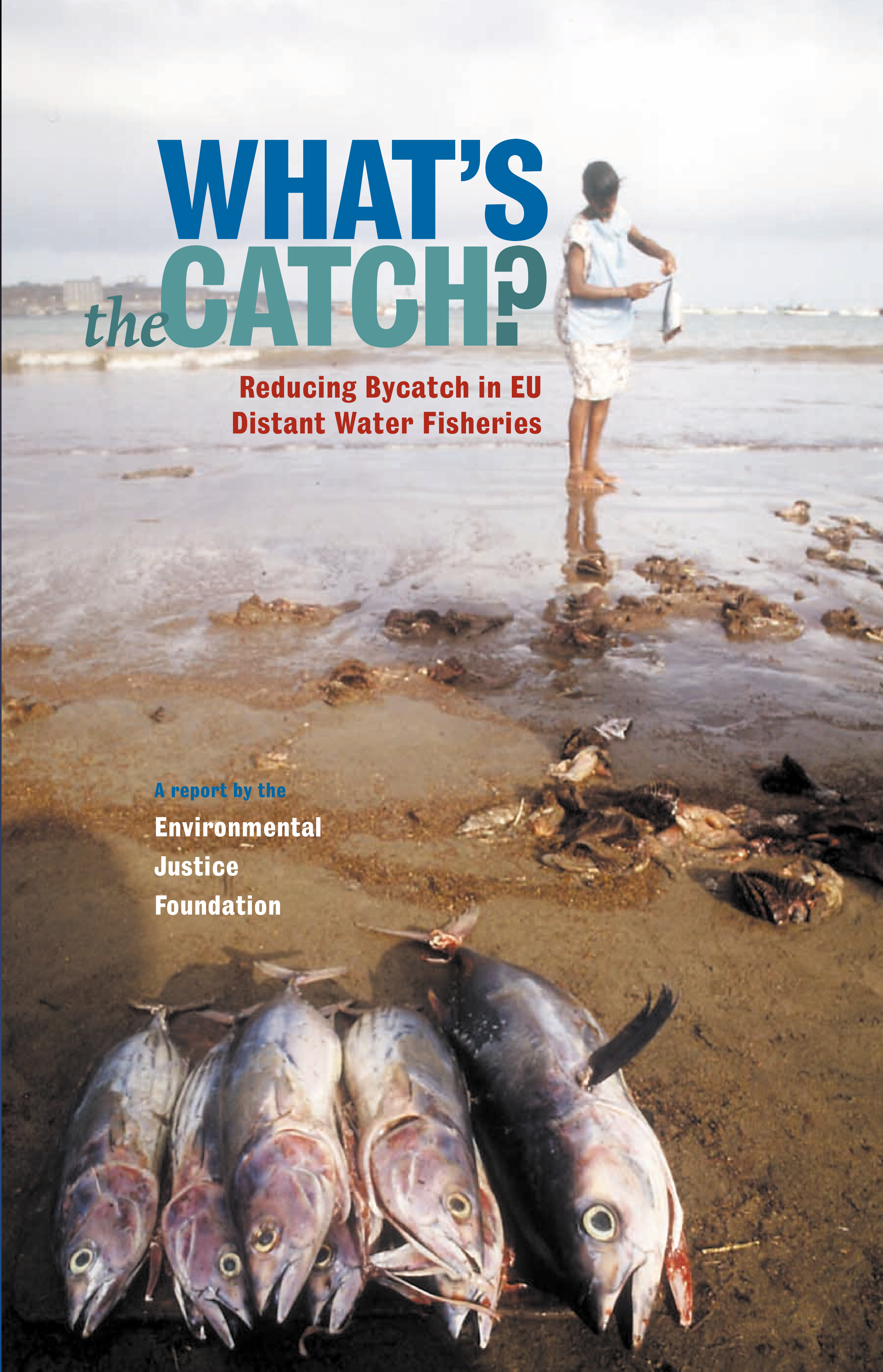

WHAT'S *the* CATCH?

Reducing Bycatch in EU Distant Water Fisheries

A report by the

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This document should be cited as: EJF. 2005. *What's the Catch?: Reducing Bytcatch in EU Distant Water Fisheries*. Environmental Justice Foundation, London, UK.

ISBN No. 1-904523-07-2

CONTENTS

In 2003, the Environmental Justice Foundation (EJF) began an international campaign on Bycatch Reduction. This campaign grew from extensive research on the wider ecosystem effects of tropical shrimp trawl fisheries.

EJF's approach is to make practical recommendations and highlight successful technical and operational methods to reduce bycatch.

Acknowledgements

This report was researched, written and produced by the **Environmental Justice Foundation Charitable Trust** (**Annabelle Aish**, **Louis Buckley**, **Steve Trent** and **Juliette Williams**).

Design **Dan Brown** (dan.brown@ukf.net)

Cover photo © FAO / M. Marzot

Printed on 100% post-consumer waste paper.

Thanks to **Brian Emmerson** and all at **Emmerson Press** for continued support. www.emmersonpress.co.uk

EJF would like to thank the following people and their organisations for the invaluable time and assistance with information, ideas and visual materials used in this report:

Helene Bours, **Dr. Matt Broadhurst**, **James Brown**, **Dr. Frank Chopin**, **Alistair Dillon**, **Marydele Donnelly**, **Michael Earle**, **Matthew Gianni**, **Beatrice Gorez**, **Dr. Martin Hall**, **Pavel Klinckhamers**, **Dr. Rebecca Lewison**, **Dr. Andrew Smith**.

In thanking these individuals, we in no way imply that they or their organisations endorse the report's content.

EJF's marine campaign is generously supported by the **Rufford Maurice Laing Foundation**

Glossary

Artisanal fisheries: Typically inshore fisheries with small-scale vessels using traditional or basic methods. These fisheries usually involve households (as opposed to companies) but can be subsistence or commercial in nature.

Bycatch Reduction Device (BRD): A device fitted into a fishing gear (usually trawl) to allow the escape of non-target organisms. Most BRDs work by exploiting behavioural differences between target and non-target organisms. Commonly used BRDs include: square mesh codends, square mesh panels or windows, fisheyes, bigeyes and radial escape sections.

Bycatch: The incidental catch of non-target species and undersized individuals of the target species. Non-target commercial species may be retained or discarded along with unwanted bycatch.

Cephalopod: Animals (molluscs) with tentacles converging at the head, around the mouth. (Examples: squid, cuttlefish, and octopus).

Codend: The end section of a trawl net which retains the catch. Codend mesh sizes and structure are usually regulated, as it is in this part of the net that most 'size-selection' takes place. The codend may be preceded by a device to reduce bycatch (e.g. BRD or TED).

Demersal: a habitat or fishing range on or near the bottom of the ocean. Demersal species live in close relation with the seabed and depend on it. (Examples: cod, grouper and lobster).

Discards: any marine organism caught when fishing that is not retained but returned to the sea (usually dead or dying).

Ecosystem-Based Management (EBM): An approach that takes major ecosystem components and services into account in managing fisheries, rather than focusing on individual parts of the ecosystem (such as target species). It explicitly deals with issues such as resources conservation, habitat protection, fishery and non-fishery impacts.

Exclusive Economic Zone (EEZ): A zone under national jurisdiction (up to 200-nautical miles wide) declared in line with the provisions of 1982 United Nations Convention of the Law of the Sea. Within this zone, the coastal State has the right to explore and exploit, and the responsibility to conserve and manage, both living and non-living resources.

Fish Aggregating Device (FAD): Artificial or natural floating objects placed on the ocean surface to attract schooling fish species (e.g. tuna), thus increasing their catchability.

Longline: A fishing gear in which short lines carrying hooks are attached to a longer main line at regular intervals. The main lines can be as long as 150 km, with several thousand hooks. Longline fisheries can target either pelagic or demersal species.

Mesh size: The size of holes in a fishing net. Minimum mesh sizes are often set to avoid the capture of juvenile fish before they have reached their optimal size for capture.

Fishery observer: A certified person onboard a fishing vessel who collects scientific and technical information for a management authority. This information may include: areas fished, fishing effort, gear characteristics, and levels and composition of target catch, bycatch and discards.

Pelagic: A habitat or fishing range in the water column, at anywhere between 50 and 1500 metres depth. Pelagic species spend most of their life swimming in open water with little contact with or dependency on the seabed. (Examples: tuna and billfish)

Purse seine: A deep curtain of netting that is maneuvered to form an enclosing cylinder around shoals of pelagic fish (e.g. tuna). Industrial purse seine nets can be 1500 to 2000 m long and 120 to 250 m deep.

Turtle Excluder Device (TED): a grid-like structure fitted within trawl nets to prevent sea turtles from entering the codend. Instead, they are forced out through an escape opening in the net, just forward of the grid. These devices can also exclude sharks and rays, as well as jellyfish, sponges and certain larger fish.

Trawl: A cone or funnel-shaped net that is towed through the water by one or more vessels. Trawlers can target pelagic or demersal species, and range in size from small undecked boats powered by outboard engines to large factory trawlers of up to 45m in length.

Target catch: Those species that are primarily sought by fishermen in a particular fishery, and are the subject of directed fishing effort. There may be more than one target species, particularly in demersal fisheries.

(Sources: FAO, 2005b; NMFS, 2005; Lewison, *et al.*, 2004b; Anon, 2001; Robins *et al.*, 2000; Broadhurst, 2000)

INTRODUCTION

It is estimated that 7.3 million tonnes of non-target catch (bycatch) are discarded annually by the world's fisheries (Kelleher, 2004). This has considerable economic, ecological and developmental impacts (see *Impacts of bycatch* right).

In some cases, bycatch reduction is already technically feasible and economically advantageous (Valdemarsen & Suuronen 2003) – what is needed now is the political will to implement and enforce solutions. In particular the European Union (EU) has clear moral, economic and environmental imperatives to address both bycatch and discard issues associated with its distant water fishing fleets, currently operating in the waters of 17 developing countries (CEC, 2005). EU trawl, longline and purse seine fisheries operating in the Atlantic, Pacific and Indian Oceans are of special concern.

Bycatch reduction in these fisheries would be in direct accord with international commitments the EU has made by adopting the United Nations Food and Agriculture Organisation's (FAO) *Code of Conduct for Responsible Fisheries* and in ratifying the *1995 UN Agreement on the Conservation and Management of Straddling and Highly Migratory Fish Stocks* (see page 5). Reducing bycatch would also be consistent with the recent reform of Europe's Common Fisheries Policy (see page 4).

EJF has evaluated which international policy initiatives could best address bycatch globally. There is much value in taking an integrated approach to bycatch reduction, rather than focusing on specific fisheries or specific bycatch species. As such, EJF is calling for a UN FAO *International Plan of Action (IPOA) on Bycatch Reduction* (see page 11) and considers that the EU has both the ability and a responsibility to take the lead in proposing this initiative at the FAO. We believe that such action could complement and reinforce existing FAO initiatives designed to help individual species, such as the voluntary guidelines being drafted to reduce fishery-sea turtle interactions, and the *International Plan of Action on Sharks* and that on *Seabirds* (FAO, 2003; FAO, 2005a).

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Tropical shrimp trawl fisheries

According to the FAO's most recent global estimates, tropical shrimp trawl fisheries account for over 27% of total discarded bycatch (Kelleher, 2004). Shrimp trawl fisheries have become the leading case study for EJF's Bycatch Reduction campaign, and the focus of our management recommendations on bycatch. These recommendations were most recently presented at the *Fourth World Fisheries Congress* in 2004, and are also outlined in EJF's campaign report *Squandering the Seas* (EJF, 2003).

ABOVE: *Poorly-selective fishing in developing countries can have significant impacts on food security and employment.*

© FAO/P. Cenini (top) © FAO / P. Johnson

It is estimated that 7.3 million tonnes of non-target organisms are discarded annually by the world's fisheries.

KELLEHER (2004)

Impacts of bycatch

- High levels of bycatch can cause reductions in biomass, and may alter the **ecological** structure and diversity of the oceans (Hall *et al.*, 2000). Populations of marine mammals, sea turtles, sharks, seabirds and commercial fish species have been impacted by poorly-selective fishing gears (Hall *et al.*, 2000), and for some endangered species this represents a leading cause of mortality (Gilman and Freifeld, 2003; Lewison *et al.*, 2004b).
- The **economic** costs of discarding bycatch are considerable. The incidental capture, sorting, and eventual discarding of non-target catches takes time and yields few financial rewards. In addition, the bycatch of commercially valuable species (particularly at juvenile stages) can lead to reduced profits, declining yields and premature closures of fisheries (Hall *et al.*, 2000; Kelleher, 2004; Revill *et al.*,1999).
- Poorly-selective fishing in developing countries can impact **food security** and employment, by undermining the productivity of traditional fishing grounds (FAO, 2001). This can directly affect artisanal fisheries and the local communities they support.

What is bycatch?

Most fisheries are unselective to some degree, in that they incidentally catch unwanted organisms along with their target catch during the process of fishing. This non-target catch is known as 'bycatch' (Cook, 2003). The diversity and quantity of non-target catches can vary significantly over space and time (Hall *et al.*, 2000). Bycatch is therefore dynamic, reflecting variations in marine communities, fishing methods used, and changes in the target catch of fisheries. In some cases bycatch is predictable and straightforward to manage, in other cases it is unpredictable and more difficult to control (Hall *et al.*, 2000).

If bycatch is minimal, does not deplete populations of vulnerable species or undermine the productivity of fish stocks, it doesn't necessarily cause ecological harm (Garcia, 2002). Unfortunately, on a global scale, bycatch is significantly exacerbating the threats posed by the commercial over-exploitation of the oceans: around 7.3 million tonnes of bycatch are discarded every year (Kelleher, 2004). This was not always the case; the tremendous growth of the fishing industry in the last few decades has meant not only expanding fishing fleets, but the development of vessels which are larger, faster and able to cover greater areas of ocean (Hall *et al.*, 2000). Unfortunately, these vessels are often less selective than their predecessors. And as fisheries are rapidly reaching their limits of exploitation, wastage of marine life is coming under greater scrutiny (Hall *et al.*, 2000).

Why is bycatch discarded?

Bycatch may be kept, if it can be eaten, used or sold. However, much bycatch is disposed of (Cook, 2003), and this unwanted portion of the catch is known as the 'discards' or 'discarded catch'. Survival rates of discarded organisms are generally low. Fish and other bycatch species are usually killed during the process of capture or are so damaged/traumatized they are unlikely to survive once returned to the sea (Hall *et al.*, 2000).

In some cases, bycatch is discarded because fishing regulations prevent it from being landed. This may be due to imposed quotas for certain commercial species, or outright bans for prohibited species (Cook, 2003). Alternatively, there may be insufficient mechanisms in place to process, store and transport non-target species to market (Hall *et al.*, 2000).Yet, in most cases, discarding takes place because bycatch has:

i) no economic value, being the wrong species, small/immature, inedible or damaged

ii) a much lower economic value than the target catch, so fishermen prefer to retain only the high value target species. This is known as 'high grading'. (Hall *et al.*, 2000)

In general, discarding should be discouraged where bycatch can provide a sustainable source of protein, particularly in the developing world. However, in some cases discarding may be inevitable and then efforts should focus on increasing the survival rates of discarded species (Hall *et al.*, 2000).

How can bycatch be minimised?

Bycatch can be reduced by decreasing overall fishing effort and/or by reducing bycatch per unit of effort (BPUE) (Hall *et al.*, 2000). Key methods to reduce BPUE include:

- **Technological changes** (e.g. the use of Bycatch Reduction Devices (BRDs) in trawl fisheries).
- **Operational changes** (e.g. avoiding areas where bycatch tends to be high).
- **Training** (e.g. training in the application of the 'backdown procedure' to release dolphins from purse seine nets).
- **Management actions** (e.g. setting bycatch limits for individual vessels and rewarding fishers who succeed in reducing bycatch).

One way to reduce bycatch is to transfer responsibility for bycatch reduction to the individual fisher/vessel, within an appropriate management framework. This provides fishers with motivation to modify their gears and change their fishing practices. Often they, more than anyone, know how this can best be done (Parish cited in Norris, 2002). As part of such a scheme, those fishers who are successful should be appropriately rewarded. In turn, penalties should be issued to those who are not. This process has been described by Hall (cited in Norris, 2002) as a 'Darwinian selection' of fishermen, eventually leading to the evolution of more sustainable fisheries.

This approach was used to reduce dolphin bycatch associated with tuna purse seine fisheries in the Eastern Pacific Ocean (Norris, 2002). As part of the region's International Dolphin Conservation Program, an acceptable total dolphin mortality limit was set and then divided by the number of boats in the fishery. This resulted in a dolphin mortality limit for individual vessels. Well-equipped boats with well-trained, motivated crews are able to stay below the individual limit and keep fishing; vessels exceeding the limit are forced out of the fishery. 'As a result, boat owners weed out bad operators and seek captains that are highly skilled in dolphin avoidance and rescue techniques' (Norris, 2002). Mortality levels for all dolphin populations in the region have been lowered to less than 0.1% (from an estimated 133, 000 mortalities in 1986 to around 1,877 in 1998) (Hall *et al.*, 2000). This scheme's success is notable; however, some scientists remain concerned that i) dolphin populations have yet to fully recover ii) the sub-lethal impacts of any dolphin interactions with the fishery may be significant and iii) bycatch of immature tuna and other species has increased as a result of alternative fishing practices, particularly the use of Fish Aggregating Devices (see page 8) (Lewison *et al.*, 2004b). This case study highlights both the success of a strategy that gives fishermen responsibility for reducing non-target catches, but also the inevitable limitations of a single-species approach to bycatch management (Lewison *et al.*, 2004b).

BELOW: *Dolphin bycatch associated with tuna purse seine fisheries in the Eastern Pacific Ocean has been significantly reduced: mortality levels for all dolphin populations are now less than 0.1%.*

EU Fishing Agreements with developing countries

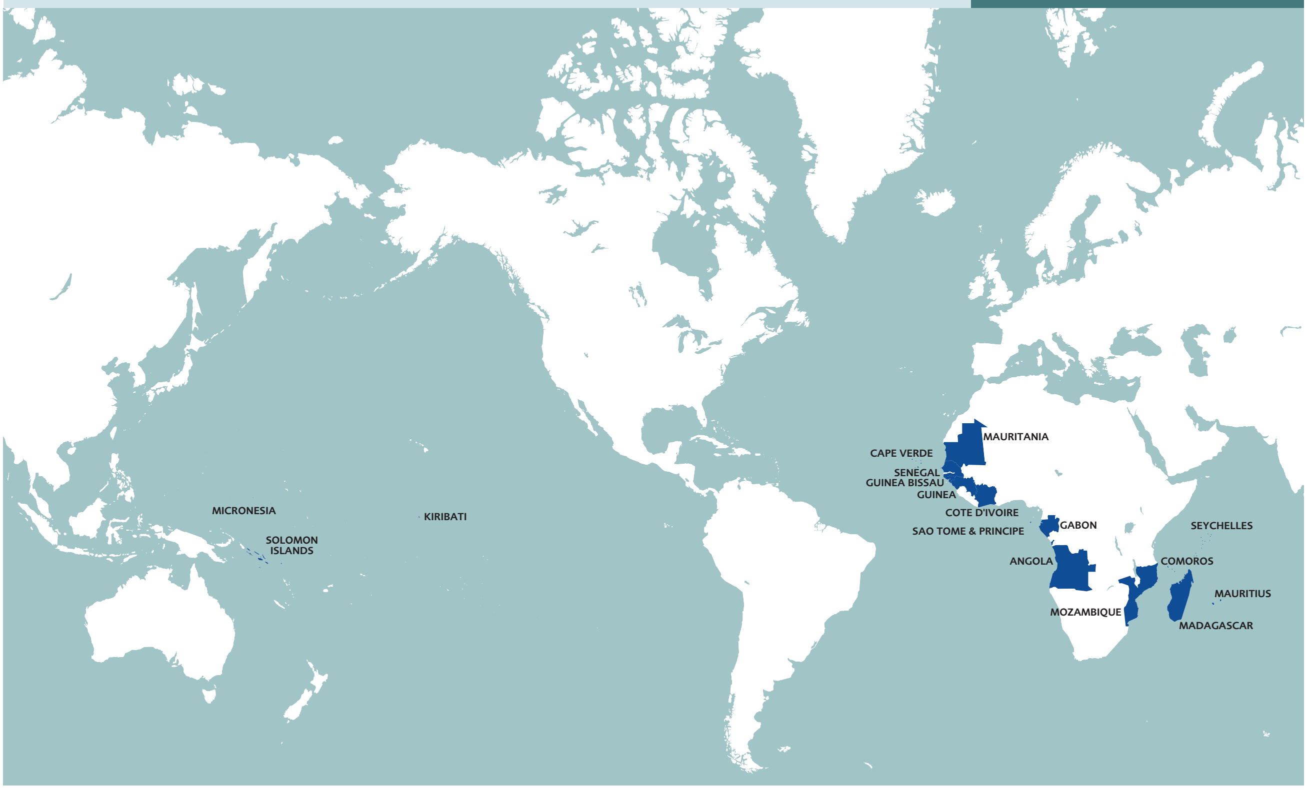
The EU currently has Fishing Agreements with 17 developing countries: **Angola**, **Cape Verde**, the **Comoros**, **Côte d'Ivoire**, **Gabon**, **Guinea**, **Guinea-Bissau**, **Kiribati**, **Madagascar**, **Mauritania**, **Mauritius**, the **Federated States of Micronesia**, **Mozambique**, **São Tomé and Principe**, **Senegal**, the **Seychelles** and the **Solomon Islands** (see map below) (CEC, 2005). An example agreement with Guinea is outlined on the right.

Fishing Agreements are intended to give the EU rights to the 'surplus' marine resources of these countries, in return for financial compensation (which ranges from around €400,000 to €86,000,000 per country per year) (CEC, 2005). These arrangements benefit the EU by helping to fulfil domestic demand for seafood (many EU stocks are over-exploited) as well as by providing employment (IFREMER, 1999). One study estimated that these agreements generate value-added of €694 million in member states through the processing and marketing of fish caught in developing country waters (IFREMER, 1999). This essentially means that for every euro of EU public spending, a turnover of roughly €3 is created.

However, there are serious concerns about the sustainability of these agreements (Gorez and O'Riordan, 2003). Almost 70% of African fisheries between Morocco and the Congo are fully developed or in decline (Alder and Sumaila, 2004). As developing countries rely on Fishing Agreements as a source of much-needed foreign currency, at times access has been given to fish stocks that are already fully exploited or over-exploited (Agritrade, 2004). For many of the agreements, no catch limits are specified. In addition, fishing access is subsidised, so EU fleets can often out-compete domestic fisheries (Agritrade, 2004). As a consequence of these agreements, developing countries are losing their natural capital and jeopardising future opportunities to make the most of their fisheries (Agritrade, 2004). Indeed, the United Nations Environment Programme has warned that by opening their waters to foreign fishing fleets, these countries may lose billions of dollars more than they gain due to environmental over-exploitation (UNEP, 2001).

Fishing Agreement between the EU and the Republic of Guinea: A case study (CEC, 2005)

Country: Guinea
Period:
01/01/2004–31/12/2008
Fishing opportunities:
2,500 gross registered tonnage/month for fish and cephalopods
1,500 gross registered tonnage/month for shrimps
Tuna:
34 seiners
14 pole-and-line vessels
9 surface longliners
Total European Community Financial Contribution: €17,000,000 (€3,400,000/year). This amount may gradually be increased to €19,975,000 (€3,995,000/year) depending on increases in fishing possibilities.
Percentage spent on 'Targeted Actions' *(to promote the conservation of resources and sustainable development)*: 41% in the first year with the possibility of a gradual increase to 44% in the last year.



EU BYCATCH REGULATIONS

ABOVE: *Bycatch limits are specified in a minority of EU fishing agreements with developing countries.*

Fisheries Partnership Agreements: A new approach?

As part of the recent reform of the Common Fisheries Policy (CFP), the European Commission released a Communication on an *Integrated Framework for Fisheries Partnership Agreements with Third Countries* (CEC, 2002a). This Communication set out a new approach for negotiating and implementing EU fishing agreements. Above all, it represented a move away from the traditional 'cash for access' arrangements towards a new 'partnership' approach with a focus on developmental and environmental concerns (IEEP, 2003). The Communication outlines the need to improve the sustainability of EU fisheries in developing country waters, for example by conducting a Sustainability Impact Assessment (SIA) for each agreement (IEEP, 2003). However, the Communication's ambiguity on some key issues will potentially make it a less effective framework for change than anticipated (Agritrade, 2004). Moreover, within the Communication, the EU's intention to maintain a fishing presence abroad, and to protect European fisheries sector interests is clearly reiterated. This perhaps indicates that a transformation in the nature of these arrangements is unlikely in the short term (IEEP, 2003).

At present, bycatch regulations under EU Fishing Agreements with developing countries are inadequate and less rigorous than those regulations governing domestic European waters. The disparity between fishing selectivity standards for EU vessels operating in domestic waters, and for those operating in developing countries has been highlighted by researchers at the FAO.

The researchers specifically compared domestic and distant water EU trawlers, focusing on the selectivity of trawl nets (Chopin and Smith, unpublished). A common measure to reduce catches of juvenile fish is to increase the mesh size of the end part of the net (known as the 'codend'). However, regulating mesh size alone is insufficient to reduce the capture of juvenile fish (e.g. Reeves *et al.,* 1992; Broadhurst *et al.*, 2004). For example, if regulations specify a minimum mesh size only, fishers may use 'codends' made from extremely rigid netting (Broadhurst *et al.*, 2004). Although this is essentially legal, it defeats the management objective, by lowering selectivity.

When a range of these selectivity factors is compared, it is found that in almost all EU Fishing Agreements only mesh size is specified for trawl fisheries; other factors that are set out for many domestic European trawl fisheries remain absent. Moreover, while several domestic fisheries are obliged to use Bycatch Reduction Devices (for example, certain cod fisheries in the Baltic Sea (CEC, 2001)), their use is not required under any agreements. The researchers conclude that EU Fishing Agreement regulations remain 'vague and simplistic', thereby allowing considerable opportunity for fleets to fish unselectively (F. Chopin and A. Smith 2004, pers. comm.).

Domestic EU bycatch legislation is very varied and is by no means always exemplary. However, bycatch issues are at least beginning to be addressed in domestic waters, as part of the reform of the EU's Common Fisheries Policy (CEC, 2002d). It is essential that such developments be mirrored in European Fishing Agreements, especially given that the EU has a prior commitment to the sustainable development of African, Caribbean and Pacific (ACP) countries (CEC, 2004c; ADE, 2002). Although these responsibilities were acknowledged in the European Commission's recent Communication on *Fisheries Partnership Agreements* (CEC, 2002a) (and subsequent Council Conclusions), from this Communication alone it is difficult to gauge how and when concrete improvements in sustainability can be expected (IEEP, 2003). For example, under the EU's Fishing Agreement with the Republic of Guinea (2004-2008) – which was negotiated after the release of the *Fisheries Partnership Agreeement* Communication – for certain fisheries, the level of bycatch authorised for EU trawlers is almost five times higher than the level authorised for the national trawler fleet (CEC, 2004b). For cephalopod trawling, a 35% fish bycatch level is permitted for EU vessels, compared to a 7.5% fish bycatch level permitted for the local Guinean fleet (Ministère de la Pêche & Aquaculture, République de Guinée, 2000). Essentially, this means that EU vessels are allowed to fish less selectively than the local fleet.

Furthermore, if this fish bycatch represents more than around half their total catch (52.5%), EU cephalopod trawlers can discard it, with permission from the Guinean authorities, unless it can be collected and delivered to local communities (CEC, 2004b). It is unclear as to what facilities and management systems exist to distribute this non-target

catch. And although discarding should always be avoided if possible, it is inadvisable for artisanal fishers to become dependent on the discards of foreign trawlers, particularly where the sustainability of their operations is in doubt.

Bycatch limits are only specified in a minority of EU Fishing Agreements with developing counties. Moreover, no penalties for exceeding these limits are stated in the agreements, with the exception of agreements with Mauritania (2001-2006) (CEC, 2002c) and Senegal (2002-2006) (CEC, 2002b). In many cases there are no set limits for bycatch or discards for EU vessels at all. More specifically, there are no references to the capture of vulnerable marine species by EU vessels, except, once again, in the agreements with Mauritania and Senegal (CEC, 2002b; CEC, 2002c). The EU should work to reduce its impact on vulnerable species abroad, as it is trying to do within its own waters (CEC, 2004a).

Although EU vessels are obliged to adhere to the coastal legislation of the country in which they operate, many developing countries do not have the resources to enforce bycatch regulations. Equally, in many cases, appropriate and detailed coastal state legislation on bycatch does not exist, or may be applied differentially under Fishing Agreements. There is no doubt that this issue requires further attention from the coastal states in question; however, given existing limitations, it is imperative that the EU shares responsibility to ensure that its vessels fish in a sustainable and selective manner abroad. This was recognized in the recent Communication from the European Commission on *Promoting more environmentally-friendly fishing methods: the role of technical conservation measures*, in which it is stated that, 'the (European) Community should aim at a consistently high level of environmental protection and conservation of fisheries resources in all Community waters, as well as in other waters fished by Community vessels'(CEC, 2004a). All EU-flagged vessels should be subject to a similar set of legally-binding bycatch provisions: there can be little justification for the EU to accept different bycatch standards for fisheries in the North Sea, for example, than for European vessels fishing off Senegal, or in the High Seas (Gianni, 2003).

Technical and operational methods to reduce bycatch cannot be simplistically transferred from one fishing region to another, yet similar standards of precaution can be achieved. These standards could be drawn from the *1995 UN Agreement on the Conservation and Management of Straddling and Highly Migratory Fish Stocks* (UN, 1995) as well as from the *FAO Code of Conduct for Responsible Fisheries* (FAO, 1995) (see right).

The 1995 UN Agreement on the Conservation and Management of Straddling and Highly Migratory Fish Stocks

This is one of the most important agreements on the conservation and management of fisheries, as it outlines a straightforward framework for the application of an ecosystem-based management (EBM) approach to fisheries (Gianni, 2003). The EU has ratified this agreement, legally binding the European Community and Member States to abide by its regulations. Echoing the voluntary *FAO Code of Conduct for Responsible Fisheries* (FAO, 1995), this UN Agreement sets out clear obligations to minimise bycatch in fisheries to the greatest extent practicable (UN, 1995). Under this agreement, states have to collect data on the total catch of non-target species by number and/or by weight; discard statistics; and the location, date and time of fishing. States must also continually review the efficacy of fisheries conservation and management measures. It further calls on states to establish mechanisms for verifying the accuracy of fishery data on target and non-target catches. But where this data do not yet exist, states are required to adopt a precautionary approach and, '*the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures*' (UN, 1995).

EU DISTANT WATER FISHERIES OF CONCERN

Trawl fisheries

Shrimp, finfish and cephalopods are targeted by EU trawlers operating in 8 developing countries under Fishing Agreements (Angola, Côte d'Ivoire, Gabon, Guinea, Guinea-Bissau, Mauritania, Mozambique, Senegal) (CEC, 2005). Trawl fisheries tend to capture high levels of non-target organisms. In a recent study by the FAO, trawl fisheries for shrimp and demersal finfish were found to account for over 50% of total estimated discards globally (Kelleher, 2004). To highlight a few examples, the discard rate for the foreign deepwater shrimp fishery in Senegal is 63%, whilst the discard rate for the cephalopod trawl fishery in Mauritania is 45% (the top of the range for this type of fishery) (Kelleher, 2004).

In the tropics, trawlers' bycatch can comprise hundreds of vertebrate and invertebrate species (Stobutzki *et al.*, 2000) and survival rates of discarded organisms are low (Hill and Wassenberg, 2000). Populations of vulnerable species, such as sea turtles, can be rapidly reduced by trawling; globally, shrimp trawl fisheries are responsible for around 150,000 sea turtle mortalities annually (Oravetz, 1999). Moreover, trawling frequently takes place in shallow coastal waters, which can act as nursery grounds for many marine species. Trawlers may damage these sensitive habitats, and incidentally catch juvenile fish; in some areas, this has led to declines in fish stocks (FAO, 2001).

As already outlined, many factors influence the selectivity of trawling gear. Mesh size is an important element, but in the absence of further regulations specifying, for example, twine thickness and material, its selective effects can easily be nullified (Broadhurst *et al.,* in press; FRS, 1999). The EU needs to address this issue in relation to its distant water fleets. In addition, the EU should perform trials to examine the efficacy of further technological modifications to reduce bycatch. Modifications tend to fall into two categories: 1) those that mechanically exclude unwanted organisms according to their size; and 2) those that separate organisms according to differences in behaviour (Broadhurst, 2000).

BELOW: *A Turtle Excluder Device (TED). If properly installed and used, TEDs work very effectively, excluding up to 97% of sea turtles from shrimp trawl nets.*

OPPOSITE: *Sea turtle bycatch is often associated with shrimp trawl fisheries in the tropics. Shrimp trawling alone is responsible for around 150,000 sea turtle mortalities annually.*

BELOW: *Trawl fisheries for shrimp and demersal finfish account for over 50 percent of total global estimated discards.*

Most modifications that exclude non-target species according to their size are grid-like structures fitted within trawl nets. Such devices prevent larger organisms from being caught, by forcing them out through an escape opening positioned forward of the grid. These grids are widely used to prevent the capture of sea turtles in shrimp trawl fisheries, and as such are known as Turtle Excluder Devices or TEDs. If properly installed and used, TEDs work very effectively, excluding around 97% of sea turtles from trawlers' nets (NMFS, 2004). TEDs can also exclude sharks and rays, as well as jellyfish, sponges and certain larger fish (Robins *et al.*, 2000). TEDs are not as effective at excluding smaller organisms (e.g. juvenile fish).

Other devices work by exploiting behavioural differences between bycatch species and target species. Although varied in size and design, these Bycatch Reduction Devices (BRDs) all depend on the so-called 'escape response' of swimming species once in the net (Watson, 1989; Wardle, 1983). These species locate and pass through the strategically placed devices, and therefore avoid being captured (Broadhurst, 2000). Commonly used BRDs include: square-mesh panels or windows, fisheyes, bigeyes and radial escape sections (Broadhurst, 2000). As with TEDs, efficacy depends on proper construction, installment and use, as well as choosing the right BRD for the fishery in question. However, performance of BRDs varies greatly; in a recent study on tropical shrimp trawl fisheries, designs tested only excluded about a third of non-target species, the majority of which were fish (Stobutzki *et al.*, 2001). Bycatch reduction in tropical shrimp trawl fisheries is most successfully achieved by using a combination of mechanical (e.g. TEDs) and behavioural-type BRDs (Brewer *et al.*, 1998). The most effective combination of exclusion devices in other trawl fisheries will depend on factors such as target/non-target species, location of fishing grounds, water temperatures, fishing times/conditions and towing speeds.

More research is needed to ensure that BRDs fulfill their potential in terms of excluding a greater range of non-target organisms in a variety of trawl fisheries. In the meantime, technologies that have shown greatest promise should be trialled and introduced into EU distant water trawl fisheries.

Purse seine fisheries

In 2005, EU purse seiners will operate under all of the 17 Fishing Agreements with developing countries, largely in pursuit of tuna (CEC, 2005). Tuna seining is conducted in three different ways that correspond to three means of detecting tuna schools (Hall *et al.*, 2000; Hall, 1998): i) on free-swimming schools of tuna; ii) on tunas associated with floating objects (naturally occurring or artificial); iii) on dolphins (this technique is mostly employed in the Eastern Pacific Ocean).

Fish Aggregating Devices (FADs) are floating structures that attract pelagic species, including tuna. The term FAD usually refers to artificial structures, built specifically for this purpose (FADIO, 2004). These devices are now widely distributed in tropical and subtropical waters globally (Bromhead *et al.,* 2003). Indeed, more than half of the worldwide tuna catch (estimated at around 3.5 million tons a year) comes from schools associated with floating objects (FADIO, 2004). This trend is increasing, with the use of FADs being particularly prevalent in the Indian Ocean (Fonteneau & Hallier, 2003; FADIO, 2004). EU purse seiners fish for tuna using FADs in the Indian, Pacific and Atlantic Oceans (FAO, 2005c; Bromhead *et al.,* 2003).

Of the three methods listed above, catching tuna using floating objects leads to the highest bycatch levels (Hall, 1998). Globally, FAD fishing has been conservatively estimated as being responsible for over 100, 000 tonnes of bycatch annually (Bromhead *et al.,* 2003). Bycatch on FAD sets typically makes up 10% of the catch (compared to 1-2% on free-swimming schools) and comprises both undersized tuna and a wide variety of other pelagic species. These non-target species include dolphin fish, billfish, wahoo, triggerfish, barracuda, rainbow runners, sharks and sea turtles (Bromhead *et al.,* 2003; Norris, 2002). There is even anecdotal evidence that fleets operating in the Indian Ocean may be catching certain whale species (including minke and humpback) (Clover, 2005).

The main tuna species targeted under FADs is skipjack tuna, but FAD-related purse seine fisheries are increasingly catching large quantities of juvenile yellowfin and bigeye tuna (the latter is classed as a 'vulnerable' species by the IUCN) (Bromhead *et al.,* 2003). Indeed, the vast majority of tunas associated with floating objects are less than 100 cm in length, and therefore mostly sexually immature (Hall, 1998). One study reported that almost 20% of the tuna catch can be discarded in these types of fisheries because it is below the market minimum requirement for size or condition (Hall, 1998).

For many areas there is little data on the levels and composition of bycatch associated with these fisheries, or on the status of non-target species' populations (Lewison *et al.*, 2004b). In general, the use of FADs is regarded as a non-sustainable practice for which solutions are urgently needed (Bromhead *et al.,* 2003); at present there are few well-established technical or operational means to reduce bycatch in these fisheries (M. Hall 2004, pers. comm.). Innovative bycatch reduction measures need to be devised, and the EU should take a principal role in funding and directing this research.

BELOW: *A manta ray and leatherback sea turtle caught incidentally by tuna purse seiners operating in the Atlantic.*

Clockwise from below left © Hélène Petit; © NOAA Courtesy of South Pacific Commission (SPC); © NOAA

ABOVE: *A leatherback sea turtle and a loggerhead sea turtle caught on longlines. A recent global study estimated that more than 200,000 loggerheads and 50,000 leatherbacks were taken as pelagic longline bycatch in 2000.*

Longline fisheries

In 2005, EU longliners will have access to the waters of all 17 developing countries with which the EU has Fishing Agreements (CEC, 2005). Longlines are used by the EU to catch pelagic species, such as swordfish and tuna, with vessels operating thousands of hooks per day (Valdemarsen, 2004). Sea turtle, marine mammal, shark and seabird bycatches associated with rapidly expanding pelagic longlining are of particular concern to the international community (Baum *et al.*, 2003; Lewison *et al.*, 2004b; Gilman and Freifeld, 2003; Crowder & Myers, 2001; Ovetz, 2004). Some pelagic longline fisheries are also reported to catch undersize individuals of the target species and other non-target fish (Crowder & Myers, 2001).

Sea turtles are caught in pelagic longlines i) when trying to take the bait, ii) when externally hooked on a flipper or exposed skin, or iii) when entangled in fishing lines (Hall *et al.*, 2000; M. Donnelly 2005, pers. comm.). A global assessment of the impact of pelagic longlining on loggerhead and leatherback sea turtles estimated that more than 200,000 loggerheads and 50,000 leatherbacks were incidentally caught by longliners in 2000 (Lewison *et al.*, 2004a). Of these, thousands die each year from interactions with longline gear in the Pacific Ocean alone. Given the 80–95% declines in Pacific loggerhead and leatherback populations over the last 20 years, this bycatch level is unlikely to be sustainable (Lewison *et al.*, 2004a).

Practical field experiments carried out in the swordfish longline fishery of the NW Atlantic have shown that hook and bait types are two of the most important gear parameters affecting catch rates of sea turtles (Watson *et al.,* 2004). The use of (larger) circle hooks and fish bait (such as mackerel in lieu of squid) significantly reduced loggerhead and leatherback interactions with longline gear in this fishery. Although the results of these experiments remain preliminary, they suggest potential catch reductions of 90% for loggerhead turtles and 75% for leatherback turtles may be possible (Watson *et al.,* 2004).

However, the experiments undertaken to date have focused on swordfish fishing and there remain significant knowledge gaps in terms of how these modifications perform in other regions and fisheries (for example, in tuna longline fisheries) (M. Donnelly 2005, pers. comm.). Additional research is needed to determine whether further modifications (such as day versus night-time haul-backs), and evolving gear technology (such as very large hooks), might prove to be effective in all longline fisheries. For these reasons, sea turtle scientists are not convinced that the use of circle hooks and fish bait is the final solution for reducing sea turtle capture and mortality in longline fisheries (M. Donnelly 2005, pers. comm.). In addition, the use of circle hooks may cause possible increases in the bycatch of other marine species, such as sharks (Ovetz & Steiner, 2004). Minimising sea turtle bycatch is not yet a clear-cut task and much more investment is required in researching and trialling potential methods. As a consequence, some envi-

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ronmental organisations have called for closures of these fisheries in the Pacific to prevent further sea turtle population declines (STRP, 2000; STRP, 2003).

Longline fisheries are also thought to be one of the greatest threats to seabirds internationally, possibly driving several species of Albatross towards extinction (Gilman and Freifeld, 2003; BirdLife International, 2004). Although data on the incidental catch of seabirds are lacking for many longline fisheries, particularly in the tropics (Valdemarsen, 2004), it is estimated that hundreds of thousands of seabirds, including tens of thousands of albatrosses, are caught annually in longline fisheries worldwide (Gilman and Freifeld, 2003; BirdLife International, 2004). Aside from the impact on seabird populations, birds can remove up to 70% of the bait from longlines, which can be very costly for the industry (JNCC, 2004).

Reducing seabird bycatch in longline fisheries is a relatively straightforward process. Several methods almost entirely eliminate seabird captures when effectively employed. Technical changes include weighting the longline gear, which can achieve a 90% reduction in contact with hooks and a 90-95% drop in mortality of seabirds (Crowder & Myers, 2001). Operational changes can also be simple and effective. 'Side setting', which entails setting gear from the side of the vessel (rather than the stern), had the lowest mean seabird contact and capture rates of all the seabird avoidance treatments tested in the Hawaiian longline tuna and swordfish fisheries (Gilman *et al.*, 2003).

The EU needs to commit to a bycatch reduction research programme for its distant water longline fisheries. The most promising modifications should be trialled by EU vessels without delay. Multilateral initiatives are also required to successfully tackle bycatch of these migratory species, which transverse multiple nations' Exclusive Economic Zones and the High Seas. The EU could provide support for the development of a set of international or regional rules governing pelagic longlining practices.

ABOVE LEFT: *Seabird bycatch reduction techniques being trialled on a longline fishing vessel. Longline fisheries are thought to be one of the greatest threats to seabirds internationally, possibly driving several species of Albatross towards extinction.*

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TABLE 1: *Key technical and operational methods to reduce bycatch in trawl, longline and purse seine fisheries* (adapted from Lewison* et al., *2004b)*

Technical/operational fix	How it works	Fishery
Turtle Excluder Devices	Grid-like structures that physically exclude turtles (and other large organisms) from nets	Trawl
Bycatch Reduction Devices (e.g. square-mesh windows, fisheyes and radial escape sections)	A range of devices that separate species by differences in behaviour and allow unwanted organisms to escape	Trawl
Bird scaring lines	Keep seabirds from baited hooks	Pelagic longline
Weighted lines	Quickly sink hooks out of reach of seabirds	Pelagic longline
Side-setting	Reduces the 'scavenging area' of seabirds by half	Pelagic longline
Line-setting devices	Place baited hooks immediately underwater out of reach of seabirds	Pelagic longline
Circle hooks	Reduce the frequency of deeply ingested hooks and limit gut perforation of non-target organisms	Pelagic longline
Medina panels	Fine-mesh net aprons that reduce the probability of dolphin entanglement during net retrieval	Purse seine
The 'Backdown procedure'	Reversing a fishing vessel along a curved path, causing the top part of the net to sink, thereby releasing dolphins	Purse seine

*None of these methods eliminate bycatch entirely. Further development, testing, and implementation of bycatch reduction techniques is required across ocean areas and fisheries.

CONCLUSION

Many fishers, scientists, governments and non-governmental organisations agree that reducing non-target catches should be one of the first steps in addressing the global problem of overfishing. This briefing document highlights the most pressing bycatch issues associated with the EU's distant water fleets, and provides a preliminary guide as to how these can begin to be resolved.

However, bycatch reduction solutions are rarely instantaneous or complete. As Hall *et al.,* (2000) explain, 'Not all bycatch problems yet have a satisfactory solution, and it is necessary to think of fisheries as dynamic systems, where evolution is taking place, and changes should be expected'. As a major fishing power, the EU should be at the forefront of this evolution. Europe needs to take a lead in promoting responsible fisheries management abroad, thereby fulfilling the international commitments it has made to the sustainable use of marine resources.

A UN FAO International Plan of Action on Bycatch Reduction

Research institutions, NGOs, intergovernmental organisations and Governments are undertaking important work to reduce bycatch globally. Some focus on the incidental capture of endangered and vulnerable species, others address declines in food security linked to high bycatch levels in the developing world. Others still work to mitigate the impacts of bycatch on the commercial fishing industry.

However, there is much value in taking an integrated approach to bycatch reduction, rather than relying on a piecemeal focus on specific fisheries or specific bycatch species. An International Plan of Action (IPOA), under the auspices of the UN Food and Agriculture Organisation (FAO), would help to support current bycatch reduction schemes and extend their scope and success. Lessons learnt in one context can be applied to others. Effective bycatch reduction technology and techniques can be transferred between countries and regions. More crucially, an overarching approach would help avoid the substitution of one bycatch problem with another, when alternative fishing methods are introduced in new areas. Finally, an IPOA could push forward research on bycatch reduction, giving this field the injection of innovation it urgently needs.

As with the four other IPOAs in existence, an IPOA on Bycatch Reduction would be a voluntary instrument, existing in parallel with legally-binding measures (for example, the bycatch provisions of the *1995 UN Agreement on the Conservation and Management of Straddling and Highly Migratory Fish Stocks*).

EJF would like the EU to take the lead in calling for this International Plan of Action at the next viable opportunity at the FAO. Given that the EU has recently reformed the Common Fisheries Policy to prioritise the conservation and sustainable exploitation of fisheries resources, such a proposal would be in line with current European concerns (CEC, 2002d). An IPOA would not only assist the EU in addressing its own bycatch issues (including those associated with distant water fleets), but would also advance international policy in terms of reducing wastage from fisheries.

BYCATCH REDUCTION PRIORITIES FOR THE EU'S DISTANT WATER FLEET



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EJF recommends that the European Union should:

- Assess the levels and composition of bycatch and discards in each distant water fishery, recording location, date and time of fishing.
- Identify any risks that bycatch might be posing to the sustainability of target fisheries, and to the broader health of marine ecosystems. Even a low rate of bycatch can have an ecological impact if fishing effort is high and bycatch species are vulnerable to over-fishing. Where data are incomplete, a precautionary approach should be taken.
- Initiate bycatch reduction research programmes. Bycatch reduction technology is continually evolving and improving, though progress will require sufficient investment in research (Kennelly and Broadhurst, 2002). The success of any new gear depends not only on how much bycatch it excludes, but also how easy it is to construct, install, use and regulate; retention of the target catch is also critical (Broadhurst, 2000). Similar conditions apply to operational changes. Finally, estimates of survival rates for organisms released from fishing gear will be vital for any quantification of the long-term benefits of bycatch reduction techniques (Broadhurst, 2000; Suuronen *et al.*, 1996).
- Promote training, capacity-building, awareness-raising and stakeholder involvement in bycatch reduction programmes. Reducing non-target catches will only be successful if all stakeholders are involved in the process (Kennelly and Broadhurst, 1996). Fishers, in particular, need to be engaged in developing and testing bycatch reduction strategies. Their attitudes are crucial and determine the efficacy of bycatch reduction schemes (Broadhurst, 2000; Norris, 2002; Hall *et al.*, 2000; Haflinger, 2001).
- Introduce mandatory operational and technical changes to reduce non-target catches where necessary. Bycatch reduction programmes should begin by focusing on fishing gears and techniques that are having a severe ecological or socio-economic impact. Where bycatch reduction techniques are inadequate, it may be necessary to reduce overall fishing effort (Hall *et al.*, 2000).
- Consider making bycatch reduction the responsibility of individual vessels/fishers, where appropriate. When supported by suitable incentives/disincentives, this can be a particularly effective strategy to reduce bycatch per unit effort (Norris, 2002; Hall *et al.*, 2000).
- Increase observer coverage on vessels to i) guarantee bycatch reduction methods are being used, and ii) monitor their performance. Enforcement is key: research in the Gulf of Mexico indicates that despite mandatory use of Turtle Excluder Devices (TEDs) in shrimp trawl fisheries, sea turtle strandings due to non-compliance continue to occur (Lewison *et al.*, 2003).

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