

## International Commission on Land Use Change and Ecosystems: Marine Fisheries

Marine ecosystems provide a wide range of services to human society<sup>1</sup>. Among these, marine capture fisheries are of enormous economic and social importance. However, marine fish catches have stagnated or are declining, with 80% of stocks either fully or overexploited<sup>2</sup>. Developing and implementing management systems for the sustainable extraction of marine fishery resources requires policy reform at global, regional, national, and also local levels.

Marine capture fisheries have exceptional value as a source of food, livelihoods and income for millions of people across the globe. Fish provide more than 2.9 billion people with at least 15% of their average per capita animal protein intake<sup>2</sup>. Nearly 44 million people are engaged in the primary production of fish worldwide<sup>2</sup>. Most marine fishers work in small-scale fisheries, mainly in developing countries<sup>3</sup>. These countries have contributed more than half of total capture fish production since 1990 and more than two-thirds in 2005<sup>4</sup>. Approximately 170 million people are involved in the fishing industry and 520 million are potentially dependent on the sector<sup>2</sup>. Annual global fish trade is worth \$92 billion<sup>2</sup>, while the entire seafood industry is valued at \$200 billion.

Depletion of fishery resources is primarily driven by the open-access nature of fisheries, which results in excess capacity, economic waste and the widespread use of unsustainable fishing practices<sup>5</sup>. Growing global demand for seafood, globalization of fish trade and rising fish prices are also powerful drivers of overfishing<sup>6</sup>. Both chronic overfishing and associated habitat loss have a highly negative effect on the availability of remaining marine resources, threatening both the livelihoods of producers and the food security of consumers worldwide.

**Sustainable management of fisheries has failed in many parts of the world** as a result of ill-functioning institutions and a lack of political will amongst states to implement fisheries regulations at national or international levels<sup>2,7</sup>. Poor management of marine fisheries means that the difference between the potential and actual economic benefit is roughly \$50 billion per annum<sup>4</sup>.

Marine capture fisheries support a global industry that we cannot afford to lose. Some fishing communities have already suffered due to collapse of fish stocks such as Newfoundland cod<sup>8</sup>, while others have thrived due to the sustainable yields and high economic values of catches resulting from successful fisheries management<sup>9</sup>. **The long-term survival and success of the global marine fishing sector depends on a sustainable ecosystem-based approach to fisheries management.**

In contrast, aquaculture production continues to increase globally, contributing 51.7 million tonnes in 2006 with a value of \$78.8 billion. However, intensive aquaculture systems that require the use of fish-based feed inputs increase demand on other fish species and may reduce overall protein available for human consumption<sup>10</sup>. Policy recommendations for sustainable aquaculture as a viable alternative to capture fisheries will be provided in a subsequent document and included in a broader marine recovery package.

Overfishing is already causing severe economic hardship and ecological damage, and the problems will only increase unless sustainable fisheries management programmes are implemented. **The root causes of overfishing must be addressed at all levels of governance.** At the international level, urgent reform of Regional Fisheries Management Organizations (RFMOs) is required so they cover all oceans and function effectively. At the national and provincial levels, a range of tools to manage offshore and inshore fisheries must be applied to protect the livelihoods of millions of people in the coastal zone. Fisheries management must be both biologically and economically sustainable while also integrating ecological, economic and social issues and their drivers.

This paper outlines a series of high-level policy recommendations to improve the biological and economic sustainability of marine capture fisheries. These recommendations focus on six aspects of fisheries reform and management: Overcapacity and Subsidies, Regulation of Fisheries, Marine Protected Areas, IUU Fishing, Rights-based Management and Bycatch and Discards.

**References:** (1) UNEP (2006). *Marine and coastal ecosystems and human wellbeing*. UNEP. (2) FAO (2009) *State of World Fisheries and Aquaculture 2008*. FAO, Rome. (3) Berkes, F. et al (2001) *Managing small-scale fisheries: alternative directions and methods*. IDRC publication, Ottawa. (4) World Bank and FAO (2009) *The Sunken Billions*. The World Bank, Washington DC. (5) FAO (2008) *Technical Guidelines for Responsible Fisheries: Managing fishing capacity*. FAO, Rome (6) Pauly, D. and J. Alder (2005). *Marine Fisheries Systems*. In *Ecosystems and Human Well-being: Current State and Trends*. Millennium Ecosystem Assessment. (7) Allsopp, M. et al. (2009) *State of the World's Oceans*. Springer, Dordrecht. (8) Hutchings, J.A. and R.A. Myers. (1994) *Canadian Journal of Fisheries and Aquatic Sciences*. 51(9):2126–2146. (9) Hilborn, R. et al. (2005) *Philosophical Transactions of the Royal Society B* 360:47-57. (10) Naylor, R.L et al. (2000) *Nature* 405: 1017-1024.

## Overcapacity in Marine Fisheries

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Current fishing capacity is currently more than twice the level required to capture marine fish<sup>1,2,3</sup>. This overcapacity causes "overfishing, the degradation of marine fisheries resources, the decline of food production potential, and significant economic waste"<sup>4</sup>.

Overcapacity is a result of competition between fishers in open-access fisheries and is exacerbated by subsidies that artificially increase the profitability of fishing<sup>5,6</sup>. Each year, governments spend about \$20 billion on these harmful subsidies<sup>7</sup>.

Conventional fisheries management methods aimed at stock conservation do not solve the problem of overcapacity because they do not change the economic incentives faced by fishers<sup>5</sup>. For example, in Total Allowable Catch (TAC) systems fishers still compete for their share of the total catch, resulting in a "race for the fish"<sup>7</sup>. Vessel buyback programs aimed at reducing overcapacity are only a temporary fix, because they fail to address the root causes of overcapacity<sup>8</sup>.

When properly enforced and scientifically monitored, rights-based management systems can eliminate unhealthy competition between fishers, halting the growth of overcapacity and enabling fishers and society to maximize profits and benefits from their fishery. Catch rights in fisheries can further contribute to sustainable management by creating the economic incentive to conserve fish stocks. When catch rights are transferable, market forces promote economic efficiency, eliminating redundant capacity<sup>5</sup>.

### Key Policy Recommendations:

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The following measures aim to provide economic security for fishers while reducing overfishing, thereby encouraging economic and environmental sustainability.

**Where feasible, establish a rights-based management system** to create incentives for economically efficient fishing. Rights-based management in industrial fisheries may take the form of individual catch rights, while in artisanal fisheries it may include territorial or community-based rights. National governments should provide the policy framework to enable rights-based management for both industrial and small-scale fisheries.

**Where feasible, make catch rights tradable.** A good example of tradable catch rights is the Individual Transferable Quota (ITQ) system. Tradable catch rights for industrial fisheries should be implemented in coastal waters by states and on the high seas by RFMOs.

**Eliminate subsidies that promote overcapacity and overfishing,** such as boat construction and modernization programs, port construction and renovation programs, fishery support services, tax exemptions and fuel subsidies.

**Continue subsidies that promote sustainability,** such as monitoring, control and surveillance programmes, stock assessment and other fisheries research, and management of Marine Protected Areas. Government purchase of excess capacity may be included with caution, as their success depends heavily on implementation methods<sup>1</sup>.

**Address subsidy reform through multilateral, enforceable agreements.** This could be achieved through international institutions such as the World Trade Organization or RFMOs.

**Use the resources saved by eliminating harmful subsidies to implement transitional measures** to mitigate impacts of capacity reduction such as employment losses. Transitional measures may include occupational retraining or financial compensation.

**Implement specific measures to protect the rights of small-scale and artisanal fishers** because of their importance to global food security and livelihoods.

**References:** (1) Asche, F. et al. (2008) *Marine Policy* 32: 920-927. (2) Sumaila, U.R. and D. Pauly (2007) *Nature* 450: 945. (3) World Bank and FAO (2009) *The Sunken Billions. The Economic Justification for Fisheries Reform*. The World Bank, Washington DC. (4) FAO (1999) *International Plan of Action for the Management of Fishing Capacity*. FAO, Rome. (5) FAO (2008) *Technical Guidelines for Responsible Fisheries. Managing Fishing Capacity*. FAO, Rome. (6) Yagi, N. et al. (2008) *Fisheries Science* 74: 1229-1234. (7) Khan, A.S. et al (2006). *The Nature and Magnitude of Global Non-Fuel Fisheries Subsidies*. In *Catching More Bait: a Bottom-up Re-estimation of Global Fisheries Subsidies*. Eds U.R. Sumaila and D. Pauly. The Fisheries Centre, University of British Columbia. (8) Beddington, J.R. et al. (2007) *Science* 316: 1713.

## International Regulation of Fisheries

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The United Nations Convention on Law of the Sea (UNCLOS)<sup>1</sup> and the 1995 Fish Stocks Agreement (UNFSA)<sup>2</sup> establish the fundamental principles and obligations for the management of fisheries under international law. In addition, the 1995 UN FAO Code of Conduct for Responsible Fisheries and associated FAO instruments further elaborate on the principles and obligations in UNCLOS and the UNFSA, particularly regarding the application of the precautionary approach and sustainable ecosystem-based management of fisheries<sup>3</sup>. Key to international cooperation and the multilateral implementation of these agreements are regional and sub-regional fisheries management organisations (RFMOs). These bodies are responsible for the management of fisheries on the high seas, and in the cases of straddling stocks and highly migratory fish stocks, in national waters as well. States are required by UNCLOS and the UNFSA to join and cooperate with these bodies and to establish and abide by regulations to sustainably manage harvested fish stocks and protect their associated ecosystems<sup>3,4</sup>.

There is clear evidence that the increasing numbers of overexploited or collapsed fish stocks is a result of the failure of States to comply with their obligations under international law and the failure of the RFMOs to sustainably manage fisheries. In national waters these problems have often resulted from an emphasis on short-term socio-economic considerations rather than long-term sustainability when setting catch limits for harvested fish stocks. Problems with certain RFMOs have been documented in a recent independent review which identified the following issues, including: (i) many RFMO conventions need updating to incorporate the provisions of the UN FSA and other internationally agreed standards and modern principles of fisheries management (ii) a failure of States to provide timely and accurate catch and bycatch data (iii) lack of compliance by States with the rules and recommendations of RFMOs (iv) a lack of transparency in decision making (v) failure to establish management measures consistent with scientific information and advice (vi) decision making structures which allow one or more States to block or 'opt out' of compliance with needed regulations (vii) IUU fishing (viii) inadequate funding<sup>4</sup>.

## Key Policy Recommendations

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### Review and reform of existing RFMOs through:

- Requiring RFMOs to be periodically reviewed and where necessary reformed consistent with States' obligations under international law;
- Identifying fleet overcapacity where it exists and reducing it accordingly;
- Ensuring the application of ecosystem based management of fisheries and the precautionary approach as outlined in international law or else prohibit fishing;
- Ensuring RFMO management measures are based on the best scientific information available.

**Immediately establish RFMOs** for species and/or areas of the high seas where they are absent.

**Further develop the international legal framework** to allow for the equitable access, allocation and application of management and enforcement measures for fisheries for straddling, highly migratory and high seas fish stocks.

### Improve enforcement of international fisheries law through:

- Use of the International Tribunal of the Law of the Sea (ITLOS) to ensure the effective implementation of international fisheries law, particularly the UNFSA;
- Allowing access to ITLOS by non-state entities in cases relating to the mis-management of fisheries on the high seas.

**Establish international measures on traceability of caught fish** by effective port and market State measures and strengthening the international legal regime for flag State responsibility in fisheries.

**Ensure effective implementation of internationally agreed measures for the management of high seas deep water fisheries**, in particular UN GA resolution 61/105.

**Establish environment impact assessments** as a prerequisite for permitting large-scale fisheries on the high seas.

**Fund research** to "assess the impacts of fishing, other human activities and environmental factors on target stocks and species belonging to the same ecosystem or associated with or dependent upon the target stocks"<sup>4</sup>.

**References:** (1) United Nations Convention on the Law of the Sea (1982) (2) United Nations General Assembly (1995). Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks. (3) FAO (1995). Code of Conduct for Responsible Fisheries. FAO, Rome. (4) Hurry, G.D. et al. (2008) *Report of the Independent Review*. International Commission for the Conservation of Atlantic Tunas (ICCAT).

## The Role of MPAs as a Fisheries Management Tool

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Marine Protected Areas (MPAs) are increasingly being considered as an important tool for achieving an ecosystem approach to fisheries management and as a rational and practical way of managing marine resources to facilitate the achievement of ecosystem-based fishery objectives<sup>1</sup>. Community-based MPA management or co-management initiatives are also an important and often highly successful approach for small-scale artisanal and subsistence fisheries as part of integrated coastal zone management.

In terms of fish and fisheries it has been shown that MPAs:

- Can lead to an increase in the density, biomass, individual size and diversity of nearly all fish functional groups<sup>2</sup> and export both biomass and eggs/larvae to neighbouring fisheries and habitats respectively<sup>3</sup>.
- Have great potential to complement and underpin other commonly used fishery management practises, helping to increase the overall success of management<sup>4</sup>.
- By protecting areas from fishing, enable habitats to recover from fishing disturbance, increasing species diversity, habitat complexity and productivity, as well as restoring ecological processes such as water filtration and carbon sequestration in sediments and reef structures<sup>5</sup>. In particular, MPAs can play a key role in the protection of slow-growth habitats such as deepwater coral and sponge communities.
- Reduce mortality of non-targeted species due to bycatch, discards, collateral mortality from fishing gears and ghost fishing<sup>6</sup>.
- Provide protection for breeding and nursery areas of important fishery species, including mobile and migratory species, and particular spawning aggregation sites for heavily exploited species<sup>7</sup>.
- Create more natural, extended population age structures and larger population sizes that will increase resilience to environmental fluctuations and directional climate change, as well as offering a buffer against management failures, and reducing risks of fisheries collapses and extinctions<sup>8</sup>.

### Key Policy Recommendations:

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**Implement a Global Network of Marine Protected Areas** that afford a high level of protection from fishing to enable the protection of 20-30% of marine habitats including offshore pelagic habitats. The cost of such a network was estimated at \$5-19 billion in 2004<sup>9</sup>, but is still considerably less than global expenditure on subsidies to industrial fisheries, at \$30-34 billion per year<sup>10</sup>. This network has been estimated to create 1 million new jobs<sup>9</sup>, helping to offset any restructuring costs for local fishing communities.

**Provide adequate support for the setting up of a Global MPA Network** in terms of infrastructure, capacity, management and enforcement.

**Integrate the use of MPAs as a management tool into regional fisheries management programmes at the ecosystem level** to complement other approaches such as Individual Transferable Quotas.

**Support both small-scale co-management initiatives and traditional management practises involving MPA's** to promote best practise community-based management for artisanal and subsistence fisheries.

**Provide funding for further MPA research** for subjects such as MPA Success Indicators, Fisheries Benefits of MPAs for a range of target species and fisheries worldwide particularly for the pelagic zone, Fisheries Models incorporating MPAs and assessing the suitability of MPAs for different fisheries.

**References:** (1) Martin et al. (2006). Background paper 1: *Experiences in the use of Marine Protected Areas with fisheries management objectives – a review of case studies*. FAO Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations. (2) Halpern, B.S. and R.R. Warner (2003) *Ecology Letters* 5:361-366. (3) Sobel, J. and C. Dahlgren (2004) *Marine Reserves: A Guide to Science, Design and Use*. Island Press, Washington, D.C. (4) Sainsbury, K. and Sumaila, U.R. (2003) *Incorporating ecosystem objectives into management of sustainable marine fisheries, including "best practice" reference points and use of marine protected areas*. In M. Sinclair and G. Valdimarsson (eds) *Responsible fisheries in the marine ecosystem*. FAO, Rome. 343-361. (5) Roberts, C.M. and J.P. Hawkins (2000). *Fully Protected Marine Reserves: A Guide*. Washington, DC: Endangered Seas Campaign. (6) Murray et al. (1999). *Fisheries* 24(11): 11-25. (7) Sadovy, Y.J. and M.L. Domeier (2005) *Coral Reefs* 24: 254-262. (8) Roberts, C.M. et al (2005) *Philosophical Transactions of the Royal Society B*, 360:123-132 (9) Balmford, et al. (2004) *PNAS* 101(26): 9694-9697. (10) Sumaila, U.R. and D. Pauly (2007). *Catching More Bait: a Bottom-up Re-estimation of Global Fisheries Subsidies*. The Fisheries Centre, University of British Columbia.

## Illegal, Unreported and Unregulated Fishing

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Illegal, Unreported and Unregulated (IUU) fishing is a symptom of poor ocean management and represents a significant threat to the sustainability of fishing, recovery of overexploited fish stocks and marine ecosystems.

### Impacts

Illegal fishing harms fish stocks and the wider ocean ecosystem. It contributes directly to overfishing and depletion of fish stocks, and also increases uncertainty in stock assessments used to make management decisions<sup>1</sup>. Fishing in protected areas or using banned gear increases by-catch and destroys marine habitat<sup>1</sup>. IUU fishing deprives coastal states of landing fees, license fees, taxes and export earnings<sup>2</sup>. Legal fishers suffer increased costs, decreased incomes and lost employment opportunities as a result of resource depletion by IUU fishing<sup>3</sup>. In developing countries, illegal fishing threatens food security and livelihoods in coastal communities with few alternative sources of food or income<sup>3</sup>. IUU operations also often do not meet international standards of vessel safety and may involve human rights abuses of the crew<sup>4</sup>.

### Status and Trends

Because of its clandestine nature, IUU fishing is extremely difficult to measure. Recent studies have produced global estimates of illegal fish catches between 11 and 26 million tonnes, worth \$10-23 billion<sup>1</sup>. IUU fishing became prevalent in the 1970s and 80s, and reached its peak in the 1990s. Over the last decade, there has been some progress in curtailing IUU fishing, with levels dropping in 11 ocean regions but rising in another five<sup>1</sup>. IUU fishing levels are connected to both maritime control and overall strength of governance in coastal states<sup>1</sup>. East and West Africa have been especially hard hit, where internal political instability and lack of resources in many coastal countries results in uncontrolled coastal waters. Currently, the eastern Atlantic (West African coast) experiences the highest amount of IUU fishing, with total estimated catches 40% higher than reported catch figures<sup>1</sup>. IUU fishing is often carried out by large industrial vessels, which may be registered with so-called Flag of Convenience countries, but are usually owned by companies in developed countries, particularly East Asia and Europe. However, the increasing power and range of small coastal vessels in developing countries, particularly SE Asia and Africa, is generating new opportunities for IUU activity.

### Policy Options

Illegal fishing is driven by **economic incentives and poor ocean governance**. Overcapacity and market demand make illegal fishing profitable<sup>5</sup>, while the benefits from engaging in illegal fishing far outweigh the cost if apprehended<sup>6</sup>. Failures to govern both the oceans and the seafood markets have facilitated the proliferation of IUU fishing. Inadequate surveillance and intelligence-sharing between states and regions makes IUU fishers unlikely to be detected, while lack of enforcement by flag, coastal and port states makes even detected IUU fishers unlikely to be sanctioned<sup>5</sup>. Effective policies to combat IUU fishing must begin by improving detection of IUU through regional cooperation in surveillance and control, in particular gathering and sharing vessel information. This information must then be used to strengthen enforcement capacity and prevent illegally-caught fish from entering the seafood market<sup>8</sup>.

Currently, **detection of IUU fishing** is impeded by poor capacity for surveillance and poor communication of intelligence information. Surveillance of coastal waters requires financial and human resources that many countries lack. On the high seas, RFMOs may lack the funds, means and legal mandate to undertake effective surveillance and act against vessels undermining their regulations. Funding and training to improve ocean monitoring in developing countries is critical to reducing the high levels of IUU in these areas. Transparency and communication of information about fishing activity are necessary for not only detecting IUU fishing when it occurs but also identifying illegally caught fish when it is landed and traded<sup>5</sup>.

**Satellite-based monitoring and tracking systems** can be useful, and include the GPS-based Vessel Monitoring Systems (VMS) and Synthetic Aperture Radar-based Vessel Detection Systems (VDS). VMS units, in which on-board GPS units automatically transmit information about vessel location and speed, are becoming widespread. However, there are limits to the effectiveness of VMS. Some varieties of on-board transmission units are vulnerable to data-falsification. Furthermore, even accurate VMS data are transmitted to the vessel's flag state but not to coastal states, port states, or RFMOs. Vessel Monitoring Systems are a powerful tool that could contribute to the detection of illegal fishing, but to be effective, transmitters must be tamper-proof and data must be shared among states<sup>5</sup>. VDS can be effective in identifying the presence of vessels in low and mid-latitudes (where ice bergs do not produce a confounding signal), but cannot identify individual vessels and so rely on surface-based support to complete the surveillance picture.

**Flag state non-compliance** represents a serious failure of ocean governance and remains a significant

barrier to the elimination of IUU fishing<sup>5</sup>. Flag states with open registers have no citizenship or nationality requirement for vessels to fly their flags and many of these states cannot or will not take enforcement action against these vessels<sup>5</sup>. Persistent IUU activity by vessels registered with these countries should be met with a coordinated and coherent international response, leading via diplomatic engagement eventually to sanctions against countries or prohibitions on the import of fishery product from vessels registered to them.

Historically, **IUU control measures** have focused on apprehending vessels and prosecuting illegal fishing operators. These measures must continue to be strengthened, particularly in coastal developing states. However, there has been a recent trend toward a diverse range of port and market measures to prevent illegally-caught fish from entering the market<sup>8</sup>. The UNFAO has recently concluded negotiations on an International Agreement on Port State Measures based on its Model Scheme<sup>9</sup> to deny port access to vessels engaged in or supporting IUU fishing. Domestic legislation in market states banning the import of illegally-caught fish, such as the Lacey Act in the United States, has also been effective in blocking trade in IUU fish products<sup>5</sup>. Public sector traceability measures such as Catch Documentation Schemes have been successfully applied to some fisheries<sup>4</sup>, while a European Community Catch Certification Scheme will take effect in 2010<sup>10</sup>. Private sector traceability programmes such as the Marine Stewardship Council's certification scheme that promotes sustainable sourcing policies through eco-labelling may also contribute to improved traceability. Port and market state control measures should be used in conjunction with more traditional control measures at sea to ensure illegal fishing is deterred at every stage of the supply chain.

## Key Policy Recommendations

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**Reduce overcapacity** through measures outlined in page 3 of the Fisheries Document.

**Gather and share information** on fishing vessels and catch

- Expand and strengthen monitoring and surveillance to enhance IUU fishing detection. These can include Vessel Monitoring Systems (VMS), aerial and satellite surveillance, observers, and maritime surveillance by government agencies, NGOs, and fishers.
- Provide technical capacity building for developing countries to set up and operate effective monitoring and surveillance techniques, including regional collaboration for cost-effective monitoring
- Invest in development of improved technology such as satellite based VDS and tamper-proof VMS systems, and harmonise the technology to facilitate timely and accurate sharing of data
- Promote the use of the International Monitoring, Control and Surveillance (MCS) Network for sharing IUU vessel intelligence<sup>5</sup> and create a global database of fishing vessels<sup>11</sup>

**Implement control measures** throughout the fish supply chain

*Flag state measures*

- Develop framework for legal and coordinated international diplomatic and economic action against non-compliant flag states<sup>5</sup>, for example, through the International Tribunal for the Law of the Sea<sup>7</sup>

*Coastal state and RFMO measures*

- Improve high seas governance through measures outlined in page 2 of the Fisheries Document
- Strengthen the abilities of coastal states and RFMOs to locate, apprehend and prosecute IUU fishers
- Improve legislation and enforcement of regulations relating to maritime safety of vessels
- Increase penalty levels for IUU offenders

*Port state measures*

- Ratify, and encourage others to ratify rapidly, the UNFAO Port State Agreement; develop mechanisms for practically implementing it; and provide funds for capacity building to allow its early and effective implementation in developing countries
- Implement domestic port state policies to refuse port entry and landing of fish by IUU vessels

*Market state measures*

- Implement domestic legislation and policies making it illegal to import or sell IUU fish, such as the Lacey Act (USA), and increase penalty levels for offenders.
- Implement harmonised, fraud-resistant catch documentation or certification schemes ensuring traceability of seafood products
- Promote private traceability schemes through eco-labelling and sustainable sourcing policies

**References:** (1) Agnew, D.J., et al. (2009) *PloS ONE* 4 (2). (2) MRAG (2005) *Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries*. (3) High Seas Task Force (2006) *Closing the net: Stopping illegal fishing on the high seas*. (4) FAO (2002) *Implementation of the international plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing*. FAO, Rome. (5) FAO (2009) *State of the World's Fisheries and Aquaculture 2008*. FAO, Rome. (6) Sumaila et al. (2006) *Marine Policy* 30(6): 696-703. (7) Gianni, M. & Simpson, W. (2005) *The changing nature of high seas fishing: How flags of convenience provide cover for illegal, unreported and unregulated fishing*. (8) OECD (2004) *Regulating IUU fishing or combating IUU operations?* (9) FAO (2007). *Model Scheme on Port State Measures to combat Illegal, Unreported and Unregulated Fishing*. FAO, Rome. (10) EC Regulation 1005/2008 to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing. (11) FAO (2009) *Combating Illegal, Unreported and Unregulated fishing, including through a legally binding instrument on port state measures and the establishment of a global record of fishing vessels*. FAO, Rome.

## Fisheries Bycatch and Discards

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Bycatch can be defined as 'that part of the capture that is discarded at sea, dead (or injured to an extent that death is the result)<sup>1</sup>. The problem of bycatch has been recognised ever since people started to catch fish. In the 20<sup>th</sup> Century fishing technology and capacity rapidly increased, with a corresponding lack of effective regulation to control overfishing and bycatch levels. The management and mitigation of bycatch is one of the most pressing issues facing the global commercial fishing industry<sup>2</sup>, and is regarded as fundamental to fish stock sustainability and a conservation/food security imperative<sup>3</sup>.

### Status and Trends

Global estimates of bycatch are difficult to quantify as data is incomplete for many areas and fisheries<sup>2</sup>. In the 1980's commercial fisheries annual bycatch was estimated at 27 million tonnes or 25% of the total global catch<sup>4</sup>. A more recent estimate using a different method to derive bycatch led to a total of 7.3 million tonnes<sup>5</sup>. A new definition of bycatch itself which includes all unmanaged and wasted fisheries' catch produced a total of 38.5 million tonnes, accounting for 40% of global marine catches<sup>3</sup>. However, using the more widely accepted definition<sup>1</sup>, it is generally agreed that the total bycatch in commercial fisheries has decreased since the 1980's, which was mainly attributed to a combination of bycatch mitigation measures and an increased utilisation of bycatch for food and livestock feeds<sup>5</sup>. Increased utilisation of bycatch for human consumption and aquaculture is especially high in Asia and parts of Africa and is considered to be part of a global trend<sup>6</sup>. However, the concept of bycatch in terms of defining target/non target catches is weak for many fishing communities in developing countries where most of the catch is usually retained for food<sup>2,3</sup>.

### Impacts

The main types of bycatch that are still major issues for fisheries management include sharks on longlines, cetaceans in gill nets and trawls, discards from shrimp trawls, seabirds on longlines, pinnipeds in trawls, seabirds in coastal gill nets and juvenile fish in trawls<sup>2,7,8,9</sup>. As well as causing the mortality of large, long-lived and often rare or endangered species such as turtles, sharks, cetaceans, seabirds and some invertebrates there are considerable ecological impacts on marine ecosystems. These include effects on benthic fauna and habitats, scavenging species, predator-prey interactions, diversity (genetic, species and community), nutrient recycling and ecosystem resilience and function<sup>7,10,11</sup>. Bycatch and discards can therefore be a serious conservation issue as well as a substantial waste of potential food resources<sup>12</sup>. Both target and non-target stocks can be further reduced through bycatch mortality, contributing to ecosystem degradation. Damaged ecosystems will be less commercially viable in terms of fish stocks than ones managed sustainably.

### Policy Options

Solutions to reduce bycatch need to be tailored to specific fisheries and can differ between regions of the world<sup>2</sup>. The overall process of bycatch mitigation implementation can be split into three stages<sup>13</sup>:

1. Selecting and prioritising species and fisheries that require bycatch reduction action;
2. Bycatch mitigation: selecting the methodology and measures for a particular fishery;
3. Implementation, compliance and monitoring, with feedback to enable adaptive management.

Furthermore, three main approaches to bycatch reduction (**technical, regulatory and social**) have been suggested. These approaches should be adopted in an integrated way<sup>2</sup>. Examples of successful bycatch mitigation are presented below.

**Technical** approaches can be split into three types; **selectivity, deterrence and avoidance**. Selectivity and deterrence both involve making changes to fishing gear. Examples of **selective gear** are bycatch reduction devices (BRDs) and turtle exclusion devices (TEDs) for shrimp and prawn trawl fisheries, which are now mandatory for a large number of these 'bycatch heavy' fisheries around the world.

**Deterrence** involves measures to prevent bycatch mainly for passive fishing gear such as longlines and gillnets. An example of successful deterrence is the reduction in seabird mortality in CCAMLR waters. A number of deterrence methods were made mandatory including the use of streamer lines, weighted longlines and night setting of gear<sup>14</sup>. These methods along with effective monitoring using observers and compliance by the fishers enabled a drastic and consistent reduction of bycatch levels. Deterrence can also be very effective for coastal gillnet fisheries<sup>15</sup> but is not widely used, resulting in high mortality of seabirds, cetaceans, sharks, and turtles<sup>9,16,17,18</sup>.

**Avoidance** measures include the use of time and area closures to protect species at certain stages of their life history such as the closure of juvenile nursery areas or adult spawning grounds. Permanent area closures are also used to protect vulnerable species from incidental capture. Examples are area closures for the Hawaiian monk seal and the vaquita porpoise in the Gulf of California. However such closures often just

displace fishing effort, and although protecting one species, can lead to unintended consequences for others<sup>19</sup>.

**Regulatory** approaches can be effective but may inadvertently cause increased discards of other target species that fishery managers are also trying to protect<sup>2</sup>. Therefore any regulatory legislation must be carefully evaluated beforehand. **Reducing fishing effort in commercial fisheries is one obvious way to reduce bycatch.** For overexploited fisheries a reduction in fishing effort can significantly reduce bycatch without greatly affecting target catches. Examples of legislation that address bycatch directly are the Magnuson-Stevens Fishery Conservation and Management Act in the United States, and the 1996 New Zealand Fisheries Act. Bycatch quotas for vulnerable species are also used where fishing ceases when the quota is reached, for instance for Hooker's sea lion in New Zealand or dolphins in the IATTC-managed Eastern Pacific Ocean, both examples of environmental legislation that has been effective in changing fishing practises. Discard bans operate in Norway, Iceland and New Zealand, where bycatch of commercial species is landed for a guaranteed value. Total bycatch bans in Namibia require that all bycatch is landed for processing into fishmeal and fishers pay a surcharge towards the processing cost.

**Social** measures to reduce bycatch are critical if both technical and regulatory measures are to be most effective. Fishers need to be made aware of the ecological and economic costs of bycatch and discards, particularly the loss of revenue and time. In the north-west Atlantic groundfish fishery there was an estimated loss of potential income of \$50 million when the 1987 year class of yellowtail flounder was harvested prematurely and then discarded<sup>20</sup>. Awareness initiatives to explain the use of technical measures can improve compliance and reduce bycatch considerably<sup>14</sup>. However, in some cases even when deterrent measures are mandatory fishers tend to ignore them or do not implement them effectively.

Economic incentives to fish sustainably are becoming more common through certification schemes, where bycatch mitigation can be a condition for operating a certified fishery. Public opinion, linked to media attention and peer pressure within fishing communities or fisheries can also play a large part in changing fishers' attitudes and fishing behaviour. Making a change happen often requires a 'champion' within the fishing community who can perceive the problem, is receptive to new information and is able to positively influence fellow fishers<sup>21</sup>.

## Key Policy Recommendations

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**Review current bycatch mitigation measures** in RFMOs and inshore fisheries including those in developing countries

**Conduct research into new technical bycatch mitigation techniques** for fisheries lacking such measures

**Implement appropriate existing mitigation measures** for fisheries where bycatch reduction is poor (e.g. inshore gillnets).

**Implement regulatory measures** that provide economic incentives (or disincentives for non-compliance) for fishers to reduce bycatch to an ecologically acceptable level through sustainable fisheries certification schemes, the issuing of fishery licences and control of licence fees.

**Focus on social measures** in combination with technical and regulatory ones in order to drive change in fisher's attitudes and fishing behaviour. Examples include improved awareness coupled with persuading key fishers in a community to actively support change and influence fellow fishers.

**Ensure that all regulated fisheries are monitored effectively** using on-board observers or remote cameras to record bycatch, including discard estimates. Expand the remit and extent of observer programmes where necessary and conduct research into new or improved remote monitoring techniques.

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## Rights-based Fisheries Management

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In open access fisheries, fishers compete for their share of the total catch, resulting in a damaging “race to fish” which often leads to overcapacity, overfishing and reduced catches<sup>1,2</sup>. Eliminating harmful competition between fishers is critical to improving the sustainability of fisheries worldwide. Secure harvest rights can create incentives for economic efficiency and ecological sustainability. In this paper we tackle rights-based management approaches for both large-scale and small-scale fisheries, but separately, because of the largely different nature of these two types of fisheries<sup>3,4</sup>.

### Large-Scale Fisheries and Rights-based Management

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In the large-scale commercial fishing sector, group or individual catch shares can eliminate the “race to fish” by granting fishers a set proportion of the total allowable catch (TAC)<sup>5,6</sup>. Catch shares, also known as fishing quotas, may be transferable or non-transferable, and may be allocated to individuals or groups of fishers. Individual Transferable Quota (ITQ) systems are the most commonly used form of rights-based management in large-scale fisheries, and will be the focus of this section.

The adoption of individual fishing rights in large-scale fisheries has accelerated since the 1970s. By 2008, 20-25% of the global marine catch was harvested using ITQ or similar systems<sup>7</sup>. At least 15 nations use ITQs as a major management tool<sup>7</sup>, including New Zealand, Iceland, Canada, Namibia, the United Kingdom, Norway, Australia and the United States<sup>8</sup>. On the high seas, individual fishing rights have proven more difficult to implement. To date, none of the Regional Fisheries Management Organizations (RFMOs) have implemented individual fishing rights<sup>6</sup>.

ITQ systems can generate a number of economic and ecological benefits. Transferability of fishing quotas enables a reduction of excess capacity, improving economic efficiency<sup>1,6</sup>. Use of quotas allows fishing to be more cost-effective, increasing profits<sup>1</sup> and reducing the need for subsidies. Secure harvesting rights confer a stewardship incentive to fishers as catch share values are directly linked to fish stock health. This incentive has led fishers to lobby for reduced TACs to rebuild stocks, invest in scientific research to improve stock assessment, and fund monitoring, control and surveillance (MCS) to reduce illegal fishing<sup>9</sup>. Large-scale fisheries with ITQ systems are less likely to collapse<sup>8</sup>, often have improved TAC compliance, greater fisher involvement in the decision-making process and improved cooperation between fishers, managers and scientists<sup>9</sup>. Through improved efficiency and stewardship, ITQs can “halt and even reverse the global trend toward fisheries collapse”<sup>8</sup>.

However, catch shares alone are not a guarantee of sustainable fishing. Their success depends on the setting of suitable ecosystem-based TACs, which in turn relies on robust stock assessment and political will<sup>10</sup>. ITQs can provide an incentive to fishers to fill their quota with high-value fish, leading to “high-grading”, or the discarding of lower value fish. This issue has been countered in many ITQ fisheries through the combined use of on-board observers and discard quotas, which promotes more selective fishing and has led to investment in by-catch reduction techniques<sup>2,9</sup>. ITQs can address most fisher incentive issues but not all by-catch and habitat conservation issues, and should be used in conjunction with other fishery management tools such as by-catch mitigation, gear restrictions, spatial and temporal closures, input controls, and certification. Tradable quotas or ‘quota leasing’ have led in some cases to economic concentration but can be resolved through individual quota limitations and robust leasing regulations<sup>9,10</sup>. Employment losses from capacity reductions may occur, but can be mitigated through measures such as occupational retraining and financial compensation.

### Small-scale Fisheries and Rights-based Management

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Small-scale fisheries (SSF) are defined as ‘fisheries that work from the shore or from small boats in coastal or inland waters’<sup>11</sup>. SSF are made up of both artisanal and subsistence fisheries, mainly in the developing world, and are an important component of global fisheries. They provide direct employment to more than 90% of the 27 million capture fishers worldwide whilst also supporting a further 84 million in fish processing, distribution and marketing roles<sup>12</sup>. SSF catches make up half of the global fish catch for human consumption and many operate at a fraction of the cost of large-scale fisheries<sup>13</sup>. Small-scale fisheries are highly important both in terms of supporting livelihoods and providing future food security for developed and developing countries. Many countries in Asia depend on coastal fisheries for up to 50% of their animal protein, compared to a global average of 15%<sup>12</sup>. In developed countries, where there is sufficient capacity to provide effective governance and scientific assessment, SSF can be successfully managed using ITQ systems. However, ITQs are less practical in countries where such capacity is lacking and here community based management or co-management approaches are more suitable.

As for large-scale fisheries many small-scale fisheries are facing a crisis. Anthropogenic environmental degradation of the coastal zone and intensification of fishing effort in inshore waters has led to overfishing, depletion of marine resources and habitat loss. The main drivers of overfishing in SSF have been:

- open access to inshore fishing grounds and human migration into the coastal zone;
- increased demand in local or foreign markets for marine resources;
- lack of alternative food supply or income for coastal populations coupled with economic subsistence pressure driving people to keep fishing overexploited stocks;
- competition between small-scale and large-scale fisheries as industrial fishing's range expanded.

Previous neglect of SSF in national development and fisheries plans has led to a lack of regulation and management of these fisheries in many developing countries<sup>14</sup>. Furthermore, the societal and economic value of SSF at the local and national level is often greatly underestimated or poorly understood<sup>14,15</sup>.

Rights-based management in small-scale fisheries has existed for centuries in traditional fisheries of the Western Pacific using a system of territorial use rights or customary marine tenure<sup>16,17</sup>. Successful management within these systems is closely linked to the level of cultural and social cohesion within a particular community<sup>18</sup>. Successful small-scale rights-based management approaches have been adopted in many parts of the world. Examples are territorial user rights fishery systems (TURFs) operating within a co-management approach in Latin America for sea urchins (Chile) and lobsters (Mexico)<sup>3</sup>. In these cases, and in South-east Asia (Philippines and Indonesia), fisheries management forms part of an integrated approach to coastal zone planning addressing multiple issues (social, economic and ecological) that is embedded in local or regional government mandates<sup>4,19</sup>. Within these and other management strategies it is critical that fishers, along with other stakeholders, are fully integrated into a participatory decision-making process<sup>20</sup>.

## Key Policy Recommendations

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Implement rights-based management systems in both large-scale and small-scale open-access fisheries.

Implement the form of fishing rights most suitable to the fishery, fishing community and the marine environment.

Rights-based management should be knowledge-based and follow the precautionary principle as part of an ecosystem-based approach to fisheries.

### In large-scale fisheries:

- Ensure ultimate control lies with the regulatory authority, with clear lines of authority, transparency, and stakeholder involvement.
- Use rights-based management as part of a diverse fisheries management programme, alongside other tools such as marine protected areas, input controls (e.g. effort restrictions), strong monitoring, control and surveillance (MCS), and market measures such as catch certification and eco-labelling.

### In small-scale fisheries:

- Apply a knowledge-based approach incorporating multiple issues (economic, social and ecological) as part of a mandated integrated coastal zone management (ICZM) process.
- Implement forms of co-management that can strengthen the social consensus, participation, self-regulation and compliance of fishers. Fishing communities need to be fully involved in a participatory process to incorporate ownership and stewardship of the fishery. Examples exist in the Philippines, Chile and Mexico.
- Implement a rights-based co-management approach combined with other fisheries management tools where applicable, including territorial user rights in fisheries (TURFs), community fish catches, and temporary closures and reserves (MPAs).
- Ensure management is adaptive and tailored to respond to the changing local socio-ecological situation. An example is the Integrated Assessment and Advisory (IAA) Framework<sup>21</sup>.

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