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Discards in the world's marine fisheries

An update

Cover illustration:
"Water" by Giuseppe Arcimboldo (1527–1593). Courtesy of the Kunsthistorisches Museum, Vienna.

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An update

by
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This study was prepared as part of the FAO Fishery Industries Division's Regular Programme 2.3.3. Fisheries Exploitation and Utilization.

The reference materials used in compiling the quantitative data form part of the discard database and are provided on the accompanying CD-ROM. A bibliography of the citations used in the text, the references contained in the discard database and sources of other information presented in the report are also provided.

Abstract

This study provides an update of the quantity of discards in the world's marine fisheries based on a fishery-by-fishery approach. The weighted discard rate is estimated at 8 percent (proportion of the catch discarded). Based on this discard rate, in the 1992–2001 period, yearly average discards are estimated to be 7.3 million tonnes. Because of the different method used in the current estimate, it is not directly comparable with the previous estimates of 27 million and 20 million tonnes.

Trawl fisheries for shrimp and demersal finfish account for over 50 percent of total estimated discards while representing approximately 22 percent of total landings recorded in the study. Tropical shrimp trawl fisheries have the highest discard rate and account for over 27 percent of total estimated discards. Demersal finfish trawls account for 36 percent of the estimated global discards. Most purse-seine, handline, jig, trap and pot fisheries have low discard rates. Small-scale fisheries generally have lower discard rates than industrial fisheries. The small-scale fisheries account for over 11 percent of the discard database landings and have a weighted discard rate of 3.7 percent.

Evidence is presented for a substantial reduction in discards in recent years. The major reasons for this are a reduction in unwanted bycatch and increased utilization of catches. Bycatch reduction is largely a result of the use of more selective fishing gears, introduction of bycatch and discard regulations, and improved enforcement of regulatory measures. Increased retention of bycatch for human or animal food results from improved processing technologies and expanding market opportunities for lower-value catch.

A number of policy issues are discussed. These include a "no-discards" approach to fisheries management; the need for balance between bycatch reduction and bycatch utilization initiatives; and concerns arising from incidental catches of marine mammals, birds and reptiles. The study advocates the development of more robust methods of estimating discards, allowance for discards in fishery management plans, development of bycatch management plans and promotion of best practices for bycatch reduction and mitigation of incidental catches. Global discard estimates could achieve greater precision through additional studies at national and regional levels.

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Acronyms and abbreviations

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
ACFMAFMA	Advisory Committee on Fishery Management Australian Fisheries Management Authority
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BOBP-IGO	Bay of Bengal Programme Inter-Governmental Organization
BRD	Bycatch reduction device
BSAI	Bering Sea Aleutian Islands
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCRF	Code of Conduct for Responsible Fisheries
CCSBT	Commission for the Conservation of Southern Bluefish Tuna
CECAF	Commission for the Eastern Central Atlantic Fisheries (West Africa)
CFP	Common Fisheries Policy (European Union)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on (the conservation of) Migratory Species (of Wild Animals) (Bonn Convention)
COFI	Committee on Fisheries
CPUE	Catch per unit effort
CRODT	Centre de Recherches Océanographiques de Dakar – Thiaroye
DFID	Department for International Development (United Kingdom of Great Britain and Northern Ireland)
DFO	Department of Fisheries and Oceans
DSPCM	Délégation à la Surveillance des Pêches et au Contrôle en Mer
EC	European Commission
EIA	Environmental Impact Assessment
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act (United States)
ETP	Eastern Tropical Pacific
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCMA	Fisheries Conservation and Management Act (Magnuson–Stevens Act)
FIGIS	Fisheries Global Information System (FAO)
FIS	Fish Information & Services
FMC	Fishery Management Council (United States)
FMP	Fishery management plan
GEF	Global Environment Facility
GOA	Gulf of Alaska
GRT	Gross registered tons
HMS	Highly migratory species

IATTC	Inter-American Tropical Tuna Commission
IBSFC	International Baltic Sea Fishery Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ICES CM	ICES Council Meeting
ICES WG	ICES Working Group
IDCA	International Dolphin Conservation Act
IDPPE	Instituto de Desonvolvimento de Pesca Pequena Escala (Mozambique)
IDRC	International Development Research Centre
IFREMER	French Research Institute for Exploitation of the Sea
IIFFET	International Institute of Fisheries Economics and Trade
IMARPE	Instituto del Mar de Perú
INPFC	International North Pacific Fisheries Commission
IOTC	Indian Ocean Tuna Commission
IPHC	International Pacific Halibut Commission
IPOA	International Plan of Action (FAO)
ISSCFG	International Standard Statistical Classification of Fishing Gear
ITQ	Individual transferable quota
IUCN	World Conservation Union
IUU	Illegal, unreported and unregulated (fishing)
IWC	International Whaling Commission
LIFDC	Low income food deficient country
LME	Large marine ecosystem
LOS	Law of the Sea
MCS	Marine Conservation Society
MLS	Minimum landing size
MMPA	Marine Mammal Protection Act (United States)
MMS	Minimum mesh size
MPA(s)	Marine protected area(s)
MPEDA	Marine Products Export Development Authority (India)
MSA	Magnuson–Stevens Act (United States)
NAFO	Northwest Atlantic Fisheries Organization
NEAFC	Northeast Atlantic Fisheries Commission
NGO	Non-governmental organization
NMFS	National Marine Fisheries Service (United States)
NOAA	National Oceanic and Atmospheric Administration (United States)
NPFMC	North Pacific Fisheries Management Council
NRI	Natural Resources Institute
OECD	Organisation for Economic Co-operation and Development
PFMC	Pacific Fisheries Management Council
PWCC	Pacific Whiting Conservation Cooperative
RFB	Regional fisheries body
RF(M)O	Regional fisheries (management) organization
SEAFDEC	Southeast Asian Fisheries Development Centre
SEFSC	Southeast Fisheries Science Center (United States)
SERFC	Southeast River Forecast Center (United States)
SFA	Sustainable Fisheries Act (United States)
SGDBI	Study Group on Discard and By-catch Information (ICES)
SGFEN	Subgroup on Fishery and Environment
SOFIA	The State of World Fisheries and Aquaculture (FAO)

SPC	South Pacific Commission
SPREP	South Pacific Regional Environment Programme
SSC	Species Survival Commission
SSD	Seal saver device
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total allowable catch
TED	Turtle excluder device
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNGA	United Nations General Assembly
UNIA	United Nations Implementing Agreement
VNIRO	Russian Federal Research Institute of Fisheries and Oceanography
WTO	World Trade Organization
WWF	World Wide Fund for Nature

Foreword

A global assessment of fisheries bycatch and discards (FAO Fisheries Technical Paper No. 339) was published a decade ago with the hopes of stimulating further investigation of these serious problems. Since its publication, fishery scientists throughout the world, conservation and environmental organizations and members of the fishing industry have extensively referenced the report. However, these estimates no longer constitute a true reflection of current global discard levels and continued citation of the paper's estimates as such is inappropriate.

The estimates provided in the 1994 paper were largely based on data from the late 1980s and it was made clear that these estimates were of a provisional character. In 1996, a FAO Technical Consultation held in Tokyo noted that discards may have been overestimated for some FAO statistical areas in the report and there was strong evidence that discards were declining in many fisheries. FAO's 1998 publication *The State of World Fisheries and Aquaculture* attempted to update the much-cited 1994 discard estimate of 27 million tonnes and provided a revised estimate of 20 million tonnes. The senior author of the technical report also published several updates, noting a variety of factors that may have led to a decline in global discard levels during the late 1990s. This FAO update on global discards on a fishery-by-fishery basis also supports the affirmation that global discards have significantly declined in recent years.

The reasons cited for this decline have included: (i) greater utilization of bycatch species in Asia and elsewhere for both aquaculture and human consumption; (ii) adoption of more selective fishing technologies and methods; (iii) a decline in the intensity of fishing for some species having high bycatch rates; (iv) a variety of management actions that prohibit discarding in some countries, set bycatch quotas, impose time/area closures, and establish marine protected areas and no trawl zones; and (v) more progressive attitudes by fishery managers, user groups and society towards the need to solve discarding problems.

Indeed, with some exceptions, discards in most fisheries in China and Southeast Asia are now considered to be negligible and bycatch landings have increased significantly in many developing countries. Major fishing nations such as Norway, Iceland and Namibia prohibit discards and bycatch reduction devices are mandatory in many Australian, European and Northwest Atlantic Fisheries Organization (NAFO) area fisheries. Numerous national and international workshops have taken place to solve bycatch and discard problems.

Thus, it is disturbing to note that so many scientists revert to 15-year old data in order to document possible current discard levels. These old estimates are frequently cited by various advocacy groups to decry the state of the world's fisheries and the use of terms such as "dirty fishing" merely undermines the considerable efforts and investments of many responsible fishers, dedicated gear technologists and fishery managers to find solutions to long-recognized problems associated with certain fisheries and fishing gears.

We urge therefore that the 1994 global discard estimates are no longer cited to decry the state of the world's fisheries. There is no "one size fits all" solution. Bycatch and discard problems must be addressed fishery by fishery and we urge that scientists and advocacy groups alike focus on the successes of the past decade rather than on the continued citing of data not applicable to fisheries in this century.

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Executive summary

Discards represent a significant proportion of global marine catches and are generally considered to constitute waste, or suboptimal use of fishery resources. A number of United Nations resolutions have drawn attention to the need to monitor and reduce discards and unwanted bycatch, in order to assess the impact of discards on marine resources and promote technologies and other means of reducing them. The previous FAO estimate[1] of discards at a global level (referred to hereafter as "the Alverson assessment"), based on data prior to 1994, is considered to be outdated.

The present study re-estimated discards at a global level using information from a broad range of fisheries in all continents.

Selected policy and technical issues are highlighted and suggestions made for future actions. A road map for achieving further precision in the global estimate is described and associated initiatives are outlined.

METHOD

The Alverson assessment is based on the use of the FAO Fishstat database of national catches. This database provides catch (in practice, the live-weight equivalent of landings) information by country, FAO area and species (or species group). The Alverson assessment is essentially a function of landings by species. However, there is no a priori reason why the discarded quantities of a species should bear a relationship to the landings of target species.

The approach used in this study is based on the premise that discards are a function of the landings of a fishery, rather than a function of the landings of a particular species. A fishery is defined in terms of an area, a fishing gear and a target species.

A list or inventory of the world's fisheries was compiled in a discard database. Each database record contains quantitative data on: (i) the total landings of the fishery; and (ii) either the total quantity of the discards or the percentage of the total catch that is discarded. The total quantity of discards for a given fishery was generally extrapolated from the results of studies on a sample of the fishing activities.

The sources of the information on landings and discards are provided with respect to each fishery, so that the estimate can be readily verified, updated or changed, as new or more accurate information becomes available at national, regional or FAO level.

Discards (or discarded catch) were defined (FAO, 1996b) as being "that portion of the catch which is returned to the sea" for whatever reason. Post-harvest waste and discards of recreational fisheries are not included. Information on discards of turtles, seabirds and marine mammals is included in the database, but such incidental catches are a secondary target of the study. The study does not quantify either the unseen mortalities caused by fishing or the survival of discards.

The information contained in the database was compiled from three principal sources: (i) from scientific literature and from published national fisheries information; (ii) from reports and "grey" literature available within FAO or publicly available on the Internet; and (iii) from contacts with experts in national fisheries administrations, research institutions or regional fisheries organizations, many of whom provided detailed reports and databases.

[1] Alverson *et al.*, 1994. This publication is referred to hereafter as "the Alverson assessment".

The database contains four groups of fields:

- those specifying the fishing area, which include reference to the FAO fishing area codes and the country or Exclusive Economic Zone (EEZ) from which the catch is reported;
- those describing or designing the fishery, which include reference to the gear and the target species;
- those quantifying the landings by the fishery and the quantity or percentage of discards – the sources of the quantitative information are cited;
- other descriptive fields, which give the reasons for discards, relevant management measures in force, exploitation status of the fishery and other information of relevance to the analysis.

The fishery-by-fishery approach encountered several difficulties in data compilation:

- the sheer scale of the task of compiling a list of the world's fisheries and quantifying the landings of each one;
- the absence or inaccessibility of information on discards for many fisheries;
- the lack of published national fisheries catch statistics on a fishery-by-fishery basis;
- the failure of numerous publications to distinguish clearly between discards and bycatch; and
- the narrow focus of some studies on the discards of target or commercial species only.

To facilitate the discard estimates, certain assumptions were made, and use was made of fisheries information that had already been aggregated, specifically:

- in the absence of information to the contrary, artisanal fisheries were assumed to have a discard rate of 1 percent or less than 1 percent of the catch;
- in the absence of information to the contrary, "fishmeal fisheries" were assumed to have a discard rate of 1 percent or less than 1 percent of the catch;
- with some exceptions, Southeast Asian fisheries were considered to have a discard rate of 1 percent of the catch;
- tuna and other highly migratory species (HMS), and other fisheries for which statistical information has been collected by regional fisheries bodies (RFBs) were generally aggregated by ocean; and
- fisheries, in the opinion of the author considered to be substantially similar in terms of fishing grounds, target species, fishing area, socio-economic basis and management regime, were considered to have a similar discard rate.

RESULTS

Over 2 000 records of fisheries were compiled of which 1 275 contain quantitative information on either landings or discards. Of these records, 788 are quantitatively complete, i.e. they contain quantitative information on both landings and discards for a given fishery. Countries with such complete sets of information include Norway, Iceland, the South Pacific Island states, Thailand, Malaysia and Viet Nam. In the case of the Southeast Asian countries this "completeness" is based on assumptions made by national fisheries authorities regarding low discard rates, rather than on empirical information on discard quantities. There are 62 records that refer exclusively to numbers of marine animals caught incidentally (marine mammals, seabirds and turtles).

Based on the set of complete records, the sum of the recorded discards is 6.8 million tonnes with respect to total recorded landings of 78.4 million tonnes. The global weighted discard rate is 8 percent.

Applying the global weighted discard rate estimated in this study (8 percent) to a ten-year average of the FAO Fishstat[2] reported global nominal catch, total extrapolated discards are 7.3 million tonnes. Some caution is required in extrapolating from the total

[2] Fishstat Plus (version 2.3) of 24 July 2003. The nominal catch value excludes marine animals and plants.

global catch, as certain major fish producer countries are not adequately represented in the database. These include the Democratic Republic of Korea, the Republic of Korea (no discard information), the Russian Federation, New Zealand and the Philippines. The European Union (EU) member countries and India have only partially been covered. A number of small fish-producing countries are not included.

Shrimp and demersal finfish trawl fisheries account for over 50 percent of total estimated discards while representing approximately 22 percent of total recorded landings. Tropical shrimp trawl fisheries have the highest discard rate and alone account for over 27 percent of total estimated discards. Small-scale fisheries generally have lower discard rates than industrial fisheries. Purse-seine, handline, jig, trap and pot fisheries have low discard rates. In geographical terms the highest discards are in the Northeast Atlantic and Northwest Pacific, which jointly account for 40 percent of discards (FAO areas 27 and 61, respectively).

At the global level it was not possible to compile a time series on discards to enable an empirical assessment of global trends in discards to be established. Nevertheless, two trends are apparent. There has been a reduction in bycatch and in discards in many fisheries, particularly those in developed countries. There is increasing utilization of bycatch and a consequent reduction in discards in many fisheries, particularly in developing countries. Several time series of discard data for selected fisheries are provided in support of these conclusions. A decrease in effort and change of target species in some major trawl fisheries has also resulted in a reduction of discards. Changes in fisheries regulatory regimes, requiring more selective fishing and prohibiting or curtailing discards, have also contributed to discard reduction.

The Alverson assessment, published in 1994, estimated discards to be 27 million tonnes (range 17.9 and 39.5 million tonnes). A subsequent (1998) FAO estimate suggested a reduced estimate of 20 million tonnes and a further study by Alverson in 1998 indicated that the 1994 assessment was an overestimate. Because of differences in method, the estimates provided in this report are not directly comparable with the Alverson assessment and consequently the extent to which the estimates represent a reduction in discards is not known.

The main spreadsheet file of the discard database and a bibliography are provided on the accompanying CD-ROM. The spreadsheet file is supplemented by numerous country and fishery files as well as files generated from databases supplied by the regional fisheries organizations or derived from national fisheries statistics. These files and source materials, including electronic copies of reference materials, are archived within FAO, classified by continent, country or regional fisheries organization. A searchable bibliography was compiled using bibliographic software.

POLICY IMPLICATIONS

The "discard problem" embraces several issues or subproblems:

- the moral problem of responsible stewardship of marine resources;
- designing a management regime that limits or prevents discarding while meeting multiple social, economic and biological objectives;
- the practical problem of enforcing regulations designed to prevent or minimize discards, particularly as discards occur at sea where enforcement is most difficult;
- the technical problems of gear selectivity and utilization of species with a low market demand through transformation or adding value; and
- the economic problems posed by efforts to reduce bycatch, increase landing of bycatch or increase utilization of bycatch.

Moral issues

International instruments, including United Nations (UN) resolutions, the Kyoto Declaration and the Code of Conduct for Responsible Fisheries (CCRF) have

highlighted the need to reduce or minimize discards. These instruments reflect the idea, enshrined in many of the world's religious and secular beliefs, that wastage of natural resources is morally wrong.

A number of countries have instituted fisheries policies and management regimes based on the principle of "no discards". A "no-discard" policy implies a paradigm shift in approaches to fisheries management. It moves the focus of management measures from landings to catches and from fish production to fish mortality. In conformity with the precautionary approach, by regarding "no discards" as the norm, any discarding then requires adequate justification.

Issues related to the Code of Conduct for Responsible Fisheries

There are two principal approaches to addressing the "discard problem":

- reducing bycatch
- increasing utilization of bycatch

These two harvest strategies may be complementary and in any given fishery an appropriate balance between bycatch reduction and utilization is required. The biological and social principles upon which such a balance can be based require further analysis and development of decision frameworks. A more precise interpretation of "the ecosystem approach" in terms of the trade-off between promoting bycatch reduction and promoting bycatch utilization may be of value. In particular, the balance between highly selective fishing that targets one trophic level (or species) only, and less selective fishing that is likely to impact upon several trophic levels (or species groups), may require further attention to enable best scientific advice to be made available.

A third approach is to improve the survival of discards and animals returned to the sea. This is of particular importance with regard to species groups such as marine mammals, turtles, seabirds, lobsters and crabs.

Responsible fishing operations (in relation to discards and bycatch) can be based on the following principles:

- making efforts to avoid unwanted catches – in particular, catches of endangered species and unwanted catches and discards that may reduce biodiversity or disrupt ecosystem function or integrity;
- where catches of unwanted species, sizes or sexes are unavoidable, making efforts to find sui uses for such animals, and/or if there is a reasonable probability of survival, making efforts to return the unwanted catch to the sea;
- taking measures to increase the survival of unwanted catch destined to be returned to the sea;
- keeping records of discards, if required for management purposes.

The incidental catch and subsequent discard of charismatic, protected or endangered species, such as turtles, marine mammals and seabirds, are likely to have an increasing impact on fishing activities and trade in fish products. The absence of a neutral and internationally accredited mechanism for compilation of information on the incidental catches of many of these species and for examination and promotion of best practices in mitigation measures may impede rational discussion and development of solutions.

TECHNICAL IMPLICATIONS

Discard information has a high inherent level of variability requiring high levels of discard sampling to give accurate assessments. On-board observer reports are considered indispensable for accurate estimation of discards. Relationships between discard rates and other variables (e.g. landings, duration of trip, length of trawl tow, market prices) tend to be weak. Consequently, raising or extrapolating discard estimates derived from samples to the level of the fleet or fishery may have a high degree of error. Accuracy is dependent on the design of an appropriate sampling protocol.

Discards account for a significant mortality in fisheries. For numerous reasons discard estimates may not be included in stock assessments, TAC determination or quota management. In general, the "accounting toolkit" for discards is deficient.

National fisheries statistics are generally collected, compiled and presented on a species-by-species or species group basis. There are several advantages in also compiling national fisheries statistics on a fishery-by-fishery basis. In particular, this may focus attention on the definition of coherent management units, link trends in landings to fishery-specific management measures and facilitate inclusion of discard estimates if required.

The discard database includes information on fishery management measures associated with discards and bycatch. The measures include legal obligations (e.g. minimum landing sizes, quotas and transhipment prohibitions), economic incentives and technical improvements (e.g. bycatch reduction devices [BRDs]). A number of fisheries have specific bycatch plans or require environmental impact assessments that specifically address bycatch and discard issues.

FUTURE DIRECTIONS

The development of guidelines on best practices can be considered with regard to:

- discard sampling, e.g. from observers, logbooks, fishers' estimates;
- raising of discard estimates to the fleet or fishery level;
- use of discard estimates in stock assessments;
- use of discard estimates in total allowable catches (TACs) and quotas;
- development of bycatch management plans; and
- introduction and adoption of bycatch reduction and incidental catch mitigation technologies and practices.

A series of related studies can be considered to supplement this study, in particular, to compile:

- information on the interaction between fishing activities and charismatic species at fishery, ocean and global level, with a focus on effective mitigation measures;
- information on unobserved mortalities caused by fishing activities; and
- additional information on survival of discards.

This study is regarded as an evolving tool rather than a static report. Ideally, it requires a further "decentralized" phase at national or regional level to: (i) verify or update the information in the discard database; (ii) give a broader "ownership" base to the discard information, through dialogue and consultation with national fisheries administrations and regional fisheries organizations; and (iii) compile discard information from countries and fisheries where information is deficient.

The global fishery-by-fishery records of landings form the backbone of the discard database. This set of records is of potential use for a range of other analyses, in particular if fields such as "status of exploitation of the fishery" are complete. Efforts are under way to integrate the database into FAO's Fisheries Global Information System (FIGIS) both as a basis for compiling the global inventory of fisheries and as a discard database subset. Records in the database may be biased towards discards, since many of these records are derived from "discards literature".