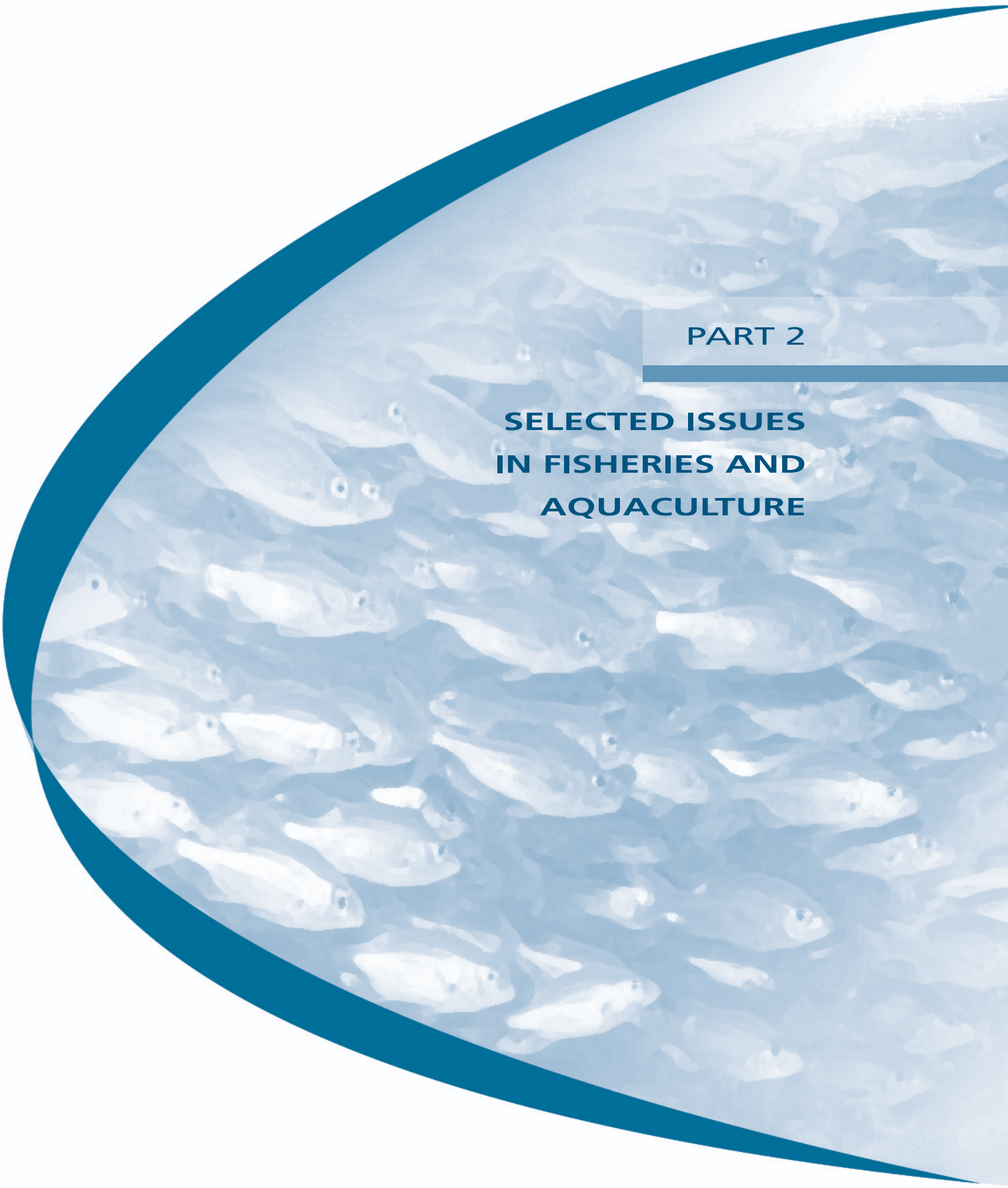


PART 2

SELECTED ISSUES IN FISHERIES AND AQUACULTURE

SELECTED ISSUES IN FISHERIES AND AQUACULTURE

Trade measures against IUU fishing

THE ISSUE

Trade measures are increasingly being used to combat illegal, unreported and unregulated (IUU) fishing.[1] The aim of these measures is to prevent IUU-sourced fish and fish products from entering into international trade. The increasingly stringent implementation of trade-related measures often poses a significant challenge, especially for fish and fish products originating from small-scale fisheries in developing countries. These countries often lack the resources and infrastructure needed to meet the requirements. As a result, they may be excluded from participating in the international trade in fish and fish products, regardless of whether their product is of legal origin or not. In other words, legally sourced fish and fish products may be excluded from international trade because developing countries are not in a position to implement the administrative requirements associated with the trade measures. This may also pose a problem for the processing sector in importing countries that rely on imports of raw material from developing countries to supply their processing plants.

IUU fishing

Now a global problem, IUU fishing occurs in virtually all capture fisheries, ranging from fisheries under national jurisdiction to high seas fisheries. It is increasingly recognized that IUU fishing undermines national and international fisheries conservation and management measures and leads to resource depletion. This, in turn, weakens the ability of the fisheries sector to meet national and global economic, social and environmental objectives and threatens the livelihoods of people who depend on fishing. However, given the importance of developing countries in the international fish trade,[2] measures to reduce IUU fishing will fail if developing countries are not active participants in the fight to ensure legal and sustainable fishing practices.

A recent study estimates the cost of illegal and unreported fishing alone at US$10–23.5 billion per year.[3] In 2006, global capture fisheries had an estimated first-sale value of US$91 billion.[4] Even at the low end of the IUU cost estimate spectrum, the losses due to IUU fishing are substantial relative to the total value of the fisheries sector.

Trade measures against IUU fishing

Trade-based measures consist of actions directed toward products originating from IUU fishing and may include banning products from states found to be undermining fishery conservation and management measures, or rejecting individual shipments that lack required documentation of their legal provenance. As approximately 37 percent of the global fish harvest enters into the international trade, international regulations or measures that ensure that internationally traded fish does not originate from IUU fishing can be powerful instruments. However, caution must be exercised in their application to ensure that they do not create unnecessary or unjustifiable barriers to trade.

Until recently, trade measures to combat IUU fishing were mainly implemented by regional fisheries management organizations (RFMOs)[5] managing high seas fisheries. However, trade measures have now been developed to be implemented at the national level by Chile, the United States of America and the European Union (EU).

Chile

In December 2009, Chile introduced new requirements for imports of aquatic species or by-products into Chile. Imports require a certificate of legal origin certifying that the imported species were captured or harvested pursuant to national and international regulations applicable in the country of origin, and in the case of fisheries products, that the aquatic species or raw material used and their manufacturing process are in accordance with the above regulations.

United States of America

Since January 2007,[6] the United States of America has produced a biennial report of nations identified as having vessels engaged in IUU fishing. The report includes a description of efforts taken by listed nations to take appropriate corrective action and a report of progress at the international level to strengthen the efforts of international fishery management organizations against IUU fishing. The United States of America also seeks to strengthen international fishery management organizations to address IUU fishing through the adoption of IUU vessel lists, stronger port state controls, market-related measures and other actions.

Once a nation has been identified as having vessels engaged in IUU fishing, the United States of America will work with and encourage the identified nation to take appropriate corrective action to address IUU fishing. The absence of steps by identified nations to address IUU fishing may lead to prohibitions on the importation of certain fisheries products into the United States of America.

European Union

The EU Regulation to prevent, deter and eliminate IUU fishing (the EU IUU Fishing Regulation) entered into force in January 2010.[7] It aims to ensure that any individual or business wishing to import fish and fish products into the EU can only do so if the country under whose flag the fish was caught can show that it has in place, and enforces, laws and regulations to conserve and manage its marine resources. Among other measures, the EU IUU Fishing Regulation allows EU member states to ban fish imports if they:

- are not accompanied by a catch certificate;
- were caught by a vessel that has been found to engage in IUU fishing;
- were caught by a vessel included in the EU IUU fishing list; or
- were caught by a vessel flying the flag of a non-cooperating third country.

The catch certificate that must accompany any imports of fish and fish products caught by third-country fishing vessels is a central element of the EU IUU Fishing Regulation. The certificate is issued by the flag state of the vessel that originally caught the fish. Catch certificates of a given flag state will only be accepted once that country has confirmed to the European Commission that "it has in place national arrangements for the implementation, control and enforcement of laws, regulations and conservation and management measures".[8] Trade sanctions can also be imposed on fish caught by vessels found to have engaged in IUU fishing. European Union member states can ban imports as an immediate enforcement measure if a vessel has been caught fishing illegally. The European Commission can also add a vessel engaged in IUU fishing to an IUU vessel list if the flag state has failed to take action. Imports of fish and fish products from listed vessels to the EU are prohibited.

Vessels included in IUU lists of RFMOs will automatically be added to the EU list. A country can also be put on the list if it is found to have failed to implement adequate measures to address recurrent IUU fishing activities involving vessels flying its flag, fishing in its waters or using its ports. It must also have adequate measures in place to prevent access for illegally caught fisheries products to its market. In addition, the EU can implement short-term emergency measures if actions by a third country are deemed to undermine the conservation and management measures of RFMOs.

The EU IUU Fishing Regulation will recognize certain RFMO schemes as complying with its requirements, although fish from unrecognized RFMO schemes will have to provide both RFMO and EU documentation.

The EU IUU Fishing Regulation is much broader in scope than previously implemented trade-related measures. It applies to imports originating from waters under national jurisdiction (exclusive economic zones [EEZs]) as well as from the high seas. The EU is the world's largest importer of fish and fish products, with imports valued at US$49 billion in 2008 (including intra-EU trade). All imports of fish and fish products into the EU will be subject to the requirements of the EU IUU Fishing Regulation, which means it will significantly affect international fish trade. The EU IUU Fishing Regulation has a provision for catch documents issued under certain RFMO catch documentation schemes to be accepted in lieu of the catch certificates required by the regulation. However, some developing countries have raised concerns about their capacity to meet the requirements set out in the EU IUU Fishing Regulation. In response, the EU has foreseen the possibility of providing assistance and capacity building in developing countries to help them implement the EU IUU Fishing Regulation.

Implications for developing countries: the case of EU regulations

For some developing countries, especially those with limited administrative infrastructures, the challenges of meeting the requirements associated with the implementation of trade measures may prove difficult.

The two main challenges created by the EU IUU Fishing Regulation for developing countries are related to their capacity to:

- develop national arrangements for the implementation, control and enforcement of laws, regulations and conservation and management measures that deal with the problem of IUU fishing;
- implement the reporting requirements associated with the EU IUU Fishing Regulation.

The EU IUU Fishing Regulation is quite comprehensive and, in particular, requires that a catch certificate accompany all shipments. Recognizing the capacity constraints for the implementation of the certification scheme, the EU has developed a simplified catch certificate for small fishing vessels. The simplified certificate is intended to lighten the reporting requirement. However, the major hurdle for small-scale fisheries will be the cost of collecting and compiling catch certificates from individual vessels. Small-scale fisheries in developing countries typically depend on many small vessels, each supplying a relatively small quantity of fish. Because a catch certificate is required for each vessel, the compliance cost is much heavier than for industrial fleets. In addition, developing countries do not have access to electronic reporting systems. This requires the establishment of a paper trail for each vessel from the point of capture.

The EU regulations also pose challenges for shipments of fresh fish. Owing to the perishability of the product, it is imperative that the product move rapidly through the value chain in order to fetch a maximum price. These factors are of critical importance in a sector that operates on thin profit margins. Delays caused by reporting requirements will have a negative effect on the market for fresh fish. In many instances, individual shipments are composed of small, line-caught catches originating from a range of vessels operated by artisanal fishers.

As the EU applies a different set of rules to address IUU fishing by EU vessels, some countries have also questioned whether the EU IUU Fishing Regulation is inconsistent with the national treatment provisions of the World Trade Organization (WTO).[9] The EU has argued that its Control Regulation[10] has the same effect as the EU IUU Fishing Regulation and that there is therefore no discrimination.

POSSIBLE SOLUTIONS

Trade measures against IUU fishing include two main components. The first consists of the administrative procedures associated with the trade measure (identifying a competent authority, developing traceability systems, etc.). The second component relates to the development of national arrangements for the implementation, control and enforcement of laws, regulations and conservation and management measures.

Under existing international agreements, it is incumbent on various international organizations and other relevant bodies to consider providing technical and financial assistance to developing countries to assist them in adhering to international agreements, particularly those contained in the WTO agreements and the FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU).[11] This means *inter alia* helping developing countries in the implementation of the two main components of trade measures against IUU fishing.

FAO adopted the IPOA-IUU in 2001. The IPOA-IUU specifically calls upon states to develop additional internationally agreed market-related measures to prevent, deter and eliminate IUU fishing. Such measures must be interpreted and applied in accordance with the principles, rights and obligations established by the WTO and implemented in a fair, transparent and non-discriminatory manner.

The IPOA-IUU also commits states, with the support of FAO and relevant international financial institutions and mechanisms, to support training and capacity building and to consider providing financial, technical and other assistance to developing states so that they can more fully meet their commitments under the IPOA-IUU and obligations under international law.

RECENT ACTIONS

In 2009, the EU organized regional seminars in Cameroon, Colombia, New Caledonia, South Africa and Viet Nam to introduce the requirements of the EU IUU Fishing Regulation. In addition, the EU will take into account the capacity of developing countries and will assist them in implementing the EU IUU Fishing Regulation and combating IUU fishing. The constraints of developing countries in the field of monitoring, control and surveillance (MCS) of fishing activities will also be taken into account. The EU issued a statement prior to adoption of the EU IUU Fishing Regulation where it undertook to assist third countries in the implementation of the EU IUU Fishing Regulation and the EU catch certification scheme.[12]

FAO has carried out several regional workshops where participants have had the opportunity to: (i) gain a better understanding of the requirements associated with the United States' IUU approach and the EU's new IUU legislation; and (ii) exchange experiences at the national level in relation to the implementation of the EU's IUU regulations. A questionnaire has also been developed to identify the aspects of the IUU regulations that are creating difficult challenges for exporting countries. The feedback received from the questionnaire will help FAO to determine how best to provide technical assistance to affected countries.

The EU's IUU regulations and other similar measures are also discussed by the FAO Committee on Fisheries (COFI) Sub-Committee on Fish Trade. Every two years, this event brings together all the market, coastal and flag states and provides a forum where these issues are debated by policy-makers.

FUTURE PERSPECTIVES

Improvements to existing schemes and the development of new trade measures are likely in order to fulfil the requirements of the EU and other nations. Where possible, they will probably be designed so as not to create unnecessary burdens for fish trade flows. However, in the future, the private sector may also seek additional assurances that it is sourcing fish and fish products from legal fisheries. The private sector will probably be encouraged, to the extent possible, to build on and support initiatives implemented by national governments.

Given the expected difficulties of developing countries in the implementation of trade measures, development agencies and donors are likely to monitor the situation closely and to assist countries in the implementation of IUU regulations and associated trade measures, particularly in developing the capacity required to comply with the regulations.

The trade measures described above can be particularly effective in preventing IUU fish and fish products from entering regulated markets. However, they have little or no effect on fish and fish products harvested for domestic consumption or for unregulated markets. It seems plausible that, in the future, nations will be encouraged to implement trade measures that target both fisheries supplying the international trade and fisheries that supply domestic markets.

In addition, a prerequisite for combating IUU fishing is good governance of the harvesting sector. Therefore, in order to deal effectively with IUU fishing, most countries, including developing countries, will need to strengthen national arrangements for the implementation, control and enforcement of laws and regulations intended to ensure the conservation and management of living marine resources.

Maintaining biosecurity in aquaculture

THE ISSUE

While aquaculture offers relief to many of the food security issues facing the world's growing population, the sector is also in direct conflict (invariably overlapping other economic, environmental and social interests) with other users of aquatic habitats and coastal and riparian areas. A better and more widely used structure and programme for biosecurity may be one way of reducing conflicts between aquaculture and other water users.

More than 360 species are produced in aquaculture worldwide; some 25 of these are of high value and traded globally. A successful harvest can be very profitable, and this has spurred the expansion of aquaculture production in terms of area and geographical range. When done in a haphazard manner, species movement for farming can be one of the many sources of biological threats to the well-being of farmed aquatic animals as well as to humans and ecosystems. As aquaculture intensifies and diversifies, the biological hazards and risks to farmed animals, people and ecosystems also increase in number and diversity, with potentially serious consequences. Some of these hazards are infectious diseases, animal pests, public health concerns on residues and resistance of antimicrobial agents, zoonosis,[13] invasive alien species, release of genetically modified organisms and biosecurity risks posed by climate change. The growing number, complexity and seriousness of these risks have driven the development of the concept of biosecurity and its increasing application. An integrated strategy to manage biosecurity, business, environmental and social risks will better promote sustainable growth of the aquaculture sector.[14]

Biosecurity can be understood as the management of biological risks (such as those mentioned above and others that may yet arise) in a comprehensive and systematic manner to protect the health and well-being of animals, plants and people, and to maintain the functions and services of ecosystems. Through this integrated and comprehensive approach, biosecurity can safeguard animal and human health, protect biodiversity, promote environmental sustainability and ensure food safety. It can stimulate increased market supply and private investments by enabling farmers to produce healthy products that can be highly competitive in the market. It makes adherents and users responsible trading partners. Through biosecurity, developing countries can grow more food efficiently, increase their incomes and, thus, improve their resilience, reduce their vulnerability and enhance their ability to respond to the impacts of higher food prices and other threats to food security.

Examples of biosecurity risks in aquaculture

Transboundary aquatic animal diseases

Highly contagious aquatic animal diseases or pathogens, transboundary aquatic animal diseases (TAADs) can spread very rapidly anywhere and cause serious losses

and long-lasting damage. Increases in trade increase the potential of facilitating new mechanisms by which pathogens and diseases may be introduced and spread to new areas together with host movement. Examples of serious TAADs affecting aquaculture are: (i) epizootic ulcerative syndrome (EUS), a fungal disease of finfish that has recently expanded its geographic range to southern Africa, affecting wild fish populations; (ii) white spot disease of black tiger shrimp, probably the most serious viral disease of cultured shrimp and responsible for the collapse of the shrimp culture industry in many countries; and (iii) koi herpes virus (KHV), another viral pathogen affecting an important food fish (common carp) and a high-value ornamental fish (koi carp).[15] Domestic and international movements of infected broodstock and seed are proven pathways for the entry and spread of these pathogens. Infectious diseases are constraining the development and sustainability of the industry through direct losses (in many cases, costing millions of US dollars), increased operating costs, closure of aquaculture operations, unemployment, restrictions on trade, and impacts on biodiversity.[16]

Public health risks from the use of veterinary medicinal products

Veterinary medicinal products are substances (such as antimicrobial agents, chemotherapeutants, disinfectants and vaccines) used during production and processing to treat or prevent disease, carry out medical diagnosis, or restore, correct or modify physiological functions in animals.[17] Overall, veterinary substances have raised production efficiency and have been taken up rapidly by the aquaculture industry with improved learning and better understanding of health management and biosecurity application to aquaculture. The benefits are also well recognized from a wide range of applications, including, in addition to the above, development of new species for farming, alternatives to failed preventive strategies, development of culture technology, and animal welfare. However, there are also increasing concerns about veterinary medicinal products in terms of their limitations and the potential harm they may cause. These are related to bacterial resistance, antimicrobial agent residues in tissues of food products, the cost of remedying unintended effects, and the reliability of their efficacy under various aquatic environments. Along with widespread use comes growing concern about irresponsible use, such as the covert use of banned products, misuse because of incorrect diagnosis and abuse owing to a lack of professional advice. That said, there are still not enough approved products for a range of species and diseases in aquaculture.

Biological invasions

Biological invasion, a broad term that refers to human-assisted introductions and natural range expansions,[18] is a major cause of global biodiversity loss. An example is the golden apple snail, which was intended for use as a food crop, an aquarium pet or a biological control agent. However, it became a pest in rice fields and native ecosystems in the Asian countries in which it was introduced. Aquaculture can be a source of risk from biological invasions in a number of ways, e.g. bringing in non-native species for farming and the use of non-native, fresh or frozen feedstocks. These can have adverse effects on biodiversity, including decline or elimination of native species – through competition, predation, or transmission of pathogens – and the disruption of local ecosystems and ecosystem functions. The global spread of many marine organisms through shipping has been a major marine biosecurity concern in the last decade. Ballast water[19] may transport all groups of marine organisms. The transport of toxic algae in ballast water has had a profound effect on aquaculture activities, such as closure of farms during blooms. Hulls, on the other hand, can become carriers of encrusting organisms (e.g. macro-algae, bivalve molluscs, barnacles, bryozoans, sponges and tunicates), which may not only introduce novel pathogens but more seriously foul ports, coasts and aquaculture facilities, thus adding costs (for treatment and clearing) and weakening the economic viability of marine farms.

Climate change scenarios that will affect biosecurity

Many aquaculture operations located in riparian and coastal systems will be vulnerable to climate change effects, such as sea-level rise, increased incidence of storm surges and land-based runoffs, as well as extreme weather events resulting in flooding, drought and perturbations such as rise in sea temperature.[20] In the tropics, warmer air and water temperatures and rising water levels may drive species from their tropical habitats to subtropical regions. Assessments of the impacts of climate change have generally concurred that global warming could increase the range of pests and pathogens, or intensify their occurrence or increase the vulnerabilities of farmed animals to diseases. Extension in the range of diseases, particularly non-host-specific pathogens, will be induced by species movement. In addition, major losses of stocks and infrastructure are likely to result from increased incidence of storm events. Higher temperatures could increase the likelihood of the occurrence of pathogen, food safety, public health and ecological risks.

POSSIBLE SOLUTIONS

Policy options (including regulatory and implementation frameworks)

The rapid expansion of the aquaculture sector has spawned a diverse set of international, regional, national and local regulatory frameworks. A number of international agreements, organizations and programmes are part of a loose international framework on biosecurity, reflecting the historically sectoral approach to regulation in this area. Actions may include: identifying a competent authority and oversight bodies and agreeing on interagency coordinating responsibilities; making biosecurity an element of national aquaculture development programmes; establishing regulatory processes and the appropriate infrastructure to enforce them; and enhancing compliance with regional and international treaties and instruments through effective implementation of national strategies and national policies.

Knowledge base

At the heart of modern approaches to biosecurity is the application of risk analysis. It offers an effective management tool whereby, despite limited information, pragmatic decisions can be made that provide a balance between competing environmental and socio-economic interests. Its application can improve the ability of aquaculture managers in identifying risks and deciding on mitigation or management strategies to deal with risks. However, this tool needs research, databases and other vital sources of information and knowledge so that it can effectively support biosecurity assessments, surveillance, diagnostics, early warning, emergency preparedness and contingency planning. These are needed in order to: identify, understand and analyse the risks and their possible routes (or pathways); describe the individual steps and critical events leading to an introduction; and draw up effective risk mitigation measures. In addition, information from the risk analysis and on options for risk mitigation should be communicated clearly, carefully and rapidly.

Capacity building

Dealing with biosecurity risks is a common responsibility that should be shared among relevant authorities and stakeholders along the aquaculture value chain. Thus, capacity building in risk analysis and adaptive management[21] at all levels – from farms to oversight bodies of the public and private sectors – should be part of the overall programme so that threats and uncertainties from new species and innovations can be assessed rapidly. Fish farmers need reliable and timely information and effective tools. Extension and diagnostic services at primary production levels should be revitalized, and the operational effectiveness of oversight bodies to respond effectively to biosecurity emergencies needs to be maintained. Investing in capacity building for designing and implementing surveillance programmes and for preparing for, and coping with, emergencies will pay dividends. It will be less costly to detect, identify and

prevent the emergence or spread of diseases and pests than to contain them. It will cost less and minimize human suffering if such risk does not turn into an emergency, or, if it does, is met with a rapid and appropriate response.

Investment in infrastructure, capacity, regulatory frameworks and partnerships

Effective, coordinated and proactive biosecurity systems are the product of science-based knowledge and practices used within effective regulatory frameworks backed by sufficient resources for enforcement. More investment is needed in: biosecurity infrastructure; human capacity for assessing, managing and communicating risks; regulatory frameworks for controlling risks; and public and private sector partnerships for identifying, monitoring and evaluating risks. A crucial consideration is how to deal with "unknowns". This suggests the need to forge an effective regional and international cooperation to pool resources and share expertise and information. At the global, regional or national levels, the institution mandated to ensure biosecurity would be well served by putting emergency preparedness with advanced financial planning as its core function.

RECENT ACTIONS

The main regulatory instrument governing biosecurity is the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) of the WTO.[22] It advocates the use of risk analysis as the basis for taking any sanitary and phytosanitary measures. The three main international organizations and standards are: (i) the FAO/WHO Codex Alimentarius Commission, concerned with food safety; (ii) the World Organisation for Animal Health (OIE), concerned with animal (including aquatic animal) life and health; and (iii) the International Plant Protection Convention, concerned with plant life and health. With regard to international trade in aquatic animals, different obligatory international treaties and agreements and other voluntary guidelines are involved. Examples of binding international agreements are the aforementioned SPS Agreement, the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and related legislation and directives of the EU. Examples of voluntary agreements and guidelines include that of the International Council for the Exploration of the Sea,[23] the codes of practice of the European Inland Fisheries Advisory Commission[24] and the FAO Code of Conduct for Responsible Fisheries[25] and a number of supporting technical guidelines.[26] These international agreements have added to the responsibilities of competent authorities in dealing with biosecurity risks. In many instances, voluntary international guidelines are incorporated into national legislations and, thus, become mandatory at the national level.

The OIE Aquatic Animal Health Code (the Aquatic Code),[27] a reference document for use by competent authorities, import/export services and all those involved in the international trade of aquatic animals and their products, assures the sanitary safety of such trade. The OIE Manual of Diagnostic Tests for Aquatic Animals (the Aquatic Manual)[28] provides a standardized approach to the diagnosis of diseases listed in the Aquatic Code to facilitate health certification of trade in aquatic animals and aquatic animal products. Both the Aquatic Code and Aquatic Manual are updated on a regular basis with available new information. For example, in 2007, the Aquatic Code updated the list of aquatic diseases and included KHV as a reportable and notifiable finfish disease.

Countries producing foods of animal origin and wishing to export them to the EU market must satisfy certain animal health, public health, veterinary certification and residues requirements, which are published and updated regularly as EU legislation and directives.[29]

The International Day for Biological Diversity, an annual event arranged by the Secretariat of the CBD to increase understanding and awareness of biodiversity issues, was celebrated on 22 May 2009 with the theme "Biodiversity and Invasive Alien Species".[30]

GloBallast Partnerships, a five-year (October 2007 to October 2012) joint project of the International Maritime Organization (IMO), the Global Environment Facility (GEF), the United Nations Development Programme (UNDP), member governments and the shipping industry, is aimed at assisting vulnerable developing states and regions to implement sustainable, risk-based mechanisms for the management and control of ballast water and sediments in order to minimize the adverse impacts of aquatic invasive species transferred by ships.[31]

Examples of recent actions by FAO on biosecurity include: (i) technical assistance in the investigation of EUS incursion in southern Africa (2007)[32] and emergency response to KHV in Asia (2003);[33] (ii) pioneering work in promoting the application of risk analysis to aquaculture production,[34] which has now expanded to other regions (e.g. Western Balkans,[35] Persian Gulf,[36] Pacific Islands); and (iii) the organization, in December 2009, of an expert workshop on improving aquatic biosecurity through prudent and judicious use of veterinary medicinal products. This expert workshop was supported by the EU, OIE and World Health Organization (WHO) and FAO Member Governments. All these actions support the development of the knowledge base and enhance human and technical capacity on biosecurity.

FUTURE PERSPECTIVES

The recent global crisis in food prices has put pressure on both governments and the international community to ensure an adequate supply of food for a growing population. Many challenges lie ahead in terms of: continuing trade globalization; intensification and diversification of farming practices; further advancement in technological innovations in food production; changing human behaviour and ecological systems; heightened awareness for biodiversity protection; greater demand for public health and environmental protection; and increasing concerns on animal welfare and impacts of climate change. These challenges will lead to greater attention and commitments on improving biosecurity and the wider application of risk analysis and adaptive management as valuable decision-making tools. In the absence of appropriate and effectively implemented biosecurity measures, risks from biological hazards will continue to threaten the aquaculture sector, inflicting losses and requiring more resources to mitigate them.

It is not possible to know and predict precisely every potential source of harm and its pathways. Thus, it is important that the use of risk analysis as a concept be understood and embraced rather than shied away from because of the seeming complexity of the process. Effective application of risk analysis will require enabling structures and mechanisms, such as capacity building, efficient planning and governance, better institutional coordination, a programme to address issues associated with globalization and trade, a programme to manage the use of limited natural resources,[37] and a national-level strategy to deal with the social and biological impacts of climate change.

Which fish to eat: enjoying the benefits while minimizing the risks

THE ISSUE

While the consumption of seafood has well-established nutritional and health benefits, some fish species can be harmful when they accumulate contaminants. The question is how to maximize the positive consequences of seafood consumption while minimizing the concurrent negative consequences.

The risks of consuming potentially contaminated foods have traditionally received greater attention than the benefits of eating them. However, there is now a growing focus on the risks of *not* consuming certain foods, and among them fish products, given their potential beneficial components. Nutritional benefits derive not only from

the long-chain polyunsaturated fatty acids (LCPUFAs) – docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) – but also from amino acids, micronutrients (vitamins, minerals) and possibly from other nutrients (e.g. taurine), all found in fish.

The fact that fish consumption helps prevent coronary heart disease (CHD) has been well known for some time. There is now an increasing focus on fish as a source of DHA and iodine, which are essential for the early development of the brain and neural system. These nutrients are almost exclusively found in foods from the aquatic environment. The role of fish in mitigating mental disorders, such as depression and dementia, is also receiving increased attention from scientists.

However, the presence of contaminants in some fish and fish products and other foods is of increasing concern to consumers. Some fish products are known to contain contaminants such as methyl mercury (mercury in its most toxic form) and dioxins (all dioxin-like compounds).

In general, it is believed that the levels of such contaminants in seafood are well below the maximum levels established for their safe intake. Nevertheless, in fish caught in polluted waters or in large, long-lived predator species, the levels of contaminants might exceed the levels regarded as safe for consumption.

It is well known that ingested mercury might have a negative impact on the development of the neural system of children and that some fish species can be the main source of mercury in many diets. Fish can also be a source of dioxins in populations that consume fish frequently. However, the occurrence of dioxins among individuals in these populations is generally not higher than in populations having low fish consumption.[38] Therefore, reducing the consumption of fish might reduce the exposure to mercury in human diets, but the exposure to dioxins will probably be the same for individuals even if they significantly reduce their consumption of fish.

When consumption of a food can be associated with both potential health risks and benefits, risk managers try to identify an intake level that minimizes risks and maximizes benefits. It is particularly important to establish such levels when consumption levels are close to levels that should not be exceeded.[39]

Advice on limiting the consumption of fish for vulnerable groups, such as children and pregnant women, is being given by many public health authorities. While the intention is only to limit consumption of products believed to have elevated levels of contaminants, the effect in some cases has been a significant reduction in seafood consumption. However, a reduction in seafood consumption could result in a diet that might not ensure an optimal intake of essential nutrients. Both children and adults run this risk. As LCPUFAs are essential in the early development of the brain and neural system in children, advice aiming to limit the consumption of contaminated fish must be couched in such terms that not all fish is given a "bad name". Similarly, as seafood consumption reduces cardiovascular diseases among the adult population, messages intended to reduce the exposure of fish products to contaminants should go hand in hand with the promotion of safe fish products.

POSSIBLE SOLUTIONS

Most informed observers would probably agree that the solution to this issue consists of sound, science-based advice that weighs the benefits and costs for human health of consuming fish. Although much work has been done in this field, the subject is not exhausted and conclusions reached to date have not obtained universal endorsement.

Addressing this issue is a complex and resource-demanding scientific task that includes: (i) an assessment of the health risks associated with the consumption of fish and other seafood; (ii) an assessment of the health benefits associated with the consumption of fish and other seafood; and (iii) a subsequent comparison of the health risks and health benefits.

Some studies[40] have tried to balance the positive and negative sides of consuming foods of high nutritional value but that are also a source of contaminants. However, to date, the procedures used have been controversial, and experts in this field maintain that new procedures need to be developed in order to carry out quantitative

assessments of the risks and benefits to human health of consuming fish and other seafood.[41] Once the methodology has been developed, the required data will need to be obtained. The new procedures should make it possible to compare nutritional benefits with the possibility of adverse effects while accounting for the uncertainties – this should be possible for all groups in the population. In addition, scientists should be able to make quantitative comparisons of the human health risks and benefits of seafood consumption.

RECENT ACTIONS

In order to assist governments in giving advice to vulnerable population groups on the potential risks and benefits of consuming fish and seafood, the Codex Alimentarius Commission requested FAO and the WHO to hold an expert consultation on health risks associated with mercury and dioxins in fish and the health benefits of fish consumption.

The Expert Consultation on the Risks and Benefits of Fish Consumption was held from 25 to 29 January 2010 at FAO Headquarters, Rome, Italy.[42] Seventeen experts in nutrition, toxicology and risk-benefit assessment discussed the risks and benefits of fish consumption. The experts agreed that consumption of fish provides energy, protein and a range of essential nutrients, and that eating fish is part of the cultural traditions of many peoples. In some populations, fish and fishery products are a major source of food and essential nutrients, and there may be no alternative and affordable food sources for these nutrients.

Among the general adult population, consumption of fish, and in particular oily fish, lowers the risk of CHD mortality. There is an absence of probable, or convincing, evidence of mercury causing CHD. Although there is a risk that dioxins may cause cancer, the risk is comparatively small and seems to be outweighed by reduced CHD mortality for those who eat fish. Weighing the benefits of LCPUFAs against the risks of mercury for women of childbearing age, it is established that, in most circumstances, fish in the diet lowers the risk of women giving birth to children with suboptimal development of the brain and neural system compared with women not eating fish.[43]

At levels of maternal dioxin intake (from fish and other dietary sources) that do not exceed the established long-term tolerable intakes of dioxins, the risk of suboptimal neural development is negligible.[44] If the maternal dioxin intake (from fish and other dietary sources) exceeds the established long-term tolerable intakes of dioxins, this risk may no longer be negligible. Among infants, young children and adolescents, evidence is insufficient to derive a quantitative framework of health risks and benefits. However, healthy dietary patterns that include fish established early in life influence dietary habits and health during adult life.

To minimize risks in target populations, the Expert Consultation recommended that states should acknowledge that fish is an important food source containing energy, protein and a range of essential nutrients as well as being part of the cultural traditions of many peoples. States should therefore emphasize: (i) that fish consumption reduces CHD mortality in the adult population; and (ii) that fish consumption improves the neurodevelopment of foetuses and infants and is therefore important for women of childbearing age, pregnant women and nursing mothers. In order to provide sound advice to different population groups, it will also be important to develop, maintain and/or improve regional databases of the specific nutrients and contaminants in the fish available for consumption. Risk management and communication strategies that aim to minimize risks and maximize benefits from eating fish should be developed and evaluated.

FUTURE PERSPECTIVES

Mental illness

Mental illness and depression are increasing globally. Some experts predict that they will become a major burden in terms of global health, especially in the developed world.[45] In 2004, mental health overtook heart disease as the leading health problem in

Europe and was estimated to cost €386 billion a year.[46] More recent studies suggest that consumption of seafood and in particular long-chain n-3 polyunsaturated fatty acids (LC n-3 PUFAs) may also have a positive impact on dementia[47] and Alzheimer's disease, with the most promising evidence for the benefits on mood and depression.[48] However, such benefits should be considered as emerging, as they are not as well established as reductions in CHD deaths and improved early neurodevelopment.

Sustainability and alternative sources of LC n-3 PUFAs

Although there is no association between resource sustainability and health, the issue of sustainability must be considered if proven health benefits lead to greatly increased demand for seafood. With the known wide range of benefits from seafood consumption, it is pertinent to consider whether increased production is possible. For the last 20 years, global landings from capture fisheries have been stagnant at around 89–93 million tonnes. Even with the widespread failure to manage fishery resources properly, which has resulted in a situation where some 28 percent of stocks are overexploited, there is general scientific agreement that significantly more cannot be produced from wild fish populations.

However, total global fish production has continued to rise, amounting to about 142 million tonnes in 2008.[49] The balance is made up by production from aquaculture, which now amounts to 52.5 million tonnes, accounting for almost 46 percent of all fish for human consumption.

Global fish consumption has gradually increased, regardless of the increasing world population, and stood at 17.0 kg of fish (live weight equivalent) per capita per year in 2008.[50] A widespread recognition of the benefits of seafood consumption would inevitably lead to additional demand. If the recommendations of authorities in the United Kingdom of two meals of 140 g of fish per week[51] were followed, then annual per capita consumption would have to rise to 23.3 kg. This translates into an additional production of 40 million tonnes for 2008, rising to 82 million tonnes in 2050.

Aquaculturists are optimistic that far more fish can be produced, but there are issues of nutritional quality using land-based feeds. It would be necessary to incorporate LC n-3 PUFAs into the feeds. Intensive research is required on how this could be achieved, including on production from hydrocarbons by yeast fermentation, extraction from algal sources[52] and/or genetic modification of plants to become LC n-3 PUFA producers. However, for now and probably for the new decade, the source of LC n-3 PUFAs will remain marine capture fisheries.

Fisheries sector transparency

THE ISSUE

Fishing vessel registration and the maintenance of a comprehensive record of fishing vessels are fundamental pillars for effective fisheries management and enforcement at the national level and essential for collaborative effort at the regional and global levels. Their importance has been recognized in most major international fisheries instruments of recent years. However, despite this, comprehensive data on the world's fishing fleets are not readily available. In particular, the technical guidelines on the implementation of the IPOA-IUU recognize that there is no single and complete database or record of fishing vessels in the world – a situation that creates opportunities for IUU fishing vessels to escape detection.[53]

The IPOA-IUU provides the strategic framework through which states can fulfil their obligations as responsible international citizens in the fisheries context, and it has the single objective to prevent, deter and eliminate IUU fishing through effective and transparent measures. Its operational principles stress the essential nature of close and effective national, regional and international coordination and collaboration, the sharing of information, cooperation to ensure measures are applied in an integrated

manner, and transparency. Overall, the IPOA-IUU scheme underlines the fact that IUU fishing is an international, transboundary phenomenon that cannot be effectively addressed through disconnected national efforts alone. In particular, the IPOA-IUU calls on all states to maintain a record of fishing vessels entitled to fly their flag and, by strong inference, to share that record widely – in the interests of cooperation, collaboration and transparency.

POSSIBLE SOLUTION

In seeking a solution to the global lack of transparency, the proposed Global Record of Fishing Vessels, Refrigerated Transport Vessels and Supply Vessels (the Global Record) could be the essential tool currently missing from the existing IUU toolbox. The reduced effectiveness of current tools and measures stems from a lack of real-time quality information and the transparency that improved information availability would create. The Global Record would not only create a detailed record of all included fishing vessels, it would also create a reliable mechanism through which a wide variety of vessel-related information could be displayed. Through a single source, it would have the potential to provide a complete information picture and be the catalyst for significantly improved transparency and collaboration at all levels. No such information tool currently exists.

Today, IUU fishing is a global issue prevalent both within EEZs and on the high seas; and markets are global in nature, ensuring the international movement of vast quantities of fish and fish product. It is clear that the effective management of fishing vessels and their activity is essential to overcoming the IUU problem. Most countries maintain a register or record of larger industrial fishing vessels and carrier vessels, although many do not maintain any records of smaller fishing vessels. Regional registers and records also make an important contribution within the regional context. However, they often lack many of the characteristics necessary for effective global application and they usually do not provide the wider information picture envisaged by the Global Record.

RECENT ACTIONS

The 2005 Rome Declaration by Ministers on IUU Fishing called for the development within FAO of a comprehensive global record of fishing vessels, including refrigerated transport vessels and supply vessels. As a result, the Twenty-seventh and Twenty-eighth Sessions of the COFI in 2007 and 2009 endorsed a programme of work to explore the concept further so that the findings could be presented to a Technical Consultation.

The EU's Fleet Register[54] provides an example of a comprehensive fleet record, publicly available and searchable online without cost. It provides an excellent description of each vessel although it does not display ownership and operator details. The inclusion of such information would enhance its overall value and provide a model for states that would significantly improve sector-wide transparency and enhance compliance with international obligations.

However, no country outside the EU appears to provide publicly available data in this way, making it impossible to scrutinize commitments made to sustainability measures and fleet capacity reductions. Nor is it possible for practitioners of MCS to identify and assess vessels with any degree of accuracy without direct inspection and lengthy investigation. Traceability schemes also rely heavily on the ability of state parties to verify supplied data. However, without basic transparency in the sector, this is impossible, raising significant questions about the reliability of information in these schemes.

This lack of basic transparency could be seen as an underlying facilitator of all the negative aspects of the global fisheries sector – IUU fishing, fleet overcapacity, overfishing, ill-directed subsidies, corruption, poor fisheries management decisions, etc. A more transparent sector would place a spotlight on such activities whenever they occur, making it harder for perpetrators to hide behind the current veil of secrecy and requiring immediate action to be taken to correct the wrong.

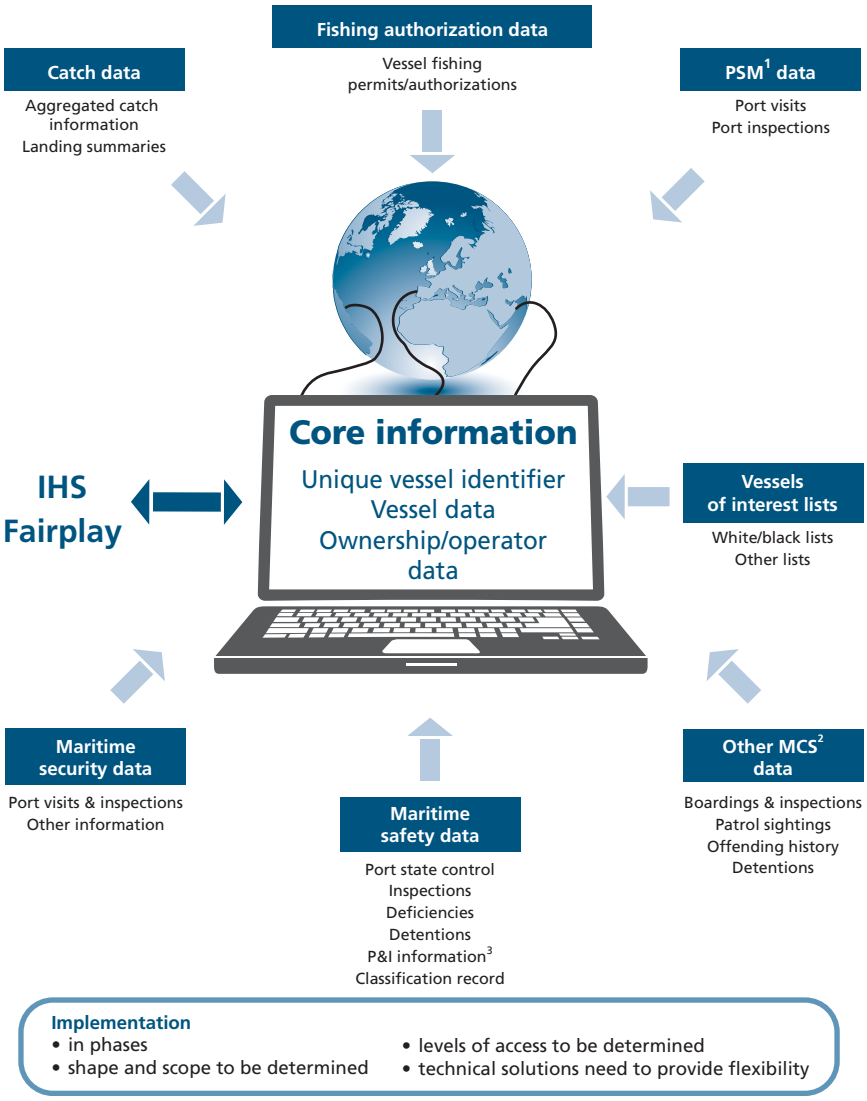
FUTURE PERSPECTIVES

The proposed "Global Record of Fishing Vessels, Refrigerated Transport Vessels and Supply Vessels" (the Global Record) is intended to be the catalyst around which global transparency in the fisheries sector can be improved. Other important recent initiatives such as the Port State Measures Agreement to combat IUU fishing and the proposed guidelines on flag state responsibility are essential additions to the strategic framework to combat IUU fishing, but they will never achieve their potential impact without a more transparent environment in which to operate. The proposed Global Record can help create that environment and, in doing so, act as a force-multiplier for all other tools and initiatives employed in the fight against IUU fishing.

The Global Record is envisaged as a global repository (database) designed primarily to provide reliable identification of vessels authorized to engage in fishing or fishing-

Figure 36

Examples of data modules as part of a comprehensive global record of fishing vessels



[1] Port state measures.
[2] Monitoring, control and surveillance.
[3] Protection and indemnity information.

Source: Based on IHS Fairplay (formerly known as Lloyd's Register-Fairplay).

Table 13
Numbers of fishing vessels by type with IHS-F (IMO) numbers

	Number of vessels[1]
Fishing vessels	12 842
Fish carriers	616
Trawlers	9 513
Fishing support vessels	397
Fish factory ships	68
Total	**23 436**

[1] Figures as supplied by IHS Fairplay (formerly known as Lloyd's Register-Fairplay) as of 30 November 2009.

Table 14
Top ten flag states with fishing vessels carrying IHS-F (IMO) numbers

	Number of vessels[1]
European Union (22 states)	3 879
United States of America	3 372
Russian Federation	1 465
Japan	1 234
Republic of Korea	1 136
Peru	714
Norway	469
China	462
Philippines	444
Morocco	425
Total (top ten states)	**13 600**

[1] Figures as supplied by IHS Fairplay (formerly known as Lloyd's Register-Fairplay) as of 30 November 2009.

related activity. An essential element will be the assignment of a unique vessel identifier (UVI) to each vessel so that, regardless of ownership or flag changes over time, the UVI will remain constant. This will provide certainty to the vessel record and facilitate the accurate association of vessel-related information so that a comprehensive information picture can be developed. Once the core vessel record has been established, it will be possible to associate a wide range of information modules and provide a comprehensive information picture on all aspects of the vessel's operation (Figure 36).

It is envisaged that the Global Record will be Web-based with simple, user-friendly search facilities making it accessible to a wide variety of users. Nevertheless, despite the underlying desire for openness and transparency, it will be possible to provide varying levels of access where appropriate. The Global Record's use of UVIs will provide a high degree of accuracy, and careful analysis is being undertaken as to the best options available to facilitate this. Administered by IHS Fairplay (formerly known as Lloyd's Register-Fairplay), the "International Maritime Organization (IMO) numbering system" that is used for merchant vessels of more than 100 GT tonnes offers an ideal model, with 23 436 active fishing vessels having already obtained IHS-F numbers (Table 13). This existing involvement in the IMO numbering scheme comes from 165 individual states, with 10 states accounting for 58 percent of the vessels (Table 14). Overall, it is believed that the global fishing fleet consists of about 140 000 vessels of more than 100 GT or 24 m length overall (LOA), and so current representation in the scheme is about 17 percent.

This relatively high level of voluntary uptake suggests confidence in the scheme and provides an excellent platform from which all flag states should be encouraged to adopt it for all qualifying fishing vessels. The IHS-F (IMO) number should be viewed as adding value to national and regional vessel registration processes and in no way replaces national or regional vessel registration numbers – it simply adds the essential international dimension needed for global fisheries sector transparency.

A number of RFMOs – and in particular the five tuna RFMOs – have demonstrated outstanding sector leadership in their drive to create a harmonized global record of tuna vessels incorporating the IHS-F (IMO) number as the UVI for each vessel. The development process for this work is providing important insights for the Global Record, and these partnerships are valued by FAO. At a Technical Consultation held at FAO in November 2010, Member States discussed the scope, shape and management of the Global Record.

NOTES

1 *Illegal* fishing is fishing that takes place when vessels operate in violation of the applicable laws and regulations. *Unreported* fishing is fishing that has been unreported or misreported in contravention of applicable laws and regulations. *Unregulated* fishing is fishing in areas where there are no conservation and management measures in place.

2 They account for about 50 percent of the fish and fish products that enter into the international trade.

3 D.J. Agnew, J. Pearce, G. Pramod, T. Peatman, R. Watson, J.R. Beddington and T.J. Pitcher. 2009. Estimating the worldwide extent of illegal fishing. *PLoS ONE*, 4(2): e4570 (available at www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0004570;jsessionid=604D72E332D75382B5EC14CB81197ADD). The study estimated the worldwide cost of illegal and unreported fishing by using detailed reports from published scientific literature and in-country specialist studies. The source studies used a number of different methods to estimate the level of illegal and unreported fishing, including surveillance data, trade data, stock assessments based on fishery-dependent data and expert opinion.

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5 Documentation schemes have been implemented by the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Indian Ocean Tuna Commission (IOTC), the Inter-American Tropical Tuna Commission (IATTC), and the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR).

6 Title IV of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MRSA).

7 European Commission. 2008. *Council Regulation (EC) No 1005/2008 of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing, amending Regulations (EEC) No 2847/93, (EC) No 1936/2001 and (EC) No 601/2004 and repealing Regulations (EC) No 1093/94 and (EC) No 1447/1999* (available at eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:286:0001:0032:EN:PDF).

8 Ibid.

9 The WTO requires that foreign origin product "shall be accorded treatment no less favourable than that accorded to like products of national origin in respect of all laws, regulations and requirements affecting their internal sale" (Article III of the General Agreement on Tariffs and Trade).

10 European Commission. 2009. *Council Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy* (available at www.illegal-fishing.info/item_single.php?item=document&item_id=689&approach_id=16).

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13 Zoonosis refers to diseases that can be transmitted between animals and humans.

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15 M.G. Bondad-Reantaso, A. Lem and R.P. Subasinghe. 2009. International trade in aquatic animals and aquatic animal health: What lessons have we learned so far in managing the risks? *Fish Pathology*, 44(3): 107–114.
16 M.G. Bondad-Reantaso, R.P. Subasinghe, J.R. Arthur, K. Ogawa, S. Chinabut, R. Adlard, Z. Tan and M. Shariff. 2005. Disease and health management in Asian aquaculture. *Veterinary Parasitology*, 132: 249–272.
17 European Commission. 2001. *Directive 2001/82/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to veterinary medicinal products* (available at ec.europa.eu/enterprise/sectors/pharmaceuticals/files/eudralex/vol-5/dir_2001_82/dir_2001_82_en.pdf).
18 Within the scope of this definition, the following terms are also used: alien species, aquatic nuisance species, exotic species, non-native species, foreign species, non-indigenous species, invasive species. See also J.T. Carlton. 2001. *Introduced species in U.S. coastal waters: environmental impacts and management priorities*. Arlington, USA, Pew Oceans Commissions.
19 Water carried by ships to ensure stability, trim and structural integrity.
20 Op. cit., see note 14.
21 Adaptive management, also known as adaptive resource management, is a structured, iterative process of optimal decision-making in the face of uncertainty that aims to reduce such uncertainties over time via system monitoring. In this way, decision-making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management. Adaptive management is often characterized as "learning by doing".
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25 FAO. 1995. *FAO. Code of Conduct for Responsible Fisheries*. Rome. 41 pp.
26 FAO. 2008. *Aquaculture development. 5. Genetic resource management*. FAO Technical Guidelines for Responsible Fisheries No. 5, Suppl. 3. Rome. 125 pp.
FAO. 2007. *Aquaculture development. 2. Health management for responsible movement of live aquatic animals*. FAO Technical Guidelines for Responsible Fisheries No. 5, Suppl. 2. Rome. 31 pp.
FAO and NACA. 2000. *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy*. FAO Fisheries Technical Paper No. 402. Rome. 53 pp.
27 World Organisation for Animal Health. 2009. *Aquatic Animal Health Code 2009*. Paris (also available at www.oie.int/eng/normes/fcode/en_sommaire.htm).
28 World Organisation for Animal Health. 2009. *Manual of Diagnostic Tests for Aquatic Animals 2009*. Paris (also available at www.oie.int/eng/normes/fmanual/A_summry.htm).
29 EU legislation and directives on animal health are available at europa.eu/legislation_summaries/food_safety/animal_health/index_en.htm.
30 Information on this event is available at www.cbd.int/idb/2009/.
31 Information on GloBallast Partnerships is available at globallast.imo.org/index.asp?page=GBPintro.html&menu=true.
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36 FAO and Regional Commission for Fisheries. 2008. *Report of the Regional Technical Workshop on Aquatic Animal Health. Jeddah, Kingdom of Saudi Arabia, 6–10 April 2008*. FAO Fisheries and Aquaculture Report No. 876. Rome. 119 pp.

37 Op. cit., see note 14.

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54 The Community Fishing Fleet Register is commonly called the Fleet Register (available at ec.europa.eu/fisheries/fleet/index.cfm).