The Global Extent of Illegal Fishing

and

Fisheries Ecosystems Restoration Research,
Fisheries Centre,
University of British Columbia

April 2008

Project no:	GB0846	
Issue ref:	001 – Final Draft 002 - Final	
Date of issue:	28th April 2008	
Prepared by:	MRAG	Dr David Agnew, Fisheries Director, MRAG Ltd (d.agnew@mrag.co.uk) John Pearce, Senior Consultant, MRAG Ltd (j.pearce@mrag.co.uk) Tom Peatman, Fisheries Consultant, MRAG Ltd (t.peatman@mrag.co.uk)
	UBC	Prof. Tony Pitcher, Professor of Fisheries, Peter Wall Institute for Advanced Studies, University of British Columbia (pitcher.t@gmail.com) Pramod Ganapathiraju, Fisheries Ecosystems Restoration Research, Fisheries Centre, University of British Columbia (prammod.raju@gmail.com)
Checked/Approved by:	Dr David Agnew, Fisheries Director, MRAG Ltd (d.agnew@mrag.co.uk)	

Contents

Abbreviations and Acronyms

Abbreviation / Acronym	Description
ASFIS	Aquatic Sciences and Fisheries Information System
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CITES	Convention on International Trade in Endangered Species (of Wild Fauna and Flora)
DEFRA	(UK) Department for Food and Rural Affairs
DFID	(UK) Department for International Development
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FERR	Fisheries Ecosystems Restoration Research, (Fisheries Centre, University of British Columbia)
FFA	Forum Fisheries Agency
HSTF	High Seas Task Force
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IOTC	Indian Ocean Tuna Commission
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
IUU	Illegal, Unregulated and Unreported
MRAG	Marine Resources Assessment Group
NAFO	North Atlantic Fisheries Organisation
NEAFC	Northeast Atlantic Fisheries Commission
RFMO	Regional Fisheries Management Organisation
SADC	Southern African Development Community
UBC	University of British Columbia
WCPFC	Western Central Pacific Fisheries Commission
WWF	Worldwide Fund for Nature

List of Figures

List of Tables

Executive summary

Illegal, unreported and unregulated (IUU) fishing has now been recognised as a global problem, and many groups have developed proposals and plans for addressing IUU fishing. In order to clearly understand the impact of these initiatives we need to have a good understanding of current and historical levels of illegal fishing on a global and regional scale. Although a number of studies of illegal fishing have been undertaken previously, this report presents the first detailed quantitative analysis of the problem on a global scale.

Estimates of illegal fishing from different Exclusive Economic Zones (EEZs) and unregulated and unreported fishing high seas regions were collected through an IUU monitoring network (commissioned directly by the project) and sourced from the available literature and through discussions with monitoring, control and surveillance (MCS) professionals. The combination of information was used to generate a series of in-depth studies detailing the level of illegal fishing for a number of different species in 60 countries (chosen as those with the highest catches in their EEZs) and 17 high seas FAO (Food and Agriculture Organisation) regions. Overall the estimates of illegal fishing are based on a number of species and areas that constitute 46% of global catches based on FAO catch statistics.

The level of IUU catches was calculated on a regional and species group basis. The results demonstrated that there are significant differences in the level of IUU catch and the trends in those catches between regions, being highest in the Eastern Central Atlantic (Area 34) and lowest in the Southwest Pacific (Area 81). Over the last 10 years IUU has declined in 7 areas, increased in one and stayed the same in the remaining 7. We estimate that the overall loss from our studied fisheries is 11-19% of the reported catch in those fisheries, worth some $5-11bn in 2003.

Taking the total estimated value of illegal catch losses within the analysed fisheries and areas and raising by the proportion of the total world catch, the lower and upper estimates of the total value of current IUU losses worldwide were between $10bn and $23bn annually, representing between 11.06 and 25.91 million tonnes. This estimate is roughly consistent with estimates made recently by MRAG (2005) ($9bn), the European Commission (2007) ($15bn) and the estimates from Pauly *et al.*.(2002) ($25bn).

1 Introduction

IUU is a global problem, and has been recognised as such by a number of recent initiatives such as the FAO International and domestic Plans of Action, the Ministerial High Seas Task Force on IUU fishing (HSTF) and various conferences and industry and non-Governmental Organisation (NGO) initiatives over the last 5 years. For example, Greenpeace, Traffic and WWF have tracked illegal-caught fish products through market chains, photographed and tracked illegal vessels on the High Seas, and published a 'rogues gallery' of vessel owners on-line. The HSTF, in particular, developed a 9-point action plan for addressing IUU fishing. The European Commission has recently developed a detailed proposal for addressing IUU fishing and fish entering the European marketplace (COM(2007) 602 final) and the European Court of Auditors has recently criticised fisheries control within EU waters and recommended a set of measures to deal with the problem (ECA, 2007).

Clearly, it will be important in understanding the impact of these initiatives that we develop an ability to track the development of IUU fishing on a global scale, so that we can identify whether IUU is been affected by them or is simply being displaced around the world. Although a number of papers have been published in recent years estimating the level of IUU fishing using a variety of methods (Restrepo, 2004; Anganuzzi, 2004; Agnew & Kirkwood, 2004; Ainsworth and Pitcher, 2005; Pitcher et al. 2002, Sumaila *et al*. 2006, Tesfamichael and Pitcher 2006, Varkey *et al.* 2008, Bailey *et al.* 2008) only one study has attempted to estimate the impacts of IUU over a whole region (MRAG, 2005). Although Pauly *et al.* (2002: Figure 1) provided preliminary global discard and illegal catch values from 1950 to 2000, this was not based on detailed quantitative studies and, to date, no single analytical global estimate of IUU exists. In their study, MRAG estimated that the value of IUU fishing in sub-saharan Africa was about $0.9bn annually. They also estimated that the total value of high seas IUU was $1.2bn. The Pauly (2002) study gives an estimate of 41.9% total IUU in 1998, (comprised of 16% discards and 25% unreported catches) worth around $40 billion globally.

This report presents the first results of a project funded by the UK government (DEFRA and DfID) to develop an international IUU monitoring network and produce the first global estimate of IUU fishing.

2 Methods

In 2007 an IUU monitoring network was set up, involving correspondents from a wide range of countries concerned with tracing the development of IUU in their region. A workshop in early 2007 developed a common format for reporting estimates of IUU fishing from different regions. Reports forwarded from this group, commissioned directly by the project, and sourced from the literature were used to generate a series of in-depth studies for 60 countries and 17 high seas FAO regions. Catches from these 60 countries and regions represent 96.4% of the world fish catch (based on 1999 FAO data). The source of all information is presented in Annex 1.

The term "IUU" can cover a wide range of issues (see discussion in Bray 2000, Agnew 2000, Pitcher *et al*. 2001). For the purposes of this report, we defined it to include catches taken within an EEZ which are both illegal and retained, and which are usually unreported, and all unreported catches taken in high seas waters subject to an Regional Fisheries Management Organisation's (RFMO) jurisdiction. The important criterion for this category is that for these fish rents are captured by IUU fishermen but lost to authorities and legitimate fishermen. These catches are usually unreported and therefore cause problems for science and management.

Catches that are discarded and unreported are not included in this report. Note that although a number of countries estimate discards through on-vessel observer schemes and suchlike, no discards from any country are included in the FAO database of reported catches. Therefore all discards logically count in the total "IUU' worldwide. However, in this report we have excluded discards and unreported legal catches, and estimate only the "illegal" or "unregulated" component of IUU.

2.1 Data sources

Countries were selected based on the volume (tonnage) of catches taken in their EEZ in order of magnitude (i.e., their importance as fishing areas -
Figure 1). A few additional countries with smaller catches (5 in all, 1.4% of world catch) were included because of their importance in IUU issues. All RFMOs were examined. Because data were required by EEZ rather than FAO area, and in order to keep catches consistent with FAO totals, catch data for each EEZ selected and for each high seas FAO region were extracted from the SEAAROUNDUS project (www.seaaroundus.org) database. Within each study, catches and IUU fishing (discarded and illegal assembled separately) of the four highest volume (i.e., tonnage caught) species were estimated from the source studies.

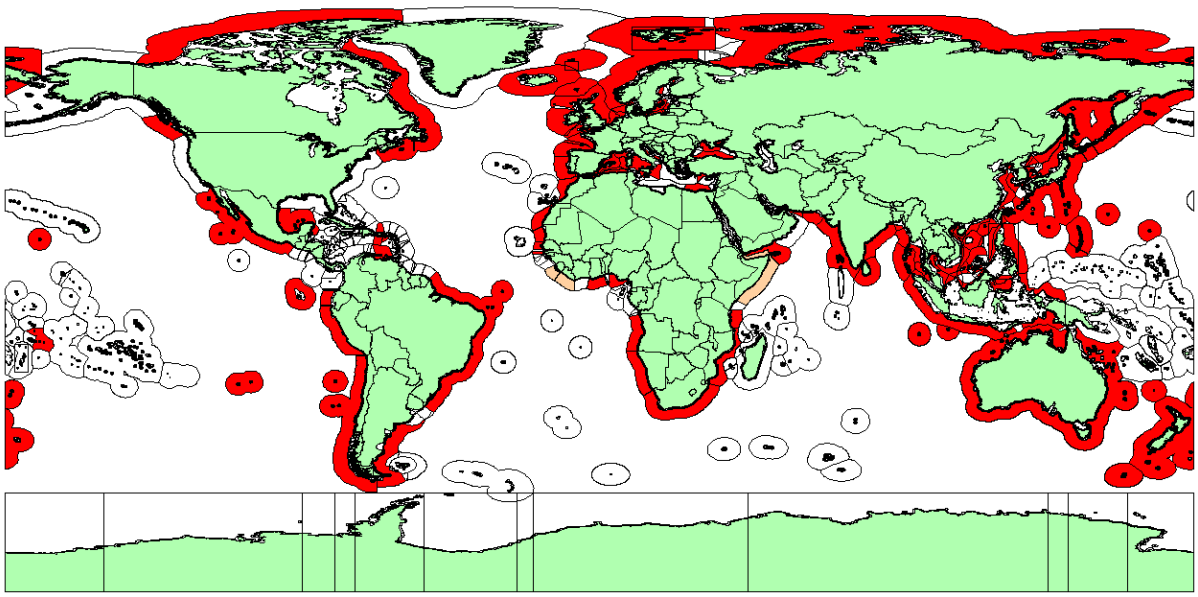

Figure 1 EEZs selected for the study

In some cases highly valuable low volume species are not reflected (e.g. sea cucumber, lobster, abalone and some other shellfish). A separate section reports the latest data on some of these species. Some high seas fisheries are not covered by RFMOs. We have assumed that these catches are reported to FAO and are not, therefore, IUU.

Estimating the level of IUU fishing is extremely difficult. We have used the "anchor points and influence table" approach of Pitcher et al. (2002); this method has been used in a number of recent studies including five of those cited above and a recent FAO sponsored study on the Arafura Sea (Waggey *et al*. 2008, in press). We extended estimates of IUU fishing over the time period 1980 – 2003 as, at the time of writing, this was the final year for which full FAO catch data were available for all areas. To smooth out unreliable annual fluctuations in the trends, the influence table was assembled by 5-year block rather than for individual years. Percentage trends for each five year block were later multiplied by the annual reported catch data to form overall annual estimates. These estimates were derived through examination of various sources including previous estimates of IUU, scientific literature (e.g., ICES reports), submissions to the IUU Monitoring Network, a database of IUU reports and incidents assembled at UBC, and discussions with fisheries staff in the countries concerned. In addition to point estimates, we used ancillary information to estimate upper and lower bounds for the IUU. Where direct estimates of IUU catches were available from specific studies (Annex 1) these estimates were used as anchor points in the calculations. If estimates for each year in the time series were not available, other information was used to infer changes to the levels of IUU. Where direct estimates of IUU catches were not available, but anecdotal qualitative information was available, this was used to set bounds on likely levels of IUU according to the following semi-objective scale:

Negligible	1-2%
Very Low	2-5%
Low	5-15%
Moderate	10-30%
High	30-60%
Very high	60-100%
Extreme	100-300%

Annual catch data for each of the 60 EEZs selected and for each of the 17 high seas FAO region were extracted from the SEAAROUNDUS project (www.seaaroundus.org) databases for each EEZ, along with detailed catch information on the four largest fisheries (usually comprising individual species or species groups and identified within the analysis database by the appropriate ASFIS species code to enable further analysis by the ISSCAAP group) catches on an annual basis. This led to 312 separate fishery estimations per year. The SEAAROUNDUS project has attributed catches reported to EEZs and High Seas by means of a geospatial algorithm (Watson *et al.* 2004). Percentage trends for IUU in each five year block were multiplied by the annual reported catch data to form overall annual estimates, separated into illegal catches and discards (including other unreported fish catch such as recreational and legal but unreported artisanal catches).

In order to estimate the global level of IUU a single estimate for the price of a tonne of fish each year was used. The price data used was that reported by FAO[1].

For some countries a historical time series of estimates of IUU could not be derived from available data sources. While they have been included in the overall estimate of IUU catches (Table 1), these data do not contribute to the figures showing the trends in illegal catch over time by region.

2.2 Calculations

For each case study and species the analysis generated the following

T_{cy}	total reported tonnage of all wild fish caught in the case study EEZ/RFMO area *c* in year *y*
t_{csy}	reported tonnage of fishery *s* in case study *c*
U_{csy}	upper bound estimate of illegal catch
L_{csy}	lower bound estimate of illegal catch

The estimate of illegal catch as a proportion of reported catch for a case study and year was calculated as $p_{yc=}\frac{\left(U_{cy}+L_{cy}\right)}{2t_{cy}}$ where $U_{cy}=\sum_{s=1}^{4}U_{csy}$, and so on.

Summing these provided an estimate of global IUU catch for the specified 312 case studies, which comprise 46% of the reported total world marine fish catch. Any remaining non-case study catches out of the reported total for each country were raised by the weighted percentages from these six analyses, providing estimates of total fish extractions by year for each EEZ and High Seas area. Unreported recreational and artisanal fisheries not included in the selected cases were also estimated separately using similar sources and technique, but these are not included here.

Results are given for IUU catch and IUU proportion by region and species. Regional estimates were developed by combining the high seas estimates along with those EEZ estimates within that region. Where an EEZ was shown to be covered by a number of different FAO regions, these EEZs were where possible divided into two separate estimates (e.g., the estimate for the Russian EEZ was broken down by for the Atlantic and Pacific catches and Canada for the west and east coasts). If this was not possible, the data reported by FAO area and recorded in FISHSTAT were used to determine the approximate

[1] FAO (2005). FAO Yearbook of Fisheries Statistics 2005. Food and Agriculture Organisation of the United Nations, Rome. (Online: ftp://ftp.fao.org/fi/stat/summary/default.htm)

percentage of catches taken in each area and the estimates distributed uniformly with reported catches (e.g., South Africa, Australia and USA).

Illegal catches were also estimated by the standard ISSCAAP species group classification in order to determine the relationship between the different groups of species and the level of illegal fishing on each group.

The regional estimates were then calculated for the following fifteen regions:

- Antarctic Ocean (FAO areas 48, 58 and 88 combined)
- Atlantic Ocean – Northwest (FAO area 21)
- Atlantic Ocean – Northeast (FAO area 27)
- Atlantic Ocean – Western Central (FAO area 31)
- Atlantic Ocean – Eastern Central (FAO area 34)
- Atlantic Ocean – Southwest (FAO area 41)
- Atlantic Ocean – Southeast (FAO area 47)
- Indian Ocean - Western (FAO area 51)
- Indian Ocean - Eastern (FAO area 57)
- Pacific Ocean – Northwest (FAO area 61)
- Pacific Ocean – Northeast (FAO area 67)
- Pacific Ocean – Western Central (FAO area 71)
- Pacific Ocean – Eastern Central (FAO area 77)
- Pacific Ocean – Southwest (FAO area 81)
- Pacific Ocean – Southeast (FAO area 87)

We have included all FAO marine regions were covered with the exception of the Arctic (Area 18), which has limited catches and the Mediterranean and Black Seas (Area 37) where EEZ boundaries are problematical. Therefore estimates of the total catches were developed for the Antarctic, 6 for the Atlantic Ocean, 2 for the Indian Ocean and 6 for the Pacific Ocean) with six species being estimated.

3 Results

In the previous review of IUU fishing and developing countries, MRAG (2005) the "Big Issue" approach was used to estimate the scale and distribution of world IUU fishing. In this report we take another look at these issues, updating and expanding where possible in the light of new information collected.

3.1 Key IUU Fisheries

Some specific fishery groups were highlighted in our previous report (MRAG 2005) of being of key interest internationally. Although all these fisheries are now included in our global estimates, we update that report here with recent information where available.

3.1.1 Tunas and tuna-like fish (large pelagics)

Since most tuna fisheries are now covered by RFMOs IUU fishing for tuna is largely either unreported, because all vessels flagged in states that are party to these organisations should report catches, or unregulated by virtue of the flag states not being party to the relevant RFMO. IOTC and ICCAT both make estimates of IUU tuna catch, and these are included in our model (see also MRAG 2005).

In the Western Pacific, the bulk of IUU fishing probably occurs within EEZs and in particular within the waters of FFA members (see, for instance, the Papua New Guinea case study in MRAG, 2005). Since previous reports of large catches (e.g. Greenpeace[2] (2005)) IUU is now largely subsumed within the catches reported to WCPFC. These estimates, and residual estimates for the WCPFC, are included in our case studies.

Catches of bluefin tuna in the Mediterranean and the high seas of the east Atlantic are underreported to ICCAT, who have suggested that in recent years reported catches form approximately 67% of total catches (ICCAT, 2007). Unreported catches in 2006 were estimated at 17,000t[3]. Recently information has come to light that Japan under-reported 100,000 t ($6 billion) of Southern Bluefin tuna over the past 20 years[4]. Within CCSBT Japan agreed in 2007 to reduce its quota to compensate for this.

3.1.2 Sharks

There is no additional information available on sharks further to that reported in MRAG (2005). Using the shark fin trade in Hong Kong as a source of information, Clarke *et al.* (2006) estimated that the total catch of sharks must be between 3 and 5 times that reported to FAO, between 1.1 and 1.9 million t per year[5]. S. Clark (pers. comm.) estimates that this

[2] http://weblog.greenpeace.org/pacific/background/pirate_threat.html

[3] ICCAT (2007). Report of the Standing Committee on Research and Statistics (SCRS). Madrid, Spain 1-5October 2007.

[4] CCSBT (2007). Report of the Fourteenth Annual Meeting of the Commission, 16 - 19 October 2007, Canberra, Australia.

[5] Shelley C. Clarke, Murdoch K. McAllister, E. J. Milner-Gulland, G. P. Kirkwood, Catherine G. J. Michielsens, David J. Agnew, Ellen K. Pikitch, Hideki Nakano, Mahmood S. Shivji (2006) Global estimates of shark catches using trade records from commercial markets Ecology Letters 9 (10) , 1115–1126.

catch is worth $292-476m in shark fin value alone. Between 66% and 80% of the total catch is therefore unreported, and probably 50% of the total catch derives from high seas waters.

3.1.3 Groundfish

Although our model only runs up to 2003 there have been important recent developments in the IUU catches of three major stocks of cod in the NE Atlantic.

NEAFC has reported IUU fishing for redfish within its area. This was estimated at about 15000 t in 2004 (OECD, 2005[6]). In 2007 NEAFC claimed that IUU fishing by non-contracting countries had effectively been halted (NEAFC, 2007) as a consequence of the NEAFC IUU A and B lists.

In the Barents Sea there is an area similar to the Bering Sea's donut hole, called the loophole, between the EEZs of Russia and Norway. There are continuing allegations about illegal cod catches from this stock (WWF, 2004 [7]; 2008[8]; Norway [9]), with most of this appearing to be illegal (unreported) catches taken in the Norwegian and Russian EEZs. WWF (2008) estimated total IUU catches in 2005 to be 110 000 - 131 000 tonnes with a further 20 000 – 60 000 tonnes discarded (WWF, 2008), an illegal practise in Russia and Norway. The IUU catches in 2005 alone were worth approximately $ 358 – 429 million. The majority of the IUU catch was made by Russian vessels. Russian "unallocated" (unreported) catches are estimated to have reduced from 101,300 tonnes in 2005 to 44,000 tonnes in 2007 (a reduction from 32% to 18% of total Russian cod catches). The imposition of the NEAFC port state scheme appears to be having an effect on reducing IUU activity in the Barents Sea.

ICES also reports reductions in the unreported catch of cod in the North Sea, but to date there is little evidence of reductions in the 37% estimated unreported catch of cod in the eastern Baltic. The North Sea reductions have happened in only the last 2 years of the fishery, and do not appear in our global estimates for which 2003 is the last year of data.

CCAMLR reported a reduction in IUU catch in the mid-2000s as enforcement in CCAMLR waters which are also under national jurisdiction was stepped up. However, the IUU catch in high seas waters, notably in the southern Indian Ocean close to the Antarctic continent, has increased again and is now 2622t of a total 15929t (16.5%) for 2003 / 04[10].

3.1.4 Abalone

The illegal trade in abalone (*Haliotis spp*.) is primarily driven by consumers in Asia, notably China, Japan and Singapore. Abalone poaching continues to be dominated by increasingly sophisticated criminal syndicates. The illegal trade in South African abalone is estimated at USD 70-140 million (approximately 1500 tonnes) (Markus Burgener, Senior Programme Officer, TRAFFIC East/Southern Africa) and has contributed to closure of the commercial fishery. CITES listing was introduced in May 2007 to help control the international trade which is often clearly illegal. For example, 11% of abalone entering Hong Kong originates

[6] OECD, 2005: Draft Synthesis Report On IUU Fishing Activities. AGR/FI(2004)18
[7] Esmark, M & N. Jensen, 2004. The Barents sea cod - last of the large cod stocks. WWF Norway report 4/2004: www.wwf.no/core/pdf/wwf_codreport_2004.pdf.
[8] WWF (2008), Illegal fishing in Arctic waters – Catch of Today Gone Tomorrow?, 52pp.
[9] Norwegian Directorate of Fisheries (2007). Russian fishing of cod and haddock 2006, Status Report (2007).
[10] http://www.ccamlr.org/pu/E/sc/fish-monit/iuu-est-table.pdf

from Mozambique (Traffic Bulletin, 2006, Vol. 21 No. 1), despite the fact that Mozambique does not possess an abalone fishery. Listing under Appendix 2 or 3 is also currently being considered for abalone in Australia (Australian Government Department of Agriculture Fisheries and Forestry, 2005). Unfortunately some countries are still not signatories and do not have to comply with its import requirements. This group includes Hong Kong, a major abalone market that accounts for more than 25% of all global abalone supply (Traffic Bulletin, 2006, Vol. 21 No. 1).

3.2 Regional Analysis

Our estimated trends in the percentage of illegal catch by region are shown in the following figures.

Very little information was available to estimate the level IUU fishing in the Northwest Atlantic with uncertainty particularly over the levels of IUU in the Atlantic cod fishery during the early 1990's giving a wide estimate of the general level of IUU at this time. Since the mid 1990's the level of IUU has reduced, reflecting a gradual increase in control by coastal states and NAFO. In the Northeast Atlantic reasonable estimates are available from various reports and ICES assessments (Annex 1). These indicate that as pressure on stocks increased following the end of the gadoid outburst (mid 1970s to late 1980s) the level of IUU increased and has only recently shown signs of being brought under control. In the Western Central Atlantic there has been a steady improvement in control by both South American coastal states and ICCAT.

In the Eastern Central Atlantic, by contrast, there appears to have been a steady increase in illegal fishing, which is at a much higher level than in the western central Atlantic. This is a large area, covering many states with a wide variety of fisheries and governance state (Morocco to Angola). There is a period in the 1990s when coastal states in NW Africa, particularly, were exerting greater control on their resources and in which period we estimate the illegal catch decreased. By contrast, we consider that in the late 1990s countries such as Guinea, Sierra Leone and Liberia suffered increasing illegal catches as a result of internal strife.

We have increasing uncertainty about the level of illegal catch in the SW Atlantic from the mid-1990s, but overall levels of IUU appear to have increased at this time, once again in response to declining resource status. In contrast, the exclusion of foreign vessels, and imposition of national control in Southeast Atlantic coastal states from the late 1980s led to a marked reduction in illegal catch at that time followed, we estimate, by a continued decline.

The decline in the Western Indian Ocean reflects gradually increasing control over time by coastal states, particularly those in the extreme north and the SADC region, and a reduction in the unreported catch estimated by the IOTC. In the Eastern Indian Ocean there has been a gradual increase in illegal catch but this masks a complex set of dynamics in which some coastal states appear to have been able to reduce the level of IUU over the period, but in some with high volumes of catches the amount of IUU appears to have increased. This may reflect increasing pressure from small scale fisheries.

The increase in estimated illegal in the Northwest Pacific is almost entirely due to the influence of China and Russia, since estimates of illegal catch in other states in the area is relatively small. However, the knowledge-base for this estimate is not as good as for other estimates in this analysis, which is reflected in the increase in uncertainty in this region.

Northeast Pacific illegal catch is currently estimated to be low and to have steadily declined over the recent few years. Peaks of IUU activity in the Northeast Pacific Ocean are linked to high estimates of IUU in the Alaskan pollock. Western Central Pacific data include coastal states of the western Pacific seaboard, where the information available to us suggests that a relatively high level of IUU has been present with little change over the years. In the Eastern Pacific a similar situation of low change exists, but with a much lower estimated proportion of illegal fishing.

The Southwest Pacific increasing control by coastal states has led to a significant reduction in illegal fishing over the last 20 years. Some reductions in the IUU catch in the Southeast Pacific are also suggested from detailed studies of some South American countries, but the general level of illegal fishing is higher here than in the western Pacific.

Finally, in the Antarctic the only illegal fishing issue is unregulated and unreported fishing for toothfish, which peaked in 1996 and has since significantly reduced.

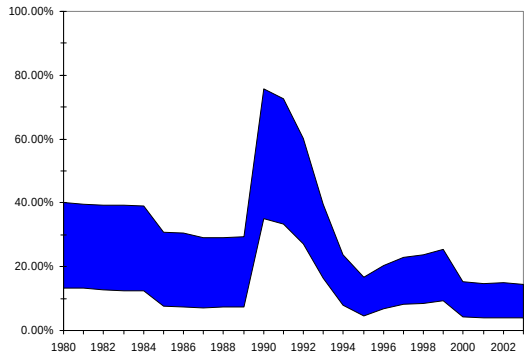

Figure 2 **Percentage IUU Northwest Atlantic (FAO Area 21) 1980 2003.**

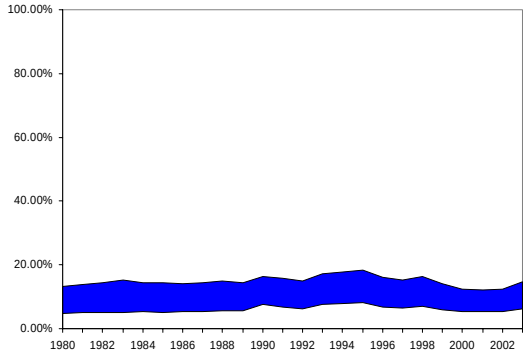

Figure 3 **Percentage IUU Northeast Atlantic (FAO Area 27) 1980 2003.**

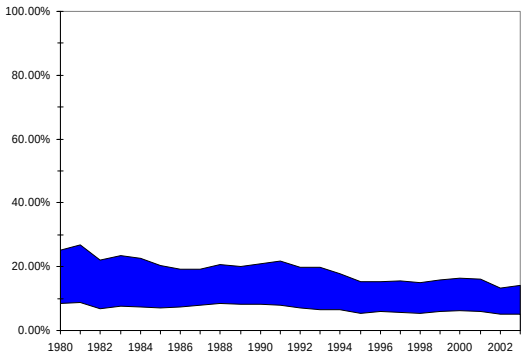

Figure 4 **Percentage IUU Western Central Atlantic (FAO Area 31) 1980 2003.**

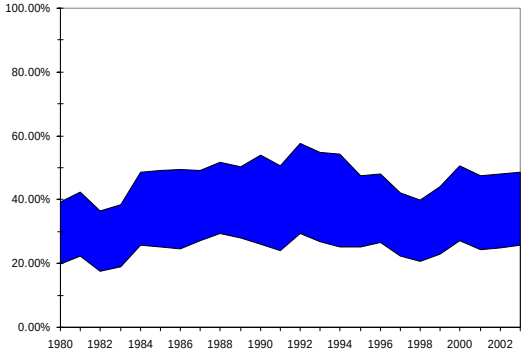

Figure 5 **Percentage IUU Eastern Central Atlantic (FAO Area 34) 1980 2003.**

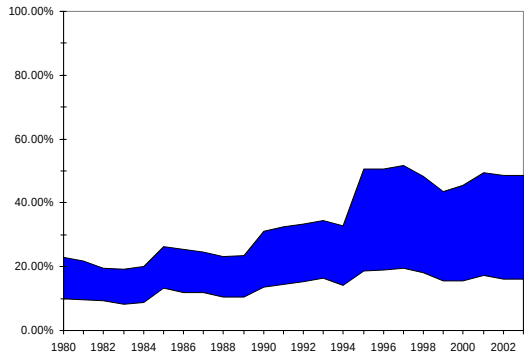

Figure 6 **Percentage IUU Southwest Atlantic (FAO Area 41) 1980 2003.**

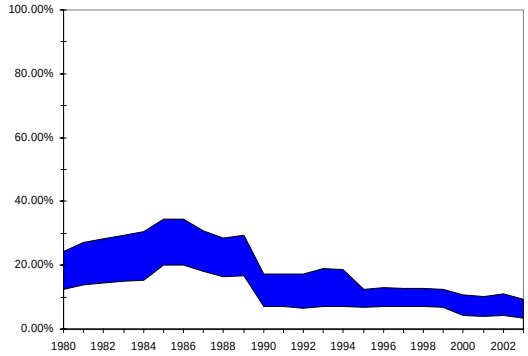

Figure 7 **Percentage IUU Southeast Atlantic (FAO Area 47) 1980 2003.**

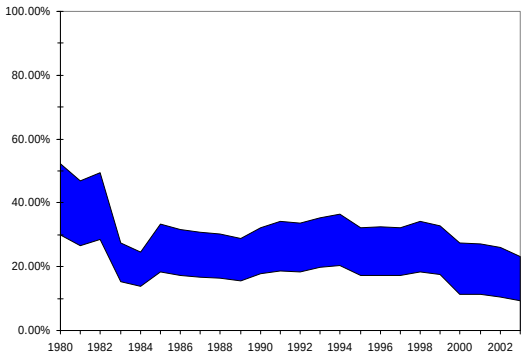

Figure 8 **Percentage IUU Western Indian Ocean (FAO Area 51) 1980 2003.**

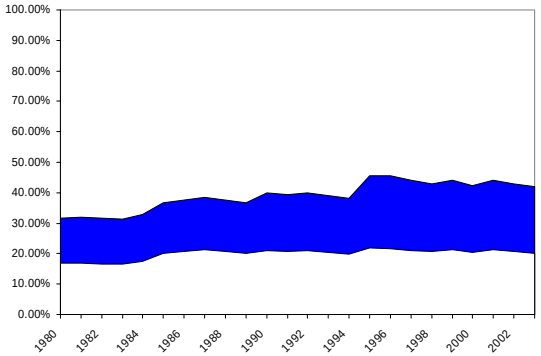

Figure 9 **Percentage IUU Eastern Indian Ocean (FAO Area 57) 1980 2003.**

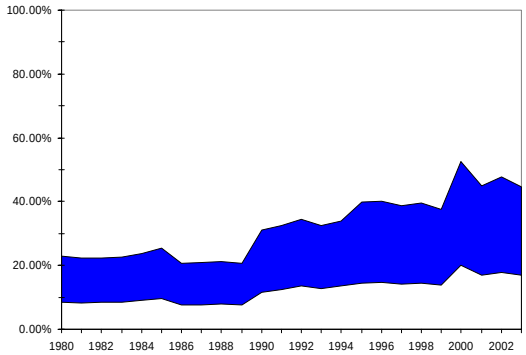

Figure 10 **Percentage IUU Northwest Pacific Ocean (FAO Area 61) 1980 2003.**

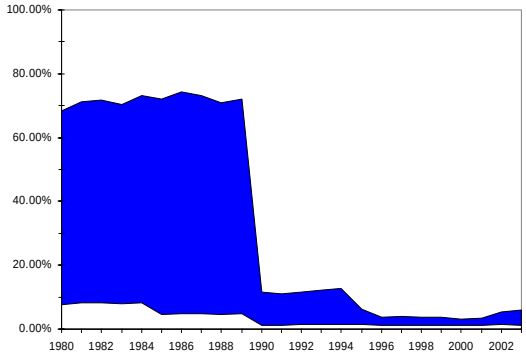

Figure 11 **Percentage IUU Northeast Pacific Ocean (FAO Area 67) 1980 2003.**

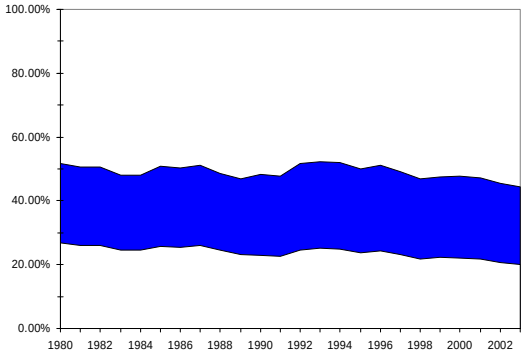

Figure 12 **Percentage IUU Western Central Pacific Ocean (FAO Area 71) 1980 2003.**

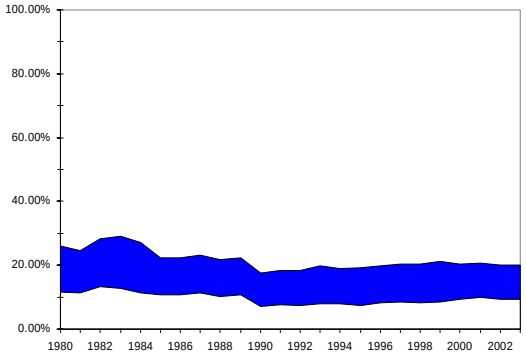

Figure 13 **Percentage IUU Eastern Central Pacific Ocean (FAO Area 77) 1980 2003.**

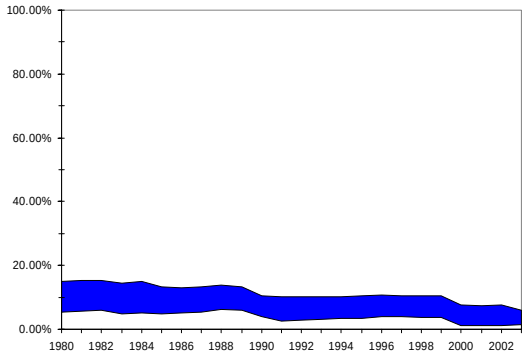

Figure 14 **Percentage IUU Southwest Pacific Ocean (FAO Area 81) 1980 2003.**

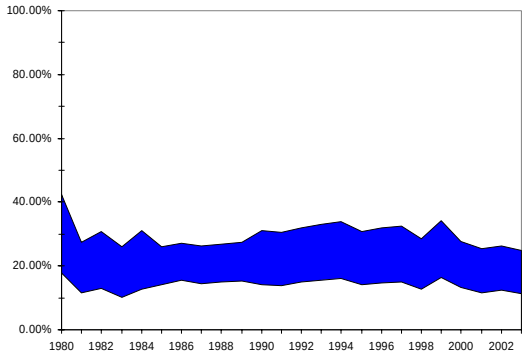

Figure 15 **Percentage IUU Southeast Pacific Ocean (FAO Area 87) 1980 2003.**

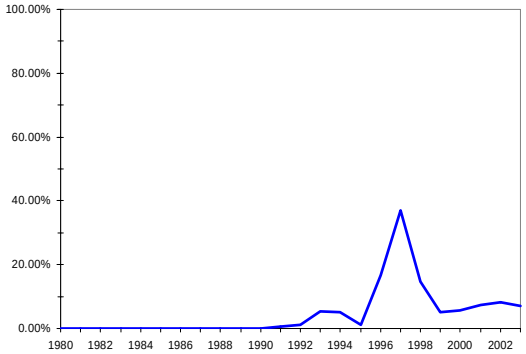

Figure 16 **Percentage IUU Antarctic (FAO Areas 48 / 58 / 88) 1980 2003. CCAMLR estimates the level of IUU precisely, for which reason we have not given upper and lower estimates here.**

Table 1 Summary of regional estimates of IUU fishing, averaged over 2000 - 2003.

Region	FAO Catch	Sum Annual Catch in EEZ / HS Analysed	Sum of Estimated Species	Lower Illegal Estimate	Upper Illegal Estimate	Proportion of FAO Regional Catch	Proportion of EEZ / HS Analysed	Lower % IUU	Upper % IUU	Average % IUU	Value Lower (US$m)	Value Upper (US$m)
Northwest Atlantic Ocean	2,226,604	1,191,043	557,147	22,325	82,266	25%	47%	4%	15%	9%	20	74
Northeast Atlantic Ocean	11,195,128	9,965,586	6,677,607	368,657	861,050	60%	67%	6%	13%	9%	332	775
Western Central Atlantic Ocean	1,768,789	587,293	390,942	21,745	58,514	22%	66%	6%	15%	10%	20	53
Eastern Central Atlantic Ocean	3,622,832	1,627,230	1,154,586	294,089	562,169	32%	71%	25%	49%	37%	265	506
Southwest Atlantic Ocean	2,142,326	1,933,845	1,403,601	227,865	673,712	65%	73%	16%	48%	32%	205	606
Southeast Atlantic Ocean	1,702,984	1,665,820	1,351,635	52,972	139,392	79%	81%	4%	10%	7%	48	125
Western Indian Ocean	4,192,273	3,538,706	2,165,792	229,285	559,942	52%	61%	11%	26%	18%	206	504
Eastern Indian Ocean	5,139,471	4,456,530	2,263,158	467,865	970,589	44%	51%	21%	43%	32%	421	874
Northwest Pacific Ocean	22,692,203	16,086,907	7,358,470	1,325,763	3,505,942	32%	46%	18%	48%	33%	1,193	3,155
Northeast Pacific Ocean	2,730,601	316,392	196,587	2,326	8,449	7%	62%	1%	5%	3%	2	8
Western Central Pacific Ocean	10,345,111	8,429,307	3,740,192	785,897	1,729,588	36%	44%	21%	46%	34%	707	1,557
Eastern Central Pacific Ocean	1,890,304	1,224,783	1,374,062	129,772	278,450	73%	112%	9%	20%	15%	117	251
Southwest Pacific Ocean	739,792	678,784	451,677	5,227	32,848	61%	65%	1%	7%	4%	5	30
Southeast Pacific Ocean	13,437,902	10,102,533	9,799,047	1,197,547	2,567,890	73%	97%	12%	26%	19%	1,078	2,311
Antarctic Ocean	136654.05	136654.05	136654.05	9593.25	9593.25	100%	100%	7%	7%	7%	9	9
	83,962,971	61,941,411	39,021,155	5,140,928	12,040,395	46%	63%	11%	25%	18%	4,627	10,836

3.3 Species Groups Analysis

Our analysis allows identification of the proportion of IUU catch by species groups. As would be expected, the highest IUU proportions are associated with high value demersal fish, lobsters and shrimps/prawns. However, it is somewhat surprising at first glance that the proportion of illegal catch is low on tunas generally. The reason for this is that most of these are taken within the areas of RFMOs where the small amounts of unreported fishing are generally associated with large volume catches (for instance of yellowfin and bigeye tuna) and in some regions (e.g. the IATTC and IOTC) unreported catches of tunas are now very small. However, in some regions such as the Mediterranean and the Southern Indian Ocean the level of unreported catches (IUU) of bluefin tuna has recently been high.

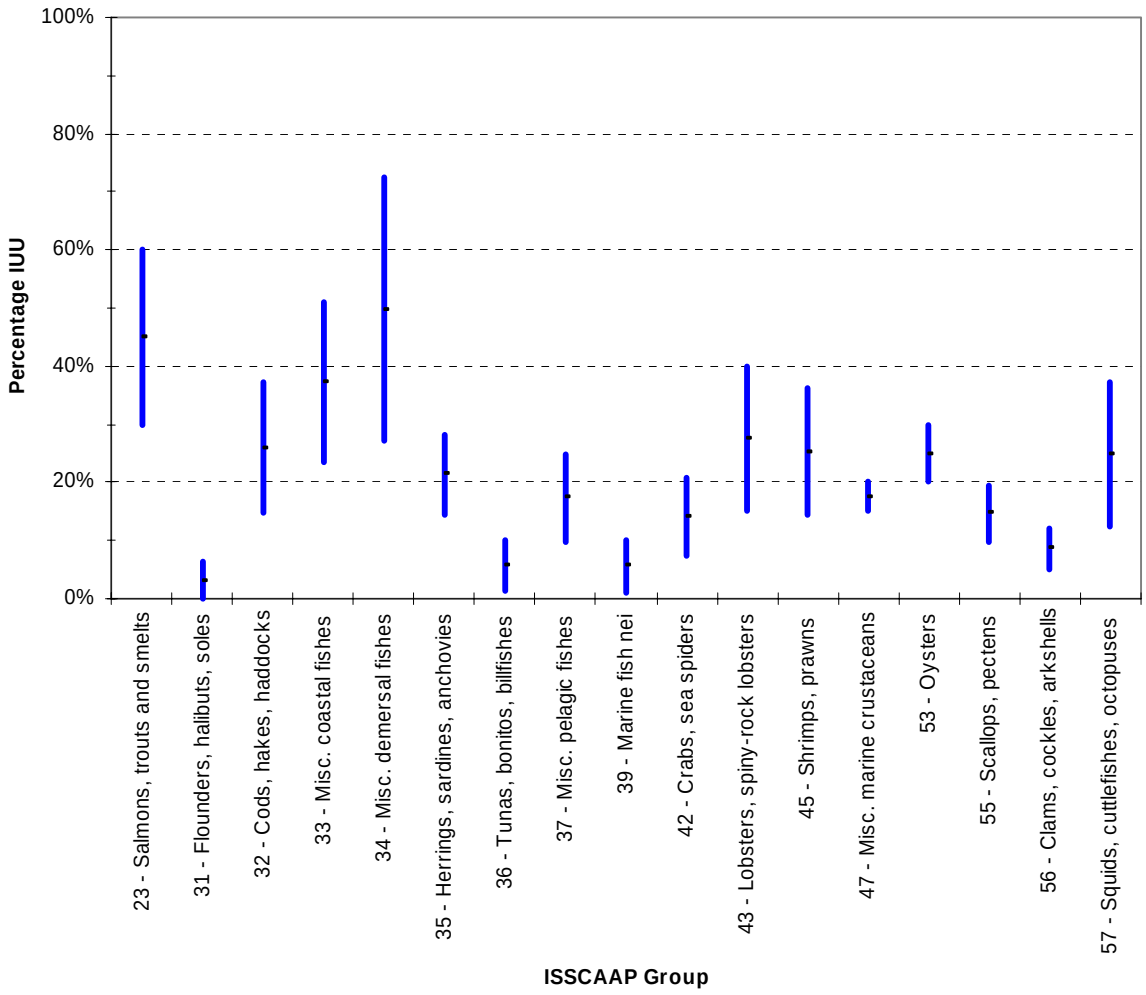

Figure 17 Percentage IUU by ISSCAAP species group 2000 - 2003.

Two species groups have not been highlighted in Figure 17 for ISSCAAP groups 24 (shads) and 38 (sharks, rays and chimaeras). The IUU estimate for shads is dominated by two high volume fisheries with known IUU problems in Bangladesh for Hilsa shad and in the Ukraine for the Black and Caspian Sea sprat and is in the region 70-150% of reported catch. Estimates of IUU for sharks were reported in 3.1.2, and is in the region 75-230% of reported.

.

3.4 Globalising

Taking the total estimated value of illegal catch losses and raising by the proportion of the total world catch analysed in this report, lower and upper estimates of the total value of current IUU losses worldwide would be between $10bn and $23bn annually, representing between 11.06 and 25.91 million tonnes. This is roughly consistent with estimates made recently by MRAG (2005) ($9bn), the European Commission (2007) ($15bn) and the estimates from Pauly *et al.*.(2002) ($25bn).

4 References

Agnew, D. J. (2000) The illegal and unregulated fishery for toothfish in the Southern Ocean, and the CCAMLR Catch Documentation Scheme. *Marine Policy*. 24: 361 – 374.

Ainsworth, C.H. and Pitcher, T.J. (2005) Estimating Illegal, Unreported and Unregulated Catch in British Columbia's Marine Fisheries. *Fisheries Research* 75: 40–55.

Asahi Shinbun (2006). Fish catch quotas exceeded September 2006. In: Clarke, S. (2007) *Trading tails: Russian Salmon fisheries and East Asian markets.* TRAFFIC East Asia, 131 pages.

Australian Bureau of Agricultural and Resource Economics, (2005).

Baddyr, M. and Guénette, S. (2002) The Fisheries Off The Atlantic Coast Of Morocco 1950-1997. Pages 191-205 in Zeller, D., Watson, R. and Pauly, D. (eds) Fisheries Impacts on NorthAtlantic Ecosystems: Catch, Effort and National/Regional Data Sets. Fisheries Centre Research Reports 9(3): 254 pp.

Bailey, M., Rotinsulu, C. and Sumaila, U.R. (2008). The migrant anchovy fishery in Kabui Bay, Raja Ampat, Indonesia: catch, profitability and income distribution. Marine Policy 32(3): 483-488.

Benavente-Villena, A.B. and Pido, M.D. (2004) Poaching in Philippine marine waters: Intrusion of Chinese fishing vessels in Palawan waters. Pages 265-268 in Silvestre, G. and Luna, C. (eds) In turbulent seas: the status of Philippine marine fisheries. Coastal Resource Management Project, Department of Environment and Natural Resources, Cebu City, Philippines, 378 pp.

Bernal, P., Oliva, D., Aliaga, B. and Morales, C. (1999) New regulations in Chilean Fisheries and Aquaculture: ITQs and Territorial Users Rights. Ocean and Coastal Management 42: 119-142.

Birkun, A. (2002) Cetaceans of the Mediterranean and Black Seas: State of Knowledge and Conservation Strategies. In G. Notarbartolo di Sciara (ed.), Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies. Report to ACCOBAMS, Monaco, February 2002. Section 10: 11 pp.

Bray, K. (2000) A global review of illegal, unreported and unregulated (IUU) fishing. Expert consultation on illegal, unreported and unregulated fishing. FAO: IUU/2000/6, 53pp.

Buchary, E.A., Pitcher, T.J. and Willoughby, N. (2008) Indonesia's non-recorded fish problem revisited. In Kalikoski, D. and Pitcher, T.J. (eds) (2008) Assessing Illegal, Unreported And Unregulated Fishery Catches (IUU): Some case studies. Fisheries Centre Research Reports 16(5): (*in press*)

Buchary, E.A., Pitcher, T.J., and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Indonesia with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 36 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Butcher, J.G. (2002) Getting into trouble: The diaspora of Thai Trawlers, 1965 – 2002. International Journal of Maritime History 14(2): 85-121.

Butcher, J.G. (2004) The Closing of the Frontier. A History of the Marine Fisheries of Southeast Asia c. 1850-2000. Institute of Southeast Asian Studies, Singapore, 456 p.

Castillo, S. and Mendo, J. (1987) Estimation of unregistered Peruvian anchoveta (*Engraulis ringens*) in official catch statistics, 1951-1982. Pages 109-116 in Pauly, D. and Tsukayama, I. (eds.) The Peruvian anchoveta and its upwelling ecosystem: three decades of changes. ICLARM Studies and Reviews 15.

CCSBT (2007). Report of the Fourteenth Annual Meeting of the Commission, 16 - 19 October 2007, Canberra, Australia.

CEDEPESCA (2003) La pesqueria de calamar en Argentina. Comunidad Pesquera no 9, July 2003, **(**http://www.cedepesca.org.ar**)**

Cheng, J., Cai, W., Cheung, W., Pitcher, T.J., Liu, Y. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of China with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 22 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Chimanovitch, M. (2001). Zona marítima. Isto é Online 1633(17/01/2001): www.terra.com.br/istoe/1633/brasil/1633_zona_maritima.htm.

Clarke, S.C., Murdoch K. McAllister, E. J. Milner-Gulland, G. P. Kirkwood, Catherine G. J. Michielsens, David J. Agnew, Ellen K. Pikitch, Hideki Nakano, Mahmood S. Shivji (2006) Global estimates of shark catches using trade records from commercial markets Ecology Letters 9 (10) , 1115–1126

Commission of the European Communities. 2007. *Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. On a new strategy for the Community to prevent, deter and eliminate Illegal, Unreported and Unregulated fishing.* Brussels. COM(2007) 601 final

DAFF (2005) Effective Export Controls For Illegally Harvested Abalone. Discussion Paper, Department of Agriculture, Fisheries and Forestry, Australian Government March 2005, 31pp. Available at: http://www.daff.gov.au/fisheries/abalone/illegalexportpaper)

DAFF (2005) Effective Export Controls For Illegally Harvested Abalone. Discussion Paper,

Department of Agriculture, Fisheries and Forestry, Australian Government March 2005, 31pp. Available at: http://www.daff.gov.au/fisheries/abalone/illegalexportpaper)

Esmark, M & N. Jensen, 2004. The Barents sea cod - last of the large cod stocks. WWF Norway report 4/2004: www.wwf.no/core/pdf/wwf_codreport_2004.pdf.

Esmerk Ltd. (2006) Denmark: Illegal cod fishing a growing problem. Politiken, 04 Feb 2006.

European Court of Auditors (ECA) 2007. Special Report No 7/2007 (pursuant to Article 248(4) second paragraph, EC) on the control, inspection and sanction systems relating to the rules on conservation of Community fisheries resources

FAO (2003) Summarized extracts on the status of implementation of the Code of Conduct for Responsible Fisheries. 25th Session, 24 – 28 February 2003.

FAO (2003a) Country Synopses - USA.

FAO (2004) Fishery Country Profile – The Arab Republic of Egypt, (www.fao.org/fi/fcp/en/EGY/profile.htm), Accessed on 2/9/2006.

FAO (2005). FAO Yearbook of Fisheries Statistics 2005. Food and Agriculture Organisation of the United Nations, Rome. (Online: ftp://ftp.fao.org/fi/stat/summary/default.htm)

FIS (2005) Mussel poaching on the rise, as fingers point at Chinese nationals, Namibia, January 10, 2005. Fish Information & Services.

Fish Information and Services (2001) Indonesia losing US$ 2 billion a year to illegal fishing operators. FIS World News, 8 May 2001. www.fis.com

Fish Information Services (FIS) (2002) Ghana: New legal law legalizes illicit foreign fishing ventures, Fish Information and Services, Document available at http://www.fis.com/fis/worldnews

Fiskaren (2006) Svart uerfiske for 330 mill. Kr, (www.fiskaren.no/incoming/article100308.ece)

Flewweling, P. and Hosch, G. (2006) Country Review: Sri Lanka, 163-174 pp. In: De Young, C. (ed.) Review of the state of world marine capture fisheries management: Indian Ocean. *FAO Fisheries Technical Paper*. No. 488, Rome, FAO. 2006. 458p.

Flewwelling, P. (2001) Fisheries Management and MCS in South Asia. FAO/FISHCODE Project, GCP/INT/648/NOR: Field Report C-6: 56pp.

Forrest, R. *et al*. (2004) Estimating Illegal, Unreported and Unregulated discards and catch on the East coast of Canada. (in prep.)

Gianni, M. and Simpson, W. (2005) The Changing Nature of High Seas Fishing: how flags of convenience provide cover for illegal, unreported and unregulated fishing. Australian Department of Agriculture, Fisheries and Forestry, International Transport Workers Federation, and WWF International, 88 pp.

Greenpeace (2006) Caught RED-handed: Daylight Robbery on the High Seas, Greenpeace Case Study on IUU fishing #3, 12 pp. (http://www.greenpeace.org/raw/content/denmark/press/rapporter-ogdokumenter/caught-red-handed-daylight-ro.pdf)

Guénette, S., Balguerías, E. and Santamaría, M.T.G. (2002) Spanish Fishing Activities Along The Saharan And Moroccan Coasts. Pages 206-213 in Zeller, D., Watson, R. and Pauly, D. (eds) Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort and National/Regional Data Sets. Fisheries Centre Research Reports 9(3): 254 pp.

Hariri, K.I., Nichols, P., Friedhelm, K., Mishrigi, S., Ahmed, B., Ali, F.A. and Salah M.K. (2002) Strategic Action Programme for the Red Sea and Gulf of Aden, Regional Organisation for the Conservation and Management of the Environment of the Red Sea and Gulf of Aden, PERSGA, 148pp.

Hariri, K.I., Nichols, P., Krupp, F., Mishrigi, S., Barrania, A., Ali, A.F., and Kedidi, S.M. (2002) Status of the Living Marine Resources in the Red Sea and Gulf of Aden Region and their Management, Strategic Action Programme for the red Sea and Gulf of Aden, final Report, May 2000, 151pp.

Hønneland, G. (2004) Russian Fishery Management: the precautionary approach in theory and practice. Martinus Nijhoff, Leiden, Netherlands. 190pp.

ICCAT (2007). Report of the Standing Committee on Research and Statistics (SCRS). Madrid, Spain 1-5October 2007.

Joseph, L. (1999) Management of shark fisheries in Sri Lanka. In Case studies of the management of elasmobranch fisheries, Shotton R (ed.). FAO Fisheries Technical Paper 378/1, Food and Agriculture Organization for the United Nations, Rome; 339–367 pp.

Kalikoski, D. and PItcher (eds) (2008) Assessing Illegal, Unreported And Unregulated Fishery Catches (IUU): Some case studies. Fisheries Centre Research Reports 16(5): (*in press*).

Kalikoski, D. and Vasconcellos, M. (2006) An Estimation of Compliance of the Fisheries of Brazil with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 15 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Kalikoski, D., Pramod, G. and Pitcher, T.J. (2008) Estimating Illegal And Unreported Fishery Catches From Chile. In Pitcher, T.J. and Kalikoski, D. (eds) (2008) Assessing Illegal, Unreported And Unregulated Fishery Catches (IUU): Some case studies. Fisheries Centre Research Reports 16(5): (*in press*).

Kalikoski, D., Vasconcellos, M. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Argentina with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 18 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Kalikoski, D., Vasconcellos, M. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Chile with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 22 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Kalikoski, D., Vasconcellos, M. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Ecuador with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 14 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Kalikoski, D., Vasconcellos, M. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Peru with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 12 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Kelleher, K., Rottingen, A. and Limmitada, M.G.A. (2002) Planning cost-effective fisheries. Monitoring,Control and Surveillance in Mozambique, Draft Report prepared for Ministry of Fisheries, Mozambique, January 2002, 61 pages.

Kozlovsky, A., Kalentchenko, M. and Nagoda, D. (2005) Analysis of illegal fishery for cod in the Barents Sea. WWF-Russia and WWF Barents Sea Program. 34pp.

Kuo, C.L. (2001) The Development and Management of Coastal Fisheries in Taiwan, In: TFRI, Aquaculture and Fisheries Resources Management, Proceedings of the Joint Taiwan-Australia Aquaculture and Fisheries Resources and Management Forum, (TFRI Conference Proceedings 4), Editors: Liao, I.C. and Baker, J., Taiwan Fisheries Research Institute, Keelung, Taiwan. 288 pp.

Long, R. and Grehan, A. (2002) Marine Habitat protection in Sea Areas under the jurisdiction of a Coastal Member State of the European Union: The Case of Deep-water coral conservation in Ireland, *The International Journal of Marine and Coastal Law*: 17(2): 235-261 p.

Lozano-Montes, H.M. (2008) An influence table for IUU in the Sea of Cortez In In Kalikoski, D. and Pitcher, T.J. (eds) (2008) Assessing Illegal, Unreported And Unregulated Fishery Catches (IUU): Some case studies. Fisheries Centre Research Reports 16(5): (*in press*)

Lozano-Montes, H.M., Tony J Pitcher, T.J. and Haggan, N. (2008) Shifting environmental and cognitive baselines in the upper Gulf of California. Front Ecol Environ. 6: 6, doi:10.1890/070056.

Matishov, G., Golubeva, N., Titova, G., Sydnes, A. and Voegele, B. (2004) Barents Sea. UNEP Regional Assessment 11: 116pp.

Melnychuk, M., Guénette, S., Martín-Sosa, P. and Balguerías, E. (2002) Fisheries In The Canary Islands, Spain. Pages 221-224 in Zeller, D., Watson, R. and Pauly, D. (eds) Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort and National/Regional Data Sets. Fisheries Centre Research Reports 9(3): 254 pp.

Metuzals. K.I., Moussalli, E., Pitcher, T.J. and Schott, S. (2007) How Sustainable are Canada's Oceans: Comments on Illegal, Unreported and Unregulated (IUU) Fishing in Canada. *(in press*).

Morato, T. and Pauly, D. (eds) (2004) Seamounts: Biodiversity and fisheries. Fisheries Centre Research Reports 12(5): 78pp.

Morato, T., Guénette, S. and Pitcher, T.J. (2001) Fisheries of the Azores (Portugal), 1982-1999. Pages 214-220 in Zeller, D., Watson, R., and Pauly, D. (eds) Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort and National/Regional Data Sets. Fisheries Centre Research Reports 9(3): 254 pp.

Morgan, G. (2006) Country Review: Yemen. In: De Young, C. (ed.) Review of the state of world marine capture fisheries management: Indian Ocean. *FAO Fisheries Technical Paper*. No. 488. Rome, FAO. 2006. 458pp.

Norwegian Directorate of Fisheries (2007). Russian fishing of cod and haddock 2006, Status Report (2007).

NOWRAP (2005) Regional Profile (http://www.unep.org/regionalseas/Programmes/UNEP_Administered_Programmes/North-west_Pacific_Region/default.asp)

OCEANA (2005) The Use of 'Rasco' Gillnets in the Anglerfish, King Crab And Deep-Sea Sharks Fisheries in the North-East Atlantic. DEEPNET_FISHING_report_eng.

OECD, 2005: Draft Synthesis Report On IUU Fishing Activities. AGR/FI(2004)18

Pakistan Daily Times (2004) Illegal Indian fishing costs Pakistan $51.72m. Friday, December 03, 2004.

Patterson, K.R., Pitcher, T.J. and Stokes, T.K. (1993) A stock collapse in a fluctuating environment: the chub mackerel *Scomber japonicus* (Houttuyn) in the eastern central Pacific. *Fisheries Research* 18: 199-218.

Pauly, D., Christensen, V., Guénette, S., Pitcher, T.J., Sumaila, U.R., Walters, C.J., Watson, R. and Zeller, D. (2002) Towards sustainability in world fisheries. Nature 418: 689-695.

Pe, M. (2004) National Report Of Myanmar on the Sustainable Management of The Bay of Bengal Large Marine Ecosystem (BOBLME), GCP/RAS/179/WBG.

Pearse, N.I. and W.B. Folson (1979) Fisheries of Cameroon, 1973. Foreign Fish leaflet. NOAA/NMFS (74-12), 13 pp.

Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Canada with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 15 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Philippines with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 18 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Turkey with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 14 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Viet Nam with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 18 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Myanmar with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 13 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Pakistan with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 13 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Russia with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 27 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Thailand with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 20 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pitcher, T.J., Watson, R., Forrest, R., Valtýsson, H. and Guénette, S. (2002) Estimating Illegal and Unreported Catches From Marine Ecosystems: A Basis For Change. Fish and Fisheries 3: 317-339.

Pitcher, T.J., Watson, R., Forrest, R., Valtýsson, H. and Guénette, S. (2002) Estimating Illegal and Unreported Catches From Marine Ecosystems: A Basis For Change. Fish and Fisheries 3: 317-339.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Angola with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 15 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Australia with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 60 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Bangladesh with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 17 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Egypt with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 19 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of the Faroes with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 26 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Germany with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 16 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Ghana with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 29 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Namibia with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 23 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Nigeria with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 22 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Poland with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 18 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with

the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Portugal with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 21 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Senegal with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 24 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Sri Lanka with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 18 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Sweden with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 19 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Ukraine with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 20 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Yemen with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 16 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G., Pitcher, T.J. and Rojo-Diaz, P. (2006) An Estimation of Compliance of the Fisheries of South Africa with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 29 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G., Pitcher, T.J. and Rojo-Diaz, P. (2006) An Estimation of Compliance of the Fisheries of the United Kingdom with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 30 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G., Pitcher, T.J., Pearce, J. and Agnew, D. (2008) Sources of information supporting estimates of unreported fishery catches (IUU) for 60 countries. Fisheries Centre Research Reports 16(4): (*in press*)

Pramod, G., Tony Pitcher, Rojo-Diaz, P. and Kalikoski, D. (2006) An Estimation of Compliance of the Fisheries of Spain with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 25 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds)

Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Pramod, G., Varkey, D. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Taiwan with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 26 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Rajan, P.T. (2003) Introduction. Pages 1-2 in Alfred, J.R.B. (ed) A field guide to marine food fishes of Andaman and Nicobar Islands. ZSI, Kolkata.

Rojo-Diaz, P. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Denmark with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 26 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Rojo-Diaz, P. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of France with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 27 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Rojo-Diaz, P. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Netherlands with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 25 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Rojo-Diaz, P., Pitcher, T.J. and Pramod, G. (2006) An Estimation of Compliance of the Fisheries of Morocco with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 23 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

SADC (2005) South Africa: marine fisheries and resources sector. South African Development Community, Namibia.

Skaret, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Norway with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 19 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Sumaila U.R., Alder J. and Keith H. (2006) Global scope and economics of illegal fishing. Marine Policy 30: 696–703.

Taghavi, S.A. (1999) Fisheries Monitoring, Control and Surveillance in the Islamic Republic of Iran, Country paper 5, GCP/INT/648/NOR – Field Report C-3 (En) Report of a Regional Workshop on Fisheries Monitoring, Control and Surveillance, Muscat, Sultanate of Oman, 24-28 October 1999, 67 -73 pp.

Tudela, S. (2004). Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Studies and Reviews. General Fisheries Commission for the Mediterranean, Rome, FAO. No. 74: 44pp.

Tudela, S., Kai, A.K., Maynou, F., El Andalossi M. and Guglielmi, P. (2005) Driftnet fishing and biodiversity conservation: the case study of the large-scale Moroccan driftnet fleet operating in the Alboran Sea (SW Mediterranean). Biological Conservation 121: 65–78.

Vaisman, A. (2001) Trawling in the mist. Industrial fisheries in the Russian part of the Bering Sea. A TRAFFIC Network Report. Cambridge: TRAFFIC International, 79pp.

Varkey, D. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of Iceland with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 27 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Varkey, D., Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of India with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 28 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Varkey, D., Pramod, G. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of New Zealand with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 31 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Varkey, D.A., Ainsworth, C.H., Pitcher T.J. and Johanes, G. (2008) Estimating illegal and unreported catches in Raja Ampat Regency, Indonesia. Fisheries Centre Research Reports 16 (5): (*in press*).

Vasconcellos, M., Kalikoski, D. and Pitcher, T.J. (2006) An Estimation of Compliance of the Fisheries of the USA with Article 7 (Fisheries Management) of the FAO (UN) Code of Conduct for Responsible Fishing. 16 pages in Pitcher, T.J., Kalikoski, D. and Pramod, G. (eds) Evaluations of Compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. Fisheries Centre Research Reports 14(2): 1191pp.

Waggey, T., Purwanto, Purwito, Nikijuluw, N. and Pitcher, T.J. (2008) A Study Of The Implications Of Illegal, Unreported And Unregulated Fishing Activities In The Arafura Sea In Relation To Indonesian Fishery Statistics. Report from DKP, Indonesia to FAO, 43pp. (*in press*).

Walia, V. (2004) Illegal fishing by Bangladeshi nationals. The Tribune, Friday, August 6, 2004, Chandigarh, India. www.tribuneindia.com/2004/20040806/punjab1.htm#10

Watson, R., Kitchingman, A., Gelchu, A. and Pauly, D. (2004) Mapping global fisheries: sharpening our focus. Fish and Fisheries 5: 168-177.

Weidner, D. M. and D. L. Hall (1993). Latin America. World fishing fleets: an analysis of distant-water fleet operations, past-present-future. Maryland, Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce. 513 p.

Weiner, T. (2002) In Mexico, greed kills fish by the seafull. The New York Times. April 10, 2002. USA.

Willoughby, N., Monintja, D. and Badrudin, M. (1999) Do fisheries statistics give the full picture? Indonesia's non-recorded fish problems. Pages 163-172 in Report of the Regional Workshop on the Precautionary Approach to Fishery Management. 25-28 February, 1997, Medan Indonesia. Bay Of Bengal Program, Chennai, India. BOPB/REP/82. [not published in FAO document: original supplied by author]. [Reprinted in Kalikoski & Pitcher (2008)].

WWF (2008), Illegal fishing in Arctic waters – Catch of Today Gone Tomorrow?, 52pp.

Zuleta, A. (2004) The management of small pelagic fisheries in Chile. FAO Fisheries Report 700. Rome, Italy.

Annex 1 Data Sources

Country	Sources
Angola	Pramod & Pitcher (2006), Gianni & Simpson (2005), MRAG (2005)
Argentina	Kalikoski *et al.* (2006), CEDEPESCA (2003), FAO (2003)
Australia	Pramod & Pitcher (2006) , MRAG (2005), DAFF (2005)
Bangladesh	Pramod & Pitcher (2006), Flewwelling (2001)
Brazil	Kalikoski. and Vasconcellos (2006), Chimanovitch (2001), Weidner & Hall (1993)
Canada	Pitcher (2006), Ainsworth & Pitcher (2005), Metuzals *et al.* (2007), Forrest (2004)
Chile	Bernal *et al.*(1999), Kalikoski *et al.* (2006, 2008.), Zuleta (2004)
China	Cheng *et al.* (2006)
Denmark	Rojo-Diaz & Pitcher (2006), ICES, Esmerk (2006)
Ecuador	Kalikoski *et al.* (2006), MRAG (2005), Patterson *et al*. (1993)
Egypt	Pramod & Pitcher (2006), FAO (2004), Hariri *et al.* (2002)
Faroe Islands	Pramod & Pitcher (2006), ICES, Greenpeace (2006)
France	Rojo-Diaz & Pitcher (2006), ICES
Germany	Pramod & Pitcher (2006), ICES
Ghana	Pramod & Pitcher (2006), Falaye,(2008) FIS (2002)
Iceland	Varkey & Pitcher (2006), ICES, Pitcher *et al.* (2002), Fiskaren (2006)
India	Varkey *et al.* (2006), Rajan (2003), Walia (2004)
Indonesia	Buchary *et al.* (2006), FIS (2001), Willoughby *et al.* (1999), Buchary et al. (2008)
Iran	Pramod & Pitcher (2006), Taghavi (1999)
Ireland	Pramod & Pitcher (2006),, ICES, Oceana (2005), Long & Grehan (2002)
Italy	Pramod *et al*. (2006), EC, GCFM
Japan	Izawa *et al.* (2006), Clarke (xxx)
Korea, North	Pramod & Pitcher (2006), NOWPAP (2005)
Korea, South	Varkey *et al.* (2006)
Latvia	Pramod & Pitcher (2006), ICES
Liberia	MRAG (2005)

Country	Sources
Malaysia	Pitcher (2006), MRAG (2005)
Mauritania	MRAG (2005)
Mexico (E & W)	Kalikoski *et al.* (2006), Weiner (2002), Lozano *et al*. (2008), Lozano (2008)
Morocco	Rojo-Diaz *et al,* (2006), MRAG (2005), Tudela *et al.* (2005), Baddyr and Guénette (2002), Guénette *et al.* (2002), Melnychuk *et al.* (2002).
Mozambique	MRAG (2005), Kelleher *et al.* (2002)
Myanmar	Pitcher & Pramod (2006), Butcher (2002 & 2004), Pe (2004)
Namibia	Pramod & Pitcher (2006), FIS (2005), MRAG (2005)
Netherlands	Rojo-Diaz & Pitcher (2006), ICES
New Zealand	Varkey *et al.*(2006), MRAG (2005)
Nigeria	Pramod & Pitcher (2006), Pearce & Folson (1979)
Norway	Skaret & Pitcher (2006), ICES, Norwegian Directorate of Fisheries (2007)
Pakistan	Pitcher & Pramod (2006), Pakistan daily times (2004)
Peru	Kalikoski *et al.* (2006), Pitcher *et al*. (2002), Castillo & Mendo (1987)
Philippines	Pitcher (2006), MRAG (2005), Benavente-Villena and Pido (2004)
Poland	Pramod & Pitcher (2006), ICES
Portugal	Pramod & Pitcher (2006), ICES
Russia (E & W)	Pitcher & Pramod (2006), Kozlovsky (2005), Hønneland (2004), Matishov *et al*. (2004), Vaisman *et al.* (2001), Shinbun (2006)
Senegal	Pramod & Pitcher (2006), MRAG (2005)
Sierra Leone	MRAG (2005)
South Africa	Pramod *et al.* (2006), MRAG (2005), SADC (2005)
Seychelles	MRAG (2005)
Spain	Pramod *et al.* (2006), ICES, Morato *et al.* (2001), Morato & Pauly (2004)
Sri Lanka	Pramod & Pitcher (2006), Joseph (1999), Flewweling, P. and Hosch (2006)
Sweden	Pramod & Pitcher (2006), ICES,
Taiwan	Pramod *et al.* (2006), MRAG (2005), Kuo (2001)
Tanzania	-

Country	Sources
Thailand	Pitcher & Pramod (2006), MRAG (2005)
Turkey	Pitcher (2006), MRAG (2005), Tudela (2004), Birkun (2002)
Ukraine	Pramod & Pitcher (2006)
United Kingdom	Pramod *et al.* (2006), ICES
United States of America	Vasconcellos *et al.* (2006), MRAG, FAO (2003a)
Venezuela	

Country	Sources
Vietnam	Pitcher (2006), MRAG (2005)
Yemen	Pramod & Pitcher (2006), Hariri *et al.* (2002), Morgan (2006)