Illegal and unreported fishing : global analysis of incentives and a case study estimating illegal and unreported catches from India

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ILLEGAL AND UNREPORTED FISHING: GLOBAL ANALYSIS OF INCENTIVES AND A CASE STUDY ESTIMATING ILLEGAL AND UNREPORTED CATCHES FROM INDIA

by

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Abstract

Illegal, unreported and unregulated (IUU) fishing has been identified as one of the important drivers affecting sustainable management of fish stocks worldwide. Although, Governments have initiated regulations and institutions to address these concerns, over the years little progress has been achieved in controlling drivers of illegal fishing. In the post UNCLOS era, countries adopting progressive laws like the United Nations Fish Stocks Agreement, FAO Compliance Agreement and FAO International Plan of Action on IUU fishing have not backed them up with adequate monitoring and surveillance assets, leading to low compliance. Most countries within the new legal framework lack adequate institutional and enforcement infrastructure to improve fisheries compliance. The thesis employs three approaches to identify and evaluate the drivers of illegal and unreported fishing worldwide. First, a case study approach using a questionnaire was used to determine adequacy of monitoring control and surveillance in fisheries of 41 countries. Results demonstrate that monitoring control and surveillance is poor, with both developing and developed countries having problems in this area. The second approach used 1211 illegal fishing penalty cases in 109 countries to show that low penalties provide economic incentives for IUU fishing to persist in many EEZs. Finally, a detailed case study of the Indian EEZ exemplifies the problems of developing countries by evaluating various stages where illegal and unreported catches occur in commercial and small-scale fisheries. The study found evidence of serious decline in mesh size in several net fisheries. Significant evidence of the abuse of joint venture tuna fisheries also reveals that only 20% of the actual catch is reported; with unreported by-catch as large as the actual tuna catch. Results from each of the maritime states in India (including the remote

Andaman and Nicobar Islands) reveal that 45000 to 60000 tonnes is taken annually by illegal foreign fishing vessels, while 1.2 million tonnes of discards and 293,000 tonnes remain unreported in the small-scale and commercial trawl fisheries.

Preface

I am the sole author on chapters 1, 3, and 7. I am the senior author on all chapters and I assume primary responsibility for the design, implementation, analysis, and writing. The contributions of co-authors for chapters 2, 4, 5, and 6 are summarized below. Tony Pitcher contributed editorial oversight and guidance on all the chapters.

Chapter 4, 5, and 6 received approval from UBC Ethics Research Board in 2008. Approval for the IUU Study questionnaire was done under the UBC ORS ethics certificate (H08-00618), UBC Behavioural Research Ethics Board, prior to undertaking the study in India.

Chapter 2 is based on conceptual model developed in Sumaila *et al*., (2006) paper (Sumaila, U. R., Alder, J., & Keith, H. (2006). *Global scope and economics of illegal fishing.* Marine Policy, 30(6), 696-703). The original paper used 16 incidents, whereas in the current work all the information for 1211 incidents in 109 countries was retrieved from GIUFI (2010) database, which was developed and owned by senior author (Pramod Ganapathiraju). I collected all the information, and wrote the manuscript. Rashid Sumaila provided edits, and guidance during all stages of the work. Tony Pitcher contributed editorial oversight.

A version of case studies for marine fisheries in 41 fishing countries has been published as Pramod, G. (2011). Evaluations of Monitoring, Control and Surveillance in marine fisheries of 41 countries, MCS Case Studies Report, Fisheries Centre, University of British Columbia, Canada, May 2011, 222 p.

A version of chapters 4 and 5 has been published as field report (Pramod, G. (2010). Illegal, Unreported and Unregulated Marine Fish Catches in the Indian Exclusive Economic Zone, Field Report, Policy and Ecosystem Restoration in Fisheries, Fisheries Centre, University of British Columbia, BC, Vancouver, Canada, 30 pages). I conducted all the interviews and wrote the entire manuscript. Tony Pitcher contributed editorial oversight and guidance on all stages of the work. Daniel Pauly gave overall comments for chapters one to seven.

Table of Contents

Abstract…………………………………………………………………………… ii

Preface…………………………………………………………………………... iv

Table of Contents……………………………………………………………… vi

List of Tables………………………………………………………………….. xiii

List of Figures…………………………………………………………………... xv

List of Symbols and Abbreviations………………………………………… xvii

Acknowledgements…………………………………………………………… xx

Dedication…………………………………………………………………… xxiii

Chapter 1: Incentives to illegal and unreported (IUU) fishing……………………… 1

1.1 Introduction 1

1.2 Discussion of the definition of IUU fishing 4

1.3 Incentives to illegal and unreported fishing 8

1.4 Thesis structure 12

1.5 Chapter 1 summary 13

Chapter 2: The global illegal fishing penalty regime: why efforts to control illegal fishing are not working?.. 15

2.1 Introduction 15

2.2 Methods 18

2.3 Benefits from illegal fishing activity 18

2.4 Expected penalty drivers 20

2.4.1 Detection likelihood driver 20

2.4.2 Avoidance driver 20

2.4.3 Penalty driver 20

2.4.4 Moral and social drivers 21

2.5 Formal penalty model 22

2.6 Risks in illegal activity (costs and benefits) 23

2.7 Components of penalty table 23

2.7.1 Arresting country 24

2.7.2 Vessel/ gear 24

2.7.3 Illegal catch / fishery 24

2.7.4 Number of vessels 24

2.7.5 Catch 25

2.7.6 Catch value 25

2.7.7 Expected revenue 27

2.7.8 Variable cost 28

2.7.9 Theta (θ) value 28

2.7.9.1 Calculation of "θ" value in the current work 28

2.7.10 Fine 31

2.7.11 Expected penalty 32

2.7.12 Total cost 32

2.7.13 Total cost / Expected revenue 32

2.7.14 New fine 32

2.8 Results 32

2.9 Discussion 39

2.10 Chapter 2 summary 40

Chapter 3: Plugging the leaks: an assessment of monitoring control and surveillance (MCS) in the marine fisheries of 41 countries…………………………. 42

3.1 Introduction.. 42

3.2 International laws relevant to monitoring control and surveillance in fisheries44

3.3 Definition of monitoring control and surveillance in fisheries......................... 45

3.4 Tools for monitoring control and surveillance in fisheries.............................. 47

3.4.1 Importance of surveillance infrastructure in fisheries 48

3.4.2 Importance of vessel monitoring system in the fisheries sector 49

3.4.3 Why is an observer scheme needed in fisheries?.. 52

3.4.4 Importance of sea based patrols in fisheries 53

3.4.5 Importance of aerial patrols in fisheries.. 53

3.4.6 Importance of dockside monitoring in fisheries 55

3.4.7 Importance of coastal patrols 55

3.4.8 Importance of monitoring transhipments at sea... 56

3.4.9 Importance of fishing gear inspections 57

3.5 Methods.. 57

3.6 Results.. 59

3.6.1 Scoring compliance with surveillance infrastructure................................... 59

3.6.2 Scoring compliance with MCS human resources 60

3.6.3 Scoring compliance with monitoring of high seas fleet............................... 62

3.6.4 Scoring compliance with vessel monitoring scheme 63

3.6.5 Scoring compliance with observer scheme... 64

3.6.6 Scoring compliance with inspections at sea.. 65

3.6.7 Scoring compliance with adequacy of aerial patrols 67

3.6.8 Scoring compliance with dockside monitoring.. 68

3.6.9 Scoring compliance with coastal patrols.. 69

3.6.10 Scoring compliance with monitoring transshipments at sea........................ 70

3.6.11 Scoring compliance with fishing gear inspections...................................... 71

3.7 Discussion 72

3.8 Comparisons among questions 75

3.9 Chapter 3 summary 78

Chapter 4: Illegal marine fish catches in the Indian Exclusive Economic Zone….. 81

4.1 Introduction.. 81

4.2 Categories of illegal and unreported catches assessed in the 2008 field trip.... 82

4.2.1 Illegal fish catches categories in the Indian EEZ.. 82

4.2.2 Unreported fish catches categories 82

4.3 Interview methodology 87

4.4 Brief reports of the study areas for assessment of illegal catches.................... 90

4.4.1 Gujarat... 91

4.4.2 Maharashtra.. 94

4.4.3 Karnataka 95

4.4.4 Kerala... 96

4.4.5 Tamil Nadu 102

4.4.6 Andhra Pradesh.. 103

4.4.7 Orissa 104

4.4.8 West Bengal.. 106

4.5 Illegal fishing by Indian trawlers in inshore waters allocated to artisanal fishers in coastal states of mainland India 107
4.6 Illegal fishing in offshore waters off India's EEZ 113
4.7 Discrepancies of foreign joint venture chartered tuna longliners 117
4.8 Fishing in disguise: LoP tuna longliners in Indian waters 119
4.9 Troubled waters: Indo-Sri Lankan illegal fishing problem 122
4.10 Incursions of Sri Lankan vessels into the Indian EEZ 125
4.11 Conclusion 127
4.12 Chapter 4 summary 131
4.12.1 Internal displacement 132
4.12.2 Displacement to foreign waters 132
Chapter 5: Unreported marine fish catches of mechanised and small-scale fishers in the Indian exclusive economic zone 136
5.1 Introduction 136
5.2 Discards 137
5.2.1 Discards by Indian fishing vessels 137
5.2.2 Discards estimates from the current study 145
5.2.3 Discards estimates from chartered LOP tuna longliners and Indian deep-sea trawlers 147
5.3 Bait fish used in small-scale and mechanised sectors in Indian fisheries 150
5.4 Post-harvest losses 152
5.5 Subsistence fisheries catches 153
5.6 Dryfish landings 160

5.7 Glut catches ... 161

5.8 Unreported molluscan catches ... 162

5.9 Take home catch of artisanal fishers ... 166

5.10 Why traditional management measures are not working? ... 169

5.11 Conclusion ... 169

5.12 Chapter 5 summary ... 173

Chapter 6: Illegal and unreported fish catches in the Andaman and Nicobar Islands… 176

6.1 Introduction ... 176

6.2 Interview methodology ... 178

6.3 Monitoring control and surveillance in Andaman and Nicobar Islands ... 179

6.4 Fisheries regulations in the Andaman and Nicobar Islands ... 181

6.5 Nature of poaching activities in Andaman and Nicobar waters ... 182

6.5.1 Extent of poaching by foreign fishing vessels ... 184

6.5.2 Incentives for domestic Indian poachers in the islands ... 186

6.6 Estimation of illegal fish catches in the Andaman and Nicobar islands ... 187

6.7 Unreported domestic catches in Andaman & Nicobar Islands ... 188

6.7.1.1 Sea shell fisheries in Andaman and Nicobar waters ... 188

6.7.1.2 Fish consumption among indigenous tribes ... 189

6.7.1.3 Consumption of fish in tourist resorts and local hotels ... 190

6.7.1.4 Take home catch of island fishers ... 191

6.7.1.5 Baitfish used by domestic vessels in the islands ... 195

6.8 Conclusion ... 195

6.9 Chapter 6 summary 203

Chapter 7: Conclusion.. 206

7.1 Main findings 206

7.1.1 Incentives that allow illegal fishing to persist in the world's EEZs 206

7.1.2 Is monitoring control and surveillance adequate in world's fisheries?....... 207

7.1.3 Are illegal fishing penalties a significant deterrent to poachers? 208

7.1.4 Factors driving illegal and unreported catch in the Indian EEZ 208

7.1.4.1 Weak governance 209

7.1.4.2 Controlling illegal catches from chartered foreign tuna longliners 210

7.1.4.3 Overcapacity in trawl and artisanal fisheries 211

7.1.4.4 Influence of peer behavior 213

7.2 Future directions 215

Bibliography.. 217

Appendix A: Cost benefit analysis for 1211 illegal and unreported fishing penalty incidents in 109 countries. 257

Appendix B: Questionnaire for the study evaluating monitoring control and surveillance in 41 fishing countries. 309

Appendix C: List of countries scored for MCS analysis: Catches and rank order 312

Appendix D: Ease of access to data for monitoring, control and surveillance in 41 fishing countries 314

Appendix E: Indian trawlers arrested for illegal fishing in Orissa's territorial waters and marine sanctuaries. 316

Appendix F: Median values of Total cost / Expected revenue for 109 countries...... 318

List of Tables

Table 4.1: Interviews conducted and places visited for estimation of IUU catches in the Indian EEZ. 85

Table 4.2: Violation of Marine Fisheries Regulation Acts by Indian trawlers in the artisanal zone. 108

Table 4.3: Estimates of illegal catches by Indian trawlers in the artisanal zone 109

Table 4.4: State-wise allocation for small-scale fishing craft in India. 112

Table 5.1: Discard estimates in the Indian maritime states from the present study........ 143

Table 5.2: Estimated discards by foreign-chartered trawlers and tuna longliners in the Indian EEZ. 149

Table 5.3: Bait fish used in commercial hook and line fisheries along the Indian coast. 151

Table 5.4: Bait fish used in pelagic small-scale fisheries using motorized boats. 152

Table 5.5: Subsistence fish landings from major estuaries, backwaters and mangroves. 157

Table 5.6: Annual reef based subsistence fish catches along the mainland Indian coast. 160

Table 5.7: Unreported molluscan catches from estuaries, backwaters and creeks in the Indian EEZ. 165

Table 5.8: Artisanal take home catches along the Indian coast. 167

Table 5.9: Unreported catches from mechanised trawlers and gillnetters. 168

Table 5.10: Unreported catches quantified from 2008 Indian field trip in the mainland EEZ. 170

Table 6.1: Estimates of fish consumption by indigenous tribes in Andaman and Nicobar Islands. 190

Table 6.2: Household consumption of fish among fishermen communities of Indian origin in the Andaman and Nicobar Islands. 193

Table 6.3: Total estimate of illegal and unreported catches in the EEZ of Andaman and Nicobar islands.. 196

Table 6.4: Sea cucumbers, gastropods and corals seized by Andaman and Nicobar Police. 199

List of Figures

Figure 1.1: Illegal and unreported (IUU) fishing patterns. 6

Figure 2.1: IUU penalties in 109 countries. 34

Figure 2.2: Median values of the reciprocal of Total cost / Expected revenue in 109 countries. (Contd.., on page 38). 37

Figure 2.3: Median values of the reciprocal of Total cost / Expected revenue in 109 countries. 38

Figure 3.1: Number of fishing vessels equipped with Vessel Monitoring System (VMS) in 53 maritime nations. 51

Figure 3.2: MCS compliance scores for surveillance infrastructure................................ 60

Figure 3.3: MCS compliance scores for human resources. 61

Figure 3.4: MCS compliance scores for high seas fleet monitoring................................ 63

Figure 3.5: MCS compliance scores for vessel monitoring system................................. 64

Figure 3.6: MCS compliance scores for observer scheme... 65

Figure 3.7: MCS compliance scores for inspections at sea. 66

Figure 3.8: MCS compliance scores for aerial patrols.. 68

Figure 3.9: MCS compliance scores for dockside monitoring. 69

Figure 3.10: MCS compliance scores for coastal patrols. 70

Figure 3.11: MCS compliance scores for monitoring transshipments at sea................... 71

Figure 3.12: MCS compliance scores for fishing gear inspections. 72

Figure 3.13: Bar chart showing number of ‘good’ and ‘fail’ compliance ratings. 75

Figure 3.14: MCS grid showing number of ‘good’ and ‘fail’ scores for each question by country. 77

Figure 4.1: Map of India. 86

Figure 4.2: Number of Pakistani fishing boats arrested in Gujarat (India)....................... 94

Figure 4.3: Estimated total illegal catch taken by foreign fishing vessels in the Indian EEZ. 114

Figure 4.4: Sri Lankan fishing vessels arrested in the Indian EEZ (1981-2010)............ 126

Figure 4.5: Map showing migration of fishing crew to Middle East countries. 134

Figure 5.1: Information from IUU interviews in 2008 showing displacement of Indian fishers due to overfishing.. 175

Figure 6.1: Map showing mainland India and its island territories. 178

Figure 6.2: Number of tourists visiting Andaman & Nicobar Islands........................... 191

Figure 6.3: Estimates of sea cucumbers catch taken by illegal foreign fishing vessels in the Andaman & Nicobar Islands.. 197

Figure 6.4: Estimates of illegal trochus catch taken by foreign fishing vessels in the Andaman and Nicobar Islands. 200

Figure 6.5: Estimates of illegal finfish catch taken by foreign fishing vessels in the Andaman and Nicobar Islands. 201

List of Symbols and Abbreviations

AFJ	Japan Fisheries Agency
ALC	Automatic Location Communicator
ANI	Andaman and Nicobar Islands
BOBP	Bay of Bengal Programme
BPL	Below Poverty Level
CCTV	Closed Circuit Television
CCRF	Code of Conduct for Responsible Fisheries
CMFRI	Central Marine Fisheries Research Institute
CPUE	Catch Per Unit Effort
DAHD	Department of Animal Husbandry, Dairying and Fisheries, India
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFV	Foreign Fishing Vessel
FMC	Fisheries Monitoring Centre
FRP	Fibre Reinforced Plastic Boat
GIS	Geographic Information System
GPS	Global Positioning System
GIUFI	Global Illegal and Unreported Fishing Incidents Database
GT	Gross Tonnage
HP	Horse Power

HSTF	High Seas Task Force
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICG	Indian Coast Guard
ICGS	Indian Coast Guard Ship
ICTSD	International Centre for Trade and Sustainable Development
IEZ	Inshore Exclusion Zone
IGO	International Governmental Organization
IMO	International Maritime organization
INS	Indian Naval Ship
IOTC	Indian Ocean Tuna Commission
IPOA	International Plan of Action to Prevent, Deter and Eliminate IUU Fishing
IRBn	Indian Reserve Battalion
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated Fishing
JCG	Japanese Coast Guard
LoP	Letter of Permission
MCS	Monitoring, Control and Surveillance
MFRA	Marine Fisheries Regulation Act
MPA	Marine Protected Area
MPEDA	Marine Products Export Development Authority
MST	Mid-Sea Transshipment
MZI	Maritime Zones of India Act
NAFO	North Atlantic Fisheries Organization

NEAFC	North East Atlantic Fisheries Commission
NEERI	National Environmental Engineering Research Institute
NGO	Non-Governmental Organisation
OAL	Overall Length
OECD	Organisation for Economic Co-operation and Development
PIN	Penalty Infringement Notice
PMF	Andaman Police Marine Force
RFMO	Regional Fishery Management Organization
SAR	Synthetic Aperture Radar
SPC	Secretariat of the Pacific Community
SRFC	Sub-Regional Fisheries Commission
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFSA	United Nations Fish Stock Agreement
UNGA	United Nations General Assembly
UNPSMA	United Nations Port State Measures Agreement
USD	United States Dollar
VDS	Vessel Detection System
VMS	Vessel Monitoring System

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Dedication

To my parents Ganapathiraju Perumalla Raju, Rama Devi

&

my wife Deepti

Chapter 1: Incentives to illegal and unreported (IUU) fishing

1.1 Introduction

Coastal states are bestowed with an intrinsic responsibility to ensure sustainable management of marine resources from both domestic and foreign fishing vessels operating in their 200 nautical miles Exclusive Economic Zone (EEZ). This responsibility is clearly stated in Article 61 of the 1982 United Nations Convention on the Law of the Sea (UNCLOS)[1] "*The coastal State, taking into account the best scientific evidence available to it, shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation*". In this context, enforcement of national and international fisheries laws assumes immense importance and countries require adequate regulatory, financial and human resources to control access to their fisheries resources. However, in the post-UNCLOS era, many countries lack the means to effectively control and regulate fishing effort in this vast new expanse. Problems in tackling Illegal, Unreported and Unregulated (IUU) fish landings are particularly acute in developing countries that possess meager patrolling and surveillance assets (SOFIA 2008, page 73; MRAG 2005; Mwikya 2006). The intent of this thesis is to look at global incentives such as illegal fishing penalties and monitoring control and surveillance (MCS) in chapters 1 to 3; while the goal of chapters 4 to 6 using a regional approach, is to get an accurate estimate of illegal and unreported fish catches in Indian exclusive economic zone (EEZ).

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[1] United Nations Convention on the Law of the Sea of 10 December 1982, UN Division for Ocean Affairs and the Law of the Sea, (http://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm).

Although the United Nations Convention on the Law of the Sea remains the overarching legal document governing optimum utilisation of global fish resources, subsequent fisheries laws like the UN Fish Stocks Agreement (FAO 1995a), UN Fisheries Compliance Agreement (FAO 1993), International Plan of Action (IPOA) to prevent, deter and eliminate IUU Fishing (FAO 2001) and the UN Agreement on Port State Measures (FAO 2009a) have all tried to plug the gaps in management of coastal, straddling and high seas fish stocks. Several of these instruments have important provisions to address IUU fishing through coastal states within their EEZ and through Regional Fishery Management Organizations (RFMOs) in the high seas.

The declining state of global fish stocks[2] (SOFIA 2009, 2010) and growing demand for fish (Pinstrup *et al*., 1997; Delgado *et al*., 2003, see also FAO 2004) necessitate measures to tackle this problem on a war footing more than ever. The fifty-ninth session of United Nation General Assembly (UNGA) attributes declining state of global fish stocks to four factors namely "*failure of States fully to implement and enforce the range of international fisheries instruments and related instruments; illegal, unregulated and unreported (IUU) fishing in*

[2] According to SOFIA (2008) three quarters of world's fish stocks are fully exploited, overexploited or depleted and that calls for better management of fish stocks.

violation of internationally agreed rules; overcapacity in international fishing fleets; and gaps in data and scientific knowledge to inform fisheries management decisions”[3].

In 2007, the impacts of excess fishing capacity and its implications through IUU fishing were also highlighted in the United Nations General Assembly Resolution 62/177[4]. The Twenty-seventh FAO-COFI session highlights the need for controlling IUU fishing through better port state control and improvement of Monitoring Control and Surveillance (MCS) measures through constant vigilance, cooperation and commitment to combat illegal fishing (FAO 2007a). In 2001, the Food and Agriculture Organisation of the United Nations had coined a new terminology of illegal, unreported and unregulated (IUU) fishing[5] to define issues associated to the conditions of these problems.

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[3] United Nations General Assembly (UNGA) Resolution A/59/298, Fifty-ninth session, Report of the Secretary-General, Para 7, Review of main developments in areas covered by General Assembly resolution 58/14 from September 2003 to July 2004**.**

[4] United Nations General Assembly, Sixty-second session, Resolution 62/177, Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments, A/RES/62/177.

[5] IPOA-IUU, International Plan of Action to prevent, deter and eliminate Illegal, Unreported and Unregulated Fishing, Food and Agriculture Organization (FAO), 24th Session of COFI, March 2, 2001.

1.2 Discussion of the definition of IUU fishing

Throughout this thesis, when referring to a global definition of illegal fishing:

Illegal fishing[5] is defined as fishing (Paragraph 3.1 of IPOA-IUU Fishing):

"3.1.1 conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations;

3.1.2 conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by which the States are bound, or relevant provisions of the applicable international law; or

3.1.3 in violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organization."

Unreported fishing is defined as fishing activities (Paragraph 3.2 of the IPOA-IUU Fishing):

"3.2.1 *which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or*

3.2.2 undertaken in the area of competence of a relevant regional fisheries management organization which have not been reported or have been misreported, in contravention of the reporting procedures of that organization.

Unregulated fishing is defined as fishing (Paragraph 3.3 of the IPOA-IUU Fishing):

"*3.3.1 in the area of application of a relevant regional fisheries management organization that are conducted by vessels without nationality, or by those flying the flag of a State not* *party to that organization, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organization; or*

3.3.2 in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law."

Although the FAO's IPOA features some aspects of IUU fishing it does not go far and deep enough to cover many issues relevant to illegal, unreported and unregulated fish landings. The legalese of the UN ignores many nuances of these and related terms such as discards, which are legal, but not reported and unreported fishing is actually a category of illegal fishing, leading to considerable confusion. A brief description of these terms under the three categories of illegal, unreported and unregulated fish catches is given below in Figure 1.1.

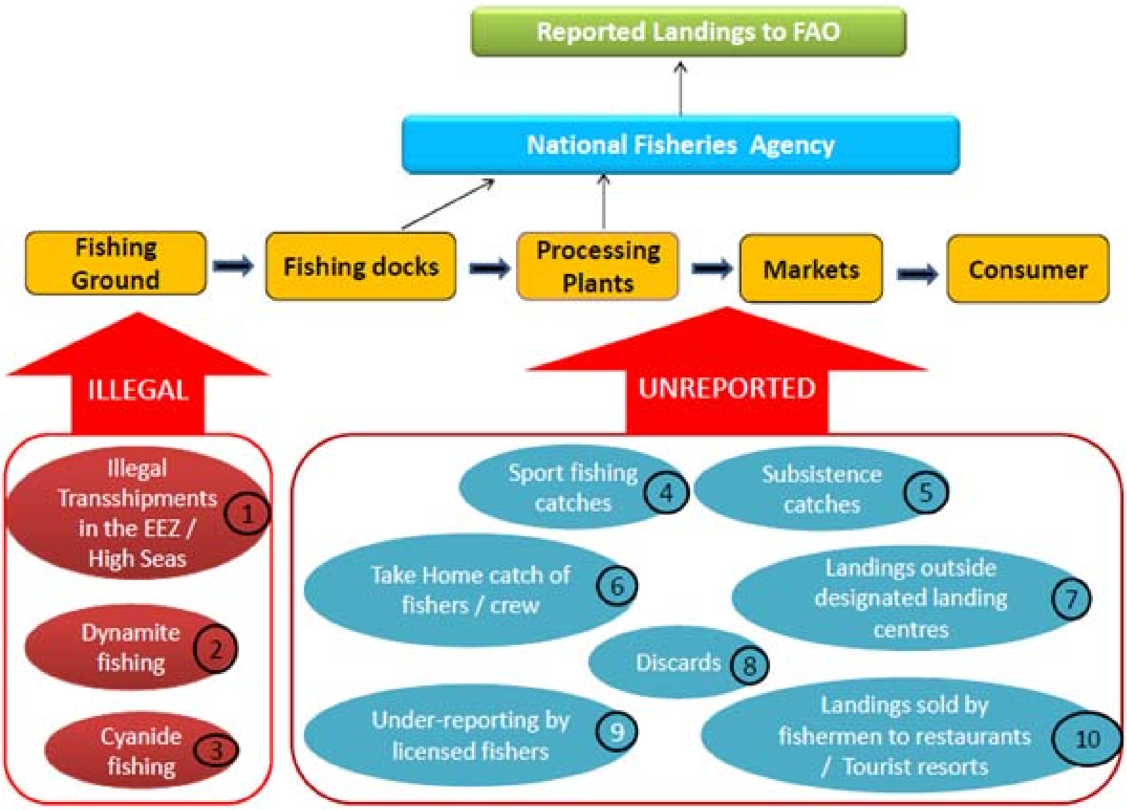

Figure 1.1: Illegal and unreported (IUU) fishing patterns.

The figure shows different components of IUU Fishing not covered under the conventional UN definition. Boxes in Yellow show different stages of fish landings from the fisheries grounds where fish are caught to the consumer. The fish landings data is mostly collected through electronic log reports at sea or catch reports submitted at ports, which in turn is processed by national governments and submitted to FAO each year. Boxes numbered 1 to 3 show various stages where the formal catch inspection scheme fails to assess illegal catches. The boxes numbered 4 to 10 show various categories of unreported catches, which are not assessed under the formal, catch inspection schemes in many countries. These categories are assessed in the fieldwork in India reported in Chapter 4, 5 and 6.

A) Illegal catches[6] also include transshipping catches contravening national and international regulations by landing them in foreign ports without the consent of national authorities; illegal transshipments from licensed vessels to foreign vessels at sea (Fegan 2003; Gillett and McCoy 2006; McCoy 2007; Gianni and Simpson 2005); fish caught through joint venture which should be landed in national ports but is landed elsewhere (Willoughby *et al*., 1997; Butcher 2004; Fegan 2003, 2005; Pramod 2010); misreporting or underreporting catches from licensed vessels to disguise quota violations (Fegan 2003; Pitcher *et al*., 2002; Nadeau 2007; Bremner *et al*., 2009; ICES 2010; Ohlen 2011; European Commission 2011a); illegal sale of recreational fish catches; illegal sale of food fishery catch to individuals / restaurants / food outlets (Gezelius 2004; e.g. New Zealand, Australia); catches from destructive fishing techniques (dynamite and cyanide fishing) which are sold along with catches from other commercial landings (e.g. Indonesia, Philippines); compressor diving for illegal fishing in Indonesian waters (Soeda and Djohani 1998; Erdmann 2001).

B) Unreported catches include take home catch of small-scale fishers and crew of commercial fishing vessels (Pramod 2010); discards (Kelleher 2005); landings sold by fishermen directly to tourist resorts and restaurants (Pramod 2010); errors in weighing fish at landing centers (Willoughby *et al*., 1997; Pramod 2010); non-recording of fish sold through non-government markets (Willoughby *et al*., 1997); beach gleaning (Pramod 2010; Willoughby *et al*., 1997); trans-national landings where fish caught in one country's EEZ and

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[6] Two categories of illegal and unreported catches discussed here (Chapter 1) from a global perspective. In chapters 4 to 6, which use a regional approach more detailed explanation of illegal and unreported catch categories is discussed in section 4.2, in the context of tropical fisheries in India.

landed in another country as catch caught in the high seas (Pramod 2010; Willoughby *et al*., 1997; Butcher 2004); landings during glut periods (Pramod 2010; Willoughby *et al*., 1997). Declining landings of commercial fish species has also resulted in increased level of seafood mis-labeling where less expensive fish are sold as expensive species (Buck 2007; Garcia-Varquez *et al*., 2011; Wong and Hammer 2008).

There is a good argument for using 'unreported' to cover ALL these categories. See Pitcher *et al*., (2002) for more discussion on these aspects. In this thesis a substantive discussion to justify many of these definitions is given in chapters 1, 4, 5 and 6.

1.3 Incentives to illegal and unreported fishing

The UNGA Resolution A/RES/60/31 (Para 33, 2006) highlights the rising threats from IUU Fishing as "*one of the greatest threats to marine ecosystems [that] continues to have serious and major implications for the conservation and management of ocean resources*." Overfishing and declining state of world's fish stocks (SOFIA 2008, 2010) coupled with range of incentives like low operational costs of IUU vessels (Hatcher 2004); corruption (Standing 2008; Tsamenyi and Hanich 2008); territorial disputes (Anwar 2006); higher revenues from IUU operations (Sumaila *et al*., 2006), subsidies (Beddington *et al*., 2007; Sumaila *et al*., 2008; Knigge and Thurston 2011), flags of convenience (Gianni and Simpson 2005), uncertain catch estimates (ICCAT 2010); weak governance (Mora *et al*., 2009; Agnew *et al*., 2009; Pitcher *et al*., (2008, 2009), inadequate port state control (Flothmann *et al*., 2010) and Monitoring Control and Surveillance (Schmidt 2005) have aggravated the suite of problems associated with IUU fishing. IUU fishing is widespread and also prevalent in the high seas (Anon 2008a) and regional fishery management organization (RFMO) jurisdictions where IUU catches appear to be on the rise (HSTF 2006; Agnew *et al*., 2009; ICIJ 2010). Even among many developed countries in the European Union that have access to good MCS resources, poor compliance and a low level of sanctions (European Commission 2008) have compromised the benefits expected from this investment in MCS. Commercialization of small-scale fisheries and the subsequent breakdown of social structure have contributed to an increase in use of illegal fish gear and boats in Indian waters (Pramod 2010).

Globally, fisheries management efforts have largely been inadequate in spite of the declining catches (Mora *et al.,* 2009; Pitcher *et al*., 2009). Progressive legislative instruments like the US Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 and the more recent European Commission Council Regulation [(EC) No. 1005/2008] to prevent, deter and eliminate IUU fishing are steps in the right direction, but their implementation has been plagued by non-compliance in many domestic commercial fisheries in both continents (King and Sutinen 2009; European Commission 2008; Anon 2008b). Clearly, the prevalence of IUU fishing is not restricted to some countries. A recent study by Pitcher *et al*., (2008, 2009) has shown that 30 of the 53 top fishing countries perform poorly in controlling illegal fishing.

Enforcement assumes importance here, as the sovereign rights to sustainably exploit a resource also require the means to effectively patrol it. In this regard Article 73 of the UNCLOS explicitly gives each coastal state "*sovereign rights to explore, exploit, conserve and manage the living resources in the exclusive economic zone, take such measures,* *including boarding, inspection, arrest and judicial proceedings, as may be necessary to ensure compliance with the laws and regulations adopted by it in conformity with this Convention*". However, the growing fleet capacity (Anon 2005a; Pauly *et al*., 2002) and technological sophistication of global fleets to operate beyond the EEZ, means that coastal states should be prepared to ensure compliance from domestic fleets while confronting incursions of illegal foreign fishing vessels violating the 200 nm EEZ. In circumstances, where the coastal state wishes to license foreign fishing vessels to fish surplus stocks in its EEZ, such agreements should require adequate MCS assets to get long term economic benefits and optimum long term harvest of the resource. Such measures have been stated in Paragraph 4 of Article 62 in UNCLOS which requires coastal states authorizing fishing by foreign fleets to "*determining the species which may be caught, and fixing quotas of catch, whether in relation to particular stocks or groups of stocks or catch per vessel over a period of time or to the catch by nationals of any State during a specified period; regulating seasons and areas of fishing, the types, sizes and amount of gear, and the types, sizes and number of fishing vessels that may be used*".

Growing demand for fish in emerging economies such as China has also caused a spike in the use of destructive fishing techniques. For example growing demand for live reef fish in Hong Kong, China and Taiwan has caused an increase in use of destructive fishing in Philippines and Indonesia (Cesar *et al*., 2000; OECD 2004). The mobile nature of the distant water fleets also warrants attention as both licensed and illegal vessels can deplete a resource and move at a much faster pace to new fishing locations (Berkes *et al*., 2006; Bentley 1999; Johannes and Riepen 1995). In Indonesia, early intervention to protect marine habitats from destructive fishing has been shown to be more cost-effective than trying to rehabilitate damaged habitats after blast fishing (Haisfield *et al*., 2010). The scale of illegal catches from larger IUU vessels (>50 GT) operating in the EEZ [41,000 tonnes of fish are trafficked in Yemen every year (Anon 2009a)] and high seas [10,000 tonnes of groundfish were illegally caught in the North Atlantic Fisheries Organisation (NAFO) convention area in 2001 (OECD 2003)] are difficult to control due to the large jurisdictions covered by these fleets and the changing nature of fishing operations (Chapter 3 of this Thesis).

In the Philippines, Chinese poachers are often apprehended and released later due to diplomatic pressure or pardon from government authorities (Anon 2010b). In a nine year period (1998-2007) close to 600 Chinese poachers were apprehended and released in Philippines with only one conviction in 2005 (Anon 2006, 2007a; Anon 2008c). As aptly stated by one government official in Philippines "*Demand is only once side of the coin, illegal fishing by locals was triggered by government inaction. Until the mid-nineties most of reef fish caught in our waters was only marketed in local markets. In my regency, we started encountering more Chinese boats stealing reef fish from our waters. In the initial period (1990-2001) the government stated lack of patrolling resources and from 2002 onwards they caught and often released the Chinese poachers, citing diplomatic pressure. Nowadays, I would say that more illegal boats frequent our waters and land it as their own in Hong Kong markets. Government inaction has emboldened Chinese poachers and we are the one to suffer"* (Anon, *pers. comm*. 2007; Anon 2007b). As the above case in Philippines illustrates, weak government stewardship triggers a cyclic process of localized illegal fishing as disgruntled fishers unhappy with local governance and government, drive faster depletion of the resource, leading to long term economic losses for both fishers and the government. The economic incentives to fish illegally are discussed in Chapter 2 of this thesis. A more rigorous account of economic incentives is provided in (Charles *et al.,* 1999; Sumaila *et al*., 2006).

1.4 Thesis structure

Chapter One highlights some of the existing problems with control on illegal fishing. The chapter looks at major incentives to illegal and unreported fishing in coastal waters, high seas and RFMO jurisdictions. A brief background of the IUU fishing is provided, followed by a review of legislative instruments to deal with the problem. Among the incentives identified for IUU fishing two major aspects a) IUU Penalties and b) Monitoring Control and Surveillance in Fisheries were selected for detailed analysis in the Thesis.

Chapter Two reviews the economic incentives for illegal fishers, through risks and costs associated with engaging in IUU fishing. Data on IUU Fishing Penalties for 109 countries during 1980-2009 were analyzed using 1211 IUU prosecution cases.

Chapter Three reviews the status of Monitoring Control and Surveillance using a questionnaire approach. 41 countries landing 87% of world's fish catches were evaluated for the study using the technique of Pitcher (1999). A detailed analysis of eleven questions namely 1) Surveillance infrastructure, 2) MCS Human Resources, 3) High seas fleet management, 4) Vessel Monitoring System coverage, 5) Observer coverage, 6) Inspections at Sea, 7) Aerial patrols, 8) Dockside monitoring, 9) Coastal patrols, 10) Monitoring of

Transhipments and 11) Fishing gear inspections was conducted to explore MCS capabilities in world`s fisheries. This is perhaps the first attempt to quantify management effectiveness of MCS resources in the fisheries sector.

Chapter Four provides a detailed estimation of illegal catches in India`s Exclusive Economic Zone using 203 confidential interviews from a visit to India in 2008, while Chapter Five provides a detailed estimation of unreported fish catches from small-scale fisheries, subsistence catches, discards and take home catches. Chapter Six looks at illegal and unreported catches from remote offshore island territories of India in Andaman and Nicobar islands.

Chapter Seven synthesises the results of the thesis and looks into the adequacy of measures to control IUU fishing globally and identifies gaps in existing management framework. The chapter recommends adoption and strict implementation of national and international laws to prevent, deter and eliminate illegal fishing.

1.5 Chapter 1 summary

Chapter 1 of the dissertation reviews the incentives and disincentives to illegal and unreported fishing worldwide. In addition, the chapter provides a preview of aspects such as illegal laundering of catches at sea, which are not covered under the current definition of IUU fishing (FAO 2001). The context for the thesis was set by; (1) showing different stages at which IUU landings can occur in marine fisheries, from the point when the fish is first caught at sea to the point until it reaches the end customer; (2) exploring different categories of unreported catches in tropical and temperate fisheries which need attention for better reporting of fish catches to United Nations Food and Agriculture Organization. Several incentives (such as subsidies, corruption, overcapacity etc.) and disincentives (better laws and adequate MCS infrastructure) to curtail illegal and unreported fishing are also discussed. Chapter 1 also introduces the other chapters in the thesis.

Chapter 2: The global illegal fishing penalty regime: why efforts to control illegal fishing are not working?

2.1 Introduction

Illegal fishing, for long, has been recognized as a major problem afflicting sustainable utilization and management of global fish stocks (Agnew *et al*., 2009). Illegal fishing is conducted by domestic and foreign vessels that contravene national and international obligations of the state while fishing within their EEZ and the high seas (FAO 2001). This chapter explores the economic incentives for illegal fishers, through risks, costs associated with poaching, avoidance and apprehension. It also explores whether illegal fishers take monetary costs and benefits into account while engaging in illegal fishing (Sumaila *et al*., 2006). Data from GIUFI (2010) database with information from more than 1000 illegal fishing incidents (from time of occurrence to final prosecution in the courts) was used for assessment of the adequacy of IUU penalties in 109 countries.

Illegal, fishing occurs both within the exclusive economic zone (EEZ) and on the high seas when activities are not adequately monitored and regulated under State laws. Illegal catches also undermine management and conservation of fish stocks by depleting the resource and decreasing the catch allocated to licensed fishers (Agnew *et al*., 2009; Pitcher *et al*., 2002). Illegal catches can come from a wide array of areas like unreported transshipments at sea, under or misreported catches, fish from closed areas, etc. (Pitcher *et al*., 2002), with their extractions varying from year to year, by fishery and jurisdiction (Agnew *et al*., 2009; GIUFI 2010). Illegal catches also affect stock assessments as reported catch and effort data often used in absence of such data result in distortions of available catches (Pauly *et al.*, 2002; Patterson 1998; Bremner *et al.*, 2009).

The illegal fishing problem has been receiving more attention in recent decades since the coming into effect of UNCLOS[7], and several international instruments like FAO's International Plan of Action (IPOA)[8], FAO Compliance Agreement[9], UN Fish Stocks Agreement[10] and the more recent FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing[11] emphasizing the need to regulate activities of fishing vessels both within and outside the EEZ. The problem needs

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[7] United Nations Convention on the Law of the Sea, Montego Bay, 10 December, 1982.

[8] FAO International Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated fishing, Rome, FAO. 2001. 24p.

[9] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. New York, 4 December, 1995.

[10] The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (in force as from 11 December 2001).

[11] Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, FAO, November 22, 2009.

due attention as new forms of corporate (AAD 2003; Griggs and Lugten 2007) and organized crime (Gastrow 2001; Putt and Anderson 2007; Le Gallic and Cox 2006) have made their way into illegal fishing activities.

Penalties for illegal fishing differ by country, region, value of the resource targeted, national and international regulations signed by the country and more importantly by the penalty levied on illegal fishing activity (GIUFI 2010). Even within political entities / countries having a common fisheries policy like the European Union, wide variations in penalty have been observed. The average penalty for breach of fishing laws in Finland in 2001 was only EUR 84, while a similar offence attracted a penalty of EUR 12,700 in Ireland. Further, Ireland imposed an average fine of EUR 7470 for 32 cases in 2001, while France imposed average fines of EUR 2483 for 35 cases, and with Spain imposing even lower penalties at an average of EUR 928 for 2803 cases during the same period (Siggins 2003). These discrepancies in penalties are sufficiently large to suggest a case for harmonization of monetary penalties at least within the European Union (Sloley 2008). Variations in the legal penalties for similar crimes are known to be culture dependent, and derive from events and trends in the history of different peoples (Nunn 2009), but differing penalties for illegal fishing are unhelpful in an increasingly globalized seafood market (Berkes *et al*., 2006). Wide variations in penalty by fishery, country, jurisdiction (See Appendix A for variations in penalty by fisheries in each country) and management areas provide financial incentives for illegal fishers and distant water fleets to target operations in such regions. Hence, results from the present study will throw light on the effectiveness of penalties to deter illegal fishing.

2.2 Methods

Becker (1968) developed the first economic model to predict incentives for people to engage in a criminal activity. Subsequent works by other scientists assert that criminals engage in an illegal activity if the expected profits from that activity exceed profits that can be made from a legal activity (Stiegler 1971; Sutinen and Anderson 1985; Milliman 1986; Vincent and Ali 1997; Kirkwood and Agnew 2004). This argument that financial incentives are the main drivers of illegal fishing activity propelled the emergence of deterrence models (Kuperan *et al*, 1998; Charles *et al.,* 1999). Recent work in this field has also looked at moral, institutional and social drivers that compel individuals to engage in illegal activity (Sutinen *et al.,* 1999; Tyler 1990; Stiegler 1971). The model developed by Sumaila *et al*., (2006) considers five drivers of IUU fishing a) benefits from engaging in illegal activity; b) likelihood of detection; c) penalty faced by fisher when caught; d) cost to the fisher while engaged in such an activity; and e) the degree of moral and social standing of a fisher in the society. The conceptual model developed in the current Chapter follows the assumptions of Sumaila *et al*., (2006) as it appears to be holistic taking into consideration all the economic, social and moral drivers that explicitly motivate an individual to engage in IUU activity. (See Sumaila *et al*., (2006) for more information on the formal model).

2.3 Benefits from illegal fishing activity

According to Le Gallic (2008) two major drivers of illegal fishing activity are overcapacity of the world's fishing fleets, which provide incentives for vessel operators to move their operations to distant waters to reduce operational and labour costs. The second driver is the weakness of international legal frameworks, which allows the continuance of flags of convenience fishing practices (Le Gallic 2008). Globalization of the fishing industry and increasing range of the distant water fleets also aggravate problems associated with illegal fishing (Berkes *et al*., 2006). Institutional drivers such as weak monitoring, control and surveillance (MCS) and low penalties can also drive these activities (See Chapters 2 and 3). Poor MCS coupled with low penalties can reduce the risks faced by IUU operators (Le Gallic 2008), while subsidies (Thurston 2010) can transfer excess capacity to foreign country EEZs, where monitoring is poor.

The current model (in this chapter) assumes that the ability to make profit from an illegal fishing is one of the main incentives for an individual to engage in illegal activity. According to Sumaila *et al*., (2006), there are three possible scenarios under which an individual would want to engage in illegal fishing activity. First, if a fisher is making profit from legal activity, then the probability of him engaging in cheating is low, however, if the fisher's income is declining from legal activity and if he/she can generate profit from illegal activity the probability of cheating will increase. Second, if the fisher is making profit from a licensed activity the incentives to engage in illegal activity are low. The third category of fishers would include fishers who make profit from legal activity but still engage in illegal activity to increase their profits. Other factors that might influence an individual's decision to engage in illegal activity include catches, CPUE, price and cost of fishing (Kirkwood and Agnew 2004; Sumaila *et al*., 2006).

2.4 Expected penalty drivers

2.4.1 Detection likelihood driver

When the probability of getting apprehended is higher, there are fewer incentives for a fisher to cheat. Among others, this driver is influenced by three factors namely (a) capabilities of MCS agencies; (b) social acceptance of violations in fishers community; (c) awareness of regulations; (d) level of funding and involvement of non- governmental organizations in detecting infringements (Sumaila *et al*., 2006; Nielsen and Mathiesen 2001). In Quebec, fisheries violations were found to be most sensitive to changes in likelihood of detection, with increase in fines producing greater deterrence (Furlong 1991). Compliant fishers can also engage in opportunistic illegal fishing if the probability of detection is low (Nielsen and Mathiesen 2001).

2.4.2 Avoidance driver

A fisher engaged in illegal activity will take certain measures to avoid being noticed by enforcement agencies (such as engaging in activity at night or at times of the day when patrolling is less (Anderson (1989); Crawford *et al*., (2004); Anon, *pers. comm*. (2007), illegal transshipment of catch (Anon 2005c; Heazle and Butcher 2007), choosing locations less frequented by enforcement officers (Salmon poachers in British Columbia, Canada (Anon, *pers. comm*. 2008), which are all referred to as avoidance activity (GIUFI 2010).

2.4.3 Penalty driver

Severity of penalty is also one of the important drivers, which motivates or discourages an individual to cheat. The more the penalty, the less would be the likelihood of cheating. This driver is linked to the detection driver, as absence of enforcement negates the severity of a strong penalty. For example, in Philippines and Tanzania, minimal penalties in the coastal reef fishery meant that there are more repeat offenders as fishers get away with a nominal fine in most cases (GIUFI 2010; Anon 2009c). Penalties can range from (i) amount of the fine; (ii) confiscation of catch; (iii) confiscation of gear and other fishing equipment; (iv) cancellation of license for a temporary period; (v) exclusion from the fishery for the rest of the fishing season; (vi) exclusion of repeat offenders from fishery with restrictions on access to fishing grounds; (vii) putting vessel captain and owners into jail.

In the Australian state of Victoria, first time offenders are given a Penalty Infringement Notice (PIN), with repeat offenders penalized through seizure of catch, imprisonment and more serious offences processed through courts. In Western Australia, fisheries regulations allow mandatory penalties of 10 times the value of catch for protected species like abalone and rock lobsters, with serious cases warranting cancellation of fishing licenses (Western Australia Department of Fisheries 2008). In the US Northeast groundfish fishery, deterrence effect of enforcement was weak as benefits from violating fishing regulations were nearly 5 times the economic value of penalties (King and Sutinen 2010). South Africa has brought in new racketeering laws (leader of an abalone smuggling syndicate was sentenced to 10 years), which allow long jail terms to deter new individuals from participating in such activities (Anon 2004a).

2.4.4 Moral and social drivers

Some recent studies on small-scale and artisanal fisheries have also shown that an individual's behavior is strongly influenced by community (Hatcher *et al*., 2000). These kinds of drivers need special attention in developing countries where small-scale fisher's land the bulk of catches and where examination of compliance issues needs examination of both fisher and the community. Breach of fisheries regulations would depend on three levels of violators (i) chronic violators; (ii) moderate violators; and (iii) non-violators (Kuperan and Sutinen 1998). Among these three categories of fishers, chronic violators engage in illegal activities under any set of circumstances while moderate violators will only contravene regulations if the potential for profit exceeds penalty and probability of being caught (Sumaila *et al*., 2006). Secondary triggers that affect the decision of a fisher to engage in illegal fishing include the perceived legitimacy of regulations, and the general moral code of fishers and their communities (Kuperan and Sutinen 1998; Tyler 1990; Sutinen *et al*., 1990; Keane *et al*., 2008).

2.5 Formal penalty model

Using the conceptual framework discussed in Sumaila *et al*., (2006), a global penalty model with far more detailed estimates of penalty by country, fishery, fleets and location was developed using incidents from GIUFI (2010) database. Some of the assumptions made in the model developed by Sumaila *et al*., (2006) are reflected below. The model assumes that a fisher will try to maximize economic gains from the illegal activity, with his actions moderated by moral and social pressure. In cases when a fisher is engaged in an illegal activity with no regulation, he exhibits less avoidance as the probability of being caught and expected penalty are close to zero. An IUU fisher will choose the illegal activity such that marginal revenue from the activity equates sum of marginal cost of fishing together with the marginal cost of moral and social factors associated with that activity. In scenarios where a fisher partakes in an illegal activity in the presence of enforcement, the fisher will choose the level of activity such that marginal revenue is equal to or greater than sum of marginal cost, and a potential marginal fine when he is caught while engaged in illegal fishing.

2.6 Risks in illegal activity (costs and benefits)

Appendix A is a visual representation of the model in Sumaila *et al*., (2006), excluding moral and social components as these drivers are poorly reflected in the data given by enforcement authorities for prosecutions and penalties. Implicit assumptions were also made in the model that avoidance activity of vessel will be incorporated in the vessel's variable cost (See Appendix A), and the benefit from such activity is to reduce MCS effectiveness (reduce "θ") of the vessel. Appendix A lists vessels that have been arrested while fishing illegally in EEZs of 109 countries and their offshore island territories. First entry in the table (page 232) shows vessels arrested by Country (Canada), number of vessels detained (2), its illegal catch (1.7 tonnes), its estimated market value (691) in USD, and its fine in (14614) USD during that year. The 'fine' column uses information from the original data. In most cases information for both 'catch' and 'fine' was available in the source (GIUFI 2010)

2.7 Components of penalty table

The various components of the penalty table (Appendix A) are given below and were modified from Sumaila *et al*., 2006.[12]

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[12] Calculations for all the variables (in italics) in Appendix A follow the method described in Sumaila *et al*., (2006). When more detailed changes or different method was followed this is described, since the IUU incidents in Sumaila *et al*., (2006) used 16 IUU cases where as the current study uses more than 1000 IUU fishing incidents from EEZs of 109 countries and overseas island territories in the GIUFI (2010) database. Incidents

2.7.1 Arresting country

Country arresting the illegal vessel within its EEZ (e.g. Canadian Coast Guard vessel apprehending a fishing vessel 23 nautical miles within its exclusive economic zone (EEZ) for fishing illegally contravening its national laws. All the incidents mentioned in this chapter (Appendix A) are for fishing vessels arrested within the country's EEZ.

2.7.2 Vessel/ gear

The vessel implicated in the illegal activity (trawler, longliner, purse seiner, dragger, squid jigger, fishing boats, catamaran, gillnetter, crabber, sport fishing vessel, refrigerated cargo ship, fish carrier, etc.). In the case of certain fisheries such as abalone and shellfish, fishing gear (e.g. Dive Gear) was used in the column instead of fishing vessel.

2.7.3 Illegal catch / fishery

This column represents the total illegal catch confiscated for the specific illegal / unreported fishing incident. A generic category of "Finfishes nei" was used when a detailed breakdown of species is not available OR when the illegal catch comprised of several species of fish and invertebrates. In cases, where specific species comprised the illegal catch in its entirety, its details were given (e.g. Salmon, Atlantic Cod, Anchovies etc.).

2.7.4 Number of vessels

This column contains the number of illegal fishing vessels implicated in the illegal activity.

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derived from GIUFI used multiple sources for each IUU incident tracking illegal fishing cases from time of arrest to the period or fine to jail time thereby increasing the reliability of the information.

2.7.5 Catch

This column contains the illegal / unreported catch for one or more illegal vessels in each incident. Weights for all the species in the illegal catch were converted into "tonnes" in this column (e.g. pounds, kilograms, etc. were converted into tonnes).

2.7.6 Catch value

In the 'catch value' column, value of the illegal catch was calculated using information provided in the original source and other sources mentioned below. The catch value was converted from the respective country's currency into United States Dollars (USD $) for that year using World Bank exchange rates. In cases where the value was mentioned (in USD) in the incident, it was used as a direct source of catch value instead of the exchange price for that year. It is pertinent to note that for most of the incidents in the GIUFI database catch value in U.S. dollars ($) was mentioned, as each incident in the GIUFI database has information from several sources (tracking information from time of arrest, value displayed in court cases, auction value of illegal catch, international market price for the illegal catch, species etc.). In specific cases, where the illegal catch (e.g. Ribbon fish sold within country (India) or regional markets (when it is exported to China), price of the IUU catch from regional markets was used. Fish prices in national or regional markets (e.g. North America, Asia, Europe, etc.) were only used when price of the species was not available in international markets). In cases, where the IUU catch has international market price, like for tuna, sharks, lobster, abalone etc. the international market price was always used for assessing the value of illegal catch.

In cases where catch was comprised of mixed species, price of illegal catch was calculated using average fish price of all species that can be caught within the EEZ. This was necessary as it was not possible to predict with certainty whether illegal catch on the vessel came from one fishing area or a broader EEZ / High Seas area. In some cases, when illegal catch by different species or common name were available for the total illegal catch, value of each species was calculated separately and then added to the value of other illegally caught species to derive the value of total IUU catch. (e.g., 220 tonnes Bluefin tuna, 12 tonnes Skipjack tuna, 2 tonnes Swordfish (total IUU catch: 236 tonnes). In cases, where the value of the illegal catch was not available for that country's EEZ, the value of similar species in neighboring EEZ's or value of the catch during that year in an importing country was used (e.g., tropical lobsters in Brazil imported by USA).

In cases, where illegal fishing vessels were arrested for minor violations such as use of illegal gear or illegal fishing for certain duration in a closed area, average catch of the vessel / day / fishery for that year was used to calculate a more accurate estimate of illegal catch onboard. (e.g., an Alaskan Pollack fishing vessel fishing for 2 days in a closed area, average catch of vessel / day / season for that fishery during that year was used to calculate illegal catch for the 2 day period, with information of flag, tonnage and average catch by vessel in that fishery derived from GIUFI database). In situations when illegal catch was mentioned in number (e.g., 21 lobsters), average weight of the specific species was used to calculate total weight of the illegal catch. In some cases, where illegal catch was mentioned in quantity of body parts (e.g., 100 tonnes shark fins), the average weight of shark fins was assumed to be 2% of total body weight (IUCN 2003). In cases, where illegal catch was mentioned as confiscation of catch from fishing gear (e.g., catch from 50 lobster traps), average catch of lobster traps during that period (by fishery and country) was used to calculate the total illegal catch. In the 'fine' column when the penalty was given as jail term to crew members, average income per month of all crew members was used to calculate equivalent monetary value for the fine (e.g., captain jailed for 2 years, 15 crew members jailed for 1 year, then monthly wage of skipper and crew members by their nationality were multiplied with the duration of the jail term to calculate total fine in USD).

In cases where the value of the 'fine' column was given in national currency, it was converted into USD using computed data at (http://www.st.nmfs.gov/commercial/landings/gc_runc.html) for global fish prices. In most cases the value of catch was provided in prosecution reports and information dossiers of documents. In cases where only the quantity of illegal catch was available, the value of catch was calculated using prices in GIUFI (2010), and the Global Fish Prices Database (Sumaila *et al*., 2007). Information from Lery *et al*., (1999); GIUFI (2010) was used to calculate variable cost of fishing (as percentage of landed value). The formal model used in this analysis is described in Sumaila *et al*., (2006).

2.7.7 Expected revenue

Expected revenue = $\theta*0 + (1-\theta)*$catch value. This captures the revenue to the country when apprehended catch from illegal fishing activity is usually confiscated. This value is given in USD ($).

2.7.8 Variable cost

Variable costs are the cost of operating the illegal vessel as distinct from the fixed costs of acquiring it. Variable costs were derived from NOAA (1993); Lam *et al*., (2010) and information derived from GIUFI (2010) database in specific cases where more information was available.

2.7.9 Theta (θ) value

Data in "θ" column denotes the probability of detection of an illegal fishing vessel in the relevant jurisdiction, and is used for calculating cost and benefits of the risk involved while engaged in IUU fishing[13]. Although there is scarcely any actual data to calculate value for "θ" column, Sumaila *et al*., (2006) state that it would be reasonable to say that the probability of detection value would be below 0.2 with a 1 in 5 chances of being detected. Consultations were also conducted with 14 maritime experts familiar with fisheries and monitoring control and surveillance capabilities in respective countries to adjust the "θ" values accordingly. Most experts consulted agreed that an average "θ" value of 0.1 is likely to be applicable to most fisheries in world's EEZs. This issue is further discussed below.

2.7.9.1 Calculation of "θ" value in the current work

In the current work, 0.1 was used as a conservative value for probability of detection, but in cases where data suggested higher chances of being apprehended, a higher value in the range of 0.2 to 0.3 was used (GIUFI 2010; See Chapter 3 for more information). For example, abalone poachers in Australia ($\theta = 0.3$) have higher chances of detection compared to fishers

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[13] It is pertinent to note here that for the current economic analysis of penalties information only from illegal and unreported fishing incidents in the GIUFI (2010) database were used.

in other commercial fisheries, as enforcement and monitoring are far better in this sector. Other fisheries with higher probability of detection include squid fisheries in the Argentine EEZ, which would have a "θ" value of 0.2 compared to hake fisheries which would have a lower "θ" value within the same EEZ (GIUFI 2010).

"θ" value also signifies the probability of being detected, arrested and convicted for illegal fishing activity in each incident. In each country for the two time periods of 1980-1994, and 1995-2009, for each specific fisheries such as abalone, scallops, crabs, Finfishes nei, etc., the level of fisheries enforcement was checked to get "θ" values. Drivers of low or high "θ" values included patrolling effort in relation to EEZ area, MCS infrastructure (See chapter 3), number of illegal fishing prosecutions, fisheries patrols at sea, aerial patrols, dockside patrols, market inspections etc. Then accordingly values of 0.1 or less, or a higher value of 0.2, were given for specific fisheries in each EEZ. These "θ" values were then adjusted after consultations with maritime experts familiar with fisheries management and enforcement in these countries. Most maritime experts suggested that the "θ" value might not exceed 0.2 in global marine fisheries, with the exception of very few well patrolled jurisdictions, due to the fact that efficiency of patrolling relies on availability of good modern technology such as adequate government budgets, coastal radars, vessel monitoring systems, good surveillance infrastructure, level of resources allocated to fisheries management in domestic (provincial fisheries) and federally managed fisheries etc. Further, the experts stated that the time allocated for fisheries patrolling which is often perceived as a non-traditional threat, in relation to other threats such as maritime security, smuggling and drug peddling etc. also influence low "θ" values in many fisheries. Likelihood of being caught also differs for both domestic and offshore fisheries within a same EEZ. For example, in the case of salmon fisheries in the west coast of Canada, patrolling might be relatively good in the Pacific Ocean, but the low likelihood of being caught and extent of poaching in coastal waters, recreational and subsistence fisheries in rivers etc. would drive the "θ" value down.

To elaborate on this discussion, I will now use Figure 4.3 in Chapter 4 as an example to explain how the "θ" value might vary between different time periods from 1980-2009 (see page 112), in India's marine fisheries. During 1980s, the Indian Coast Guard had only 1 patrol aircraft, 2 frigates stationed in Mumbai, 2 patrol boats in Chennai, and 3 patrol boats in Andaman Islands (Anon *pers comm*., 2008); This patrolling infrastructure, which was grossly inadequate in relation to the area of EEZ that needs to be patrolled for illegal fishing by foreign vessels. So, during the 1970-1980 time period, the "θ" value would be 0.05. In the next decade, in relation to the relative increase in MCS infrastructure, fisheries inspections, number of patrols, etc. "θ" value increased to 0.07 in 1990s, and 0.1 in the 2000-2009 time periods. Hence, for the current analysis, a theta value of 0.1 is used for Indian fisheries for the 1995-2009 time period (See Appendix A: Cost benefit analysis of illegal fishing penalties). The above "θ" value was finally used after consultations with maritime experts, and using additional data such as the 2008 IUU interviews with enforcement personnel and fishers which served as leverage to adjust the "θ" value to 0.1 in India's fisheries. In the case of India, although the patrolling by Coast Guard has relatively improved in recent decades, poor compliance and fisheries enforcement in state managed fisheries within 0-12 nautical miles also drives the "θ" value to 0.1 or less.

The value of "θ" would also be influenced by the number of fishing vessels, with countries like India and China that operate large fishing fleets having a lower "θ" value as the probability of being searched by patrolling agencies becomes less for most fisheries in these countries. Using these variables, an analysis was done to explore the question of whether potential benefits of engaging in IUU fishing will be greater than potential costs when the "θ" value is between 0.05 - 0.3, using value of fine, catches and variable costs of fishing. A second question explored in this analysis was what fines should have been imposed on each of the cases in Appendix A to make costs equivalent to benefits for risk aspects of an MCS activity when the probability of detection "θ" value lies between 0.05 to 0.3.

2.7.10 Fine

Fine is the financial penalty imposed by the country for the illegal fishing activity in USD ($). In cases where information of 'fine' was available but information for 'catch' was inconclusive or absent, 'illegal catch' from vessels of similar flag and tonnage caught for illegally fishing within same region (e.g. fishing ground, EEZ) and time period were used to estimate the illegal catch of the vessel (In such cases a conservative estimate of catch was drawn from other illegal fishing incidents). For example, if the illegal fishing vessel was from Spain caught for illegally fishing in Canadian EEZ, information on catch confiscated from 2-10 Spanish vessels arrested in this jurisdiction for illegal fishing in that respective year was taken and average catch for the 10 incidents was taken to arrive at an estimate of illegal catch for one Spanish IUU vessel. Similarly if the vessel was penalized for fishing in a closed area using aerial surveillance or VMS signals, the illegal catch of the vessel for the presumed period, i.e. couple of hours to 1-2 days was estimated to get conservative estimate of value of the illegal catch.

2.7.11 Expected penalty

It is the product of the probability of detection (in this study, value ranged from 0.05 - 0.3) and the fine imposed. Its value is given in USD ($).

2.7.12 Total cost

The sum of variable cost and expected penalty expressed in USD ($).

2.7.13 Total cost / Expected revenue

It is the ratio of the potential total cost of illegal fishing to the potential value of engaging in illegal fishing. A value of 1 and above implies engaging in the illegal activity is not a profitable proposition.

2.7.14 New fine

The number of times the reported fines need to be multiplied by in order to make the potential gain equal to potential cost of engaging in illegal fishing when "θ" = 0.05, 0.1, 0.2 or 0.3.

2.8 Results

Globally, calculations for 109 countries using 1211 Illegal and Unreported (IUU) penalty cases show that on average for the 1980-2009 period (Figure 2.1) the ratio of potential costs to expected revenue was less than 1, i.e. 70-100% profitability[14] for IUU operators (shaded

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[14] See Total Cost / Expected Revenue column in Appendix A for more information. Figure 2.1 is a visual representation of the Total Cost/ Expected Revenue value, and it looked at number of times the value was less than 1 (in the Total Cost/ Expected Revenue column) for IUU Penalty cases. For example in 1980-2009 period for the country Canada, the value of Total cost / Expected revenue was less than 1 for 54 out of 90 cases, which shows that it was 60% profitable for IUU operations, alluding to moderately adequate penalties for commercial

in red) in 34 countries (Russia, Brazil, China, South Korea, Philippines, Trinidad and Tobago, Vietnam, Myanmar, Sri Lanka, Egypt, Palau, Vanuatu, Fiji, Kiribati, Micronesia, Cook Islands, Tuvalu, New Caledonia, Solomon Islands, Mexico, Ireland, Spain, Bulgaria, Ukraine, Georgia, Morocco, Gambia, Ghana, Mozambique, Sierra Leone, Falkland Islands, South Georgia, Heard and McDonald Islands and Chagos Islands), while it was 40-70% profitable to engage in illegal fishing in the EEZs of 19 countries (Canada, USA, UK, France, Norway, New Zealand, India, Indonesia, Marianas Islands (US Overseas Island territory), Papua New Guinea, American Samoa, Peru, Nicaragua, Bahamas, Angola, Namibia, South Africa, Somalia and Kerguelen Islands). Six countries: Australia, Argentina, Japan, Malaysia, Seychelles, Guinea Bissau, and one British Crown dependency (Isle of Man) had consistently high penalties and are heading in the right direction with less than 40% profitability making it uneconomical for vessels to engage in illegal fishing. Figure 2.2 (reciprocal plot) shows that although the median values of Total cost / Expected revenue for more than half of the countries in the analysis lie below 1, the ranges suggest that poachers may still make a profit even in countries with a relatively low index score. Appendix F shows the actual median values of total cost / expected revenue used in this plot.

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fisheries in this country. The ratio of potential costs to the expected revenue is high when the value is below 1 (i.e it is profitable for the IUU operator), and it is uneconomical for an IUU vessel when the Total cost / Expected revenue value is greater than or equal to 1.

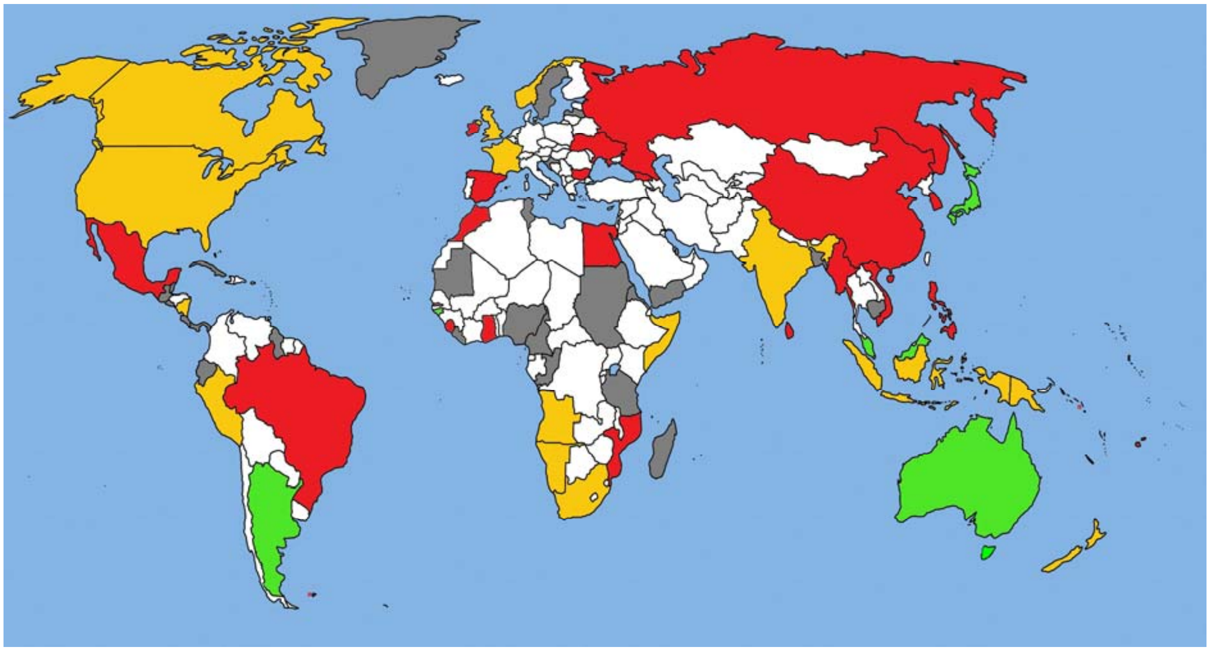

Figure 2.1: IUU penalties in 109 countries.

IUU fishing penalties in 109 countries and offshore island territories between 1980-2009 (See values for Total Cost / Expected Revenue column in Appendix A – Cost benefit analysis of illegal fishing penalties table for 1211 cases). Red colour shows that it was 70-100 % profitable for IUU operators. Orange colour shows that it was 40-70% profitable for IUU operators in these countries EEZs, while green shows that existing penalties are profitable for less than 40% of IUU operations. Grey colour denotes that more information is needed for penalties in these countries before arriving at any conclusion. White colour denotes the countries had no data or that were not covered in the current analysis. Please refer to Appendix A for more information, as many penalty cases in island countries in Atlantic, Indian and Pacific Ocean are not obvious in the map.

The results from the analysis in Figure 2.1 clearly show that countries shaded in red are more profitable for IUU vessel operators, as potential benefits of illegal operations are more in these countries even if they are caught. No concrete conclusions can be arrived for IUU penalty deterrence in 49 countries (*data is available for less than or equal to 3 IUU penalty* *incidents per country* – shaded in grey colour in Figure 2.1)[15] and more information is needed for IUU prosecution cases in these countries (Sweden, Maldives, Malta, Croatia, Tunisia, Eritrea, Congo, Nigeria, Tanzania, Equatorial Guinea, Cameroon, Liberia, Mauritania, Sudan, Yemen, Qatar, Bahrain, Madagascar, Bangladesh, Cambodia, Latvia, Cuba, Jamaica, Ecuador, Guyana, Costa Rica, Guatemala, Panama, El Salvador, Belize, St. Vincent Islands, Comoros Islands, Greenland, Tonga, French Polynesia, Niue, Tromelin Island (France Overseas Territory), Howland and Baker Islands (United States Minor Outlying Islands), Guam (United States Island Territory), St. Paul Island (French Southern Antarctic Territories), British Virgin islands (Offshore British Island Territory), Channel Islands (British Crown Dependencies), Marshall Islands, Nauru, Crozet islands (French Southern Antarctic Territories), Shetland Islands (Offshore British Island Territory), Madeira islands (Portugal Offshore Island Territory), Azores (Portugal Offshore Island Territory), and Clipperton Island (France Overseas Territory)). Every effort was made to contact relevant ministries and national enforcement agencies to get best available information on IUU cases and the present attempt would achieve more success if more countries come forward to share such information.

[15] In Appendix A, IUU penalty incidents have been split under two 15 year blocks from 1980-1994 and 1995-2009, due to the fact that significant improvements have been made in MCS during these two periods and "θ" value has increased between the two periods, for many commercial fisheries. So, results from Figure 2.1 give a holistic view of the IUU penalty regime from 1980-2009, as data is scarce for many developing countries in the first time period during 1980-1994. More detailed analysis by decade is possible when more data sources become available in future.

It is pertinent to mention that more information on penalties is needed, as IUU case dossiers on penalties are not easily accessible in many countries. Several hurdles to accessing such information remain due to out of court settlements, reasons of confidentiality or prolonged judicial process. For example, in the case of Japan, information on penalties was not publicly available as "When Agency of Fisheries (AFJ) or Japanese Coast Guard (JCG) arrest illegal fishing vessels, they ask for deposit money to release these vessels. Then, AFJ or coastal guard releases the vessel and takes legal proceedings. For most cases, these vessel owners /fishers never come back to Japan to appear in courts. AFJ or the Coast Guard then confiscates their deposits as penalties. There is a rule to decide the amount of deposit money, but this is treated as confidential" (Anon, *pers. comm*. 2010). In stark contrast, most of the apprehended illegal foreign vessels are rarely prosecuted in India, with vessel and crew members regularly released due to intervention by the federal government on the pretext of improving bilateral relations with neighbouring countries (See Chapter 4).

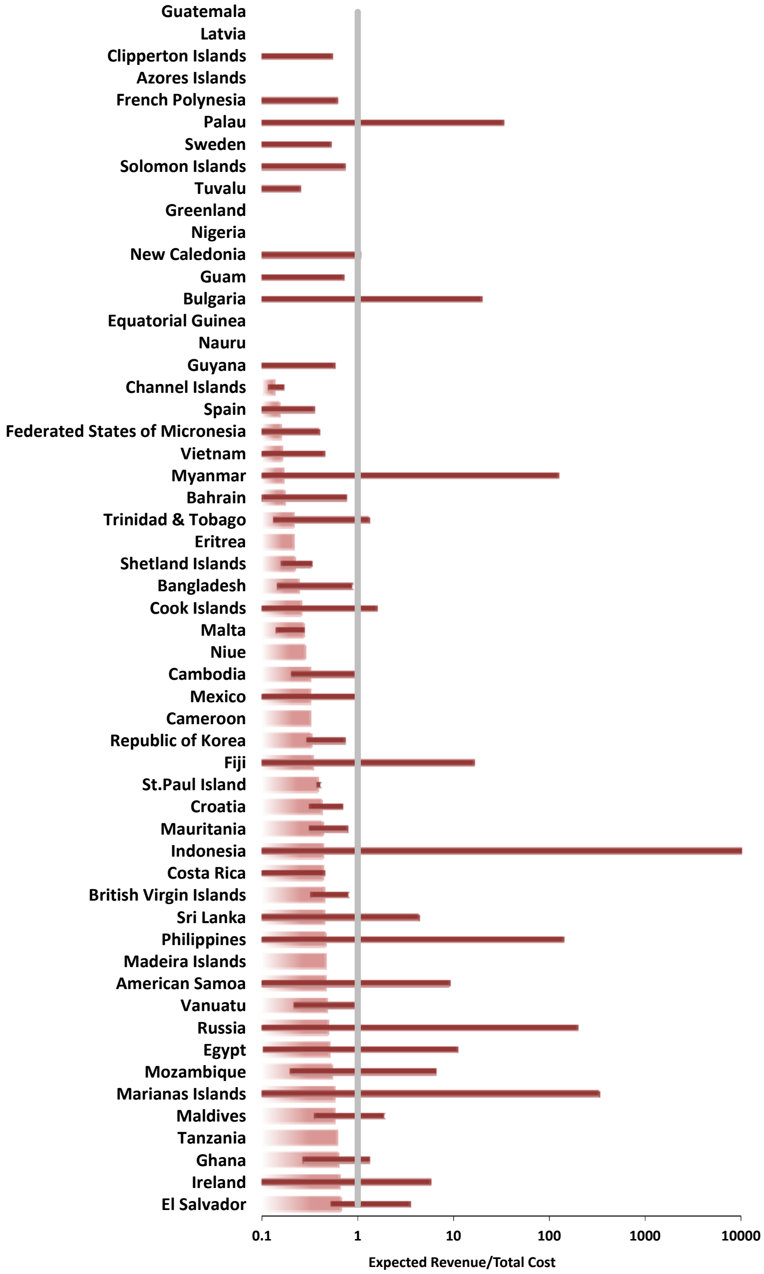

Figure 2.2: Median values of the reciprocal of Total cost / Expected revenue in 109 countries. (Contd.., on page 38).

Shaded bars show average values, while solid lines show the range of the values. Values above 1 indicate that profit can be made from illegal fishing. The Total cost / expected revenue is plotted on a logarithmic scale, values above 1 indicate that profit can be made from illegal fishing. The above figure shows that although the median value of more than half of the countries in the analysis lie below 1, the ranges (solid lines) suggest that poachers may still make a profit even in countries with a relatively low index score. Appendix F shows the actual median values of total cost / expected revenue used in this plot.

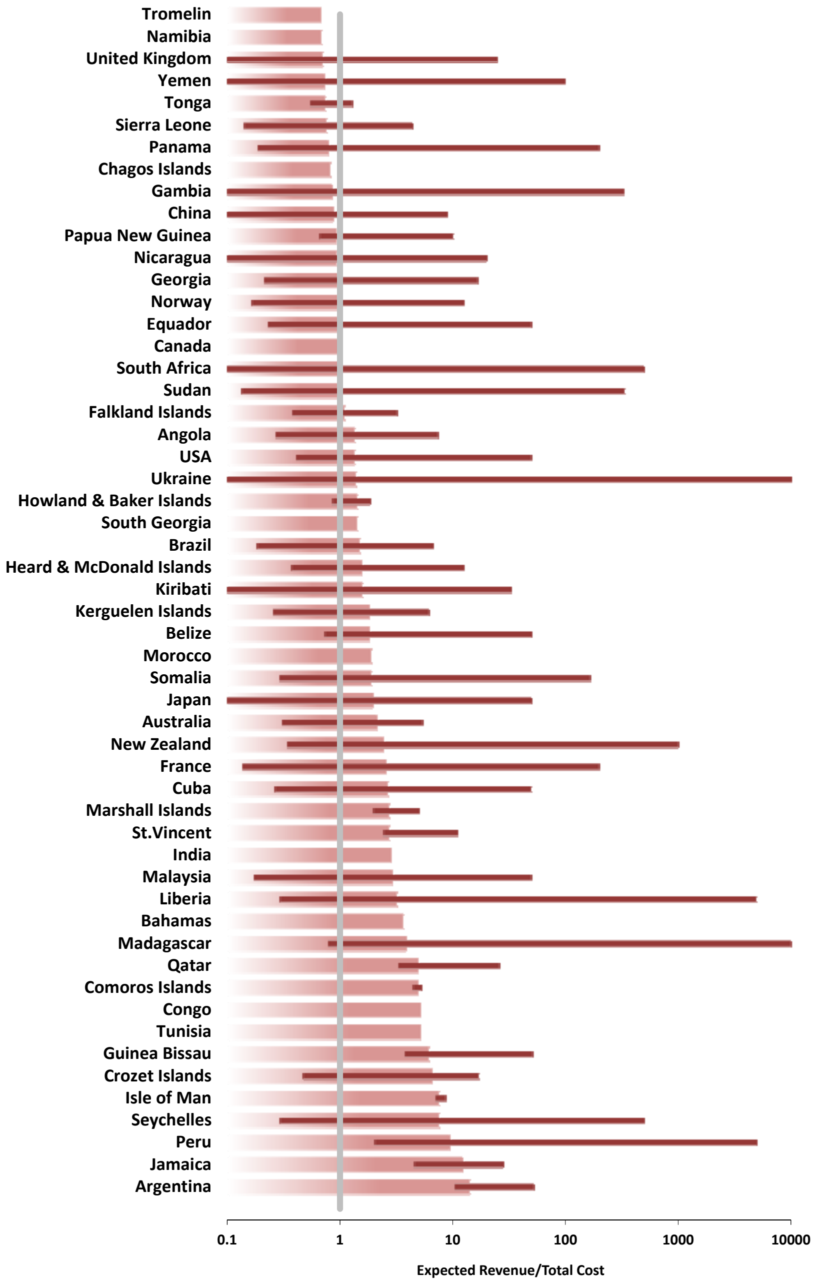

Figure 2.3: Median values of the reciprocal of Total cost / Expected revenue in 109 countries.

Shaded bars show average values, while solid lines show the range of the values. Values above 1 indicate that profit can be made from illegal fishing. The Total cost / expected revenue is plotted on a logarithmic scale, values above 1 indicate that profit can be made from illegal fishing. The above figure shows that although the median value of more than half of the countries in the analysis lie below 1, the ranges (solid lines) suggest that poachers may still make a profit even in countries with a relatively low index score. Appendix F shows the actual median values of total cost / expected revenue used in this plot.

2.9 Discussion

Le Gallic (2008) recommends use of higher tariffs to prevent imports of fish products from countries supporting IUU fishing as a measure to discourage illegal vessel operators. Other measures suggested include catch documentation and labeling schemes to aid in traceability of fish products; making IUU operations unviable by refusing port access which will increase fuel costs and streaming time for IUU vessels (Le Gallic 2008). Illegal fishing can also cause a negative impact on the socio-economic status of fishers employed on illegal fishing vessels through labour and human rights violations (ITF 2006). Illegal foreign fishing can have far reaching effects altering ecosystem integrity with potential economic impacts through decline of fish stocks targeted by domestic fishers (Pascoe *et al*., 2008). Often gains from illegal fishing outweigh the risks when fishers target high value fish like tuna and toothfish (Anon 2008a; Anon 2010d). A survey of fines imposed on IUU fishing in OECD countries showed that existing penalties have little impact on IUU catches, as penalties are not a sufficient deterrent compared to high value of the catches (Schmidt 2005). Few countries like New Zealand and Australia have taken serious action in this direction by legislating laws which allow confiscation of fishing vessel, gear and catch implicated in IUU fishing within their EEZs (Anon 2005b; Anon 2000a). Other attempts to control illegal fishing include long jail terms to keep repeat offenders and smuggling rings away from poaching activities (Anon 2004a).

Economic incentives for IUU fishing include fleet overcapacity (European Commission 2011b), lack of port state control, low MCS effort, and shortcomings in enforcement of flag state responsibility (Sutinen and Anderson 1985; Warner-Kramer 2004; HSTF 2006; also see

Chapter 4 of this thesis). Fishers can also engage in IUU practices by transferring illegal catches at sea, which are difficult to detect in the absence of regular surveillance (Anon 2005c). Non-compliance with quota can also occur through mis-reporting where vessels report catches of quota species while fishing for other valuable fish (Angel *et al*., 1994); and under-reporting of landed catches (Anon 2009b; Polacheck and Davies 2008). IUU catches in the high seas are difficult to detect in the absence of regular patrols and aerial surveillance, which provides gaps for vessels to operate with impunity (Bours *et al*., 2001; Agnew 2000; Kirkwood and Agnew 2004). Spiraling costs of fisheries enforcement have also led to the advent of new programs like North Pacific Ground Fishery Observer Program, where observers are required to report violations that they witness at sea (NOAA 2003).

2.10 Chapter 2 summary

Chapter 2 of my thesis explored illegal fishing penalties in 109 countries using 1211 IUU prosecution cases using the conceptual model of Sumaila *et al*., (2006). In comparison to 16 cases used in Sumaila *et al*., (2006) paper, in the current analysis 1211 illegal and unreported fishing incidents for 109 countries were evaluated. The current analysis in Chapter 2 is perhaps the most comprehensive work done so far globally to evaluate effectiveness of illegal fishing penalties to deter illegal fishing. Appendix A shows a wide variety of fisheries and fishing fleets that were explored for the analysis in each country to provide a diverse perspective on illegal fishing penalties in each country. Results from the current analysis can be used to address low penalties in specific fisheries and increase enforcement to prevent occurrence of such incidences in future. Research in this direction needs attention as globally many fish stocks are witnessing a decline and with estimates of illegal fishing ranging between \$10 bn and \$23.5 bn annually (Agnew *et al.*, 2009), this issue needs more focus than any time ever.

Using the Total Cost / Expected Revenue values in Appendix A, a detailed overall comparison of adequacy of illegal fishing penalties in developed and developing countries is discussed in terms of profitability below (also see Figures. 2.1 and 2.2). Among European countries, it was moderately profitable (40-70%) for IUU operators in jurisdictions of France, UK and Norway, while it was highly profitable (>70%) in Spain, Ireland, Ukraine, Georgia and Bulgaria. Among other developed countries, Canada, USA and New Zealand showed moderate profitability (40-70%) for IUU operators, with Australia and Japan being the only two countries with low profitability (<40%). Among developing countries in Asia, Malaysia was the only country with low profitability (<40%), while China, Philippines, Vietnam and South Korea showed high profitability (>70%) for illegal fishing operators in these jurisdictions.

Among Pacific island countries and territories Papua New Guinea, American Samoa and Marianas Islands (US Overseas Island territory) were moderately profitable (40-70%), while Fiji, Kiribati, Federated States of Micronesia, Cook Islands, Tuvalu, Palau, Vanuatu, Solomon Islands and New Caledonia jurisdictions were highly profitable (>70%) for IUU operators. In the Southern Antarctic territories, the British territories of Falkland Islands and South Georgia had high profitability (>70%); French Antarctic territories of Kerguelen Islands showed moderate profitability (40-70%); and the Australian territories of Heard and McDonald Islands showed high profitability (>70%) for illegal fishing operators.

Chapter 3: Plugging the leaks: an assessment of monitoring control and surveillance (MCS) in the marine fisheries of 41 countries

3.1 Introduction

The United Nations Convention for Law of the Sea[16] (UNCLOS) was perhaps the biggest recent advance for coastal States in terms of increasing jurisdiction and economic opportunities for exploitation of living and non-living resources. The sovereign rights that it brought with it also increased responsibility for monitoring and control of this extended territory. Perhaps one of the most intriguing questions is how many countries at that point of time in 1982 possessed adequate monitoring, control and surveillance (MCS) capabilities to control resources over a 200 nautical mile maritime zone often with meagre maritime patrolling infrastructure. Thirty years down the line, progress has been achieved in many coastal nations in terms of increasing maritime preparedness for confronting and managing threats for longer distances from the shore. In parallel, one also needs to recognise the increase in number, size and technological sophistication of distant water vessels, necessitating better monitoring of fishing activities beyond the EEZ (Hatcher and Robinson 1998; Kwon 2000; Haward and Bergin 2000; Goldstein 2009). Increase in capacity of new high seas fishing vessels from countries such as China also deserves due attention (Xue 2006).

[16] United Nations Convention on the Law of the Sea of 10 December 1982.

Globally, lack of adequate enforcement has been identified as one of the major impediments to sustainable utilisation and management of fisheries resources (Sutinen and Anderson 1985; Sutinen 1988; Peterson and Teal 1986; Olson and Morgan 1985; Montgomery 2000; Kelleher 2002). Although some countries like Indonesia have enacted better fisheries laws, their enforcement remains weak (SCS 1981). In Indonesia, efficiency of enforcement operations was impacted by equipment, number of operations, poor coordination of law agencies and reduced capabilities of law enforcement agencies at sea (Sutinen 1988). It is interesting to note that a neighbouring country Malaysia performs better for compliance with international laws and fisheries management aspects (Pitcher *et al.,* 2008). According to Sutinen (1988) the main purpose of surveillance and enforcement is to act as deterrent to violations of fisheries regulations and other maritime laws. Several studies have discussed impacts of illegal fishing on national and regional economies in the absence of adequate MCS (Sutinen *et al*., 1992; Coulter 1996; Gordon 1997; Flewwelling 2001; Ganesan 2001; Butcher 2004; Anwar 2005; Agnew *et al*., 2009). Studies in marine protected areas (MPAs) have shown that successful management requires effective enforcement to accrue benefits from such efforts (Guidetti and Claudet 2009).

Fisheries is one the major activities within the Exclusive Economic Zone (EEZ) of any coastal nation and management of its operations needs a strategic policy to ensure compliance with national and international laws. The Coast Guard and the Navy are the principal agencies involved in monitoring control and surveillance of fish stocks within this extended jurisdiction in most maritime countries. However in this context, one also needs to draw attention to the fact that monitoring of fisheries resources is one among the multitude of duties that enforcement agencies undertake within a country's EEZ. Very few jurisdictions have exclusive fisheries patrol vessels to monitor their fleets on a regular basis; notable few include South Africa, Namibia, China, UK, Iceland, Taiwan and Falkland islands. Shortage of patrolling assets and inadequate MCS can aggravate poaching problems due to lack of ability to monitor large numbers of distant water and domestic vessels operating within a country's EEZ. With the exception of Flewwelling (2001) study in 11 South Asian Countries; Pitcher's (2008, 2009); and Mora *et al*., (2009) studies in recent years, no major attempt has been made to quantify MCS related issues in the fisheries sector.

3.2 International laws relevant to monitoring control and surveillance in fisheries

Since the advent of United Nations Convention on Law of the Sea many new international instruments like UNFSA[17], the FAO Code of Conduct for Responsible Fisheries[18], and the

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[17] Article 5(l) of UNFSA urges coastal fishing states to "implement and enforce conservation and management measures through effective monitoring, control and surveillance".

[18] Article 7.1.7 of the FAO code of Conduct for responsible fisheries "States should establish, within their respective competences and capacities, effective mechanisms for fisheries monitoring, surveillance, control and enforcement to ensure compliance with their conservation and management measures, as well as those adopted by subregional or regional organizations or arrangements".

international Plan of Action on IUU Fishing[19], have dealt with the necessity to undertake effective monitoring, control and surveillance in global fisheries. International laws like UNCLOS, UN Fish Stocks Agreement, and FAO Compliance Agreement discuss issues on necessity of measures to ensure compliance of fishing vessels both within and outside the EEZ. Article 18(1) of the United Nations Fish Stock Agreement (UNFSA) requires signatory nations to ensure that vessels flying their flag do not undermine conservation measures. Article 18(2) of UNFSA requires nations to grant authorisation to fish on the high seas "*where it is able to exercise effectively its responsibilities in respect of such fishing vessels*". Article 18(3)(b)(iv) of UNFSA requires flag states to expand existing regulations "*to ensure that vessels flying its flag do not conduct unauthorised fishing within areas under the national jurisdiction of other states*".

3.3 Definition of monitoring control and surveillance in fisheries

The definition for fisheries monitoring control and surveillance developed by a MCS Conference of Experts in 1981 was used for this study (FAO 1981). As per this definition **Monitoring** is defined as "*the continuous requirement for the measurement of fishing effort characteristics and resource yields*"

The monitoring component receives, integrates and verifies data submitted by licensed vessels; at sea inspections and sightings; observers, VMS, satellite images, radar; port

[19] Paragraph 24 of the IPOA on IUU Fishing "States should undertake comprehensive and effective monitoring, control and surveillance (MCS) of fishing from its commencement, through point of landing, to final destination....."

inspections logbooks, dockside monitoring, landing reports; and data from aerial surveillance (Flewwelling *et al*., 2002).

Control is defined as "*the regulatory conditions under which the exploitation of the resource may be conducted*"

The control component addresses five key issues i) responsibilities of all fisheries personnel for effective coordination of MCS operations ii) ensure compliance with international agreements like UNCLOS, UN Fish Stocks Agreement, FAO Compliance Agreement etc. iii) control activities of domestic fishing vessels; stipulate terms and conditions for fishing vessels (vessel identification, catch reporting requirements, transhipping, flag state responsibility) iv) draw regulations to devise appropriate penalties for violators (Flewwelling *et al*., 2002).

Surveillance is defined as "*the degree and types of observations required to maintain compliance with the regulatory controls imposed on fishing activities*"

Success of surveillance requires fisheries personnel to concentrate on both data collection and involve stakeholders in participatory conservation activities (Flewwelling *et al*., 2002). The basic infrastructure required for surveillance include: a) national headquarters for coordinating fisheries operations with links to regional field offices; b) central operations room to check current status of fishing operations; c) communications system to landing centres and mobile patrols in the field for coordinating operations; d) computerised data entry and control system; e) surveillance equipment including aircraft, vessels, sea and air surveillance, VMS, radar, satellite technology, GIS and land transportation (Flewwelling *et al*., 2002).

3.4 Tools for monitoring control and surveillance in fisheries

MCS mechanisms are not a panacea for all fisheries related problems, but can act as a good management tool if used effectively. According to Flewwelling *et al*., (2002) fisheries MCS activities receive low priority among military agencies, and allowing a single agency such as a Fisheries Ministry / Coast Guard to play the lead role can enhance their effectiveness. Some of the key MCS tools needed for fisheries management include enforceable legislation, control through licenses; data collection through dockside monitoring, observers, sea and port inspections; communication structure through a Fisheries Monitoring Centre (FMC); patrol vessels with capability to stay for extended durations at sea; availability of aircraft for rapid deployment with the ability to search vast areas; use of new technology such as VMS, radar, video and infra-red tracking; bilateral, regional and sub-regional co-operation with other MCS components ; and professional staff (Flewwelling *et al*., 2002). Several studies have been conducted evaluating law enforcement effectiveness in the fisheries sector (Fidell 1976; Sutinen and Anderson 1985; Blewett *et al*., 1985; Sutinen 1985; Sutinen *et al*., 1990; Flewwelling 2001; Kelleher 2002).

Flewwelling *et al.,* (2002) state that effective MCS requires a two-pronged strategy of **preventative approach** which includes encouragement of voluntary compliance through enhancement of community / fisher awareness; participatory management; peer pressure towards voluntary compliance; system of accurate data collection; surveillance and verification of compliance. A secondary parallel **deterrent / enforcement approach** is also necessary to ensure compliance by flagrant violators whose activities might harm activities of legal fishers. The approach should include inspections, investigation and prosecutions through courts (Flewwelling *et al*., (2002). MCS needs effective co-ordination of land, sea and air components, with its effectiveness largely determined by inter-agency synchronization mechanisms in place for fisheries management in the respective country. The **land component** is the most important element of any MCS system and entails port inspections (to check accuracy of catches, transhipments), dockside monitoring and trade of seafood products. The **sea component** includes radar, sonar and vessels used in enforcement of regulations in EEZ and high seas. A major chunk of resources for the sea component is allocated to at-sea patrols, while other "no force" techniques such as observers, vessel registers and Vessel Monitoring System (VMS) serve as deterrents to fisheries violations. The **air component** includes use of aircraft, satellites and VMS signals to track activities of vessels at sea. This is perhaps one of the best methods to track fishing activities over a large area within a short period and can help in optimising enforcement efforts to areas where vessels are fishing and where violations are detected during patrols. The air component can also serve as precursor of illegal activity to trigger MCS action and gather crucial evidence through photographs and video evidence of illegal activities (Flewwelling *et al*., 2002).

3.4.1 Importance of surveillance infrastructure in fisheries

Continuous monitoring through surveillance infrastructure serves as an important management tool to ensure compliance with fisheries laws and to ensure that interests of the government and licensed fishers are not compromised by infractions from domestic and foreign vessels operating within a country's EEZ. Such infrastructure in the fisheries sector could include a wide array of tools from sea based patrol vessels to smaller Fibre Reinforced Plastic (FRP) craft, speedboats for patrolling shallow waters, aerial patrolling aircraft and surveillance vessels chartered through regional fisheries agreements. Land based infrastructure would include 4 wheeler vehicles, land based Fisheries Monitoring Centres linked to satellites, and Radar stations for data collection and monitoring. Some countries like Senegal have used “no force” mechanisms such as network of coastal radars to serve as early warning for intrusions of industrial vessels into their 6 nautical mile coastal inshore zone (Flewwelling *et al*., 2002). Maldives has used satellite images along with VMS to track activities of licensed vessels operating within their EEZ (Flewwelling *et al*., 2002). Coastal Radar system is more effective in developing countries where large number of vessels operating in inshore waters can be effectively tracked, while offshore industrial vessels can be tracked through VMS. Some of the constraints in electronic tracking using radar include difficulty in proving disputes regarding such violations in the courts, especially when such evidence is used to initiate a chase and seizure of an illegal fishing vessel (McKenna 2004). According to FAO (2007b) AIS transmitters placed on coastal fishing vessels can be used to detect fisheries violations for vessels operating within 50 nautical mile zones. Several studies have discussed use of space based synthetic aperture radar (SAR) to enhance fisheries surveillance (Freeberg 1995; Montgomery *et al*., 1998; Clemente-Colon *et al*., 1998). Space based SAR with their all-weather; day and night capability can also provide valuable intelligence during certain seasons when sea based patrols are affected (Montgomery 2000).

3.4.2 Importance of vessel monitoring system in the fisheries sector

The advent of vessel monitoring system certainly transformed the way fisheries is managed globally with some nations in the Pacific and European Union solely relying on this technology to track their vessels activities inside and outside the EEZ. According to

Flewwelling *et al*., (2002) VMS has the potential to provide cost effective MCS and a viable alternative to traditional enforcement at-sea. Many international instruments such as the FAO Code of Conduct (*Article 7.7.3*), UN Fish Stocks Agreement (*Article 5(j), 18(3)(e) and g(iii)*), IPOA on IUU Fishing (*Paragraph 24.3*) advocate the use of VMS. Article 9 of NEAFC Scheme of control and enforcement and IOTC resolution dated 06/03 adopted on May 26, 2006 require vessels of both contracting and non-contracting parties to use VMS on transhipment vessels (FAO 2007b).

According to Flewwelling *et al*., (2002) use of VMS is ideal for industrial fishing vessels rather than artisanal fisheries where their sheer numbers make them difficult to control. Further the authors state that each state wishing to use satellite based MCS must require (i) installation of automatic location communicators (ALC) as part of the licensing system; (ii) vessels have to be clearly marked for identification to allow comparison of patrol sighting data to satellite VMS data; (iii) require vessels to report their position at regular intervals along with information on their activities and catches; (iv) require landings / transhipments to take place in designated ports or in presence of observers; (v) ensure confidentiality of information and use collected data for enforcement purposes only (Flewwelling *et al*., 2002). Several studies have stressed on the need to integrate VMS data with other MCS tools to enhance enforcement capabilities in the fisheries sector (FAO 2005; FAO 2007b).

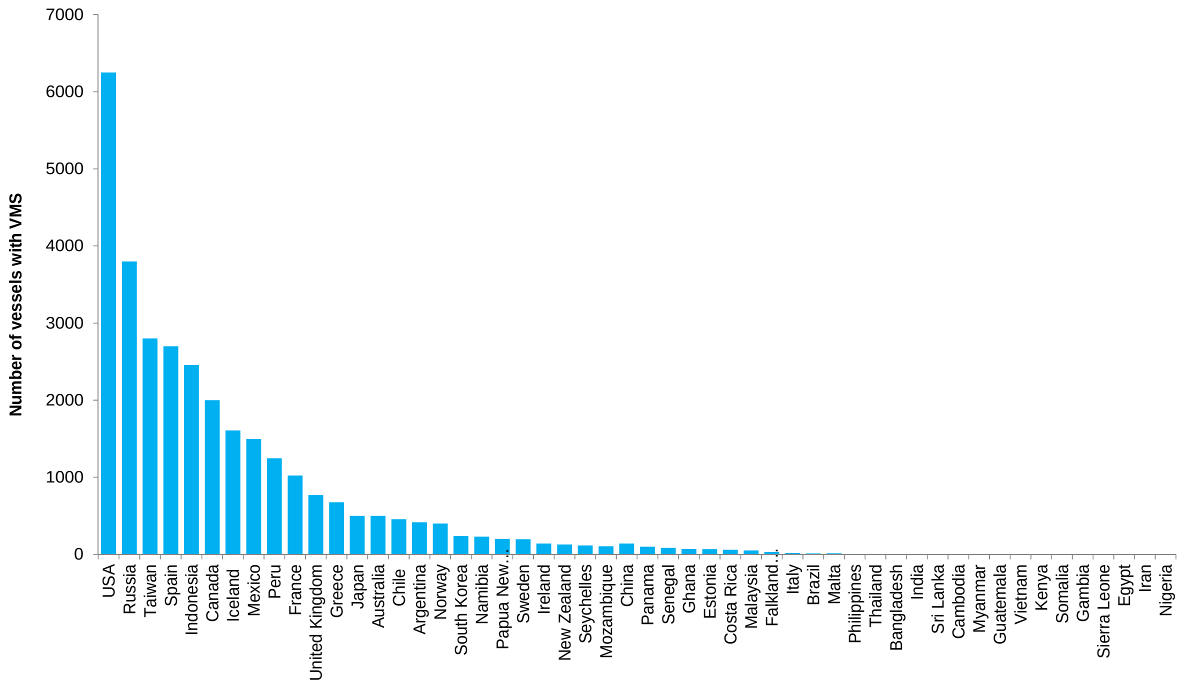

Figure 3.1: Number of fishing vessels equipped with Vessel Monitoring System (VMS) in 53 maritime nations.

Data for the number of vessels covered through VMS was collected through Question 4. (Vessel monitoring system) in the MCS case studies for 41 fishing nations (see Pramod 2011). Data for remaining 12 countries was collected from GIUFI (2010) database. The figure shows that although many developed countries have installed new technologies such as VMS to monitor their fishing vessels, most of the developing countries (with the exception of Indonesia) are yet to catch up with such modern technology and currently very few fishing vessels from these countries are equipped with VMS to monitor their fleets at sea. This problem assumes importance especially in countries such as China with huge distant water fleets, which currently have very low VMS coverage.

In South Pacific countries, surveillance efforts through VMS assume immense importance as exploitation of tuna stocks by distant water fleets contributes to economic viability of these nations (Bergin 1988). In Iceland, several enforcement cases were successfully prosecuted based entirely on VMS data (FAO 2007b). In Madagascar, all industrial fishing vessels are required to be fitted with tracking devices to monitor zoning incursions in the inshore shrimp fishery (FAO 2007b). In Seychelles, all foreign fishing vessels that offload catches in its ports are to be fitted with VMS and transmit their position reports during their presence in Seychelles EEZ (FAO 2007b). Such initiatives can be replicated in African countries where the scale of such incursions by foreign fishing vessels into the Inshore Exclusion Zone remains very high (GIUFI 2010). Although the technology has its advantages, incidents of tampering with equipment through blocking of antenna and switching off power supply have been documented in several countries (FAO 2007b). In such countries, VMS reports can be verified with satellite imagery and radar through Vessel Detection System (FAO 2007b).

3.4.3 Why is an observer scheme needed in fisheries?

Fisheries observers can serve as deterrent to fisheries violations by their mere presence onboard fishing vessels, while collecting scientific data for fisheries management at the same time. Observers can also serve as enforcement assets when they are required to report fisheries violations witnessed at sea (Porter 2010). While dockside inspections can detect some violations for port landings, at sea violations such as discards, high grading, retention of prohibited species and retention of non-quota species can be better detected through observers at sea (Anderson 1989; King *et al*., 2009). From 2000-2002, observers in the US North Pacific groundfish fisheries reported 590 violations alluding to their importance in fisheries enforcement system (Porter 2010). Placement of observers on fishing vessels can also serve as secondary source of data to countercheck bias in data submitted by fishing vessels (Furlong and Martin 2000; Allard and Chouinard 1997). However, fisheries violations reported by observers cannot promote compliance unless active investigation and prosecutions follow them by enforcement agencies (Porter 2010). Analysis of NMFS observer data showed that observer reported incidents were prosecuted less often in US Fisheries (Porter 2010). Porter (2010) states that prosecutors many not enforce fisheries violations reported by observers as these cases are less severe than traditional enforcement cases.

3.4.4 Importance of sea based patrols in fisheries

Patrol vessels by their mere presence on fishing grounds act as deterrent to fisheries violations, and help to gather critical intelligence on fishing activities. Boarding's through at-sea patrols provide information on accuracy of data and provide checks on use of legal gear, catch logs, radio reports and logbooks (Sutinen 1988). They are also the principal means of conducting inspections of fishing fleets at sea (Sutinen 1988). According to Sutinen (1988) enforcement effort by patrol vessels depends on number of previous sightings / encounters with fishing vessels, with their efficiency determined by path of patrol boat, time spent at sea and how widely fishing vessels are distributed at sea.

3.4.5 Importance of aerial patrols in fisheries

Aerial patrols provide strategic picture of fishing activities and provide tactical data for patrol vessels with information on locations of fishing vessel activity, their movements and indirectly through data on fish migrations (Sutinen 1988). However, in the absence of legal or administrative sanctions, vessels sighted by patrol aircraft have limited or no impact on level of violations (Kelleher 2002). Armacost (1992) has discussed about level of aerial patrols required for fisheries law enforcement in relation to fishing activity in US waters. In the absence of national monitoring programme, countries like Sierra Leone, Cape Verde, Gambia, Guinea, Guinea-Bissau, Mauritania and Senegal rely on joint air and sea surveillance provided by Sub-regional fisheries commission (SRFC) for monitoring licensed and unlicensed fishing vessels operating within their EEZs (Flewwelling *et al*., 2002). South Korea has used combination of surveillance instruments such as Radar, Closed Circuit Television (CCTV) cameras and GPS receivers to monitor illegal fishing activities within their EEZ (Lee and Kim 2004). The Korean system is effective in targeting poaching activities as radar positions of vessels are compared to GPS position reports to counter check accuracy of reporting (Lee and Kim 2004). In countries like Denmark, Argentina, USA, and New Zealand, CCTV on fishing vessels have been used to monitor compliance with fishing rules and cut discards at sea (Anon 2009d; McElderry 2008; Bonney *et al*., 2009).

Satellite images (Radarsat) can serve as vital sources of information for poaching activities of smaller vessels in the 15-20 metres range which can go unnoticed during routine air patrols (McKenna 2004). Using Radarsat satellite images a geographical location can be observed 2-3 times / week, and can capture 300 km wide by 3000 km long area (McKenna 2004). Other suggested technologies include tracking devices like "shiploc" which use GPS to transmit vessel's position to a satellite 15 times / day and have been used by IMB to track ships captured by pirates (McKenna 2004). Other emerging technologies such as Satellite imagery, lights emitted by fishing vessels have been used to determine fishing intensity of squid vessels off Argentine coast can be used in fisheries enforcement (Waluda *et al*., 2002).

3.4.6 Importance of dockside monitoring in fisheries

Although several international instruments such as FAO Code of Conduct, FAO Compliance Agreement, UN Fish Stocks Agreement, IPOA on IUU Fishing and the more recent UN Post State Measures Agreement advocate implementation of port state control to prevent influx of illegal fish shipments, implementation of these measures remains lukewarm in several countries. To overcome the problem of illegal transhipments at sea, countries which do not have adequate infrastructure for at-sea monitoring and enforcement can bring forth laws which mandate presence of dockside observers and authorise transhipments only at ports. The need for proper dockside controls is further validated in light of recent evidence on large scale of "black fish" landed in UK (Anon 2010e) and Ireland (Anon 2007c). Dockside monitoring is an important management tool to monitor catches offloaded from fishing vessels, tallying vessel catch rates against its quotas, and to check fisheries violations of non-quota species.

3.4.7 Importance of coastal patrols

Coastal fisheries patrols assume immense importance in developing countries with large small-scale fleet landing catches in discrete locations along the coastline. Often, these patrols would look at compliance with use of legal fishing gear, illegal fishing in protected areas and destructive fishing practices. However, this problem is even prevalent in developed countries through under-reporting/overfishing in the recreational and subsistence sectors (Pramod *et al.*, 2008). Coastal patrols also assist in providing deterrence and enforcement of laws against destructive fishing practices, execution of zone limits for trawlers and fishing boats etc. Coastal patrols also assume high importance in tropical countries where small-scale fisheries land bulk of nation's fish catches, and adequate enforcement in these waters can ensure sustainable exploitation of coastal resources.

3.4.8 Importance of monitoring transhipments at sea

Paragraph 34 of the UNGA Resolution 59/25, 17 January 2005, directly acknowledges the problems related to Illegal transhipments "*common means of conducting illegal, unreported and unregulated fishing involves the unreported or misreported transshipments of fish at sea*". Transshipments at sea are difficult to track unless there is a certain degree of regular enforcement through aerial patrols and VMS tracking of vessels. However, transhipment is used by plethora of nations to legitimately transfer catches at sea to avoid loss of valuable fuel and cruise time while undertaking fishing operations. However, transhipments also provide opportunity for illegal operators to transfer illegal catches in EEZs of foreign countries as well as to disguise quantity of fish taken by vessel in quota fisheries. Illegal transhipments also make it difficult to track fishing locations and transfer of catches from flags of convenience vessels (GIUFI 2010; Gianni and Simpson 2004). ICCAT regulations advocate monitoring of all transhipments by observers at sea and necessitate all transhipments to occur in ports unless special provisions under Section 2 of 06-11 apply (Hurry *et al*., 2008). However, the recent annual reporting of ICCAT member states on port state measures shows that inspections at ports are random and inconsistent, alluding to poor application of rules even in well-established RFMOs (Hurry *et al*., 2008).

3.4.9 Importance of fishing gear inspections

Regular inspections of compliance with fishing gear help in enforcing mesh size regulations, preventing zoning conflicts, reducing by-catch, and to prevent capture of juvenile fish and other invertebrates. Inspections on a regular basis can also help to minimise damage through lost or discarded fishing gear (Macfadyen *et al*., 2009) and help in proper disposal of damaged ones through shore collection system. Inspections help to ensure proper tagging of fishing gear for help in identifying owners to minimise gear conflicts and illegal gear at sea. Moreover, they prevent misuse of multiple gears in a single license fishery in tropical small-scale fisheries in the developing world (Pramod 2010).

3.5 Methods

In this study, an evaluation was conducted using a case study approach to evaluate the management effectiveness of patrolling agencies to monitor and control fisheries resources within the 200 nm exclusive economic zone. The Exclusive Economic Zones (EEZ) of 41 maritime countries landing 87% of the world's fish catch were assessed using a rapid appraisal technique for 11 questions designed by the author using the 'Rapfish' method outlined in Pitcher and Preikshot (2001).

The questionnaire (See Appendix B) lists the themes and international laws relevant to MCS in Fisheries. The 11 questions are grouped under two fields a) MCS Infrastructure and b) Vessel inspections. Each question was scored on a scale of 0 to 10, to indicate the scale of compliance with each attribute, where 10 indicates perfect compliance. Uncertainty in each score is clearly reflected in the score range for each question. The eleven questions were designed using aspects derived from international laws like UNCLOS, UNFSA, PSMA, FAO-CCRF and the IPOA on IUU Fishing (See Appendix B). Appendix C shows the percentage of world fish catch (in tonnes) landed by 41 countries in the evaluation (the 41 countries landed 87% of the world's fish catches in 2005). The 41 country reports for MCS evaluation[20], containing 538 references and 209 pages is published separately as Pramod (2011), which provides detailed text and scores for the 11 questions in the analysis. However, lack of information posed a persistent problem for many aspects such as inspections at sea, aerial patrols etc., despite every effort to contact national and regional enforcement agencies to gather information for the relevant aspects. Gaps in access to information for MCS study for each country were evaluated and are provided in Appendix. D. Information in Appendix D, shows the extent of information available through various sources such as government records, journals to academic literature and internet for the present study.

In this chapter an attempt has been made to quantify compliance with international laws relevant to MCS aspects. ; The aim of this study was to explore MCS capabilities of coastal nations to enforce national and international fisheries laws within their maritime zone (EEZ) and the high seas [9 questions relevant to MCS compliance within the EEZ and 2 Questions (Q.3 & Q.4 Field 1) for the high seas]. The present study does not reflect a nation's management effectiveness for facing other maritime threats such as terrorism, security,

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[20] Pramod (2011) Evaluations of Monitoring, Control and Surveillance in marine fisheries of 41 countries, MCS Case Studies Report, Fisheries Centre, University of British Columbia, Canada, May 2011, 222. ftp://ftp.fisheries.ubc.ca/CodeConduct/CountriesCodePDF/MCS%20Case%20Studies%20in%2041%20Fishing%20Nations.pdf

human trafficking, drugs, etc. A clear distinction on this aspect is essential as fisheries is one among several activities monitored by enforcement agencies in a country's EEZ, with priority being afforded to it depending on the country's location, it's EEZ area, defence priorities, number of agencies involved, coupled with financial, administrative and regulatory allocation of patrolling and manpower assets. It is important to mention that the present study does not attribute efficiency of MCS operations within a country's EEZ to one single agency as often such operations often rely on co-ordination between large number of enforcement agencies[21] and so usually no single agency can be held accountable for good or bad scores for questions in the survey.

3.6 Results

Analysis of key questions relating to monitoring control and surveillance is given below.

3.6.1 Scoring compliance with surveillance infrastructure

The first question in the analysis looks at the extent of patrolling and surveillance infrastructure available for monitoring fishing activities within a nation's EEZ. The analysis (Figure 3.2) reveals that of the 41 countries, 13 (31%) received scores within the 'good' range of 7- 10 and have adequate infrastructure for regular patrolling of fisheries resources within their EEZ. All these countries have consistently invested substantial legal, financial and administrative resources to ensure optimum utilisation of patrolling assets through regular apprehensions of illegal fishing vessels and higher detection rate of violations within their EEZs (GIUFI 2010). Five countries (12%) have acceptable scores above 6/10 (Sweden,

[21] Fisheries enforcement duties in many coastal states are shared between one or more of these agencies such as Coast Guard, Navy, Marine Police, Customs, Fisheries Ministry etc.

China, South Africa, Taiwan and Mauritania). However, 14 countries (34%) received "fail" grades of 4 and below (Peru, Myanmar, Madagascar, Sri Lanka Indonesia, Philippines, Vietnam, Bangladesh, Cambodia, Guinea, Nigeria, Cameroon, Ghana and Sierra Leone) making these countries highly vulnerable to illegal fishing.

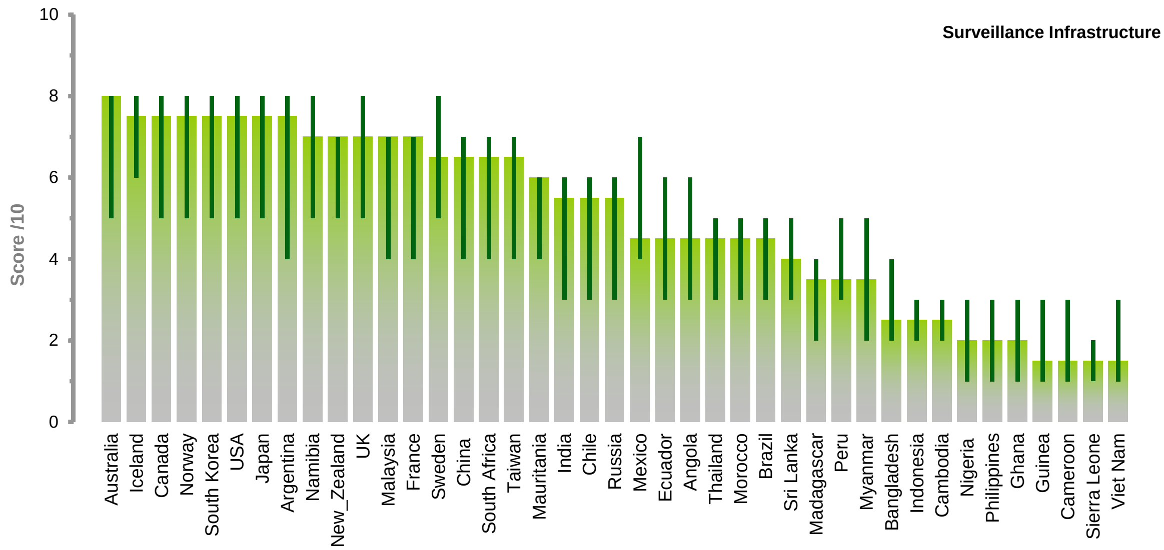

Figure 3.2: MCS compliance scores for surveillance infrastructure.

Bar chart showing compliance of 41 fishing countries for Question 1. Surveillance infrastructure. Shaded bars show the average compliance scores while error bars are derived from upper and lower score limits for each question and country (See Appendix B for details related to how questions were scored); Scores below 4/ 10 indicate a 'fail' rating; scores between 6 to 7 are considered a 'pass' rating; and scores above 7/10 denote 'good' rating.

3.6.2 Scoring compliance with MCS human resources

The second question in the analysis evaluates the availability of trained officers available for monitoring the fisheries sector. The analysis reveals that 25 countries (61%) have low compliance scores, which fall within fail grades of less than 4 (Madagascar, Mexico, Peru, Argentina, Brazil, Chile, Ecuador, Russia, Morocco, Angola, Mauritania, Guinea, Ghana, Nigeria, Cameroon, Sierra Leone, India, Bangladesh, Philippines, Myanmar, Sri Lanka, Thailand, Cambodia, Indonesia and Vietnam). The worrisome trend is that even developed countries like Iceland have only passable scores of 6.5/10. Developed countries like Namibia, Sweden, France, Iceland, UK, USA, Canada, Malaysia and China (22%) have moderate scores of 5.5/10, with a range of 3-7, alluding to need for improvement in these countries (See Figure 3.3). Two countries (Argentina, and India) achieved compliance scores of 3.5/10, in spite of having good surveillance resources. A majority of developed countries in the analysis perform poorly due to shortage of manpower in monitoring both nearshore and recreational sectors while developing countries appear to have shortage in both small-scale and industrial sectors. Almost all the countries have shortage of manpower for monitoring shipments from their ports as well as for checking vessels transiting through their ports.

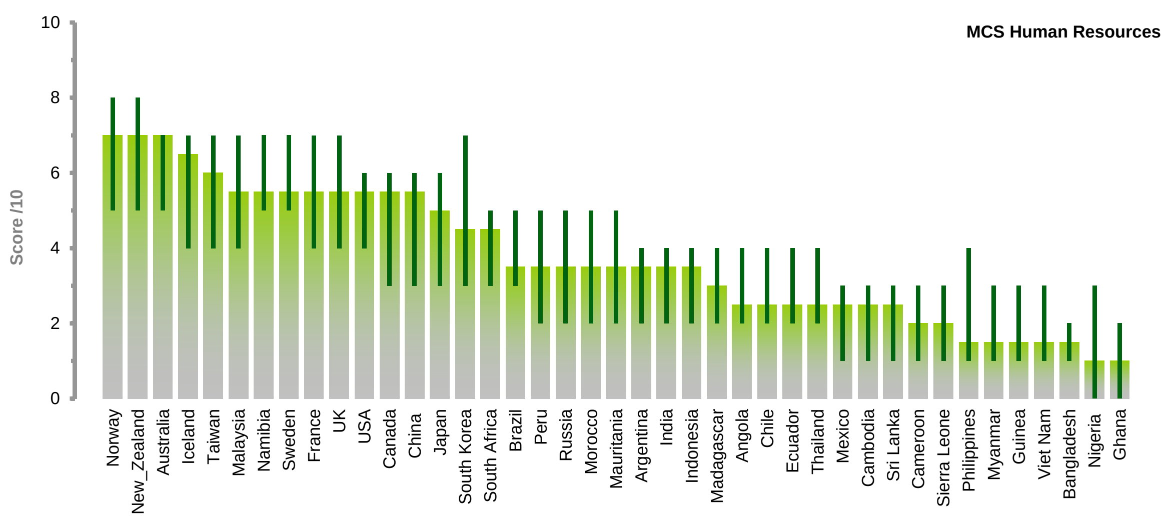

Figure 3.3: MCS compliance scores for human resources.

Bar chart showing compliance of 41 fishing countries for Question 2. MCS Human Resources. Shaded bars, error bars and symbols are explained in Figure 3.2.

3.6.3 Scoring compliance with monitoring of high seas fleet

The need for monitoring high seas fleets has been explicitly stated in many international laws like the FAO Compliance Agreement, UN Port State Measures Agreement (PSMA), UN Fish Stocks Agreement and the IPOA on IUU Fishing. Q.3 deals with this aspect looking at whether each country has taken appropriate measures to monitor its fishing vessels operating beyond its EEZ, and if such activities are licensed with proper reporting procedures to prevent illegal and unreported fishing in high seas and RFMO jurisdictions. Analysis of Figure 3.4 reveals that of the 41 countries only 4 (10%) received good grades above 7/10 (Iceland, USA, New Zealand and Australia). One country (Mexico) received passable score of 6/10, while 9 out of 41 countries (22%) received moderate scores in the range of 4 to 6 (Peru, Chile, Canada, Norway, Japan, Namibia, Sweden, France and UK). However, 27 countries had completely unsatisfactory grades of less than 4/10 (Malaysia, South Korea, Argentina, Angola, Ghana, Brazil, Madagascar, Morocco, Sri Lanka, China, Russia, South Africa, Philippines, Cameroon, Indonesia, Taiwan, Ecuador, Bangladesh, Thailand, India, Mauritania, Sierra Leone, Guinea, Nigeria, Myanmar, Cambodia and Vietnam). Lack of control for fleets from China, South Korea and Taiwan with a huge high seas presence has severe implications in controlling IUU fishing and conserving migratory stocks in the EEZs of foreign countries and the high seas.

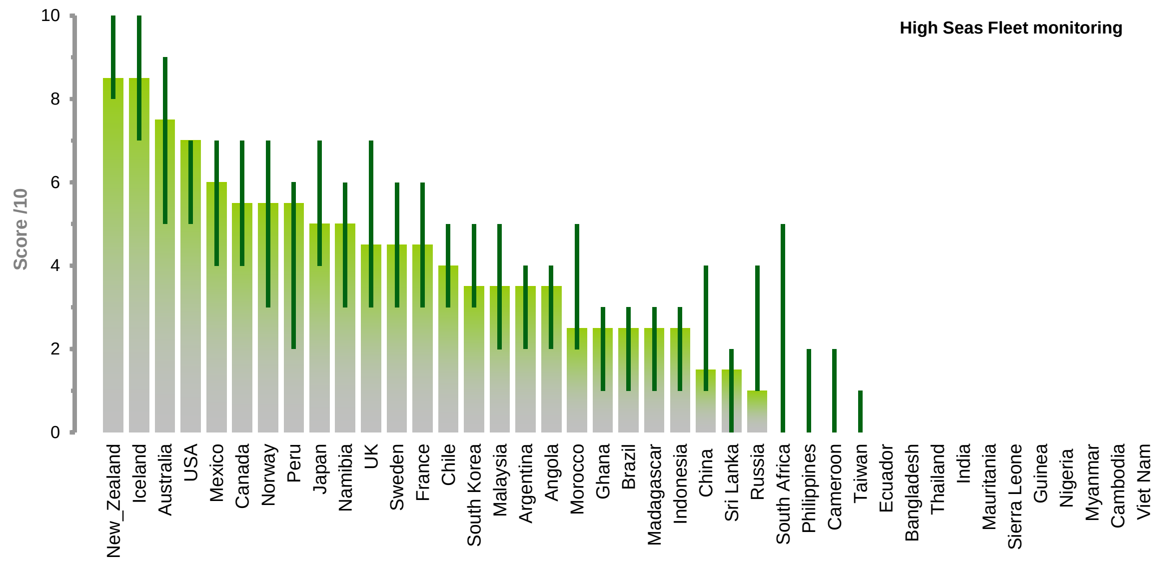

Figure 3.4: MCS compliance scores for high seas fleet monitoring.

Bar chart showing compliance of 41 fishing countries for Question 3. High Seas Fleet Monitoring. Shaded bars, error bars and symbols are explained in Figure 3.2. Fifteen countries, South Africa to Vietnam got '0' scores for this question and hence there are no bars in the above figure for these countries.

3.6.4 Scoring compliance with vessel monitoring scheme

The analysis reveals that 7 countries (17%) have "good" scores within the range of 7/10 (Iceland, Namibia, New Zealand, Norway, Madagascar, UK and USA) for monitoring major portion of their fishing fleet through vessel monitoring system (Figure 3.1 & Figure 3.5). All these countries have active VMS programmes backed by progressive legislations to monitoring their fleets on a continuous basis. A further, 4 countries (France, South Africa, Argentina and Chile) have passable score within a range of 6/10, and increasingly are making VMS an integral part of many new fisheries. However, no less than 22 countries have unacceptable low compliance scores (4 or less); these include Indonesia, Mauritania, Taiwan, Cameroon, Ghana, Brazil, Sweden, China, South Korea, Morocco, Malaysia, Philippines, Guinea, Myanmar, Thailand, Cambodia, Sri Lanka, Sierra Leone, Vietnam, Bangladesh, Nigeria, India.

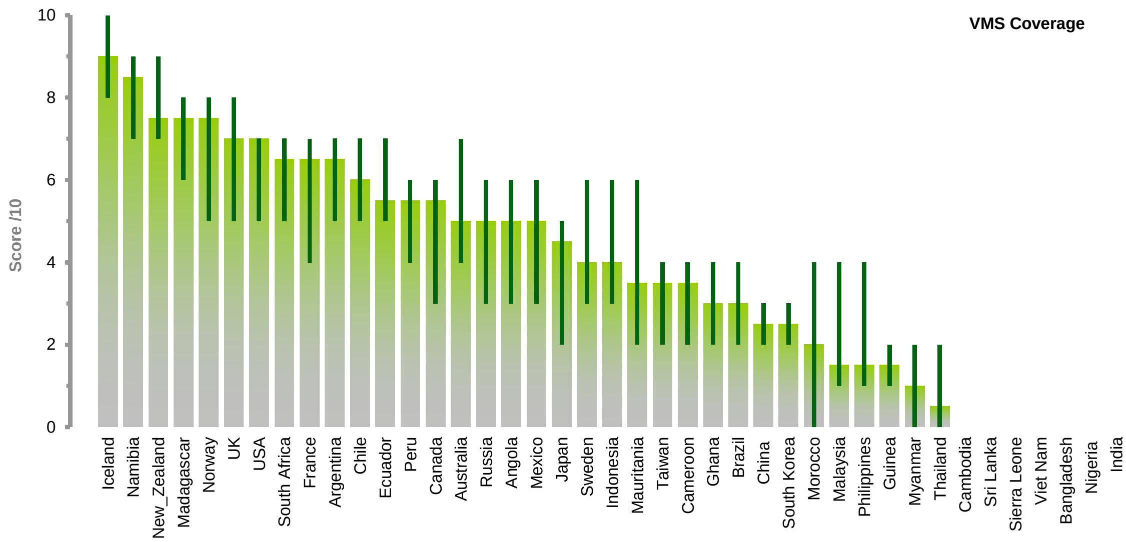

Figure 3.5: MCS compliance scores for vessel monitoring system.

Bar chart showing compliance of 41 fishing countries for Question 4. Vessel Monitoring System (VMS). Shaded bars, error bars and symbols are explained in Figure 3.2. Seven countries namely Cambodia, Sri Lanka, Sierra Leone, Vietnam, Bangladesh, Nigeria and India got '0' scores for this question and hence there are no scores and error bars in the above figure for these countries.

3.6.5 Scoring compliance with observer scheme

Figure 3.6 shows that only one country (Namibia) has good score of 8.5, with three countries having passable scores in the range of 6/10, and upper confidence limits above 7 (Australia, Norway, and USA). Canada, Madagascar, Argentina and New Zealand have a wide range of scores above 4.5/10, so their estimates are uncertain. However, 32 of the 41 countries (78%) have "fail" grades on the observer coverage issue, of which Angola, Sweden, UK and Peru have made some improvements on this aspect and are planning to include more fisheries under observer scheme. The remaining 28 countries (68%) have unequivocal "fail" scores (Iceland, Japan, Mexico, Chile, Ecuador, Philippines, Myanmar, Russia, Taiwan, France, south Korea, Brazil, Sierra Leone, Morocco, Mauritania, Guinea, Cameroon, Indonesia, Ghana, China, Malaysia, Thailand, Cambodia, Sri Lanka, Vietnam, Bangladesh, Nigeria and India.

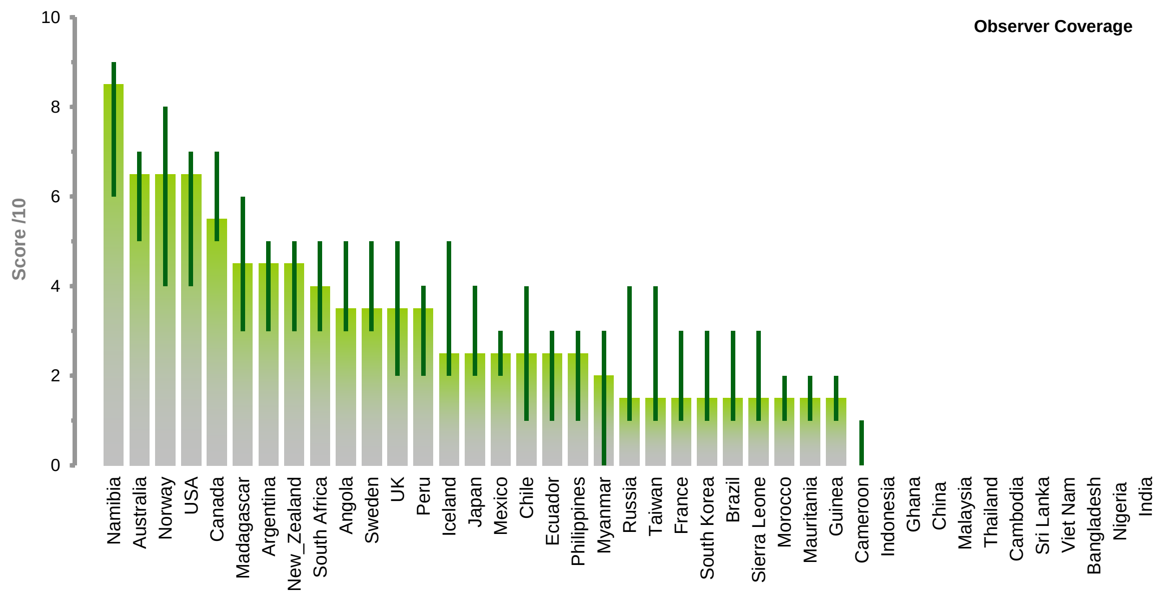

Figure 3.6: MCS compliance scores for observer scheme.

Bar chart showing compliance of 41 fishing countries for Question 5. Observer Scheme (VMS). Shaded bars, error bars and symbols are explained in Figure 3.2. Eleven countries namely Indonesia to India received '0' on score for this question and hence there are no scores and error bars in the above figure for these countries.

3.6.6 Scoring compliance with inspections at sea

Figure 3.7 shows that of the 41 countries only two countries (USA and Norway) had good scores on this question, while three other countries (7%) had scores within passable range of 6/10 (Namibia, Malaysia and Canada). However, 24 countries had unacceptable low scores of 4 or less; these are Madagascar, Peru, Sierra Leone, Mexico, Thailand, Russia, Indonesia, Sri Lanka, Myanmar, Cameroon, Morocco, Ecuador, Brazil, India, Angola, Cambodia, Vietnam, Bangladesh, Guinea, China, Philippines, Ghana, South Korea, Nigeria and Chile. 15 countries (37%) received scores in the intermediate score range between 4 to 6, with their upper confidence limits reaching passable scores of 6, so their estimates are uncertain (Malaysia, Taiwan, South Africa, Namibia, Canada, South Korea, Mauritania, Sweden, UK, Australia, Iceland, Russia, France, New Zealand, Argentina and Japan). The reliability of the scores for this question can only increase when more information on inspections at sea is readily available, as most of the countries except Canada, USA, Namibia, Norway and Malaysia do not provide any reliable estimates on number of fisheries inspections by their patrol vessels at sea.

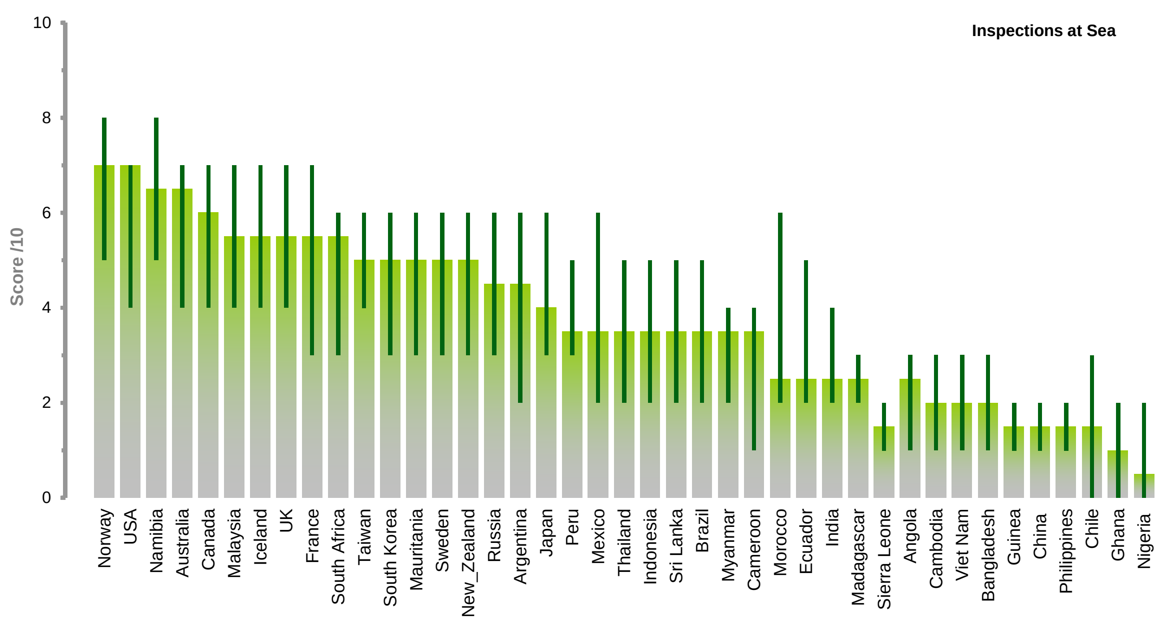

Figure 3.7: MCS compliance scores for inspections at sea.

Bar chart showing compliance of 41 fishing countries for Question 6. Inspections at Sea. Shaded bars, error bars and symbols are explained in Figure 3.2.

3.6.7 Scoring compliance with adequacy of aerial patrols

Figure 3.8 illustrates that only one country (Australia) has good score of 7.5, while UK and New Zealand receive passable scores within the range of 6/10. Countries like India, Iceland, Japan, USA and Namibia (12%) having scores of 5.5 and upper confidence limits in the passable range of 6/10. Countries like Peru, Norway, France, Malaysia, have scores in the intermediate 4.5 to 5 range, although their upper confidence limits are in the passable score of 6, so their estimates are uncertain. These discrepancies can be attributed to lack of information on aerial patrols in these countries or due to degree of information that is publicly available for such content in these countries. Many countries in the analysis had shortage of information for aerial patrols so more information is needed before drawing any concrete conclusions. However, 26 countries (South Korea, Mauritania, Angola, Chile, Thailand, Sweden, China, Madagascar, Ecuador, Brazil, Russia, Indonesia, Morocco, Taiwan, Nigeria, Sri Lanka, Myanmar, Sierra Leone, Ghana, Mexico, Bangladesh, Philippines, Cambodia, Vietnam, Ghana and Cameroon) had completely unacceptable scores below 4/10, which must be considered a poor performance on an important prerequisite for monitoring offshore fishing incursions and transhipments.

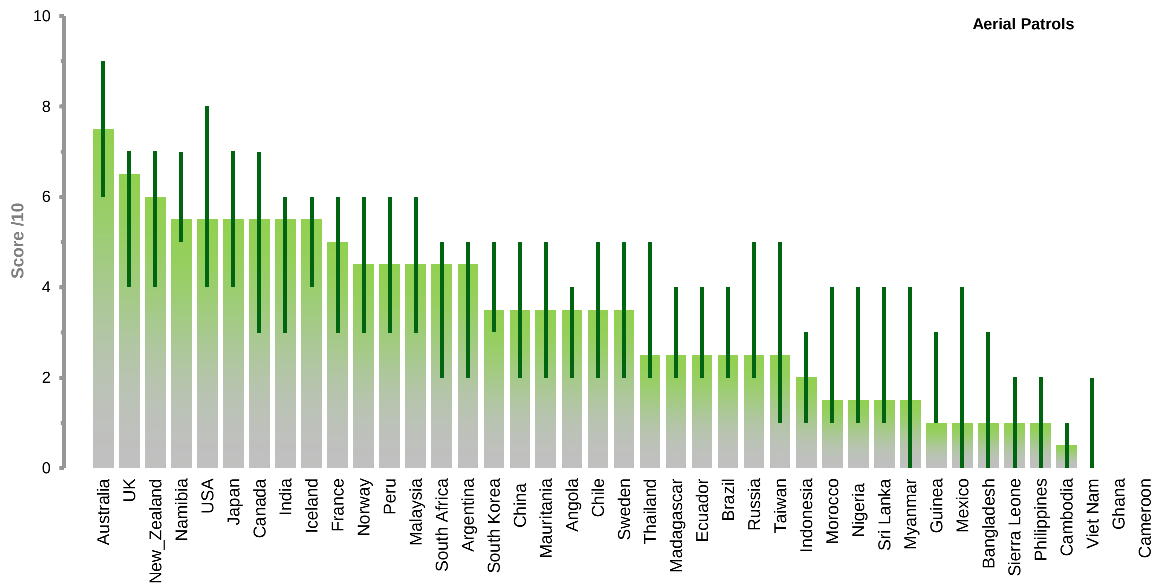

Figure 3.8: MCS compliance scores for aerial patrols.

Bar chart showing compliance of 41 fishing countries for Question 7. Aerial Patrols. Shaded bars, error bars and symbols are explained in Figure 3.2. Three countries namely Vietnam, Ghana and Cameroon received '0' scores for this question and hence there are no scores and error bars (Ghana and Cameroon) in the above figure for these countries.

3.6.8 Scoring compliance with dockside monitoring

Four countries receive "good" scores above 7/10 (Iceland, New Zealand, Norway and Sweden), while two developed countries USA and Canada received passable scores above 6/10 (See Figure 3.9). Most countries (27, 66%) fall under the "fail" grades for dockside controls (Argentina, Malaysia, South Korea, Peru, Chile, Morocco, Japan, Mexico, Angola, Myanmar, Brazil, Indonesia, Ecuador, Nigeria, China, Sri Lanka, Philippines, Bangladesh, Cameroon, Taiwan, Guinea, India, Vietnam, Russia, Sierra Leone, Ghana, Thailand and Cambodia). The recent global study by Flothmann *et al*., (2010) on lack of accountability and transparency in port state control appears to strengthen results from the present study, which show poor performance by most countries.

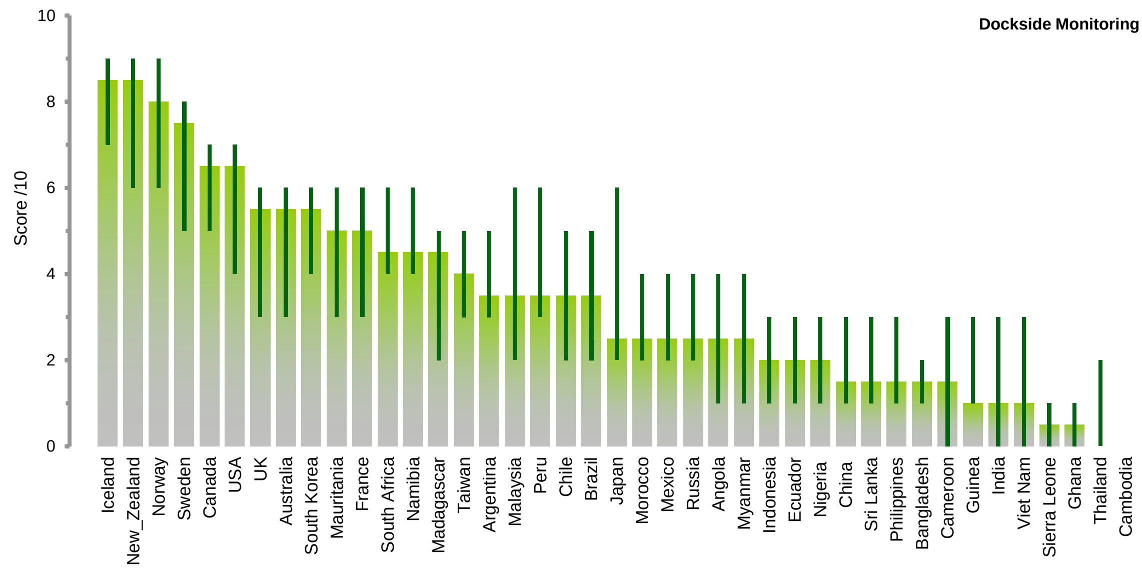

Figure 3.9: MCS compliance scores for dockside monitoring.

Bar chart showing compliance of 41 fishing countries for Question 8. Dockside Monitoring. Shaded bars, error bars and symbols are explained in Figure 3.2. Two countries namely Thailand and Cambodia received '0' scores for this question and hence there are no scores and error bars (Cambodia) in the above figure for these countries.

3.6.9 Scoring compliance with coastal patrols

The analysis reveals that of the 41 countries, 3 (7%) received good scores within the range of 7/10 (New Zealand, Norway and Namibia). Further, Sweden, Iceland and South Korea received passable score within the range of 6/10 (See Figure 3.10). However, 30 countries (73%) have low compliance scores of 4 or less (South Africa, Canada, Chile, Taiwan, France, Morocco, Angola, Madagascar, Brazil, Bangladesh, Mauritania, Peru, Thailand, Mexico, Indonesia, Ghana, Sri Lanka, Myanmar, Ecuador, China, Russia, Philippines, Argentina, Cameroon, Nigeria, Guinea, Sierra Leone, India, Cambodia and Vietnam).

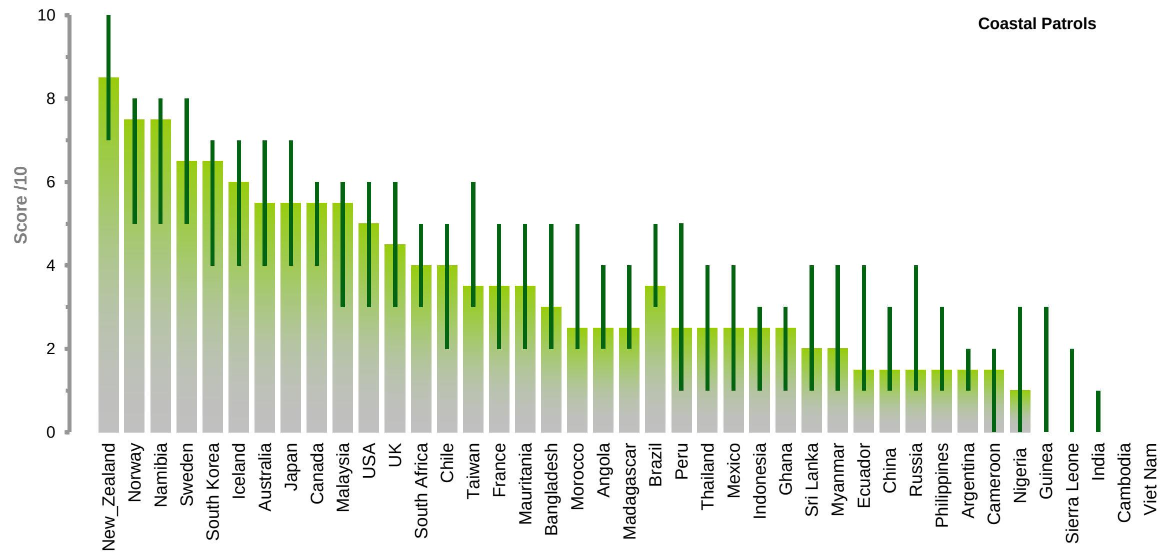

Figure 3.10: MCS compliance scores for coastal patrols.

Bar chart showing compliance of 41 fishing countries for Question 9. Coastal Patrols. Shaded bars, error bars and symbols are explained in Figure 3.2. Five countries namely Guinea, Sierra Leone, India, Cambodia and Vietnam received '0' scores for this question and hence there are no scores and error bars (Cambodia and Vietnam) in the above figure for these countries.

3.6.10 Scoring compliance with monitoring transshipments at sea

Results from the current analysis (Figure 3.11) reveals that only one country (Namibia) achieved a score above 7/10. However, two countries (New Zealand and Norway) received passable scores of 6.5 with their upper confidence limits in the 7/10 ranges. Two countries (Canada and Sweden) received scores in the range of 5 to 6, with upper confidence limits in passable range of 7 leaving their estimates. 29 countries received low compliance scores of (less than 4); these are Mauritania, Japan, Madagascar, Guinea, Angola, Russia, Morocco, Peru, Ecuador, Argentina, Cameroon, Sri Lanka, Brazil, Mexico, Nigeria, Taiwan, Ghana, Sierra Leone, China, Philippines, India, Cambodia, Indonesia, Bangladesh, Myanmar, Vietnam and Thailand.

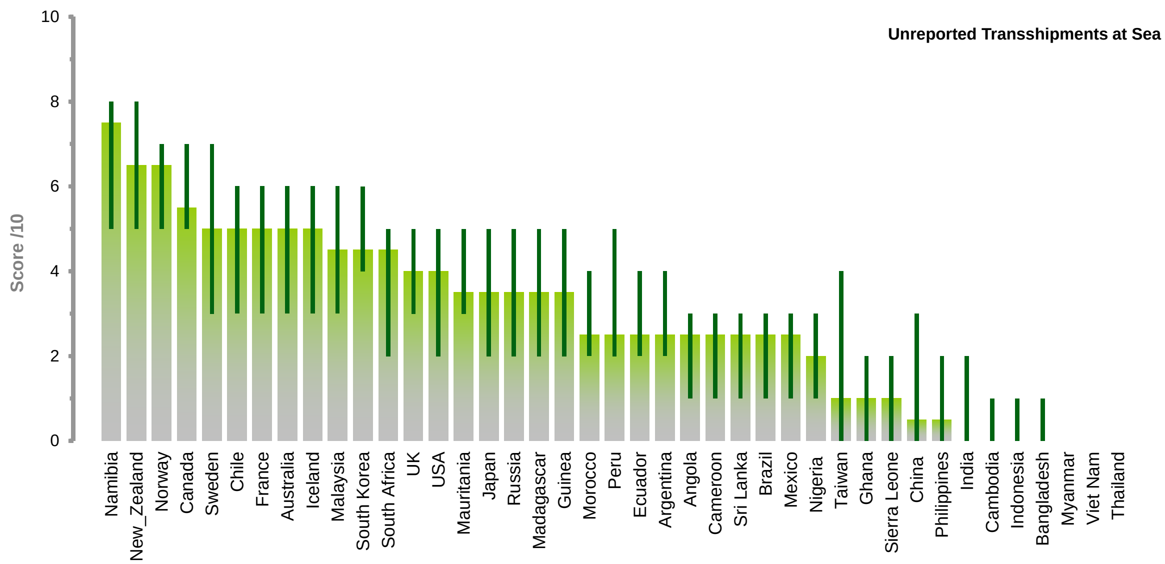

Figure 3.11: MCS compliance scores for monitoring transshipments at sea.

Bar chart showing compliance of 41 fishing countries for Question 10. Unreported Transshipments at sea. Shaded bars, error bars and symbols are explained in Figure 3.2. Seven countries namely India, Cambodia, Indonesia, Bangladesh, Myanmar, Vietnam and Thailand received '0' scores for this question and hence there are no scores and error bars (Myanmar, Vietnam and Thailand) in the above figure for these countries.

3.6.11 Scoring compliance with fishing gear inspections

Namibia and Sweden are the only two countries to get good scores in the analysis for fishing gear inspections (Figure 3.12), with scores above 7/10. One country South Korea, received passable score of 6.5, showing that it is headed in the right direction. Eight countries (New Zealand, Canada, USA, France, Madagascar, Australia, Iceland, and Malaysia) had scores in the range of 4 to 6, with wide variation in their confidence limits between 4 and 7 making their estimates uncertain. More data would be needed to arrive at any concrete conclusions for these countries. However, 31 countries (75%) in the analysis received unacceptable low scores below 4/10 (Japan, UK, Argentina, Chile, South Africa, Peru, Mexico, Mauritania, Morocco, Ecuador, Bangladesh, Brazil, Cameroon, Norway, China, Angola, Thailand, India, Cambodia, Vietnam, Taiwan, Ghana, Sierra Leone, Nigeria, Philippines, Indonesia, Sri Lanka, Myanmar, Guinea and Russia).

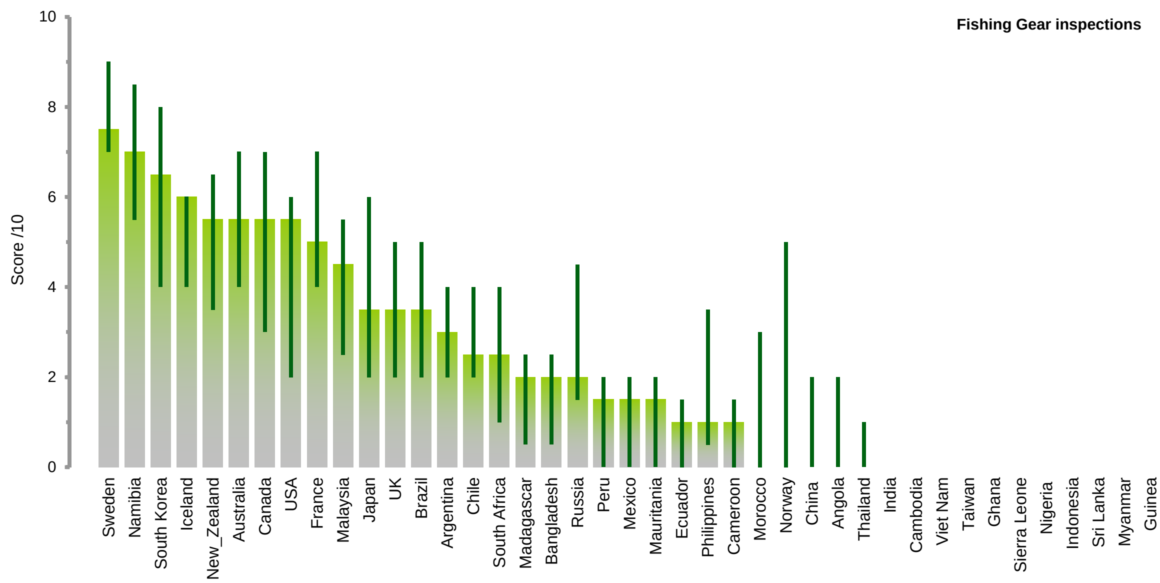

Figure 3.12: MCS compliance scores for fishing gear inspections.

Bar chart showing compliance of 41 fishing countries for Question 11. Fishing gear inspections. Shaded bars, error bars and symbols are explained in Figure 3.2. Sixteen countries namely Morocco to Guinea received '0' scores for this question and hence there are no scores and error bars (India, Cambodia, Vietnam, Taiwan, Ghana, Sierra Leone, Nigeria, Indonesia, Sri Lanka, Myanmar and Guinea) in the above figure for these countries.

3.7 Discussion

The declining state of world fish stocks (FAO 2009a) necessitates the enhancement of capacity of nations to derive benefit from their fishery resources through better monitoring and enforcement of regulatory laws. In many developing countries international and national laws are not backed by sufficient regulatory and legal sanctions (Pramod 2010). The effectiveness of enforcement programs is influenced by: deployment strategies, capabilities and capacity of surveillance units, types of fisheries violations, distribution of fishing activity, time of the year, and surveillance priorities of monitoring agencies (Millar 1995). According to Sutinen (1988) enforcement effectiveness can be maximised and costs minimised through high penalties. MCS system is also likely to be more successful when countries can assert the same level of sovereignty on resources at sea as they do on land. Developing countries with scant patrolling resources can increase chances of apprehending illegal fishing vessels through intelligence provided by artisanal fishermen and optimising use of MCS assets through regional fisheries co-operation with other countries.

Effectiveness of co-operative surveillance in combating illegal fishing has been effectively demonstrated by France and Australia in Sub-Antarctic Island territories and can be replicated elsewhere (Gullett and Schofield 2007). Increasingly, poachers are resorting to new strategies such as communicating position of enforcement vessels to other poaching vessels to avoid capture necessitating use of new technological tools for monitoring distant water fleets (Baird 2004). To avoid cloning of fishing permits, countries like Mexico have started using new technology for commercial fishing permits which have better security features such as visible and invisible optical fibers, high security micro-prints and modified images which can be read using special reading equipment (Anon 2010f). Technologies such as these can be used by enforcement agencies in other developing countries like Indonesia and Malaysia where foreign fishing vessels are repeatedly caught using cloned / forged fishing permits (GIUFI 2010).

In developing countries it has often come to notice that absence of authority or political intervention in arrest cases of foreign fishing vessels affects the morale of enforcement personnel. As aptly stated by one enforcement officer in the Indian Ocean "*How do you expect me to take action on foreign poaching vessels when I spend my valuable manpower and patrolling assets to apprehend a foreign fishing vessel after chasing it for several miles with great effort to bring it to the nearest port, only to be informed later that the vessel was merely fined a couple of hundred dollars or that it was left on intervention from some politician in the federal government. The morale of me and my crew is utterly devastated and the next time I see poaching vessels I merely chase them away instead of apprehending them*" (Anon *pers comm*., 2008).

Absence of statutory authority also affects the ability of enforcement agencies to affect an arrest during resource protection duties (Letts 2000). Low enforcement assets in relation to extent of geographical area to be patrolled affect fisheries protection in countries like Philippines and Indonesia (Viswanathan *et al*., 1997). Deployment of MCS resources in UK, Canada and Indonesia also appears to be affected due to shortage of funds (Millar 1995; Sihaloho 2009).

Figure 3.13 shows compliance of countries by counting the number of 'good' and 'fail' grades for all the 11 questions. Twelve countries (29%) (Myanmar, Cambodia, Cameroon, Guinea, Nigeria, Bangladesh, Vietnam, Sri Lanka, Sierra Leone, Indonesia, Philippines and Ghana) received fail grades in all parts of the analysis. Three countries (7%) Namibia, Norway and New Zealand received good scores on 6 out of 11 questions, with moderate scores in range of 4-7 for the remaining 5 questions. Malaysia was the only developing country to receive a good compliance score for 1 out of 11 questions, but failed to show good performance for nearly 40% of the overall questions.

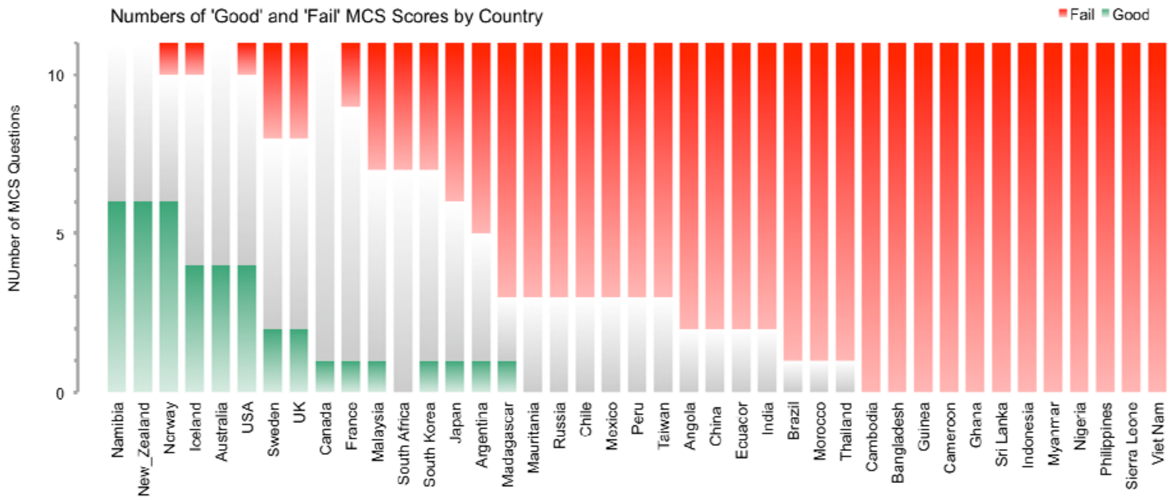

Figure 3.13: Bar chart showing number of 'good' and 'fail' compliance ratings.

Ratings for the top 41 fishing countries against 11 questions expressing compliance with MCS attributes. Green bars indicate the number of 'good' compliance ratings across the 11 questions; for each country, shaded grey bars denote moderate scores in the range of 4 to 7, while red bars denote the number of 'fail' compliance ratings across the 11 questions. Hence, for each country the three colours in it's bar show the number of scores in each category. Country bars are sorted by number of good and bad scores for the 11 MCS questions in the analysis.

3.8 Comparisons among questions

Grades given for the 11 questions (Figure 3.14) reveals that only one question (Surveillance infrastructure) received 'good' compliance score for 13 countries. Of the 41 countries, 12 developing countries received fail grades on all the 11 questions. It is also disturbing to note that almost half of the countries had a bad performance on 9 out of 11 questions in the analysis. Overall comparison of results shows that both developing and developed countries have problems in compliance with MCS issues even after three decades of economic progress in the post UNCLOS period. The analysis also reveals poor compliance with drafted fisheries regulations for most of the developing countries, although developed countries with better resources and infrastructure should have shown better performance. The results from the current study are in agreement with Mora *et al*., (2009) study which revealed that only 17% of the world's EEZs have proper enforcement in fisheries.

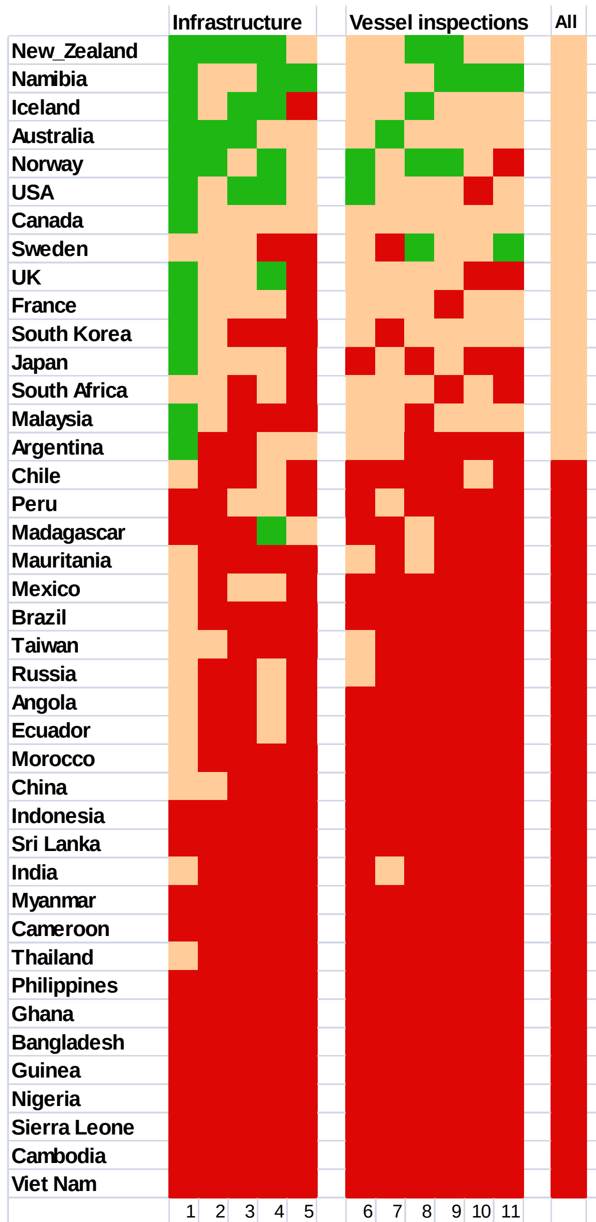

Figure 3.14: MCS grid showing number of ‘good’ and ‘fail’ scores for each question by country.

41 fishing countries were rated against 11 questions in two fields for expressing compliance with MCS issues. Green indicates ‘good’ compliance rating, orange denotes moderate scores, while red denotes ‘fail’ compliance ratings. The numbers 1 to 11 at the bottom of the figure show the 11 questions that were scored for compliance with MCS issues. Rightmost column shows overall MCS rating.

3.9 Chapter 3 summary

In chapter 3, I used a rapid analysis approach to identify compliance with monitoring control and surveillance in marine fisheries of 41 nations. I designed a questionnaire with 11 questions for this purpose. Attributes for the design were derived from a wide range of international laws such as UNCLOS, FAO Code of conduct for responsible fisheries, UN fish stocks agreement, UN Fish compliance agreement and the IPOA on IUU fishing. 41 countries landing 87% of the world's fish catches were evaluated in this chapter.

Of the 41 countries landing 87% of the world's fish catches, none received "good" scores of 70% and over, with only three countries (Namibia, New Zealand and Norway) achieving "good" scores for more than 50% of the MCS questions. Three developed countries (Iceland, Australia and USA), received good scores for 37% of the MCS questions, and have taken bold initiatives in recent decade to improve MCS compliance in the fisheries sector. Twelve countries (Cambodia, Bangladesh, Guinea, Nigeria, Sierra Leone, Ghana, Sri Lanka, Indonesia, Myanmar, Philippines and Vietnam) received "fail" grades on all the questions. Most of the developing countries showed poor performance ("fail" grades), with Malaysia being the only exception to show good performance for some questions. Further, the current study shows that even among the developed countries, issues such as high seas fleet monitoring, dock-side monitoring, fishing gear violations and unreported transshipments have been poorly addressed.

Limitations in the current work were overcome by contacting regulatory and monitoring agencies to get information for areas that had no publicly available information. However, some countries had shortage of information for attributes like number of dockside inspections per year, number of aerial and sea based patrols per year. Accuracy of scores and reliability would increase once such information is provided for research similar to mine. Confidentiality has been cited as one the reasons but many developed countries like USA, Australia and New Zealand stand as good examples, which provide information, related to MCS in fisheries and other countries can replicate such measures. Access to data and reliability of scores due to access are given in Appendix C.

In an ideal setting, monitoring control and surveillance act as deterrence to illegal activities such as smuggling, drug trade and illegal fishing. However, it would be impossible to achieve this level of MCS effort as these operations rely on military assets, which have different priorities in different jurisdictions during different periods of the year. Rarely, can a country's navy or coast guard use 100 per cent of its assets for one particular sector or marine resource crimes like illegal fishing. MCS is an expensive endeavor (Arnason *et al*., 2000) and many developing countries with low affordability and meager patrolling assets can rarely patrol beyond a few miles from the shore (Pramod 2011).

According to one MCS expert (Respondent 199), costs of enforcement vary with government budgets, which vary by year, by sector and by how much money they make from sectors like fisheries. To minimize costs, such as rising fuel and manpower costs, patrols at sea are prioritized depending on previous sightings of illegal fishing vessels in different jurisdictions or use at-sea patrols in such jurisdictions when aerial patrols detect any violations (Anon *pers comm.,* 2010). Research on fishers behaviour can also be of immense help as their decision to comply with rules can be influenced by plethora of factors such as regulations, sophistication of their boats, market prices and abundance of fish stocks (Ludwig *et al*., 1993; Wilen *et al*., 2002). Cases of accidental incursions by small artisanal craft from neighbouring countries need to be treated with utmost sensitivity and the recent agreement between Indonesia and Malaysia (accidental breach of maritime borders by traditional boats of 5-10 gross tons will not be prosecuted) is a step in the right direction (Satriastanti 2011).

Chapter 4: Illegal marine fish catches in the Indian Exclusive Economic Zone

4.1 Introduction

This chapter sets out the interview methods used to assess illegal and unreported fish catches in the field trip to India. Then illegal catch issues in each state from Gujarat in the Arabian Sea to West Bengal in the Bay of Bengal are reviewed in detail. Subsequent sections describe estimates of a number of categories of illegal fishing, namely - Illegal fishing by Indian trawlers in inshore waters allocated to artisanal fishers; Illegal fishing in offshore waters off India's EEZ; and illegal catches by foreign joint venture chartered tuna longliners.

Taking advantage of previous local contacts, language and knowledge of the coastal areas of India, in a 7–month field visit[22] from May - November 2008, information that may be used to make a complete estimate of fishery extractions, including illegal and unreported landings was undertaken. Nine of the ten coastal states of India were visited, including the Andaman Islands. Methods used were over 200 confidential interviews, gathering of grey literature reports and direct observations. The purpose of the field trip was to get estimates of illegal and unreported catches from India's long and often inaccessible

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[22] The trip was sponsored by the UBC Cecil and Kathleen Morrow Scholarship for 2007, by the Department for Environment, Food and Rural Affairs (DEFRA), UK Government, as part of global analysis of illegal fishing, with partial funding by MRAG (UK, as relating to a core area of interest) and partly by NSERC (through Prof. Tony Pitcher).

coastline to improve current estimates of total catch statistics from both mechanised and subsistence fishery sectors.

4.2 Categories of illegal and unreported catches assessed in the 2008 field trip

Overall definitions of the various categories of illegal and unreported catches are provided in Chapter 1, pages 4 to 8. These are expanded here for the particular case of Indian marine fisheries.

4.2.1 Illegal fish catches categories in the Indian EEZ

Illegal fish catches in the Indian EEZ, come from three categories of fleets and these estimates are discussed in detail in chapters 4, 5 and 6. Illegal catch categories discussed in chapters 4 (Indian mainland) and 6 (Andaman and Nicobar Islands) include: (a) Indian trawlers fishing illegally in the 0-8 km coastal zone allocated to artisanal fishers in the eight coastal states; (b) Illegal fishing by foreign fishing vessels in the Indian EEZ; (c) Illegal fishing by Chartered foreign fishing vessels operating under License of permission (*joint venture agreement with Indian companies*); (d) Illegal fish catches through use of illegal fishing gear in the mechanised sector (*Use of illegal mesh size in trawl fishing gear and fishing in closed areas*), and small-scale fisheries (*use of illegal fishing gear in various small-scale sector such as gillnets, fishing within marine protected areas, fishing during closed seasons etc*.).

4.2.2 Unreported fish catches categories

Unreported fish catches in the Indian EEZ, come from both mechanised and non-mechanised categories of fleets and these estimates are discussed in detail in chapters 5 (Indian mainland EEZ) and 6 (Andaman and Nicobar Islands). A brief discussion of various categories of unreported catch is provided here with more detailed explanation is given in chapter 5.

Unreported catches discussed in chapters 5 and 6 include: (a) Discards[23] from commercial trawlers and chartered foreign joint venture tuna longliners (*part of the fish catch from each haul that are not retained onboard trawlers, and discarded at sea due to small size or low market prices*); (b) Post harvest losses (*catches that are dumped due to spoilage after landing, due to heat, pest infestation, during processing or transportation of fish to the markets*); (c) Subsistence fisheries catches from coastal habitats (*catches by fishermen in inshore habitats such as beaches, estuaries and creeks for consumption at home each day, without intention to make a profit through sales*); (d) Glut catches (*Catches during certain seasons or part of year, when landings are plenty and catch is thrown at landing centres due to low market demand*); (e) Molluscan catches (*Shellfish catches for meat consumption, ornamental trade and for use in lime industry for cement production*); (f) Take home catches of trawler crew (*Catch that is divided among crew after each trip at fishing ports as an incentive and taken for consumption at home*); (g) Fish consumed by trawler crew at sea (*Portion of the fish caught at sea that is consumed by crew at sea during 1-12 day fishing trips*); (i) Take home catches of artisanal fishers

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[23] Although Regulation 5, of the Maritime Zones of India Rules 1982, states that the "crews may not discard surplus catch," this regulation is never enforced in Indian fisheries. In the current study of illegal and unreported fish catches in Indian EEZ, discards are unambiguously treated as a category of <u>unreported catches</u>, as government officials in both Federal and State Government of India, stated during interviews in 2008, that discards are not considered "illegal", but rather as a category of unreported catches.

(*portion of the landed catch that is taken home after each fishing trip for consumption at home*); (j) Reef based subsistence fish catches (*Catches caught in coral reefs and reef based habitats for consumption at home and survival on a daily basis*); (k) Bait fish catches (*Fish that are brought for use as bait for catching tuna and sharks in the longline; hooks and line gear sectors*); (l) Fish gleaned at landing centres (*Fish that is dumped at landing centres due to depredation by sharks and other predatory fish*); (m) Dryfish landings (*Dryfish that is dried on top of fishing trawlers and landed after each fishing trip in fishing ports*); and (n) Fish directly sold to tourist resorts and restaurants (*Fish that is sold by fishers to restaurants and tourist resorts directly without formal reporting at landing centres in Andaman islands*).

As the 6 million fisherfolk (Ministry of Agriculture, India, website, 2006) are spread over approximately 8100 km of coastline, the main foci of the interviews were to (a) derive estimates for subsistence catches in the small-scale sector, and (b) in the mechanized sector estimates of discards, fish meal landings and take home catches of crew members. Illegal catches by foreign fishing vessels as well as domestic trawlers were also estimated through interviews with trawler crews and enforcement officers. Literature was also collected from State fisheries departments, central government agencies, industry records, fisheries journals and newspapers. Special emphasis was given to collecting grey literature as well as publications of IGO’s like the Bay of Bengal Programme.

Table 4.1: Interviews conducted and places visited for estimation of IUU catches in the Indian EEZ[24]. The only maritime state not covered through the field visit was Goa and the union territory of Daman and Diu. Information from Lakshadweep islands is under review and not covered in this thesis.

State	Name of small-scale and mechanized fish landing centers / fishing ports	Number of Interviews conducted	
		Small-scale	Mechanized
Gujarat	Porbandar, Veraval, Jamnagar, Kutch, Bhavnagar, Okha	10	12
Maharashtra	Mumbai, Thane, Ratnagiri, Raigad, Malvan	9	9
Karnataka	Malpe, Mangalore, Karwar	12	14
Kerala	Cochin, Kasargod, Kannur, Neendakhara, Munambam, Trivandrum, Kovalam	11	18
Tamil Nadu	Tuticorn, Chennai, Pulicat, Rameshwaram, Pamban, Mandapam, Nagapattinam, Cuddalore, Kanyakumari	11	14
Andhra Pradesh	Suluru, Nizampatnam, Kakinada, Machilipatnam, Visakhapatnam, Bheemunipatnam	18	12
Orissa	Paradeep, Chandipur, Chatrapur, Puri, Bhittarakanika	11	11
West Bengal	Calcutta, Roychowk, Digha, South Parganas	11	9
Andaman islands	Port Blair, Diglipur, Wandoor, Mayabundar	7	4
	Total	**100**	**103**

[24] Table 4.1 provides a list of places visited during the IUU trip, but several interviews were also conducted with government officers and enforcement personnel to get an in-depth picture of the extent of IUU catches in Indian EEZ. Data from such sources is cited as (Anon, *pers. comm.*) or Respondent No: X, etc. for confidentiality reasons.

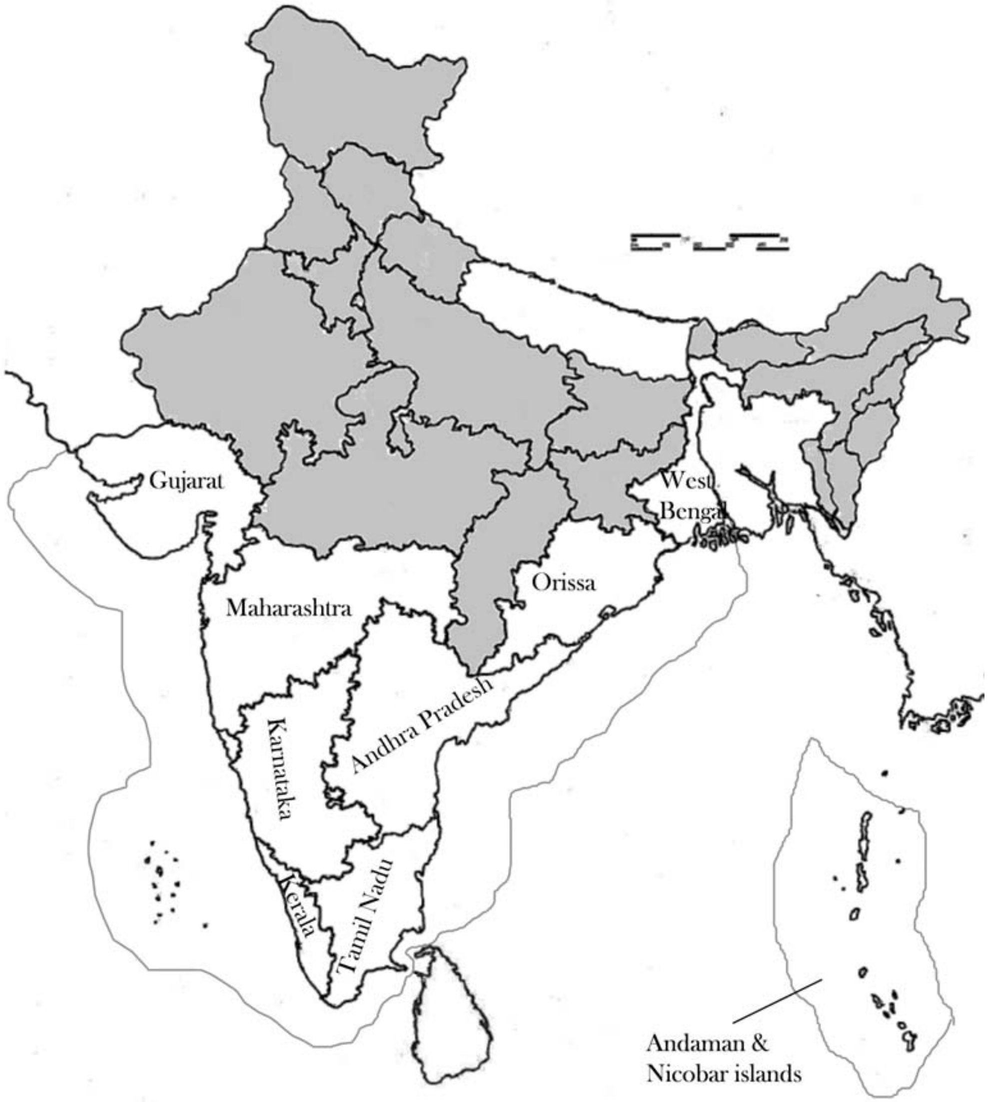

Figure 4.1: Map of India.

Map showing nine coastal states and offshore islands (Andaman and Nicobar Islands). The thin grey line outside the map represents the EEZ boundary. Image Source: (Hand drawn: Pramod Ganapathiraju). Image not to scale.

4.3 Interview methodology

A semi-structured questionnaire[25] was used to determine the amount of illegal and unreported fish caught and landed by artisanal fishers (hook and line, gill nets, traditional gears) and mechanized trawlers in India. The illegal catches estimation looked at infringement of trawlers into the 5-12 mile fishing zone, which is reserved for the artisanal sector by the Government of India's Fisheries Laws. Interviews through the questionnaire helped to determine the total percentage of illegal and unreported catch in India's marine fisheries sector. For example, any fish caught by a mechanized trawler within 5 nautical miles from the shore is illegal as this zone is reserved for artisanal fishers. However, it is pertinent to mention that although fish catches in the artisanal zone are illegal, it is not categorized as unreported in this study as all this catch is landed in Indian fishing ports and forms part of reported catch through CMFRI and FAO. Interviews with artisanal fishers regarding activity by trawlers in their 5-8 km zone helped in determining illegal catches from the industrial sector (See Table 4.2 and 4.3 for results of this analysis). For the artisanal sector, interviews with fishermen on take home catches (any fish catch not sold and retained for consumption at home after fishing trip), recreational catch by part-time fishermen and catches from remote fish landing centres which are presently poorly monitored by government officials were used in determining unreported catches. The latter are not illegal, but are rarely reported correctly.

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[25] Approval for the IUU Study questionnaire was provided in 2008 by UBC ORS Ethics certificate (H08-00618) from UBC Behavioural Research Ethics Board awarded prior to undertaking the study in India.

A snowball approach was used in contacting fishers. Since most of the fish landing centres are in remote locations. I worked with 1-3 field assistants in each state's port/ fishing location (both mechanised and artisanal landing centres). Myself and field assistants went to the main fish landing centres in each village and asked people engaged in fishing randomly whether they would be willing to participate in this survey. If they agreed, we informed them the purpose of our study through oral consent, as most of the fishers are illiterate. If they gave us permission, we then asked them the questions in the questionnaire. Each maritime state has designated fish landing sites for small-scale fisheries and fishing harbors for large mechanized trawlers operating beyond 5-12 nautical miles. For small-scale fisheries in each State there are numerous landing centers at district level. Interviews with small-scale fishers were conducted in at least 10 per cent of landing centers in each district. The landing centers were chosen randomly along the coastline to give a broader picture of fishing activity in each district. For example, if there are 16 designated small-scale landing centers numbered 1 to 16 from South to North, landing centers numbered 1, 5, 10, 15 were chosen for the study to uniformly cover required number of interviews throughout the coastline. Some of the constraints in choosing landing centers included access by road, and ability to get there at least on a two-wheeler. Each participant was interviewed for approximately 30-60 minutes once during the survey[26].

[26] Chapters 4 and 5 provide illegal and unreported catch estimations from the Mainland Indian EEZ (which includes the nine coastal states from Gujarat on the West Coast to West Bengal on the East coast of India). Illegal and unreported catches for Andaman and Nicobar islands is presented separately in Chapter 6.

The present study also shed light on the extent of poaching by foreign trawlers in Indian EEZ from 1960 to 2009. Interviews with boats skippers from Gujarat, Maharashtra, Kerala, Orissa, Tamil Nadu, and West Bengal gave estimates of illegal fishing by Thai, Pakistani, Sri Lankan and Taiwanese trawlers in the Indian EEZ. These estimates are of immense value, as very few paper records exist of poaching especially during the 1960-1980 period. On the East Coast of India (Bay of Bengal) interviews with deep sea fishing vessel skippers revealed the locations of Thai and Taiwanese poaching vessels with certainty as foreign trawlers were frequent invaders of Indian coastline, fishing as close as 3-9 nautical miles of Orissa, West Bengal and Andhra Pradesh during the 1970-1985 period. Estimates of number of poaching vessels arrested and average catch per illegal vessel were derived from apprehended vessels in the GIUFI database. A conservative estimate of illegal fishing was derived using Government and media reports (Anon 1976; Anon 1980; Rao 1981; Dan 1982; Anon 1990; Rao 2009) during 1970-1980, with estimates from arrested vessels and vessels observed poaching in the GIUFI (2010) database giving more reliable and independent illegal catch estimates for 1970-2009. Interviews from my survey in 2008 served as anchor points for estimates of illegal fishing vessels observed in different jurisdictions during the 1980-2008 periods.

For estimations of illegal catches by foreign fishing vessels (FFV) illegal catch found onboard apprehended FFV's was used (Number of vessels arrested / year X mean illegal catch per vessel (by flag) = Total illegal catch for arrested FFVs. This estimate was in turn multiplied with number of vessels that were observed poaching per year (Vessels observed poaching but were not arrested). Finally estimation of illegal transshipments by

Chartered LoP (License of Permission) tuna vessels was added to get total illegal fishing catches in mainland Indian EEZ / year from 1960-2009[27]. The upper and lower confidence limits were derived from interview data and enforcement records collected during the 2008 trip[28].

4.4 Brief reports of the study areas for assessment of illegal catches

West coast (Arabian Sea): 52 interviews were done with trawler crew and 42 with small-scale fishermen in the coastal states of Gujarat, Maharashtra, Karnataka and Kerala. Interviews were undertaken by primary author (Pramod) and field assistants hired and trained by him for this purpose. A total of 14 field assistants were hired for this period[29]. In the small-scale sector, interviews were conducted with fishermen operating gillnets, hook and line, trammel gill nets, and Cast nets. In the mechanized sector interviews were conducted with skippers and crew of demersal trawlers, longliners, and gillnetters.

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[27] The illegal catch provided here represents IUU Fishing estimates for Mainland Indian EEZ in Arabian Sea and Bay of Bengal. Estimation of IUU fishing catches for Andaman and Nicobar islands is presented separately in Chapter 6.

[28] Pramod, G. (2008) Field trip to eight maritime states and offshore island territory of Andaman and Nicobar islands for estimation of illegal, and unreported marine fish catches in the Indian EEZ, May to November 2008.

[29] See Pramod (2010) for names of Field Assistants.

4.4.1 Gujarat

Gujarat has 1600 km[30] coastline with 164,183 km^2 continental shelf supporting 18,369 mechanized vessels and 11,784 non-mechanized vessels. The State has 263 marine fishing villages, with 59,889 fisherfolk operating along its coastline. Trawlers, gillnetters and dol-netters are the main fishing craft in the mechanized sector while plank-built boats and canoes figure more prominently in the artisanal sector (CMFRI 2005a). Trawlers target sciaenids, ribbonfish, lobsters, shrimps, etc., and contribute 71% of the total catch, while gillnetters target pomfret, seerfish, tuna and sharks; and dol-netters (tidal bag-net) land 19%, with the remaining 10% are landed by dugout boats and canoes with outboard motors and non-mechanized boats using gillnets (Zyundheen *et al*., 2004). A good account of marine fisheries in Gujarat is given in Shiyani (2002); Johnson (2001); Praveen *et al.,* (1998) and Devaraj *et al*., (1998).

Fishermen in Porbander and Veraval stated that they are forced to go further and take risks in Pakistani waters as most of Gujarat's coastal waters are polluted leaving fishermen with no option but to go farther offshore to catch fish or trawlers which fish along northern Gujarat waters where waters are relatively unpolluted with more catches per each haul, but this as such leaves them vulnerable to arrests in Pakistani EEZ (As Respondent 5, 11, 9, 10 state: *when there is little fish in local waters and no GPS or other*

[30] "All coastline distances are quoted with a feature size of 1 km". The feature size of kilometre (km) was used in chapters 4 to 6, as length of the coastline are measured in km in most of the Indian government documents. See (Weisstein, Eric W. "Coastline Paradox." From MathWorld--A Wolfram Web Resource. http://mathworld.wolfram.com/CoastlineParadox.html).

equipment it is hard to say whether we are in Indian waters, it is important to know that we use landmarks as guidance points for locating fishing grounds and we were rarely caught for intruding into Pakistani waters in the past; nowadays we are forced to go offshore as far as 4-8 hours away from shore to catch fish and with no visible landmarks it is hard to say where you are when you are arrested. We often see Indian coast Guard vessels guiding us away from maritime boundary waters, but they can't guide us throughout the year."

Respondents 9, 11 and 14 stated that some fishers do inadvertently cross Indian waters as Pakistani waters are relatively unpolluted and less trawled compared to Indian waters "*Most of Indian boats that fish along Indian maritime border are trawlers while bulk of the observed fishing activity along Pakistani waters is conducted through gillnetting, so their waters are more rich with fish like "Lal Pari" (Nemipterus species;* Threadfin breams*) which fetch higher price in the Indian markets*[31]." Respondent 3 stated that the disputed nature of maritime boundary along the Indo-Pak border also often confuses fishermen as there are several cases where local boats from Indian side near Rann of Kutch were apprehended far inside Indian waters barely a kilometre from the fishing port. Respondent 14 stated that there were several instances in the past where several innocent

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[31] Most of the apprehended Indian trawlers and boats were from Jakhau, Porbandar and Okha. In the last decade most of the fishing activity has moved north due to pollution and declining catches in central and southern Gujarat waters. Operating in close proximity to the Indo-Pak border exposes them to apprehensions by Pakistan's Maritime Security Agency, especially due to disputed nature of Indo-Pak maritime boundary in Rann of Kutch.

Indian fishing vessels were reportedly detained by Pakistan's Maritime Security Agency (MSA) whenever Pakistani fishing boats were arrested in Indian waters, alluding to reciprocal arrests.

Gujarat ranks second among the top three marine fish producers in India. The bulk of the catch is exported due to low local demand in the state. The Gujarat Fisheries Act, 2003 is the primary legislative act responsible for protection, conservation and development of fisheries in territorial waters of the state. Section 4(a) of the Act prohibits use of fishing gear with less than 40 mm mesh size at the cod end portion. However, interviews with fishers revealed that almost all trawlers (95%) use one of the smallest mesh sizes in the cod end of trawl net (8-18 mm) essentially resulting in recruitment overfishing. A recent study by Mohamed *et al*., (2010) shows similar trends with cod end mesh size of Gujarat trawlers as low as 20 mm indicating poor compliance with fisheries regulations. Estimates of illegal catches by trawlers in the 5 nautical mile artisanal zone give an estimate of 740 to 1,130 tonnes for Gujarat. Intrusions by trawlers into the artisanal zone were reported in Kutch, Jakhau, Jamnagar, Bhavnagar, Bharuch and Valsad districts. Fig 4.2 provides details on the number of Pakistani fishing boats detained for illegal fishing in Gujarat waters (Indian EEZ).

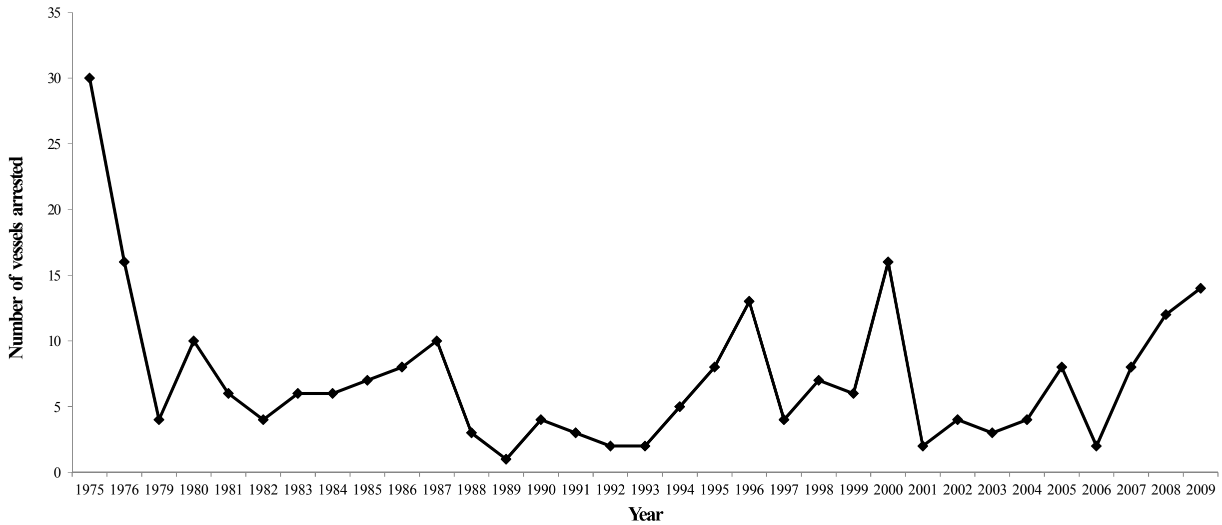

Figure 4.2: Number of Pakistani fishing boats arrested in Gujarat (India).

Number of Pakistani vessels detained for illegal fishing in Indian waters (1975-2008), Source: GIUFI Database (2010).

4.4.2 Maharashtra

Maharashtra has 720 km coastline with a continental shelf of 111,512 km^2 supporting 23,508 fishing crafts of which 13,053 are mechanized, 3382 were motorized and 7073 non-motorized. The State has 406 marine fishing villages with 65,313 fisherfolk operating along its coastline. Trawlers, gillnetters and dol-netters are the main fishing crafts in the mechanized sector (CMFRI 2005b).

Small-scale fishermen in Thane and Mumbai districts have reported illegal incursions by multi-day trawlers into dol-net fishing grounds. Fishermen reported that such illegal incursions have resulted in declining catches of pomfrets, shrimps and Bombay duck in recent years. Estimates drawn from interviews with fishermen reveal that illegal catches by trawler intrusions into inshore traditional grounds amount to loss of 1100 to 1800 tonnes each year for the artisanal sector.

Maharashtra notification Section 4 of the Maharashtra Marine Fishing Regulation Act, 1981 dated October 13, 1999 states that purse seine gear should not been operated by any mechanized vessel within 12 nautical miles from shore. However, fishermen reported that compliance with this notification is lackluster due to absence of enforcement by state government agencies. Moreover, Maharashtra Notification dated 12th December 1997 affirms that no trawl gear should have less than 35 mm mesh size for trawlers operating in territorial waters of Thane, Mumbai, Raigad and Sindhudurg district. However, it was reported during interviews that most of the vessels operate trawl gear with mesh size between 15–25 mm, which is far less than the regulatory requirements.

4.4.3 Karnataka

Karnataka has 300 km coastline with continental shelf of 27,000 km^2 supporting 15,655 fishing crafts of which 7577 were traditional non-motorized craft, 3705 were motorized and 4373 mechanized vessels (2515 trawlers; 1254 gillnetters) CMFRI (2005c). Trawlers, gillnetters and purse seiners are the main fishing vessels in the mechanized sector while plank built boats and canoes are the main fishing craft in the artisanal sector.

No previous estimates were available for comparison with the above estimates hence estimates from the current IUU trip are the best available estimates for discards in Karnataka. The Karnataka Marine Fisheries Regulation act requires all mechanized trawlers operating along the coast to use a cod end mesh size of at least 30 mm. However, most of the trawlers were using 10-15 mm cod end mesh size resulting in indiscriminate capture of juveniles of fish and shrimps. This has also contributed to substantial discards during the monsoon season. Illegal fish catches by trawlers in the inshore traditional zone result in annual loss of 1200 - 1950 tonnes (based on interviews with small-scale fishermen along Karnataka coast).

4.4.4 Kerala

Kerala has 590 km coastline with continental shelf of 36,000 km^2 supporting 29,177 fishing crafts of which 5504 vessels were mechanized, 14,151 motorized and 9522 non-motorized fishing crafts. Of the vessels operating along the Kerala coast, trawlers comprised (72%), ring seiners (8%) and gillnetters (7.8%) in the mechanized sector (CMFRI 2005d).

Since the early eighties overfishing in coastal waters has been witnessed in both mechanised trawl and motorized boat sectors (Kurien 2005). Further, unsustainable exploitation in backwaters and inshore fishing grounds is pushing both subsistence and motorised fishermen towards destructive fishing practices (Kurien and Achari, 1990; Harikumar and Rajendran 2007). Dynamite fishing has also been reported in some jurisdictions (Lal Mohan 1991). Previous studies also indicate that there are several gaps in collection of landings data. "There is no organized system of collecting landings and effort data, and the available estimates seem so very crude. "The present scale of unregulated fishery in the backwaters could be gauged from the quantity of young shrimps being caught at various points by the filtration fishery (Chemmeen kottu)" (Kalawar *et al*., 1985). The exact number of vessels being inducted into the fishery in the mechanised and motorized sectors also remains uncertain as large numbers of them are being constructed without permission from the authorities (Harikumar and Rajendran 2007).

Under Notification No. 448, dated February 18, 1986 of the Kerala Marine Fishing Regulation Act, 1980 the use of mid water trawl and bottom trawl gear with less than 35 mm stretched mesh is prohibited while fishing in territorial waters of the State (Kerala Government, 1986). Kerala Gazette No.10, dated March 11, 1986 also prohibits use of bottom trawl gear from sunset to sunrise in specific areas of the coast. Kalwar *et al*., (1985) reported that random inspection of mesh size from trawlers operating in Shaktikulangara revealed that most trawls were operating 20 mm mesh size in the cod end. A recent study by Kurup and Radhika (2004) found that 80% of trawlers engaged in shrimp trawling use cod end mesh size of 18 mm, while the remaining 20% used mesh size varying from 20-25 mm.

In this fieldwork it was found that shrimp trawlers use a mesh size of 10-20 mm, which indicates a further decline in cod end mesh size to target even smaller sized juveniles of shrimps and fish. Violations by trawlers into waters less than 20 m depth (reserved for traditional fishermen since 1980) have been reported since the inception of inshore artisanal zone (Kalwar *et al.,* 1985). In the late eighties, mini trawlers were using a cod end mesh size of 10-12 mm, against the required mesh size of 20 mm (Vijayan *et al*., 1990). In this fieldwork, enquiries with crew of mini-trawlers revealed that they are now using cod end mesh size of 8-12 mm, which indicates a further decline in mesh size for the 4000 mini trawlers operating along the Kerala coast. Stake nets are using mesh size of 10-12 mm and ring seines use 7-9 mm, which further illustrates a drastic decline in mesh size, resulting in recruitment overfishing of both fish and shrimps in their nursery grounds. Estimates of illegal catches by trawlers in the 5 nautical mile artisanal zone give an estimate of 2100 to 3320 tonnes for Kerala. Intrusions by trawlers into artisanal zone were reported in all the coastal districts with higher frequency of violations in Allepey, Ernakulam, Kozhikode, Kollam and Kasargod districts.

A ban on purse seining was initiated in the eighties to prevent loss of livelihood for traditional fishers, which led to design of an improvised new gear called "ring seine", which works in a similar fashion was developed from a traditional seine gear. The new net is 450 to 1000m long and employs up to 50 crew. This also led to development of larger plank built boats[32] ("Kettu Vallam"), which were fitted with up to 3 outboard motors of 40 HP (40x3 =120 HP). Although these boats are far larger than the specifications for a traditional motorized fishing boat as per KMFRA 1980, they continue to operate ring seines during the monsoon ban, under the traditional motorized sector. Blatant violation of mesh size regulations is evident in both mechanized and traditional

[32] These boats were largely improvised for use in small-scale fisheries to catch sardines during fishing ban period for larger trawlers and purse seiners operating from fishing harbours. Although the scale of fish catches and size of fishing vessels are quite high with bulk of operations taking place on a commercial scale, the Kerala Government has done little to prevent misuse and overcapacity in the ring seine fishery.

sectors, with purse-seiners, ring seine (Statutory requirement 20 mm), and bottom trawlers (Statutory requirement 35 mm) having a mesh size of 8-15 mm, which is far less than the statutory requirements under the Kerala Marine Fishing Regulation Act, 1980. Of the 1727 stake nets operating in Cochin backwaters, 794 are licensed stake nets and 933 are illegal stake nets in operation (Thomson and Berkes 2006). Reliable estimates of unlicensed nets are hard to determine as several reports in the past also indicate that unlicensed nets are up to three times the number of licensed nets operating in Cochin backwaters (Kalawar *et al*., 1985; Anon 2007d; Pramod 2010).

Using estimates from this fieldwork, it was found that if we take the legal statutory requirements of the Kerala Government, almost 90 % of the 1727 stake nets are engaged in illegal fishing[33], as majority of these nets do not follow the distance and mesh size[34] requirements as well as illegal operation of nets during high tide[35]. Removal of illegal stake and Lift nets (also called Chinese dip nets or *Cheenavala* in Kerala) by the Fisheries Department has been met with stiff resistance by fishers in backwaters, so in recent years no action has been taken on illegal nets in operation. According to Thomson (2003) there

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[33] Section 19 of Government water rules 1974 regarding fishing in Government waters stipulates that the distance between two stake nets in a stake line shall not exceed four meters and distance between two stake line shall not be less than 50 meters.

[34] As per Travancore- Cochin Fisheries Act (1950) allowed mesh size of stake nets is 20 mm.

[35] Section 22 of the Government Water Rules 1974 “ruled that stake nets should not operate during flow tide (high tide)”.

are more illegal nets (stake and Chinese dip nets) than licensed nets. Using catch information of average stake net catches/year, it is estimated that around 1119 to 3732 tonnes of illegal shrimps and fish are landed by these (assuming 933 illegal nets are in operation) stake nets within Cochin backwaters. This figure of illegal catch can range from 1864 to 6216 tonnes if we assume that 90% of nets are operating illegally in Cochin backwaters (adding illegal catches from mesh size, distance and operational requirements defaulters calculated for 1554 illegal stake nets in operation).

According to Vijayan *et al*., (2000) there are 17,724 stake nets in the state of Kerala and 90% of the stake nets have cod mesh size of less than 13 mm (George *et al.,* 1998) against statutory requirement of 20 mm. Assuming that 54% of stake nets operating in Kerala are illegal and unlicensed from the above figure (Thomas and Berkes 2006), this would give an estimated illegal catch figure of 11,484 to 38,280 tonnes per year for 9570 illegal stake nets in the State. The State Fisheries Department is responsible for monitoring and enforcement of fisheries regulations in backwaters, but it is neither equipped with the appropriate infrastructure or manpower for these tasks. According to stake net fishermen, Fisheries Department officials never inspect or enforce any rules within backwaters. The history of non-compliance with fisheries regulations in backwaters goes back to several decades, with as many as 3131 unlicensed dip nets operating against 1692 licensed nets; 3887 unlicensed versus 12900 stake nets in the year 1989 (Nair 1989; Pauly, 1991; Srinivasan 2006). Fisher's in many sections of the backwaters stated during interviews that they do comply with informal rules governed by Sanghams (Fisheries Society), which prevent them from using stake nets at high tides.

However, Thomson (2003) states that most of nets located near bar mouth, Thevara and Aroor operate even during high tides.

Previous studies also indicate that there are several gaps in collection of landings data. "*There is no organized system of collecting landings and effort data, and the available estimates seem so very crude. The present scale of unregulated fishery in the backwaters could be gauged from the quantity of young shrimps being caught at various points by the filtration fishery (Chemmeen kottu)*" (Kalawar *et al*., 1985). The exact number of vessels being inducted into the fishery in the mechanised and motorized sectors remains uncertain as large numbers of these vessels are being constructed without permission from the authorities (Harikumar and Rajendran 2007). Low penalties coupled with corruption and lack of regular monitoring has been cited as major reasons for continuance of illegal fishing in Cochin's estuaries (Srinivasan 2005).

East Coast (Bay of Bengal): 61 interviews were conducted with trawler crew and 51interviews were done with small-scale fishers in the coastal states of Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and the island territories of Andaman Islands. A total of 16 field assistants were hired for conducting interviews during this period. In the small-scale sector, interviews were conducted with fishermen operating gillnets, hook and line, trammel gill nets, and cast nets. In the mechanized sector interviews were conducted with skippers and crew of demersal trawlers, longliners, and gillnetters.

4.4.5 Tamil Nadu

Tamil Nadu has 1076 km coastline with continental shelf of 41,000 km^2 supporting 54,420 fishing crafts of which 24,448 were traditional non-motorized craft, 22,312 were motorized and 7618 mechanized vessels (5256 trawlers; 2361 gillnetters, purse seiners, liners, dol-netters) CMFRI (2005f). Catamarans (63%), plank built boats (34%) and dugout canoes (3%) are the main fishing craft in the artisanal sector.

With the exception of mesh size violations in the mechanised and small-scale sector and inter-sectoral conflicts between trawlers and artisanal craft, the majority of other fishery regulations are enforced well for fishing vessels operating in Tamil Nadu waters. Similar observations were made by Bavinck *et al*., (2008) who state that the closed season is implemented well in Tamil Nadu due to close co-ordination between mechanised boat owners association and the Fisheries Department. Interviews with fishermen in Rameshwaram, Mandapam and Tuticorn revealed widespread use of destructive gear such as inshore trawling gear "*Irratai Adi*" which has caused immense damage to inshore reefs and sea grass beds.

Estimates from this fieldwork on illegal catches by Indian trawlers in the 3-mile artisanal zone give an estimate of 460 to 1220 tonnes for Tamil Nadu. Intrusions by trawlers into artisanal zone were reported in Nagapattinam, Rameshwaram and Tuticorn districts. Fishermen often complained that compensation for damages of artisanal gear is very minimal or none in many cases. Small-scale fishermen complained that the mechanised boat owners associations do not compensate them unless they provide some evidence such as vessel name, registration number and area of incident. Often the compensation paid does not even for the travel expenses from their fishing village to fishing harbor, hence in many cases fishermen do not complain to the authorities, except the village councils. Overall analysis for all the districts in TN reveals that compensation is available for only 10-35% of the reported incidents, and the compensation is far less than the costs of actual damage to the gear and boats.

4.4.6 Andhra Pradesh

Andhra Pradesh has 974 km coastline with continental shelf of 33,000 km^2 supporting 41,039 fishing crafts of which 24,386 were traditional non-motorized craft, 14,112 were motorized and 2541 mechanized vessels (1802 trawlers) CMFRI (2005g). Trawlers and gillnetters are the main fishing vessels in the mechanized sector while catamarans (64%), and plank built (34%) are the main fishing craft in the artisanal sector.

Illegal catches within this state waters are difficult to analyze, as fishermen are apprehensive about the use of information given to scientists. Estimates from this fieldwork on illegal catches by trawlers in the 8 km artisanal zone give an estimate of 1300 to 2600 tonnes for Andhra Pradesh. The exact number of unregistered mechanised trawlers operating in state waters is uncertain, but interviews with fishermen revealed that around 40-60 such mechanised trawlers operate in the state’s waters. Each unregistered trawler (10-14 metres OAL) catches around 66 tonnes fish per year (3 tonnes of fish per trip; 22 trips per year); so 50 trawlers would land around 3300 tonnes of fish per year.

The State Fisheries Department has arrested some unregistered vessels in recent years (Anon 2008d).

4.4.7 Orissa

Orissa has 480 km coastline with continental shelf of 26,000 km^2 supporting 23,740 fishing crafts of which were traditional non-motorized craft, 4719 were motorized and 3577 mechanized vessels (1340 trawlers) CMFRI (2005h). Previous studies have not given any estimates on discards in Orissa's marine fisheries. Hence, estimates of discards from the current trip are the best available estimates for this state. Illegal fishing violations ranged from mesh size violations, inter-sectoral conflicts between motorized fishing vessels and trawlers due to incursions into inshore artisanal zone. Estimates from this fieldwork on illegal catches by trawlers in the 5 km artisanal zone give an estimate of 2100 to 4100 tonnes for Orissa.

Although Orissa has very few enforcement assets, the State Fisheries Department, Forest Department and the Indian Coast Guard have coordinated one of the best patrolling efforts along the Indian coastline to patrol and enforce fishing and marine regulations within marine protected areas here. The reason for existence of this level of enforcement in this State, while there is scarcely such effort in other coastal states of mainland India, is due to the presence of huge international and national media every year during the Olive Ridley turtle-breeding season. The coastline of Orissa's has one of the single biggest Olive Ridley breeding and nesting grounds (locally known as "*arribadas*") in the Indian Ocean. Since mid-nineties, the issue of massive deaths of Olive Ridley turtles each year due to trawling in inshore waters esp., during turtle breeding season received huge media attention through conservation non-governmental organisations and government institutions such as Wildlife Institute of India. This led to announcement of several marine protected areas where fishing is banned every year in the stretch where olive turtles congregate to breed and then come ashore to lay eggs along the coastline. Both the state and federal government have announced regulations which prohibit fishing by both mechanised trawlers and motorized boats using gillnets and driftnets in these waters. The Forest Department undertakes patrols on shore and inland in rivers and near estuaries, while Coast Guard undertakes patrols at sea to apprehend any trawlers violating the conservation zone, which extends upto 20 km (The Orissa State Fisheries Department imposes ban on fishing up to 20 km from the shoreline from November 1 to May 31 each year). Majority of the trawlers violate this ban as the turtle-breeding season coincides with shrimp fishing season, so trawlers congregate in coastal areas to catch shrimps.

In recent decades, the Coast Guard has also provided one patrol ship and aerial surveillance during the turtle-breeding season to help the Forest department in apprehending illegal fishing vessels. It is also perhaps the only state where mechanised trawlers are regularly arrested every year for fishing in inshore artisanal zone and Marine Sanctuaries (Gahirmatha marine sanctuary and Rushikulya marine conservation area). Some of the type of violations and arrests of fishing boats and trawlers are given in Appendix E. Majority of illegal trawlers were from Orissa and Andhra Pradesh (Appendix E, GIUFI (2010). Around 60% of arrested trawlers were from Andhra Pradesh, while the remaining 40% were gillnetters and trawlers from Orissa. Figures from Appendix E, show that around 50-70 trawlers were arrested in late nineties, with around 40-50 trawlers apprehended by Forest Department, State Fisheries Department and Indian Coast Guard patrol boats each in year during 2000-2009 period. Skippers on vessels arrested for illegally fishing in Orissa's marine sanctuaries revealed that Coast Guard and Forest Department usually confiscate the catch and gear, before taking them to Paradeep port for prosecution in local courts. In most cases the vessels are kept in port for 1-2 months, and boat owners often have to pay fines ranging from Rs. 50,000 – Rs. 90,000 (approx. US$ 1100 - 1500) to get their trawlers released, after paying such fines with police and local courts (Respondents 156, 162, 167, 171).

4.4.8 West Bengal

West Bengal has 158 km coastline with continental shelf of 17,000 km^2 supporting 18,646 fishing crafts of which 15,444 were traditional non-motorized craft, 1776 were motorized and 6829 mechanized vessels (610 trawlers) CMFRI (2005e). Gillnets, fixed bagnets, and shore seines are the main fishing craft in the artisanal sector.

There is a growing problem due to illegal incursion of Bangladeshi fishing trawlers to fish in the West Bengal's rich estuarine waters; very few such trawlers have been apprehended due to mangrove and creeks serving as hideouts for such illegal trawlers along Indo-Bangladesh border in the Sundrabans (Respondents: 178, 179, 186). Illegal fish catches by trawlers in the inshore traditional zone result in annual loss of 802 to 1920 tonnes (based on nine interviews with small-scale fishermen along West Bengal coast). Fishermen reported that due to intense patrolling by the Coast Guard, in recent years

Bangladeshi vessels have been observed moving towards Orissa's territorial waters. Both the Forest Department and the Coast Guard along the Orissa Coastline have arrested many such Bangladesh trawlers in recent years.

4.5 Illegal fishing by Indian trawlers in inshore waters allocated to artisanal fishers in coastal states of mainland India

Interviews conducted during the 2008 field trip also revealed the extent of illegal fishing by Indian trawlers in the inshore fishing zone allocated to small-scale motorized and non-motorized fishers under the State Marine Fisheries Regulation Acts (MFRA). It is pertinent to note here that although catches by trawlers in the artisanal zone is illegal, the catches from this vessels are not considered unreported, as catches from all these trawlers is landed in Indian fishing ports and forms part of national fisheries statistics that is reported to UN Food and Agriculture Organisation each year.

Table 4.2: Violation of Marine Fisheries Regulation Acts by Indian trawlers in the artisanal zone.

Results from interviews with small-scale fisheries in eight coastal states and 2 offshore island territories (Lakshadweep islands, Andaman and Nicobar islands).

State	MFRA	Mesh size regulations violation rate		Illegal intrusions of Indian trawlers into 5 nm artisanal zone	Violations of foreign vessels into Indian EEZ (Number of vessels sighed per year)
		Small-scale	Mechanised trawlers		
Gujarat	-	85%	95%	M	6-24 vessels / year
Maharashtra	Yes	80%	90%	H	1-2 vessels / year
Karnataka	Yes	90%	100%	M	1-3 vessels / year
Kerala	Yes	100%	100%	H	1-4 vessels / year
Tamil Nadu	Yes	80%	95%	M	8-16 vessels / year
Andhra Pradesh	Yes	85%	95%	H	1-5 vessels / year
Orissa	Yes	80%	85%	M	1-2 vessels / year
West Bengal	Yes	95%	90%	M	12-16 vessels / year
Andaman and Nicobar Islands	No	65%	50%	L	10-24 vessels / year
Lakshadweep Islands	No	NA	NA	NA	2-5 vessels / year

	91-100% mesh size violations
	80-89 % mesh size violations
	50-79% mesh size violations
H	High (Intrusions observed 76-100% of fishing days in an year)
M	Medium (Intrusions observed 50-75% of fishing days in an year)
L	Low (Intrusions observed less than 50% of the fishing days in an year)

Table 4.2 shows result from interviews with small-scale fishers in the eight coastal states and 2 offshore island territories (Lakshadweep islands, Andaman & Nicobar islands). Table 4.4 shows the artisanal zone, which varies from 5- 8 km in the eight coastal states. Table 4.4 also shows the various State fisheries regulations, which prohibit trawling in the inshore artisanal zone. During the interviews in 2008, small-scale fishers were asked to mention the number of trawlers intruding into their artisanal zone each year (Pramod 2008). Analysis of interviews on illegal intrusions by Indian trawlers reveals that high

level of incursions took place in Maharashtra, Kerala and Andhra Pradesh, with fishers reporting such incursions at least 75-100% of the fishing days in a year. Moderate level of trawler incursions (50-75% of fishing days in a year) into artisanal zone were observed in Gujarat, Karnataka, Tamil Nadu, Orissa and West Bengal.

Table 4.3: Estimates of illegal catches by Indian trawlers in the artisanal zone[36]

State	Illegal catches in tonnes / year
Gujarat	740 to 1130 tonnes
Maharashtra	1100 to 1800 tonnes
Karnataka	1200 - 1950 tonnes
Kerala	2100 - 3320 tonnes
Tamil Nadu	460 to 1220 tonnes
Andhra Pradesh	1300 – 2600 tonnes
Orissa	2100 – 4100 tonnes
West Bengal	820 – 1920 tonnes
Total	9820 – 17,840 tonnes / year
Please refer Table. 4.4. for details on area allocated to artisanal fishermen in each state	

[36] Please note that although these catches are "illegal", they are not assessed as unreported landings in the current study as they are reported through national fisheries agencies to FAO due to the fact that they are landed in Indian fishing ports and form part of national catch enumeration in all the coastal states.

Estimates of illegal catches by Indian trawlers in the artisanal zone are given in Table 4.3. Data reveals that every year artisanal fishers in the eight coastal states loose around 9820 to 17,840 tonnes of fish catch every year, with Kerala and Orissa facing far higher losses of around 2000-4000 tonnes each year. These incursions not only result in loss of fishing gear and catches but also result in destruction of nursery grounds for smaller fish and shrimps, especially around creeks, estuaries and backwaters (Pramod 2008).

Data collected through interviews with skippers of Indian deep-sea vessels in Table 4.2 also shows the violations by foreign fishing vessels in the Indian EEZ (Pramod 2008). High incursions of foreign vessels were by observed by fishers in Gujarat (6-24 vessels observed each year), followed by around 8-16 vessels observed in Tamil Nadu waters each year. Mesh size measurements were also undertaken in small-scale and mechanised sectors to see compliance of fishers to state and federal fisheries laws, which specify legal cod-end of the fishing gears (see Table 4.2, column 3 for more details on violation rate). Data from interviews shows that 80% of the fishing trawlers had smaller cod-end mesh size compared to the legal size, while the cod-end mesh size violations was far higher in all the remaining seven coastal states (90-100% of the gears had smaller mesh size than the legally specific size limits).

Eleven respondents (59, 63, 65, 69, 72, 115,118, 124, 131, 156, 164) stated the incentives behind such incursions; intensity of trawling increased in late sixties largely to cater to export demand for shrimps in USA and Europe. During 1970-1990, seasonal incursions into inshore areas were reported during shrimp season when adults migrate to coastal waters, largely targeting shrimps for export markets. Due to decline in shrimp catches since 1990s, trawlers have been reportedly increasing fishing in artisanal zones both during post-monsoon season, when shrimps are abundant in coastal areas, as well as to target smaller species of fish and invertebrates for conversion into fish meal in the poultry sector. Prior to 1995, trash fish landed by trawlers along in Bay of Bengal fetched very low price as it was usually sold as fishmeal into poultry sector where demand was very low. Due to spike in aquaculture activity in late nineties, several fishmeal plants came up along the coast hence prices of trash fish landed in fishing ports of Bay of Bengal increased. Smaller trawlers in the Sona and Pablo category (10-15 m overall length) along Andhra and Orissa coast fished in waters within the vicinity of fishing ports (6-8 hour trips) to reduce operational costs and exclusively landed several categories of non-commercial fish and invertebrates for the fishmeal industry.

Table 4.4: State-wise allocation for small-scale fishing craft in India.

Marine Fisheries Rules and Marine Fisheries Regulation Acts mentioned in the footnote provide detailed explanation of zones allocated to artisanal fishers in 8 coastal states.

State	Zone allocated exclusively for Artisanal fishermen[37]	Relevant State Legislations
Gujarat	5 nm from shore (9 km from the coast horizontally)	[38]Gujarat Marine Fishing Rules, 2003
Goa	5 km from the shore	Goa, Daman and Diu Marine Regulations Act
Kerala	Area from the shore up to the 25 fathom line in the sea, along the coast line of the State from Kollengode to Paravoor Pozhikkara for a length of 78 kilometers; and the area up to 18 fathom line in the sea, along the coast line from Paravoor, Pozhikkara to Kovilthottam for a length of 26 kilometers; and the area up to 12 fathom line in the sea, along the coast line from Kovilthottam to Manjeswaram for a length of 486 Kilometers	Kerala Marine Fishing Regulation Ordinance, 1980[39,40]
Tamil Nadu	3 nm from the shore; No deep-sea fishing vessels shall operate at depths of 25 fathoms or below.	Tamil Nadu Marine Fishing Regulation Rules, 1983[41,42]
Andhra Pradesh	8 km from the shore (Contravention may lead to fine of Rs. 2,500 /-	A.P. Marine Fishing Rules, 1995[43]

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[37] Trawling by mechanised fishing vessels (trawlers) is prohibited within this zone

[38] Gujarat Fisheries Rules, 2003, Gujarat Government Gazette Ex., 15-8-2003, Registered No.G/GNR/2, Vol. XLIV.

[39] Government of Kerala Notification dated December 29, 1980, G.O.(P) 156/80/FandPD.

[40] Government of Kerala Vol. XXIX No.1055 dated December 3, 1984, G.O. (P) 136/84/PW, FandPD.

[41] Tamil Nadu Marine Fishing Rules 1983, Directorate of Fisheries, G.O. Ms. No. 993, Forests and Fisheries Department dated August 17, 1983.

[42] Tamil Nadu Notification for Regulating Deep-sea Fishing Vessels, G.O. Ms. No. 166 dated 22.8.95.

[43] Andhra Pradesh Marine Fishing (Regulation) Rules, 1995, Animal Husbandry and Fisheries Department, Registered No.HSE/49, July 23, 1996.

State	Zone allocated exclusively for Artisanal fishermen[44]	Relevant State Legislations
Orissa	Waters up to 5 km from shore allocated only for non-mechanised traditional crafts; Mechanised fishing vessels up to 15 m OAL beyond 5 km from the coast; Mechanised fishing vessels above 15 m beyond 10 km from shore	Orissa Marine Fishing Regulation Rules, 1983[45]
West Bengal	Non-mechanised vessels up to 9 metres in length up to 8 km from shore (Zone A); Non – mechanised vessels above 9 metres in length can only operate up to 20 km but not below 8 km from shore (Zone B); Mechanised vessels up to 15 m length are allowed to operate within 20 to 50 km from shore (Zone C); Vessels above 15 m length have to operate beyond 50 km from shore (Zone D)	West Bengal Marine Fishing Rules, 1995[46]

4.6 Illegal fishing in offshore waters off India's EEZ

One could say that India's aspirations to generate economic profits from the marine sector gained momentum in the post UNCLOS period. Illegal fishing has been seen as a persistent threat to its sovereignty and maritime security. Poaching is an incessant problem along India's coastline with its impact far difficult to assess in earlier decades from 1950 to 1980s due to absence of any concrete patrolling along its vast coastline (Peterson and Teal 1986). Growth in the domestic fisheries sector during eighties was largely hampered by lack of shore based infrastructure and short operational limit of fishing vessels to a few miles from the coast (Rao 1981).

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[44] Trawling by mechanised fishing vessels (trawlers) is prohibited within this zone

[45] Orissa Marine Fishing Regulation Rules, 1983, Government of Orissa, Forest, Fisheries and A.H. Department, Notification dated January 10, 1984.

[46] West Bengal Marine Fishing Rules, 1995, Calcutta Gazette, Magha 17, February 6, 1996, West Bengal Government Press, Alipore.

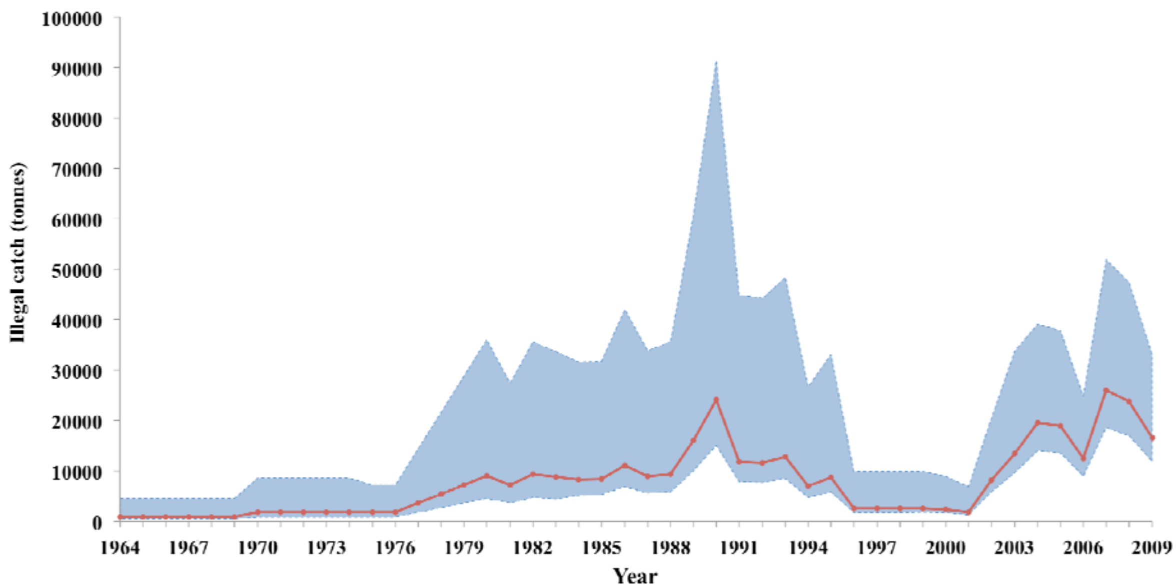

Figure 4.3: Estimated total illegal catch taken by foreign fishing vessels in the Indian EEZ.

Estimated total illegal catch (t) taken by foreign fishing vessels in the Indian EEZ (1970-2009). The Red dotted line in the figure represents the estimated illegal catch that was confiscated from vessels that were arrested in Indian waters from 1964-2009. The lower and upper bound estimates were derived independently from IUU fishing trip interviews (Pramod 2008), surveillance data in GIUFI (2010), Industry and Government records of vessels that were observed poaching in Indian waters. Illegal catches for the period 1964-1982 are for foreign fishing vessels observed poaching within 12 nautical miles from shore. India declared six miles territorial water limit from the baselines on March 22, 1956. India extended its territorial limit to 12 miles on September 12, 1967. India passed the Maritime Zones Act on August 25, 1976 to claim a 200-mile EEZ and continental shelf.

A detailed quantitative estimate of illegal catches from these foreign fishing vessels was calculated (Figure 4.3) using illegal catch confiscated from arrested vessels, number of arrested foreign vessels and number of vessels observed poaching by Indian small-scale and deep sea fishing vessel skippers and crew members (Respondents 3, 4, 7, 8, 10, 13, 14, 15, 17, 19, 23, 26, 43, 57, 61, 184, 189, 196). During the 1970-1980 period, foreign fishing vessels took at least around 15,000 to 50,000 tonnes of fish and shrimps in the Indian EEZ; in the next decade from 1980-1990, foreign fishing vessels illegally caught 35,000 to 90,000 tonnes of shrimp and fish stocks from Indian waters (Respondents 1, 13, 15). Poaching only declined in the post-1995 period (Respondents 13, 19, 23, 57, 64, 97) with catches in last decade from 2000-2009 showing illegal catches in the range of 10,000 to 25,000 tonnes probably as a consequence of improvement in monitoring control and surveillance by Indian Coast Guard limiting such incursions into the Indian EEZ.

Some of the first reports of poaching in the Indian EEZ appear in Anon (1981), which gives a very good picture of extent of poaching by Thai trawlers off Andhra Pradesh Coast. Back then, the Coast Guard with its meager fleet did manage to catch 30 trawlers for the 1981-83 period, but invading trawlers by their sheer numbers truly outnumbered capability of patrolling vessels. The Indian Coast Guard started with a fleet of seven patrol vessels in 1973, before increasing its strength to seventeen vessels by 1983 (Mohan 1984). Some of the other constraints included Coast Guard having only one Fokker aircraft operating from Calcutta to monitor the entire EEZ in the year 1983, leading to severe gaps in air surveillance during this period (Mohan 1984).

A deeper analysis of the illegal fishing vessels arrested and the information in GIUFI (2010) database reveals that during the 1950-1970 period majority of illegal and unregulated fishing occurred in three regions, i.e. the North West coast of India (Arabian Sea), central east coast of India (Bay of Bengal) and the Andaman and Nicobar Islands.

During the 1950-1970 period illegal / unregulated fishing activity on the north-west coast was conducted by Taiwanese and South Korean trawlers mainly targeting shrimp, squids, cuttlefish and sharks off Maharashtra and Gujarat coasts; rock cods and shrimps off Kerala coast; Sri Lankan fishing vessels targeted groupers and sharks of Laccadives, Kerala and Karnataka coasts. During the same period, Thai and Taiwanese trawlers targeted shrimp stocks off Orissa, Andhra Pradesh and West Bengal, while the Japanese and Korean vessels targeted Yellowfin and Bigeye tuna off Orissa coast. Off the Andaman islands Thai, Korean, Russian and Taiwanese vessels targeted tuna, with each of these vessels (up to 400 GRT) catching up to 90 tonnes in the 2 month period, majority of these vessels operated up to 4 months in the Indian EEZ until 1972 (Respondents 3, 4, 7, 10, 13, 14); (GIUFI 2010).

In the 1970-1990 periods, illegal fishing by Thai and Taiwanese trawlers was more prominent off Orissa and Visakhapatnam coast, manly targeting rich shrimp grounds between Puri (Orissa) and Krishnapatnam off the Andhra coast. (Respondents 15, 17, 19, 23, 26) reported that seasonal incursion of upto 50 Thai and Taiwanese vessels off Orissa and Andaman islands was existent even up to 1990, mainly targeting Yellowfin tuna and sharks. In the post-1990 period the rapid increase in patrolling capacity of Indian Coast Guard and continuous monitoring throughout the year through the Dornier aircraft acted as a significant deterrent in preventing incursions from Thai and Taiwanese trawlers. In the 1990-2009 periods, majority of the incursions were from Sri Lankan driftnetters and Bangladeshi trawlers in the Bay of Bengal, while very few incursions by Pakistani and Sri Lankan vessels have been reported off Arabian Sea. Majority of the Sri Lankan vessels targeted tuna in the Bay of Bengal while targeting both tuna and sharks off Lakshadweep islands. Bangladeshi trawlers targeted sciaenid and shrimp stocks off Orissa coast. According to small-scale fishermen frequent presence of Coast guard vessels and aerial patrolling resulted in apprehension of at least 80% of illegal vessels off Orissa coast, while 20% managed to get away as many of the Bangladeshi trawlers look similar to Indian trawlers operating off West Bengal and north Orissa coasts. Fishermen in Orissa reported that Indian coast Guard apprehended 95% of illegal tuna driftnetters cum longliners from Sri Lankan during the last decade, but the release of vessels after arrests provided massive incentives for the Lankan vessels to come back into Indian EEZ in subsequent years.

4.7 Discrepancies of foreign joint venture chartered tuna longliners

Under the Maritime Zones of India Act, of 1981 Indian Coast Guard is the nodal agency responsible for monitoring chartered vessels operating under joint venture Letter of Permission (LoP) with Indian companies. Up to 1995 alone, 800 of these vessels were licensed to operate in Indian EEZ (Kurien, 1995). Management of foreign chartered vessels appears to be a problem for long with past reports stating the extent of the problem "*In India, there is no centrally planned fishery development programme, foreign owned vessels are inadequately supervised*" (Peterson and Teal 1986). In recent years as many as 40-60 chartered joint venture tuna longliners have been operating in Indian waters. The joint venture vessels originally came from Taiwan, and operate under an Indian flag while fishing in Indian EEZ, while retaining their original vessel registration in Taiwan. The names of the original vessels are changed while fishing in Indian waters;

so they have no IMO number and essentially engage in ‘flag hopping’. The Association of Indian Fishery Industry has asked various government agencies to take action on the companies and vessels involved (Patnaik, 2008) with little impact as these vessels continue to fish in the Indian EEZ. Violations include dual registration[47], under-reporting, illegal transfer of catches, failure to file shipping bills to Indian Customs listing the quantity of catch being taken out while exiting Indian EEZ, and violations of the Maritime Zones of India Act[48] (Patnaik 2008; Pramod 2010).

The modus operandi is explained below. The Government of India acquires the deep sea fishing vessels on "*deferred payment*" under External Commercial Borrowing / Suppliers Credit. The original tuna vessel owner from Taiwan registers the vessels to a management company, and this company signs an agreement with the Indian company. The tuna vessel is then shown as vessel sold to Indian company on deferred payment. 10% of the down payment is made at the time of issue of the Letter of Permission (LoP) and the balance has to be paid in five equal installments. The conditions for the Indian company are that they should have a paid up capital of Indian Rupees 2,000,000

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[47] Section 435 of the Marine Shipping Act states that for a vessel to fly an Indian flag it should be registered under ownership of an Indian.

[48] As per MZI Act, 1981 an Indian vessel means " (I) a vessel owned by a Central Act or by a corporation established by a Central Act, or (II) a vessel (i) Which is owned wholly by persons to each of whom any of the following description applies: (1) A citizen of India; (2) a company in which not less than sixty percent, of the share capital is held by citizens of India; (ii) Which is registered under the Merchant Shipping Act, 1958, or under any other Central Act or any provincial or State Act".

(equivalent to US$ 43,478) whereas the amount of 10% payment works out to Indian Rupees 20,000,000 (US$ 434,782). To overcome this shortfall the seller of the vessel advances the money by the way of advance for tuna catch. This rotation of funds is only to get the necessary clearance to operate the vessels in Indian EEZ. In fact, these vessels are presumably operating through buyer and seller agreement on a commission basis, which violates the regulatory process itself (Anon, *pers. comm*. 2008; Pramod 2010). Interestingly, many of the personal sources (Academics, Government officers, enforcement personnel, captains of fishing vessels etc.) were very willing and keen to share their knowledge and information, but have expressed a clear preference for not being named, *i.e.,* wanting to remain anonymous, usually out of concern for their job security. Throughout this chapter, I treat such concerns seriously, and cite 'anonymous' for such material. I also endeavor to use such information in a manner so as not to make the original source apparent.

4.8 Fishing in disguise: LoP tuna longliners in Indian waters

Estimates of illegal tuna fish transshipments by Indian registered and foreign owned longliners was also estimated through interviews in 2008. Foreign-chartered tuna longliners are more than 20-40 metres in length, and well equipped to stay at sea for more 4-6 weeks. The majority of these vessels are Taiwanese owned along with a few Thai registered vessels in recent years. Former crew members from these vessels and Indian deep sea tuna industry officials allege that "*the original registration of these vessels are kept intact and the vessels are registered in some third country such as Tuvalu / Sierra Leone and all necessary documents are submitted to the Indian Registrar of Shipping for* *registering the fishing vessel as an Indian vessel under the Merchant Shipping Act. None of these vessels are registered with IOTC and after completing fishing in the Indian EEZ they claim that they are fishing in the International Waters, this again is a gross violation of the IOTC resolutions*" (Respondent: 72).

According to former crew members on LoP vessels, these tuna vessels under-report catches of yellowfin and bigeye tuna through the Indian companies and most of the Indian companies are aware of this plunder. LoP operator's report US$ 2 / kg as price for tuna caught in Indian waters, while the same Yellowfin and bigeye tuna catch taken by Indian tuna vessels is sold at US$ 6-9 / kg. Further, the LoP operators report no value for by-catch (by-catch contributes 50% of total catch for each haul); while records from Indian tuna vessels show that by-catch fetches US$ 1.5 / kg. Indian tuna vessel operators who process their catch in shore based processing plants (OSP), with 2% hooking rate report that annual catch is around 235 tonnes / small converted tuna longliners, while LoP vessels with far higher capacity which engage in Mid-sea transshipment (MST) with 2% hooking rate can catch upto 576 tonnes / medium sized tuna vessel.

Fishing crew working on LoP vessels (Respondents: 56, 61, 196 and 201) stated during interviews that on an average 24-60 m OAL vessel could fish continuously for 30-45 days. These vessels need to catch 260 tonnes / vessel / year to break-even and any catch above this amount will fetch profits. On an average these vessels catch up to 570-600 tonnes / year even at a hooking rate of 2%, of which the vessels make break even in less than 5 months, with any catch caught above this period fetching them high profits. Crew members interviewed during the survey also mentioned that LoP Tuna longliners report only 20% of the actual catch caught during the whole year through the Indian company. The information from interviews with crew on LoP vessels corroborates information from (Rao 2009, page 266.), which shows average 82.3 – 181 tonnes reported catch / LoP tuna longliner, which does not even cover operating costs of the vessel let alone making profits from these operations. Miyake (2004) states that current economic break-even point for tuna longliners (regardless of fleet) is 250 tonnes of average catch per vessel / year. Recent reports from Indian Coast Guard in 2009 corroborate the extent illegal tuna transshipments by LoP vessels in Indian waters, with as many as 22 LoP vessels recalled by Coast Guard (Period: Nov 1, 2008 to Jan 31, 2009) for not fulfilling the conditions of LoP license and exiting Indian EEZ without prior clearance from Coast Guard and Indian Customs (Anon 2009e).

According to the Association of Indian Fishery Industries, they have taken up these issues with the concerned investigating agencies and expect the Government to take action on Indian companies shortly. The vessels essentially engage in flag hopping as, they operate under an Indian flag in Indian waters, and use the Taiwanese flag in international waters, where they transship the tuna caught in the Indian EEZ. The tuna is eventually sold as tuna caught by Taiwanese vessels into Japanese markets. Recently, some of these chartered vessels have changed to Indian flag, as reflected by a sudden increase in Indian flagged vessels (Since 2005) in the Indian Ocean Tuna Commission (IOTC) authorized vessel list. However, several inconsistencies still exist with illegal transshipments and vessel licensing of Taiwanese tuna vessels operating in Indian EEZ.

Some of the steps that can be taken to tackle this problem include implementation of observer scheme and vessel monitoring system (VMS) as part of license requirements for all foreign-chartered vessels operating within the Indian EEZ. The VMS can provide much needed information for Coast Guard to check discrepancies in IUU fish catches, while observers onboard the tuna vessels can help to counter check transshipments at sea. This is essential, as bulk of the chartered tuna vessels operating in Indian waters do not land their catches in Indian ports.

4.9 Troubled waters: Indo-Sri Lankan illegal fishing problem

No problem has received as much media and political limelight as the Indian trawlers caught for poaching in Sri Lankan waters. The large numbers of trawlers operating from southern Tamil Nadu have contributed to the problem. Increase in capacity did not pose any problem as the shrimp boom on the Indian side of Palk Bay and Gulf of Mannar lasted until the mid-eighties. The export-oriented overseas demand for shrimp led to more investments in building new trawlers, increasing the capacity. But, when the catches declined in late eighties, instead of curtailing the overcapacity trawler operators on the Indian side found rich grounds on the other side of maritime boundary in Sri Lankan waters. As these waters were relatively unexploited due to the Tamil problem in northern Sri Lanka, the Indian trawlers frequently entered Sri Lankan waters and fished for shrimp and finfish. The problem of incursions was widespread with many casualties on Indian side as the Indian trawlers were frequently fired upon by Sri Lankan Navy gunboats trying to prevent these incursions; they saw these trawlers as potential smugglers of fuel and other supplies to the Tamil-controlled northern Sri Lankan territory (Respondents 63, 65, 66). In spite of frequent casualties, boats continued to operate until late nineties, when the incursions declined due to huge naval presence by both the Indian Coast Guard and Sri Lankan Navy (Respondent: 72).

The Government of India has taken some action in this direction by giving tokens to fishing trawlers from Palk Bay and other northern areas, which requires them to return from fishing within a specific time period, thereby preventing any incursions into Lankan waters. In recent years the problem of incursions appears to be more prominent from trawlers operating from Rameshwaram. There is no quick fix solution to the problem of incursions by trawlers from Rameshwaram due to three reasons. As aptly stated by one crew member on trawlers operating from Palk Bay "*These trawlers are owned by commercial interests and are not worth anything if they don't fish; no one would buy them for a dime even if they wish to sell them*" (Respondent 66). The second incentive for fishing crew to take risks is that their daily incomes are linked to amount of catch they bring after each trip, and as prawns fetch a higher price, occasional incursions into Lankan waters might yield higher returns. The third biggest disincentive in terms of catch per vessel appears to be overcapacity of trawlers, which are more than thrice the number of vessels that can bring in good catches from the shrimp grounds of Palk Bay and Gulf of Mannar on the Indian side. Estimates from 2008 interviews reveal that around 15-80 trawlers from Rameshwaram entered Sri Lankan waters for up to 3-9 months in a year, especially during lean periods but these incursions have declined since 2006 due to massive naval presence on both sides of the maritime boundary.

Anon (2004b) and other documents state that up to 150 Indian trawlers might be fishing illegally in Sri Lankan waters for up to 150 days in a year. The Indian trawlers reported in such activities are 28-46 foot long. Vivekanandan (2004) states that up to 2500 Indian trawlers fish illegally in Lankan waters. According to Anon (2004c) the State Government of Tamil Nadu cancelled 4 fishing licenses, imposed fines of Rs. 391,000 and suspended licenses of 603 trawlers for violating the maritime boundary. According to NEERI (2004) around 900 boats (motorized and non-motorized) operated from Rameshwaram on alternate days, and per boat catch ranges from 20-25 kg prawns and 600 kg fish. Interviews with fishermen in Tamil Nadu on the Indo-Sri Lanka maritime border revealed that, previously, illegal fishing was undertaken for profit, mainly targeting shrimp, while in recent times accidental incursions into Sri Lankan waters is for survival due to declining catches in Indian waters, overcapacity and inability of smaller trawlers from Palk Bay to fish in neighboring coastal states of mainland India.

Indian fishers in Palk Bay and Mandapam stated that accidental incursions of fishing vessels from both countries occur on a regular basis into each other’s waters. Based on interviews in the present study (Respondents: 93, 97, 103, 104 and 109), the problem of illegal fishing in Palk bay and Mandapam are likely due to three reasons. Firstly, the government of India has tried to solve the problem of incursions through increased patrolling along the international maritime boundary, instead of controlling the huge overcapacity of Indian trawlers operating along Palk Bay and Mandapam. The trawling grounds along the Palk Bay and Mandapam can hardly sustain fishing pressure from one third of the existing fleet. Fishermen from Palk Bay were of the opinion that since there is a narrow border separating India and Sri Lanka, accidental intrusions should be treated with utmost sensitivity through warnings, with crew and vessels being promptly released for such cases.

4.10 Incursions of Sri Lankan vessels into the Indian EEZ

Sri Lankan longliners are also frequently caught by the Indian Coast Guard for illegally fishing for tuna and sharks in the Indian EEZ. During the seventies and eighties they were frequently caught off Andaman and Nicobar islands EEZ. During the period 1980-2000, they fished unhindered in Bay of Bengal, as there was virtually no fishing activity in offshore waters by Indian longliners in the Bay of Bengal. Starting in 2000, many Indian built trawlers were converted into tuna longliners to fish for tuna, which brought them in conflict with Indian LoP vessels and Indian owned medium sized longliners (Operating from Visakhapatnam and Chennai). But in recent decades Sri Lankan driftnetters have been caught all along the east coast of India (Bay of Bengal), while illegally fishing for tuna. Owners of Indian longliners who operate between 60-120 km off Andhra and Orissa coasts complain that Sri Lankan drift netters frequently steal their radio buoys, and damage their longlines (Respondent 71). The Indian Coast Guard frequently hands over apprehended vessels to Sri Lankan navy, but they come back in more numbers year after year to poach for tuna. A common understanding seems to exist between India and Sri Lanka, with illegal tuna vessels from Sri Lanka and illegal Indian shrimp trawlers operating in each other’s jurisdiction being arrested and handed over to each other’s Coast Guard’s on a regular basis.

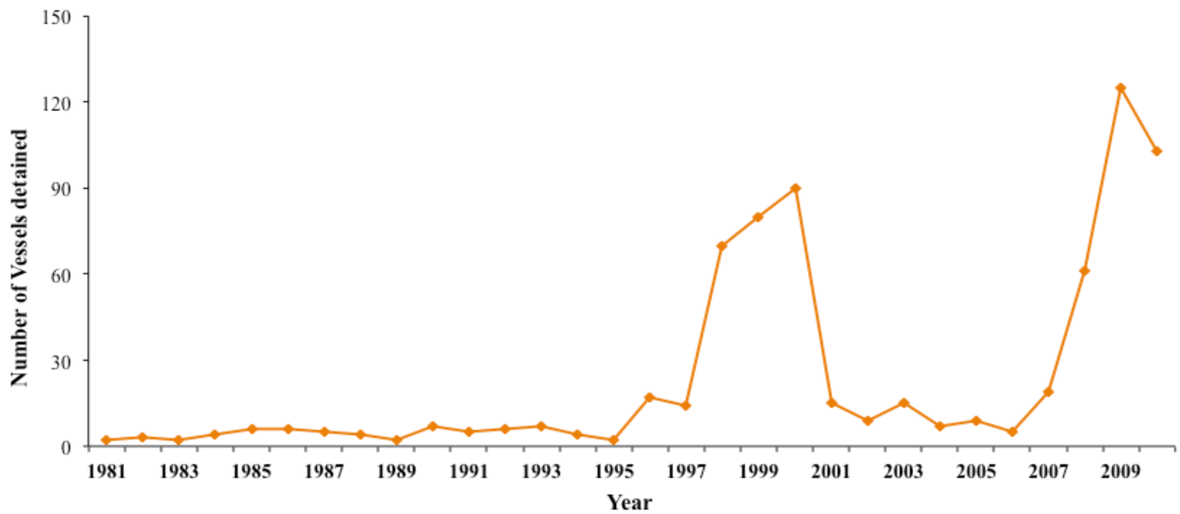

Figure 4.4: Sri Lankan fishing vessels arrested in the Indian EEZ (1981-2010).

Source: GIUFI (2010) Database.

Information from Figure 4.4 shows that the number of illegal Sri Lankan tuna vessels operating in Indian waters has increased drastically, putting Indian tuna vessels at disadvantage. A recent media report suggests that almost all the multi-day Lankan tuna vessels that were caught illegally fishing for tuna in Indian EEZ during 2009 were handed over to Sri Lankan authorities (Anon 2010g). A deeper analysis of illegal fishing vessels arrested (GIUFI 2010) prior to 1990s in Indian EEZ reveals that majority of vessels were confiscated and seldom handed back to Sri Lankan authorities. In recent decades however, almost all the vessels have been released along with the crew although Indian Coast Guard caught them while they were engaged in illegal fishing in the Indian EEZ. A press release from Government of India revealed that 116 Sri Lankan fishing vessels were arrested in 2009 (Anon 2010h). The majority of the arrested vessels were multi-day tuna longliners / driftnetters. Data from GIUFI (2010) database reveals that more than 100 of these apprehended Sri Lankan vessels in 2009 are tuna long liners. So, the Indian government has lost (each multi-day Lankan tuna vessel has a current market price of US$ 58,000 per vessel) US$ 5,764,000 from 100 vessels, which were handed over to Sri Lankan authorities after arrests[49]. Return of illegal fishing vessels on both sides does not stand in good stead as majority of these illegal multiday tuna vessels in Sri Lanka and illegal fishing trawlers from India are owned by commercial interests (Basavaiah 1995; Amarasinghe 2001; Pramod 2010). Handing over of the apprehended crew on both sides is a good move to improving bilateral relations, but governments on both sides should confiscate fishing vessels implicated in illegal fishing to send a strong signal to the vessel operators.

4.11 Conclusion

As aptly stated by India's founding leader Mahatma Gandhi "*'There is enough for everyone's need but not for everyone's greed*" commercialization of fisheries sector with gross disregard to laws and regulations has led to decline in Indian fisheries. There is no dearth of fisheries related regulations in each state (Marine Fisheries Regulation Acts), but implementation of these acts is virtually absent, except in the State of Orissa where serious attempts have been made in the last decade to implement fisheries and environmental laws in marine sanctuaries. The current study presents one of the first

[49] Chapter IV of Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981 states that "13. (1) Where any person is convicted of an offence under section 10 or section 11 or section 12, the foreign vessel used in or in connection with the commission of the said offence, together with its fishing gear equipment, stores and cargo and any fish on board such ship or the proceeds of the sale of any fish ordered to section (4) of section 9 shall also be liable to confiscation"

estimates of illegal trawler incursions into the artisanal zone reserved for small-scale fishers in India. Moreover, such estimates are very valuable as enforcement responsibility for territorial waters lies with coastal states in Indian waters, with Coast Guard responsible for monitoring waters between 12 to 200 nautical miles EEZ zone. The study revealed that with the exception of Orissa, none of the other states conducted regular patrols or monitoring of 0-6 nm waters. Estimates of illegal fishing gathered from fishermen strengthen data on fisheries violations, as enforcement in these waters has traditionally been very low in Indian waters. Confidential interviews with enforcement staff have strengthened estimates for upper and lower bounds for illegal fishing catches and serve as independent sources for strengthening data estimates collected during the surveys.

Illegal fish catches were very high in island territories, with most violators being foreign trawlers targeting sea cucumbers, trochus, shark fins and reef fish in the Andaman Islands, while shark fins and tuna were the target of poachers in the Lakshadweep archipelago. Patrolling was found to be inadequate in proportion to the length of coastline throughout the Indian coast. Interviews with enforcement staff in coastal states revealed that in some cases foreign poaching vessels possess far better monitoring radar equipment to spot patrol vessels as revealed by equipment on confiscated trawlers.

The Government of India through state governments of respective maritime states implements a fishing ban during the monsoon every year. The ban lasts for 45-60 days with each state using a different time period or criteria such as advancement of monsoon as an indicator. Absence of a uniform ban period throughout the coastline has led to fishing trawlers of several states using this legal technicality to fish where fishing ban exists and land in an adjacent state where there is no ban. During interviews (36 Respondents), fishermen in Goa, Karnataka and Maharashtra (West coast), Orissa and West Bengal (East Coast) complained that the very essence of the fishing ban is flawed as vessels from neighboring states continue to catch from one state and land in another, leading to low catches during the post ban period. With most of the coastal states having weak enforcement, due to huge gaps in allocated infrastructure, manpower and monetary resources, illegal fishing persists through domestic fishing vessels in inshore waters. Moreover, it also leads to problems in reported catches where fish caught in one jurisdiction is reported as caught in another location.

Mesh size violations have been prevalent in both commercial trawl fishery and small-scale fisheries along the Indian Coastline since the 1980s (Alagaraja *et al*., 1986; Anon 2000b), and the interviews from current study show a drastic decline in mesh sizes of fishing gears in all coastal states (inclusive of small-scale fisheries). Enforcement of mesh size regulations is dismal in all states; with Fisheries Departments in all maritime states being ill equipped to carry out surveillance or implementation of regulatory measures. To prevent overcapacity and misuse of trawlers from one state in another, trawlers from one state should not be allowed to operate in another state or use ports of neighboring states during fishing ban in their port of registration. In many cases it has been observed that a single trawler has been fishing in more than 3 states during different periods of the year. Respondents (7, 11, 23, 26, and 32) stated that trawlers often contravene the ban, by taking their vessels to neighboring states during ban in their port of registry, and returning after completion of ban period to fish in their state waters. But, most trawler owners rarely realize that this action is leading to depletion of the very stocks that are sustaining profits for them, as the bulk of the pelagic and demersal stocks along the Indian coastline are transboundary in nature. In some coastal states in India, registration is required for trawlers to operate and use port facilities in neighboring states, but vessel skippers often contravene such regulations through landings in small harbours. Since, the vessel monitoring system (VMS) does not exist in Indian fisheries, it is almost impossible for Coast Guard to monitor all the Indian trawlers that operate within its EEZ.

The majority of coastal states, with the exception of Orissa, do not have patrol vessels to enforce a fishing ban. This fact assumes importance since fisheries departments of each maritime state are the primary enforcement authority in territorial waters (0-12 nautical miles). The Coast Guard in its present role is providing supplementary support in some states during ban period, but it is impossible for Coast Guard with its present budgetary constraints to monitor vast number of trawlers operating along the Indian coastline. Illegal fishing by domestic mechanized trawlers in the inshore artisanal zone has been reported in all coastal states of mainland India[50]. Skirmishes between trawlers and artisanal boats are increasing in most of the coastal states due to declining catches and frequent incursions by trawlers into nearshore waters. Skirmishes between subsistence

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[50] The area up to 5 nautical miles from shore is reserved for artisanal fishermen (Non-motorised fishing craft) in most coastal states of mainland India under the Marine Fishing Regulation Acts (MFRA).

and motorised fishing boats have also been reported in the past, often leading to exclusion of one group or the other (Dutt, 1972; Shankar 2001; Aklekar 2011).

Interviews were also conducted with Indian fishermen operating along the Indo-Pakistan and Indo-Bangladesh maritime boundary to understand the reasons for frequent arrests of fisherfolk on both sides of the border. Declaration of 5-10 km, “no fishing” zones on both sides of border along Indo-Pakistan and Indo-Sri Lanka regions can help in preventing accidental intrusion of small-scale fishers into each other’s jurisdiction. Indian fishermen in Gujarat stated that marker buoys with flags could help in preventing accidental intrusions into Pakistan and vice versa. The no fishing zone along Indo-Bangladesh border along Sundarbans assumes more importance as piracy-related incidents have witnessed an increase on the Bangladeshi side and Border Guards were of the opinion that banning fishing activity along this region would help in controlling such activities and cross-border illegal trade of commodities by sea route. The next chapter extends the IUU analysis based on field interviews to the small-scale sector.

4.12 Chapter 4 summary

The 2008 IUU field trip interviews revealed that decline of the fish resources has come at a bad time for most small-scale fishers as they are already under tremendous pressure from industrial development and pollution (due to dumping of sewage and wastes from cities) in the coastal zone. This displacement is two pronged:

4.12.1 Internal displacement

Phase 1: Faced with declining catches and an uncertain future many fishers have been forced to move to other states to work as crew onboard trawlers. Majority of the displacement had occurred from East coast to the West Coast. Fishermen from Andhra Pradesh nowadays work as crew on trawlers in Maharashtra and Gujarat. The decline of fish resources in one state, and eventual migration to another state has also decreased benefits for crew working on trawlers (for e.g. trawler crew in Gujarat and Karnataka stated that increasingly boat owners do not give them a share of profits from their catch as they have surplus crew available for work on a daily wage basis from East coast).

Phase 2: Declining catches and low income has also increased the number of small-scale fishers who migrate to Andaman Islands in search of stable livelihoods. Interviews in 2008 revealed that displacement and migration to Andaman Islands increased in the past two decades. In the past, most of small-scale fishers who migrated to Andaman Islands were mostly from Northern Andhra (Srikakulam district). However, many fishers reported that net migration from other coastal districts along Andhra coast to Andaman Islands has increased. Although, migration to Andaman Islands from Tamil Nadu, West Bengal and Kerala has occurred in the last three decades, interviews in 2008 revealed that some fisher families have moved permanently to Andaman Islands due declining catches along several jurisdictions off the West Bengal and Andhra coast, although very few incidences of such increase in migration was reported along Tamil Nadu coast.

4.12.2 Displacement to foreign waters

Due to easy availability of surplus fishing crew in the southern coastal states, many of these fishermen from Andhra Pradesh, Tamil Nadu and Kerala have been lured by agents to work as fishing crew in Middle East states of Bahrain, UAE, and Saudi Arabia. According to one respondent (23), as many as 18,000 Indians work as low-wage fishing crew in the Gulf States. Although, it is hard to know exactly how many people are employed in these countries. Conservative estimates from one recent source suggests a figure close to 25,000 (Anon 2011). Although, these low wage jobs can be seen a blessing for folks from fishing villages, they seldom work for more than a few years as; first, they have to pay a hefty sum to the agents to secure the job (mostly borrowed from money lenders); once they get a job, they work for an employer in unchartered waters, as they are not familiar about where they are fishing and if they are arrested what kind of action would be taken. In recent years, many such arrests of Indian crew have been reported for illegally fishing in Qatar's waters while working on Bahraini boats. After arrests, the fishers usually look for help from employer, but since the frequency of arrests and fines levied is so high, employers rarely show interest, so the crew are forced to contact their families back home to pay the fines (Respondents: 32, 35, and 41). In most cases, Indian Embassies in Middle East countries pay the fines to get the crew released and repatriated back to India as their families back home cannot afford to pay fines (Anon 2011).

Figure 4.5: Map showing migration of fishing crew to Middle East countries.

Red, green and blue lines shows movement of fishing crew from Andhra Pradesh, Tamil Nadu and Kerala to work as low wage fishing crew in Middle East countries.

Figure 4.5 shows the migration of skilled fishing crew from the three coastal states of Andhra Pradesh, Tamil Nadu and Kerala. This migration of fishing crew to Middle East countries is due to loss of jobs associated with huge overcapacity in Indian trawl fishing sector. Many Trawler owners have stopped their operations due to declining profits and high operational costs in recent years. The skippers and crew from these trawlers have found jobs in Middle East countries through agents, as they don’t have alternate job opportunities in other sectors and work abroad to support their families back home.

In the commercial trawl fisheries, political leverage by fishing boat owners coupled with lack of seriousness in prosecuting illegal fishing cases aggravate IUU problems along

Indo-Sri Lanka and Indo-Pakistan maritime boundary. In cases, where foreign fishing vessels were arrested for illegal fishing, low prosecution rate has been identified as one of the main barriers to deterrence (Pramod 2010). Enforcement officials in India stated that in certain cases when illegal fishing vessels are arrested and taken to local courts, judges often fail to understand the gravity of the crime, and levy smaller penalties (Respondent: 36). Enforcement officials recommended that special tribunals or judges specially trained for environmental resource crimes should be attached to such trials along with a regular judge. Even, in cases where judges levied a heavy penalty to illegal fishing vessels from Sri Lanka, judgments were seldom enforced as a government order superseded the court's order releasing all the vessels with the crew. "*Think about the plight of Coast Guard officials, who go to great lengths to catch and bring them to ports, but are forced to hand over the very illegal fishing vessels to Sri Lankan authorities without prosecution. They spend more time after arrest to escort them to Indo-Sri Lankan maritime boundary every time. They loose precious patrolling hours for escorting duties every time a Lankan vessel is apprehended. This is truly a mockery of maritime laws"*(Respondent: 64).

Chapter 5: Unreported marine fish catches of mechanised and small-scale fishers in the Indian exclusive economic zone

5.1 Introduction

India exhibits a complex fisheries management regime due to numerous boats, fishers and a large EEZ, with varied management strategies employed in each coastal state and offshore island territories. This chapter is an attempt to explore the unreported catches from India's coastal states using a survey approach. Taking advantage of previous local contacts, language and knowledge of the coastal areas of India, information that may be used to make a complete estimate of fishery extractions, including illegal and unreported landings and discards (IUU) was collected in a 7–month field visit in 2008. Nine of the ten coastal states of India were visited, including the Andaman Islands. Methods used were over 200 confidential interviews, gathering of grey literature reports and direct observations. The purpose of the field trip was to get estimates of illegal and unreported catches from India's long and often inaccessible coastline to improve current estimates of total catch statistics from both mechanised and subsistence fishery sectors. The fieldwork was carried out over a period of seven months (May - November 2008).

This chapter describes the unreported components of IUU estimated from the fieldwork completed, together with results that suggest a total annual Indian IUU in excess of one million tonnes. A detailed explanation of various unreported catch categories is given in Chapter 4 (see section 4.2, pages 82 to 84). Interview methodology and preview of study areas is provided in Chapter 4. This chapter sets out the interview methods used to assess unreported fish catches in the field trip to India. Then unreported catch issues in each state from Gujarat in the Arabian Sea to West Bengal in the Bay of Bengal are reviewed in detail. Subsequent sections described estimates of a number of categories of unreported fishing, namely – Discards by domestic fishing vessels; Discards by chartered fishing vessels; Baitfish used in small-scale and mechanised sectors; Post-harvest losses; subsistence fisheries catches from mangroves, estuaries and coastal creeks; Reef based subsistence fish catches; Dryfish landings; unreported Molluscan catches; and Take home catches of artisanal fishers.

5.2 Discards

5.2.1 Discards by Indian fishing vessels

Discards[51] from domestic Indian trawlers have generally been reported as very low (Kelleher 2005, Bhathal 2005). However, in agreement with Davies *et al*. 2009, the current study is beginning to reveal that this situation is untrue and total discards may be in excess of 1,000,000 tonnes per annum in Indian marine fisheries. Significant quantities of discards have also been reported for Thai, and other foreign trawlers operating illegally in the Indian EEZ way back in the eighties (Dan 1982; Respondents: 53, 64, 91, 148) and this practice continues even today. Some recent studies have assumed that no discards exist for domestic

[51] Although Regulation 5, of the Maritime Zones of India Rules 1982, states that the "crews may not discard surplus catch," this regulation is never enforced in Indian fisheries. In the current study of illegal and unreported fish catches in Indian EEZ, discards are unambiguously treated as a category of unreported catches, as government officials in both Federal and State Government of India, stated during interviews in 2008, that discards are not considered "illegal", but rather as a category of unreported catches.

trawlers in India presumably due to burgeoning trash fish demand in poultry and aquaculture feed sectors in the last two decades. No concrete sources are given for Kelleher's 2005 estimates; with the only two sources being cited as *pers. comm.* from Ministry in Delhi and MPEDA, Kochi.

The current work uses information from foreign charter tuna vessels and discards from all maritime states of India. Moreover, previous studies have not taken into account the complex nature of trawling operations along the Indian coastline. Firstly, since the late eighties, there has been a massive increase in number of trawlers operating in all coastal states (See CMFRI 2005 Marine Fisheries Census reports for the eight coastal states); secondly, even within a single maritime state / fishing harbor there are two to five categories of trawlers (single-day, multiday, deep-sea trawlers etc.) which have different discard rates during different periods of the year; thirdly, there is significant discarding of pelagic fish during the monsoon season (glut discards) along different parts of Indian coastline in small-scale fisheries and this factor has not been considered seriously in any previous studies.

Moreover, previous studies have made the assumptions of low discards based on a few case studies from certain maritime states, which have proved to have anomalous, discard rates. Based on my fieldwork, several issues correct these misconceptions: A) a majority of the maritime states do not have estimates of discards from trawlers operating along their coastal jurisdictions; B) a majority of the trawlers operating along Indian coastline do not have a large hold capacity and deck space to store trash fish landed for each haul or for the whole trip; C) declining catches of target species in trawl gears in the past two decades has led to increase in duration of each fishing trip, with trips increasing from 2 days to 10 days to compensate for declining catches; D) although the duration of fishing trips has increased, operators continue to use trawlers of the same hull size, so a concurrent increase in hull capacity has not occurred in relation to increase in duration of fishing trips; E) single day trawlers are the only class of trawlers capable of landing the bulk of trash fish caught in each jurisdiction, but they constitute only 15-25% of total trawlers operating along the Indian coastline (Pramod, *Personal Observation*. 2008[52]).

Regulation 5, of the Maritime Zones of India Rules 1982, is probably the only regulatory source stating how discards would be managed in Indian marine fisheries "Crews may not discard substantial surplus catch, catch exceeding authorized quantities shall be retained onboard, recorded, and surrendered as required by authorized officers". However, since its inception mechanized vessels have never abided by this law, and no records exist on huge quantities of discards dumped by trawlers at sea. Moreover, since there is no effective mechanism to monitor fishing vessels at sea, over the last three decades fisheries discards have been assumed to be low.

Discards from marine fisheries sectors vary from one coastal state to another due to different levels of demand, availability of fish meal processing facilities, and variation in fishing days at sea (for mechanized trawlers in each state). Fishermen also reported that there was

[52] Pramod, G. (2008) Estimation of Illegal, Unreported and Unregulated fish catches in India's marine capture fisheries, Field Trip to eight maritime states and 2 island territories in India, May to November 2008, India.

significantly high discarding in many states during rainy season compared to other times of the year. Discards for the west coast have been poorly quantified in previous studies. So, discards estimates drawn from the current trip are probably among the best obtained so far. On the East coast previous studies have only estimated discards from Central Bay of Bengal, with other maritime states having very poor or no estimates of discards. Malhotra and Sinha (2007) also state that there are no reliable estimates of discards in India's marine fisheries. During the mid-nineties, discards from bottom trawlers were estimated to range from 15-36% of the total catch in Karnataka; 5-23% in Kerala and 4-14% in Tamil Nadu (Menon *et al*., 1996). Sathiadas *et al* (1994) estimate a discard rate of 5% for marine fisheries in India. FAO (2004) estimated that Indian trawlers have a discard rate of 2%, discarding 57,917 tonnes per year, which is very low compared to estimates from the present study.

Discards from the trawl fishery were the least in Gujarat among all the coastal states enumerated in the IUU trip. The probable reason for the low discards is the high demand for trash fish in the local fishmeal industry. Rao and Kasim (1985) described the trawl fishery off Veraval coast. Discards estimated from Gujarat trawlers during the present survey suggest that only 2.3% of catch is discarded, mostly during the monsoon season (bulk of it coming from trawlers operating in Northern Gujarat), which probably represents the lowest estimate of discards among trawlers operating in India's maritime states. Bostock (1986) made a similar note on trawlers operating along the Gujarat coast. His study showed that trash fish comprises 62% of the catch with none of it being discarded. Estimates from the current field trip suggest that trash fish comprised 81% of the total catch landed suggesting an increase in landings of lower value species. Gujarat sets a good example by landing bulk of the trash fish as both trawler owners and fishmeal plants have ensured a higher price for trash fish landed in this state compared to other coastal states in India. But, this study shows that Gujarat figures are not typical for discards in most of India.

Interviews with trawler skippers (9 Respondents) reveal that discards range between 8-15% of total catches landed by trawlers for each trip in Maharashtra. The quantity of discards varies from season to season with substantially higher discards during pre-monsoon and post-monsoon periods when juveniles of fishes and shrimps constitute higher percentage of the catch. No discards have been reported for trawlers operating along the Mumbai coast in previous studies (Chakraborty *et al*, 1983). Substantially high discards have also been reported along the Raigad coastline due to the presence of plastic waste in trawl catches. Trawler skippers said that the problem is now so acute that they avoid some parts of coastline due to plastic wastes constituting as much as 30-45% of the total catch in every haul. Plastic creates immense problems during sorting as it increases the time afforded for sorting between each haul. Trawler skippers blame disposal of plastic waste into the Arabian Sea in Mumbai district for this serious problem.

Discards estimated from interviews with trawler skippers and crew (14 Respondents) revealed that discards constitute 10-15% of total catches landed in fishing harbours of Karnataka. No previous estimates were available for comparison; hence these are the best available estimates for discards in Karnataka. The Karnataka Marine Fisheries Regulation Act requires all mechanized trawlers operating along the coast to use a cod end mesh size of at least 30 mm. However, most of the trawlers were using 10-15 mm cod end mesh size resulting in indiscriminate capture of juveniles of fish and shrimps. This has also contributed to substantial discards during the monsoon Season.

Discards estimated from interviews (18 Respondents) with trawler skippers and crew revealed that discards constitute 15-23% of total catches in Kerala with the discard rate depending on the type of trawler, season and fishing grounds. Reduction in ring seine mesh size has led to glut in catches of juvenile sardines during some periods of the year, when oil sardines frequent coastal waters. Decline in prices during such periods has led to low market demand resulting in substantial fish discards as excess fish which cannot be dried, and are dumped in back-waters (van der Heijden, 2007). Interviews with fishermen (4 Respondents) operating in Cochin backwaters reveals the figure for ring seine discards during glut period of 1.8 - 3 tonnes oil sardines per year. Glut landings are a big problem off the Kerala coastline as its demand depends on domestic consumption, which does not increase much every year. Every 2-3 years there are very good oil sardine catches and during such glut periods, when market demand and price are less the bulk of the catch is discarded either at sea, in backwaters or at landing centres (Respondents: 43,47,48). Since the early eighties overfishing in coastal waters has been responsible for declining catches due to activities of both motorized and mechanized sectors (Kurien 2005). In backwaters and inshore fishing grounds this unsustainable exploitation is pushing both subsistence and motorised fishermen towards destructive fishing practices (Kurien and Achari, 1990; Harikumar and Rajendran 2007; Pramod 2010).

Table 5.1: Discard estimates in the Indian maritime states from the present study.

Estimated from interviews (see text) using number of vessels and discards for each trip in different vessel categories by 8 coastal states.

State	Number of Respondents	Average annual discards at-sea by mechanised trawlers and fishing boats (tonnes)*	Range	
			Lower Limit (tonnes)	Upper Limit (tonnes)
West Bengal	9	4440	1268	7612
Orissa	11	99247	67076	131,418
Andhra Pradesh	12	207,232	134,826	279,639
Tamil Nadu	14	212,969	179,274	246,665
Kerala	18	429,074	351,778	506,371
Karnataka	14	161,042	111,985	210,099
Maharashtra	9	90037	68807	111,268
Gujarat	12	690	360	1021
Andaman and Nicobar Islands	4	13200	9600	16800
	Total	**1,217,931**	**924,974**	**1,510,893**

* Includes discards from Indian deep sea trawlers and chartered LoP trawlers

In Maharashtra, trawlers operating from Mumbai landed 3-12 baskets (each basket is 25-40 kg) of trash fish in each trip with 10-35 baskets landed at Ferry wharf. Interviews revealed that during the monsoon Season from May-June, prawn and commercial fish are given more importance for storage, with 80-90% of trash fish being discarded at Sea during this period. Even for Multi-day trawlers, trash fish from the first 3 days is discarded at sea, and only 11-25 baskets of trash fish is landed at Sassoon dock for each trip. Single-day trawlers landed more trash fish compared to Multi-day trawlers during post-monsoon Season, but discards from these trawlers were also substantially higher during May-June when prawns and bigger sized fish were given more preference for storage onboard. In Gujarat, discards were much less, due to high demand for trash fish in the dry fish industry and the presence of a large number of fish meal plants to process these catches. The high demand for fishmeal also meant that fishermen landing trash fish in Gujarat were paid more money to land these catches, which would otherwise be discarded at Sea. None of the other maritime states in India have such an organized system of trash fish collection and processing as in Gujarat (Fish meal plants also use wastes from sea food processing plants). In fact, overfishing by trawlers throughout the year in large numbers has led to drastic decline in catches of large commercial fish, but fishermen still manage to eke out a living by landing more quantities of trash fish, with trash fish compensating for a decline in commercial fish species.

The development of trawl fisheries along the Andhra Pradesh coast is discussed in Sastry and Chandrasekhar (1986); Rao (1987, 1988). During the mid-eighties for every kilo of shrimp caught, trawlers operating from Visakhapatnam, discarded three kilos (Dwivedi 1987). He further estimated that fishing vessels operating from Visakhapatnam alone discard between 864 to 960 tonnes of fish every year. 60 tonnes of by-catch was discarded every year at Visakhapatnam fishing harbour during the same period (Dehadrai 1987). During mid-nineties, at least 11% of total by-catch was discarded by sona boats (Single day trawlers) operating from Visakhapatnam (Rao 1999). However, the estimate of Rao (1999) suffers from huge gaps as it was derived in an indirect way based on landings of prawns rather than direct data from vessels at sea. Salagrama (1998) estimated that trawlers on the east coast discard 26,000 to 50,000 tonnes each year. In the present study a complete estimate of discards from all trawler categories (Pablo, Sona and Deep Sea trawlers) operating from

Visakhapatnam and three other fishing harbours and raised by the total fishing ports were derived using interview data.

5.2.2 Discards estimates from the current study

Estimates of discards from the current study through interviews in 2008 (see Table 5.1 for detailed estimates of discards in the eight coastal states), suggest that every year around 1.2 million tonnes of fish (0.9 to 1.5 million tonnes) are discarded at sea, which equals to around 45% (Range of 32 to 53%) of the reported catches (India reported 2.8 million tonnes of fish catches to FAO in 2008). Results from Table 5.1 suggest that the state of Kerala had the highest discard rate with 430,000 tonnes every year, followed by Andhra Pradesh and Tamil Nadu with discards of around 200,000 tonnes.

Results from the present study show that discards along the Indian coast have increased for two main reasons. Firstly, the numbers of trawlers operating along the Indian coastline have increased over the past four decades. Secondly, the duration of fishing trips (10-12 day trips) has also increased all along the Indian coastline, with trawlers along the Kerala, Karnataka and Maharashtra coastlines increasingly targeting deep sea stocks at 150-350 metre depth during most of the year. Longer fishing trips in deeper waters means that non-commercial species of fish and shrimps are encountered in larger numbers. Longer fishing trips also create problems for the operators of these trawlers, as they cannot store trash fish from all the hauls during each trip. The expansion of fishing into deeper waters is a positive development in terms of exploiting new fishing grounds. But, crewmembers of these trawlers mentioned that they are increasingly coming in closer range of foreign-chartered vessels operating under joint venture in Indian waters, which could lead to operational problems in future. In Kerala, each offshore gillnetter discarded between 3.1 to 3.5 tonnes by-catch / year. In all coastal states, Interviews with skippers and trawler owners revealed that fisheries department enumerators never collect data on discards at sea. Detailed estimates of discards from 8 maritime states and island territories are given in Table 5.1.

Some of the most destructive and unsustainable fishing practices involved harvesting of larval shrimp (“seed”) from estuaries and backwaters along east and west coasts. Collection of shrimp seed was more prominent off Andhra Pradesh, Orissa and West Bengal compared to other coastal states. Interviews with dealers and shrimp seed collectors revealed the actual extent of catches and discards from this sector. Clearly, in most cases, interviews revealed that the number of people involved in harvesting shrimp seed has tripled or quadrupled in the last decade. This has resulted in more discards of finfish seed and reduction of tiger shrimp seed caught per collector per day, alluding to decline of shrimp seed resources. Although the collection is banned, it is openly practiced in estuaries of most coastal states of Bay of Bengal using push nets, bag nets and scoop nets. Shrimp farmers stated that they often brought wild shrimp seed, as they are more resistant to diseases than hatchery produced shrimp seed. The collection of shrimp seed from mangrove and estuarine areas might also be one the contributing factors to declining shrimp catches and one of the major reasons for failure of annual fishing ban as shrimp seed collection is a year round activity. It is also frustrating to see that neighboring countries like Bangladesh have come with progressive legislative and enforcement actions to ban seed collection in mangrove and estuarine areas, while a developed country like India with adequate regulatory and financial resources is merely witnessing the spectacle with little concern to eradicate this destructive practice.

5.2.3 Discards estimates from chartered LOP tuna longliners and Indian deep-sea trawlers

During 1982-1983, 110 chartered or joint venture deep-sea trawlers operated in inshore waters along the South West coast, with a catch of 13 tonnes/vessel/day (Devaraj 1987). These vessels reportedly discarded 8 tonnes of catch / vessel / day, as they were targeting shrimps and discarding the bulk of the other catch. Using the above figure, an estimated 202,400 tonnes of fish were discarded by these vessels for 1982 and 1983 years (110 vessels x 230 days in operation x 8 tonnes discard /vessel). Once the limitation of fishing beyond 80 m depth was enforced in 1983, only 12 vessels remained. 120 Mexican trawlers (57[!]) were operating along the North East coast during the same period, primarily engaging in shrimp trawling in inshore waters. These trawlers likely discarded similar quantities of discards in the Bay of Bengal as they were targeting shrimps and lobsters for the export market. Foreign-chartered pair trawlers also operated in Indian EEZ from 1990 – 1997, these trawlers also discarded around 100 tonnes of fish every year.

The discards from Tuna longliners (LoP Chartered vessels) are significantly less, but interviews from crew members revealed that for some species like sharks only fins are retained (sharks comprise 5-7% of total catch), while the remaining by-catch species like seer fish, billfish are under-reported through Indian companies although they are transshipped and sold in foreign markets as Taiwanese products. Discards from these vessels ranged from 0.5-

1.2 tonnes / haul (115 fishing days per vessel excluding transit time) according to crewmembers, which would amount to around 500-1600 tonnes of discards / year. Detailed quantitative estimates of discards by foreign-chartered vessels from 1982-2009 are presented in Table 5.2. which suggest that joint venture tuna longliners (LoP permit holders) discard around 2000 tonnes in the present compared to around 500-600 tonnes in eighties and nineties.

Table 5.2: Estimated discards by foreign-chartered trawlers and tuna longliners in the Indian EEZ.

See section 5.2.3 for methods in the text.

Year	Stern trawlers	Pair trawlers	Tuna longliners	Total (tonnes)	Lower Limit (tonnes)	Upper Limit (tonnes)
1982	328900	-	-	328900	261230	456800
1983	239200	-	-	239200	124860	298000
1984	35880	-	-	35880	23000	39820
1985	17940	-	30	17970	12500	19800
1986	-	-	300	300	260	480
1987	-	-	150	150	90	230
1988	-	-	240	240	160	380
1989	-	-	900	900	600	1000
1990	29900	104	1740	31744	21890	38900
1991	38870	78	660	39608	24000	41200
1992	14950	78	690	15718	11900	18420
1993	8970	65	840	9875	7200	11920
1994	23920	65	510	24495	18900	32000
1995	14950	65	540	15555	12000	18420
1996	-	-	540	540	360	782
1997	-	-	570	570	360	782
1998	-	-	-	-	-	-
1999	-	-	-	-	-	-
2000	-	-	-	-	-	-
2001		-	-	-	-	-
2002	-	-	-	-	-	-
2003	-	-	570	570	390	840
2004	-	-	1110	1110	980	1460
2005	-	-	1710	1710	1420	2100
2006	-	-	1650	1650	1290	2980
2007	-	-	1050	1050	890	1390
2008	-	-	2250	2250	1860	3200
2009	-	-	1800	1800	1680	2400

5.3 Bait fish used in small-scale and mechanised sectors in Indian fisheries

Bait fish used in hook and line and longline fisheries also remain unreported in Indian fisheries. In the present study interviews (18 respondents) with small-scale fishing boats and offshore gillnetters cum longliners revealed the actual extent of the bait catches. Kilograms of baitfish used per trip was multiplied into number of fishing trips per year to get total bait fish used in hook and line fisheries for each coastal state. Estimates from current study reveal that 4015 tonnes of baitfish is used every year. Baitfish used includes sardines, mackerels, pony fish, carangids and cuttlefish. Most of the bait fish catch is sourced from families and other fishers within the community. Often, neighbours and friends from within the fishing community gave bait fish as goodwill gesture, but sometimes fisher's buy fish from other gillnet fishers during lean periods. In the commercial longliners operating from fishing ports, vessel owners paid money to buy bait fish from trawlers at fishing ports. See Table 5.3 and 5.4 for detailed estimates of baitfish used in each coastal state. Estimates from interviews in Tables 5.3 and 5.4 suggest that around 4300 tonnes of bait fish is used in Indian marine fisheries, with bulk of bait fish used commercial longliners from Tamil Nadu (bait fish used: 2900 tonnes); Bait fish use in small-scale fisheries was relatively low at 343 tonnes largely due to seasonal nature of hook and line and longline fishing in the artisanal sector.

Table 5.3: Bait fish used in commercial hook and line fisheries along the Indian coast.

Estimates based on interviews in eight coastal states of mainland India.

State	Number of vessels	Bait fish used (tonnes / year)[53]		
		Actual estimate	LL	UL
Gujarat	4	8	6	12
Maharashtra	253	546	473	783
Karnataka	28	107	84	130
Kerala	10	108	95	137
Tamil Nadu	781	2905	2014	3701
Andhra Pradesh	20	49	35	64
Orissa	28	73	66	82
West Bengal	66	166	148	188
Total	1190	**3962**	2921	5097

[53] Bait fish used in the commercial and small-scale hook and long line fisheries was calculated by multiplying (X) the number of vessels in each state (X) bait fish used per trip (X) total number of trips per year. The actual estimate as well as upper and lower limits was calculated using data collected through interviews in 2008. The average number of trips was 32 trips per year in commercial longline vessels (>10 m OAL) while it was around 29 trips per year in small-scale hook and line fisheries (using motorized traditional craft or FRP boats). Bulk of small-scale fisheries along Indian coastline use baitfish for catching pelagic fish (scombroids, tuna, sharks, marlins, etc.).

Table 5.4: Bait fish used in pelagic small-scale fisheries using motorized boats.

Estimates based on interviews in eight coastal states of mainland India.

State	Number of vessels in small-scale fisheries	Baitfish used in small-scale fisheries (tonnes / year)		
		Actual	LL	UL
Gujarat	2	1	0	1
Maharashtra	31	6	4	10
Karnataka	46	5	3	7
Kerala	124	48	34	63
Tamil Nadu	102	33	25	46
Andhra Pradesh	386	222	152	345
Orissa	91	25	11	35
West Bengal	36	3	3	5
Total	818	**343**	233	512

5.4 Post-harvest losses

There are also significant discards due to post harvest losses in fishing harbors' and jetties along the Indian coast. Interviews at 36 fishing harbours along east and west coast of India revealed that 1230 tonnes of fish processing wastes such as shrimp and fish heads are discarded every year (*estimates from main fishing harbours only*). Interviews with fishers in small-scale fisheries revealed that as much as 32,000 tonnes (see Table 5.10 for detailed estimates of post-harvest losses in Indian fisheries) is lost through pests and spoilage after landings. Such fish catches are buried in excavated pits or dried and used as manure in agricultural lands or as poultry feed. A couple of hundred tonnes of fish is lost in gillnet catches after landings in sardine and mackerel fisheries, where damaged fish are removed from gillnets after landings; which also includes depredated catch (leftover heads or partially eaten fish discarded at shore). Substantial quantities of post-harvest wastes are also discarded in the artisanal fisheries along fishing villages off both East and West coasts of India. For example, Immanuel *et al*., (2003) report that in Kanyakumari district of Tamil Nadu alone 608 tonnes (25-29% of body parts are discarded) of cuttlefish and squid wastes were discarded each year during 1991-93 period. Interviews revealed that significant losses occur through discards of glut catches during monsoon season (mainly sardines), when excess catches from remote landing centres in small-scale fisheries is discarded due to low market prices. During normal period such excess catch of pelagic fish is sun-dried and then sold in dryfish markets. But, if the monsoon period coincides with glut landings, fish prices go down, so excess catch is discarded as it is not economically viable to sell the fish in fresh fish markets, given the high transportation costs in relation to value of the fish.

5.5 Subsistence fisheries catches

The present study is perhaps the first attempt to quantify the contribution of subsistence catches in Indian marine fisheries, while giving a glimpse of how vital they are to sustenance of fisher communities scattered along the Indian coast. Estimates shown in Tables 5.5, 5.6 and 5.10 suggest that each year, around 6700 tonnes of subsistence catches remains unquantified in Indian marine fisheries. Subsistence catches from mangroves, estuaries and other coastal habitats (See Table 5.6 for detailed estimates) constituted bulk of the unreported subsistence catch at 5200 tonnes, while the remainder 1500 tonnes came from reef based fisheries. Utmost care was taken during interviews to check with local authorities and fishers on whether their catches are assessed by local Governments or Fisheries Departments to avoid double counting. Often, it came to notice during interviews that subsistence fisheries catches are rarely quantified in India, due to low effort, unpredictable nature of fishing operations by season / year, lack of timing associated with fishing and variability of gears used. Interviews with government officials revealed that such catches are never accounted due to shortage of manpower and other reasons cited such as: they are considered as low, due to changing volume of fishers by season and more part-time fishers entering this sector in recent years.

Interviews with fishers is beginning to unravel the true extent of catches from this sector as the survey revealed that traditional subsistence fishers are decreasing, and the existing ones are fishing for more days to compensate for rising food prices, poverty and lack of social security associated with this sector. “Consumption is one known mean of indirectly assessing subsistence fishing” (Coblentz 1997; Leopold *et al*., 2004; Labrosse *et al*., 2006). The present study is also the first attempt to estimate take home catches from subsistence, small-scale, and trawl fisheries in India’s marine fisheries. Consumption of trawler crews at sea was also estimated for the first time through this study.

Globally, subsistence fisheries have been defined and interpreted in different ways depending on the nature, context, harvests, and historical and traditional use of catches associated with this sector (Berkes 1988; Brach *et al*., 2002; King and Faasili 1998; Sharif 1986; Schumann and Macinko 2007). In the current study subsistence fisheries is defined as “*localized fishing in inshore habitats (backwaters, creeks, intertidal areas) using traditional gears like push nets, cast nets, hooks and line etc. primarily for consumption at home and survival on a daily basis, without intention to generate profit or intended for commercial sale purposes”*. Often, subsistence fishers in India engage in fishing on foot without fishing boats, and even the ones that use small dugout/ plank built boats are only able for use them in shallow habitats and can rarely accommodate more than one person and a few kilograms of fish. The under-reporting of catches from mangroves, backwaters and estuaries is often ignored and considered insignificant due to lack of proper records of fisheries and other commercial activities in these habitats (Lakshmi and Rajagopalan 2000; Ronnback 1999; Untawale 1986; Macintosh 1982). Often, molluscan, fish and crustacean catches from mangroves and backwater creeks along the Indian coast are under-reported, as majority of these fishers are unregistered (traditional boats); possess no fishing boats; or fish from shore using fishing nets in waist deep waters using traditional gears like shore seine, drag nets, push nets and cast nets. The present study is an attempt to address under-reporting from this sector and provide a preview of degradation, and displacement of subsistence fishers due to conversion of these habitats for development.

In the rapidly evolving Indian fisheries sector, economic benefits are being afforded more priority over the traditional use and long-term viability of coastal habitats like mangroves, salt marsh and backwaters. In coastal states like Gujarat, Kerala, Orissa and West Bengal, subsistence fishers of estuaries and backwater creeks have been displaced due to lack of property rights over these common pool resources. Often these marginal fishers suffer the most due to development activities, as fishing is the only source of livelihood among these communities. Lack of representation of these communities in both local and state agendas has also made them increasingly vulnerable to exploitation in the labour market. Most of these marginal fishers have stated that the number of people engaged in such activities has decreased in the last two decades due to indiscriminate land reclamation of mangroves and backwaters for industrial development, releasing of effluents leading to decline in catches in adjacent coastal waters (Kutch, Godavari, Vembanad Lake, Hooghly-Matlah estuary). Often fishers in these communities catch fish using traditional gears like traps, set nets and cast nets, which requires immense human effort to catch even a few kilograms of fish in a day. When catches are high, a part of it is sold by women in nearby markets and towns, while any remaining fish are dried for consumption during the lean season. Interviews during the survey revealed that prior to 1990; subsistence fishers engaged in fishing throughout the year, while in recent decades they find it difficult to eke out a living from fishing alone and are increasingly compelled to work as manual daily wage labour in construction, agriculture and aquaculture for certain periods of the year[54]. Often, the level of fishing effort varied by day, month and season. For example, in the state of Orissa and West Bengal, these fishers work in shrimp farms, with income from fishing in lagoons and intertidal waters during afternoon to evening period during summer. In rainy seasons when there is little shrimp farming, these fishers spend the majority of the time fishing, with occasional income from work in paddy fields during certain days. Women work as domestic help during day, drying fish and selling surplus catch in nearby markets in the evening. Women also engage in collecting shellfish for lime industries during certain days in a month. Children from these fishers work in shrimp farms, as crew on fishing boats and shrimp seed collectors.

[54] Subsistence fisheries is also the only sector where I observed more old people engaged in such activities throughout the Indian coastline. Younger fishers hardly considered it as a worthy livelihood source in many coastal states. Most of the other activities in the fisheries sector where more old people were observed included mending of fishing nets and repairing boats.

Table 5.5: Subsistence fish landings from major estuaries, backwaters and mangroves.

Estimates based on interviews in eight coastal states of mainland India.

State	Subsistence catches by location in eight coastal states of mainland India (in tonnes / year)[55]	Total Catch (t)	LL (t)	UL (t)
Gujarat	Kutch (134 t), Jakhau (12 t), Nanalayja (4 t), Mandvi (3 t), Mahi estuary (1.2 t)	184	110	187
Maharashtra	Ulhas estuary (1.6 t), Minor creeks and estuaries (2.1 t)	4	3	10
Karnataka	Mulki estuary (12 t), Netravati-Gurupur estuary (64.2 t), Kali estuary (6.3 t)	82	61	108
Kerala	Cochin backwaters (126 t), Vembanad Lake (82 t), Ashtamudi estuary (14 t), Poonthura estuary (12.6 t), Chettuva estuary (4.6 t), Minor estuaries (124 t)	363	222	520
Tamil Nadu	Pondicherry mangroves (3.2 t), Vellar-Coleroon estuary (143 t), Aralar estuary (0.4 t), Kallar estuary (0.6 t), Muthupet backwaters (23.8 t) Manakkudy estuary (0.6 t), Muttukadu backwaters (9.3 t)	181	150	361
Andhra Pradesh	Nuvvularevu (9.8 t), Godavari estuary (236t), Kandaleru estuary (3.2 t), Krishna estuary (63.1 t), Pulicat Lake (12.6 t),	325	251	568
Orissa	Chilka Lake & Bhitarkanika estuary (838 t), Budhabalang estuary (32 t), Rushikulya estuary (32.6 t)	902	674	1341
West Bengal	Sundarbans[56] (2913.6 t), Hooghly-Matlah estuary (316 t)[57]	3230	1888	3727
	Total	**5241**	**3365**	**6842**

[55] Subsistence catches are harvested from various habitats such as mangroves, backwaters, creeks, and estuaries. Major seafood commodities harvested include crabs, shrimps, fish and molluscs (Data for unreported molluscan catches is provided in Table 5.7). Data in Table 5.10 includes Shrimp Post Larvae harvested in mangroves and estuarine areas.

[56] Preliminary estimates of fresh fish landings only. Dry fish to wet weight conversions are due for many Sundarban wetlands. Such estimates will be published in future studies.

[57] Includes combined estimate of both dry-fish and fresh fish landed for consumption in inland estuarine areas.

In India under-reporting of fish catches can occur at various stages of fish trade from landing centre to retailers. For example during the interviews in 2008, in many small-scale landing centres along the east coast it was revealed that catches were never weighed but sold as lots based on visual grouping of catches, and the catch was never weighed during auction or procurement by fish dealer. Fishermen stated that weighing has never been the criteria, as species in each lot / mounds assumed more or less importance price-wise. Mutual trust and years of tradition in trading catches in this fashion has also meant that fish traders continue to use the same practice even today although weighing facilities are available. This method of quantifying catches can also lead to mis / under-reporting of catches from this small-scale sector. Fishers stated that the whole process of weighing is a time consuming process and due to faster deterioration of catch, hot weather, each person makes more profit by selling catch from one another within shortest possible time as no ice is used for preserving catch in initial stages of landings. The Kerala Govt (2005) report clearly illustrates the problems associated with monitoring brackish water fish landings along the south west coast. Marginal fisheries landings from these coastal towns are rarely monitored as "*there is no organized landing in the brackish water sector and mostly it is being done in their own house or places proximal to markets. The brackish water fishes are directly brought to the markets available in the fringes of these water bodies; however their total number has not so far been enumerated*" (Kerala Government 2005).

Often reef-based fisheries catches are largely ignored or under-reported in global fisheries (MacManus 1996; Munro and Fakahau 1993). India is no exception to this problem as reef fisheries all along the Indian coastline are grossly under-estimated (Rajasuriya *et al.,* 2000) as landing surveys are mostly restricted to fishing harbors and bigger landing centres. Every effort was made to contact village heads, co-operatives and older fishermen who work on beaches to estimate the number of fishers engaged in such activities, nets used and operational days. Major and minor rocky reefs and coral reefs are found all along the Indian coast in Gulf of Kutch, off Goa, Karnataka, Southern Kerala, Tamil Nadu, Central and northern Andhra Pradesh. Often, gear used in these fisheries include cast nets, hooks and line, traps and trammel gill nets operated at depths between 1-10 metres along the coastline.

Reef-based fisheries evaluated in the present study include catches from hook and line, shore seine, cast nets, traps and trammel nets. The first three gears are operated from shore while the latter are deployed at 4-12 fathoms depth in rocky reef areas using catamarans with 1-2 fishing crew. Data on fishing gears was based on data collected from field trip, as actual estimates of number of these fishing gears remain unknown. Coral reefs are found in Gulf of Kutch, Gulf of Mannar, Andaman and Nicobar Islands while fringing and patch reefs are prominent off Karnataka, Kerala and Tamil Nadu coasts. Minor rocky reefs are found off central and north Andhra coast. The average take home catch for reef based fisheries was 0.7 kg / crew member / trammel gillnet / day (2.1 kg/ trammel net /day); while cast nets take home catch per fishermen ranged from 0.1- 4 kg / day; hook and line catch was 0.1 to 0.5 kg/ fishermen / day (31 Respondents). Catches from all four fishing gears were used for consumption at home, with catches during peak periods dried for sale or consumption at home. However, it has come to notice that fishermen sometimes use longer sized trammel gill nets by attaching 2-3 trammel nets during good fishing season. During such seasons, majority of trammel gillnet catch (10-30 kg catch) is sold in nearby markets with some percent of catch retained for home consumption, or given to fellow fishers for use as bait in longline fisheries (See Table 5.6 for detailed state-wise estimates of reef based subsistence catches). It is pertinent to note that with the exception of snappers and shrimps most of the other reef fish have less commercial demand, so they are used as bait fish in the longline artisanal fisheries targeting seer fish, billfish and sharks. Other catches such as fishermen diving for conch shells (for sale to bangle markets in Calcutta) off Tamil Nadu and Andhra Pradesh remain grossly under-reported in national fisheries statistics. Interviews with subsistence fishers in the current study revealed actual extent of shellfish and molluscan fisheries in inshore reefs and backwaters.

Table 5.6: Annual reef based subsistence fish catches along the mainland Indian coast.

State	Total (tonnes / year)	Lower limit	Upper limit
Gujarat	99	68	136
Maharashtra	63	41	84
Karnataka	141	94	212
Kerala	431	326	494
Tamil Nadu	709	642	1024
Andhra Pradesh	73	51	121
Total	**1516**	1222	2071

5.6 Dryfish landings

Drying is an age-old practice for preserving marine fish catches in India. Dry fish are collected and processed at different stages of fish trade. In the mechanised trawl sector, dry fish are landed after each trip, as substantial part of excess catch is dried on the top (roof of the trawler) and landed after each trip (High Grade Dry Fish like Mackerel, Snappers, and Ribbon Fish), with profits from dry fish shared equally among crewmembers and the owners. A certain percentage of trash fish from last 2-3 days of multi-day trawlers is also landed in fishing harbours. This catch is then again sorted by women and dry fish traders (Low Grade Dry Fish); in most cases smaller sized fish and crustaceans with high damage are immediately dried for utilization in poultry and shrimp feed industries. Longliners caught higher percentage of sharks as well as dried shark fins per each trip compared to trawlers along the entire mainland coast. These catches are currently under enumeration and will be published in future work. Estimates from interviews in 2008, reveal that although a certain percentage of dryfish from trawlers in reported to state enumerators, substantial under-reporting occurs, as boat owners are scared about tax implications for such sales. Estimates from 2008 interviews, (See Table 5.9 for state-wise detailed estimates) reveal that every year around 56,000 tonnes of dryfish remain unreported from trawlers and gillnetters in Indian fisheries.

5.7 Glut catches

In the small-scale and subsistence fisheries, the bulk of fish caught is sold for fresh fish markets and exports. During periods of low fish prices, and low market demand, fish are sent for drying as they command a high price later. Other circumstances include landings during glut periods, nights, or at times when markets are closed. Women and marginal fishers also dry fish when they are unable to sell a certain percentage of their catch at the end of the day. Such catch is salted and sun-dried for consumption during rainy season. Dry fish are sold to dry fish traders who frequently visit landing centres, villages and local towns for procurement to fish meal plants / sale in grocery shops in bigger towns. Anchovies, *Acetes* shrimps, sardines, pony fish and smaller fish collected from subsistence gears like drag nets, traps and beach seines are also exclusively used for dry fish trade. In states like Kerala fishers (Respondents: 84, 93, 102, and 106) stated that prior to 1980, catches of sardines and mackerel were buried in earthen pits to be used as manure for coconut plantations. However, in recent years most of it is sold to poultry and fishmeal sector after drying due to high prices.

Information from interviews is valuable in understanding the intricate complexities of these marginal fishers where the whole family is engaged in work, to lead a hand to mouth existence on a daily basis. Estimates of fish catches from these fishers would not only help in understanding catches but also highlight weak local governance, their vulnerability to depleted fish stocks and impacts of urbanization and marginalization of these communities due to destruction of mangroves, coastal creeks and dumping of industrial wastes in shallow backwaters. Utmost care was taken to avoid double counting by counterchecking estimates of fish catches from these fishers by inquiring with village heads, co-operatives and local fishery departments and also to check whether such catches are enumerated by local fisheries department. Often the village heads and community leaders stated that catches from these communities are never quantified, as they are considered insignificant or none.

5.8 Unreported molluscan catches

In the enumeration of molluscan catches from brackish water lagoons, intertidal areas and estuaries, preliminary interviews were conducted with community leaders, followed by interviews with fishers, and shell trade retailers to counter check any gaps in assessment of catches from this sector. Often, molluscan catches are not adequately quantified due to scattered nature of these activities along the Indian coastline. It also came to notice that the

Fisheries Departments often placed more emphasis on management issues related to fuel and vessel subsidies in the trawl sector rather than subsistence fisheries landings. Fisheries Department staff in some coastal states mentioned that they don't have adequate staff or budget to quantify molluscan catches from remote landing centres. In this regard, interviews with stakeholders and village co-operatives twice or thrice a year can yield valuable information on catches from this sector. A wide range of mollusks such as clams, cockles, oysters, mussels and gastropods are exploited in this sector. Until 1990, traditional exploitation of molluscan shells was restricted to production of lime, through collection of dead shells in intertidal and estuarine habitats. Clam and mussel meat was also consumed traditionally in many coastal states such as Karnataka and Kerala, while some meat was used as feed in poultry sector and as manure in agriculture and coconut plantations.

Since the advent of the aquaculture revolution in the nineties, there was a spike in demand for clam meat for feeding shrimp broodstock in tiger shrimp hatcheries along the east coast. A new group of fishers evolved exclusively targeting clams and cockles for meat in these states. Interviews with staff of shrimp hatcheries in Andhra Pradesh and Orissa through phone calls revealed the extent of clam meat used in this sector. Interviews with women in the unorganized clam meat trade in Kerala and Karnataka gave estimate of how many tonnes of clams were harvested in these states. Utmost care was taken to avoid double counting of clam meat catches from landing centres and the meat sold by women traders in the local markets. Fishers reported that clam meat is sold as feed for shrimp farms; preliminary estimates suggest that in Andhra Pradesh and Orissa alone around 100 tonnes of clams are harvested for use as feed in shrimp nursery ponds, although a more detailed survey is necessary to estimate complete extent of catches from this sector. These shrimp hatcheries operate for 6-8 months in a year and largely rely on shrimp broodstock supplied by trawlers for producing shrimp post larvae in enclosed brood stock tanks. Clam meat is fed along with bloodworms and squids during shrimp broodstock maturation. Each hatchery on an average uses 16 kg of clam meat / year (160 kg whole weight), which translates to 144 kg of live clams / year. So, the 260 shrimp hatcheries along east coast of India use around 37.4 tonnes of clams / year. Estimates generated from current study reveal a staggering 42,424 tonnes of molluscan catches landed in India (See table 5.7 for detailed state-wise estimates of unreported Molluscan landings in Indian fisheries). However, the reported catches are only 7234 tonnes in 2004 (Government of India, 2007). The Government of India reports export of clams and mussel meat to foreign countries through the Marine Products Export Development Authority (MPEDA), but no data is available on how this data is sourced from processing plants, resource users or through the State Fisheries Departments.

Table 5.7: Unreported molluscan catches from estuaries, backwaters and creeks in the Indian EEZ.

State	Species / Groups exploited	Location	Clam meat for local human consumption	Total mollusks including dead shells[58] (tonnes)	Mollusk catches[59] (tonnes / year)			Source
					Actual estimate	Lower Limit	Upper Limit	
Orissa	Clams, Cockles, Gastropods	Badapur, Sonapur, Gopalpur, Haripur, Palur	-	437	360	242	536	Panda and Misra (2007)
	Clams, Cockles	Chandipur (406 t), Talsari (14 t)	-	1000	420	348	511	Present Study
Andhra Pradesh	Clams, Cockles, Oysters	Godavari (1680 t), Krishna (430 t), Kandaleru (370 t) estuaries; Pulicat lake (36 t)	-	8650	2516	1823	3088	Present Study
Tamil Nadu	Clams, Cockles, Gastropods	Muttukadu (100 t); Vellar estuary (90 t); Coleroon estuary (16 t)	-	630	206	168	322	Present Study
	Gastropods	Tamil Nadu coast (Trawl landings)	-	-	4245	3689	5320	Present Study
	Gastropods (Chanks)	Gulf of Mannar; South Tamil Nadu coast	4.2	-	430	290	464	Present Study
Kerala	Clams, Cockles, Oysters, Mussels	Ashtamudi estuary (4000 t); Chettuva estuary (160 t); Cochin backwaters (10,200 t)	78	23,000	14360	12672	17264	Present Study

58 Percentage of dead shells vs. live shells depends on location where dead shells are collected from shore / locations where live shells are exclusively collected from intertidal and estuarine shellfish beds.

59 Whole weight catches from live mollusks caught for lime production and clam meat only (does not include catches of clam meat sold to shrimp hatcheries).

State	Species / Groups exploited	Location	Clam meat for local human consumption	Total mollusks including dead shells (tonnes)	Mollusk catches (tonnes / year)			Source
					Actual estimate	Lower Limit	Upper Limit	
Karnataka	Clams, Cockles, Oysters, Mussels	Netravati-Gurupur estuary (140 t); Udayavara estuary (90 t); Kali Estuary (500t)	6 5	8000	730	556	905	Present Study
		Mulki estuary (2000 t)	12	-	2000	2000	2000	Sasikumar *et al*., (2006)
		Aghanashini estuary (16,000 t)	58	22006	16000	16000	16000	Boominathan *et al*., (2008)
Gujarat	Edible oysters, Window pane oysters	Gulf of Kutch	-	-	600	420	684	Present Study
West Bengal	Clams and Gastropods	-	-	-	420	396	528	Present Study
Andhra Pradesh, Orissa	Clams	Clam meat sold to shrimp hatcheries (37 t) and shrimp farms (100 t)[60]	-	-	137	123	346	Present Study
				Total (tonnes)	**42424**	38727 (LL)	47878 (UL)	

5.9 Take home catch of artisanal fishers

The take home catch has never been formally quantified in any of the coastal states and estimates from the present study are perhaps first such estimates for the entire EEZ covering all small-scale fishing fleets. Estimates from interviews in 2008, revealed that small-scale fishers take around 90,000 tonnes of fish for consumption at home each year (See Table 5.8

[60] According to fishermen clam meat is approximately 10% of the total body weight and hence the same conversion was applied for converting clam meat to whole weight utilized in hatcheries.

for detailed estimates state-wise). When catches are plenty, a certain percentage of the take home catch is also given to friends, community elders and unemployed fishers as a goodwill gesture. Some fish are also dried and retained for consumption during monsoon season when fishing activity is low. Export oriented markets (van Mulekom *et al*., 2006) have meant that species that were previously kept for consumption at home are now sold at local and foreign markets, due to high demand. Fishers stated during interviews that some species like sardines, mackerels and anchovies that were dried for consumption at home are rarely consumed now, due to high prices of other food commodities such as rice and pulses, compelling them to sell these fish in local markets. Seafood processing and fishmeal plants, have organized fish collection from small-scale landing centres creating this demand at the expense of food security of these poor coastal communities.

Table 5.8: Artisanal take home catches along the Indian coast.

Estimates based on interviews in eight coastal states during the 2008 field trip to India. Number of fishermen household's data is sourced from Marine Fisheries Census documents - CMFRI (2005).

State	Fishermen households	Average take home catch / trip (kgs/ trip)	Total take home catch / year		Average take home catch (in tonnes)
			LL	UL	
Gujarat	59889	0.6-2.0	2299	6132	4215
Maharashtra	65313	1.2-2.5	4075	8490	6282
Karnataka	30176	1.5-4.2	1357	3802	2579
Kerala	120486	3.2-5.6	12337	29302	20819
Tamil Nadu	203693	0.9-2.6	9166	26480	17823
Andhra Pradesh	129246	1.3-2.6	8400	20679	14539
Orissa	86352	2.1-6.3	7253	21760	14506
West Bengal	53816	3.2-5.6	6544	11452	8998
Total			51431	128097	**89761**

Table 5.9: Unreported catches from mechanised trawlers and gillnetters.

Estimates based on interviews in eight coastal states during the 2008 field trip to India.

State	Crew consumption at Sea[61]			Crew take home catch[62]			Dry-fish landings[63]		
	Average	LL	UL	Average	LL	UL	Average	LL	UL
Gujarat	5871	4227	7515	5167	3288	7045	352	258	470
Maharashtra	2083	1499	2666	1833	1166	2499	125	92	167
Karnataka	1248	1036	1460	323	238	425	37	25	51
Kerala	4796	3700	5892	4385	3151	5892	4659	3426	5892
Tamil Nadu	9061	6758	11365	9829	7372	12287	1597	1167	2273
Andhra Pradesh	2361	1837	2886	1476	1181	1771	44734	32206	57262
Orissa	1355	976	1735	1138	1030	1247	2873	2006	3740
West Bengal	712	475	949	567	501	633	1371	949	1793
Total	**27487**	20507	34468	**24717**	17927	31798	**55748**	40129	71647

61 Crew consumption at sea was calculated in each state by multiplying the total number of trawlers and longliners (X) into amount of fish consumed by crew at sea per trip (X). This figure was in turn multiplied by number of trips per year. Trip duration varied by state from 5-14 days.

62 Crew take-home catch was calculated by estimating the amount of fish catch taken by crew of trawlers and longliners after each fishing trip. A certain percentage of catch was shared among crew members as privileges, meant for consumption at home. The skipper of the vessel decided the amount of fish that would be shared between skipper and the crew. A certain kilograms of catch were also kept for the boat owner. The total take-home catch per boat was multiplied by number of vessels, and this figure which was in turn multiplied by number of trips per year / vessel category to get total take home catch for each coastal state of mainland India.

63 Dry-fish landings were calculated in each state by multiplying total dry-fish landed per boat for each trip. This figure was in turn multiplied by number of trips per year / vessel category to get total take dry-fish landings for each coastal state of mainland India. This catch is grossly under-reported in existing catch statistics of fisheries departments / and the federal government. Fishing crew reported that catch enumerators of the state and central governments seldom did such estimations.

5.10 Why traditional management measures are not working?

Firstly, the notion of Indian fisheries policy makers that allocating fishing rights of territorial waters to artisanal fishers and offshore waters (more than 12 nautical mile) to industrial trawlers is beset with problems for several reasons: 1) the artisanal sector has witnessed a massive expansion of fishing effort from coastal to offshore waters, with diversification in use of new fishing gears, mechanization of traditional craft and increased operational range at Sea; 2) availability of cheap Kerosene from BPL (Below Poverty Level fair price shops) along with subsidized Diesel from State Fisheries Departments means that fishers stay for longer durations until they catch sufficient fish; 3) Fishermen no longer buy fishing nets as they are mostly provided by middlemen who finance fishing trips; 4) Increased mobility of the fishermen allowing them to target diverse fish species in different sections of the coast during different periods of the year; 5) Spike in demand for their landings from industrial firms and processing plants which procure species like pomfrets, seer fish and snappers directly from their landing centres through co-operatives leading to higher prices for their catches than the past; 6) increase in depletion of traditional species, with landings of non-commercial species getting modest prices due to demand in fish meal industry; and 7) increasingly during peak fishing seasons, operations targeting tuna, swordfish and seerfish are financed by middlemen and retailers who buy catch directly from their landing centres, saving transportations costs to markets helping fishers to adapt to high fishing trip costs.

5.11 Conclusion

Through the present study the actual extent of illegal and unreported catches from both commercial trawl and small-scale fisheries was estimated using data collected from 200 plus interviews in India. The study revealed that unreported catches in India's marine fisheries is around 1.5 million tonnes every year with lower and upper limits of 1.1 to 1.9 million tonnes. Detailed breakup of unreported catches from various sectors is provided in Table 5.6. The latest fish statistics reported to FAO for the year 2008 show that total reported catches were around 2.38 million tonnes. So, if we account for unreported catches from the current study during the same year, the total catch would reach a staggering 3.8 million tonnes (Unreported catches of IUU), of which around 1.2 million tonnes remains unaccounted through discards alone. Along the mainland Indian EEZ itself 287,000 tonnes of marine fish catches remain unreported from mechanised and small-scale fisheries each year with a lower and upper range of 210,000 to 374,000 tonnes.

Table 5.10: Unreported catches quantified from 2008 Indian field trip in the mainland EEZ.

Estimates based on interviews in eight coastal states during the 2008 field trip to India.

Unreported catches categories	**Total**	**Lower Limit**	**Upper Limit**
Unreported Molluscan Catches	42424	38727	47878
Discards (Chartered deep-sea tuna longliners)	1800	1420	2160
Discards (Domestic Fishing Trawlers and Fishing Boats)	1217931	924974	1510893
Trawlers (Fish consumption at Sea)	27487	20507	34468
Trawlers (Crew take-home catch)	24717	17927	31798
Subsistence catches (Mangroves, backwaters, estuaries)	5241	3365	6842
Reef based subsistence fish catches	1516	1222	2071
Bait fish catches	4305	3154	5609
Artisanal Fisheries take home catch	89761	51431	128097
Fish gleaning at landing centres	2175	1364	2986
Dry fish landings	55748	40129	71647
Post-Harvest Losses	33660	32000	42600
Total (in tonnes)	**1506765**	1136220	1887049

Small-scale fishers all along the mainland coast stated that displacement of fishers has increased during the last decade due to industrial development, pollution and formation of new anoxic dead zones in coastal waters (where fishers could no longer catch fish largely due to dumping of sewage and industrial wastes, release of hot water effluents from thermal power plants in coastal waters and creeks). Small-scale fishermen stated that to compensate for decreasing catches they are using more nets, going further and staying for more days at sea. Another noticeable change according to small-scale fishermen was that more crew works on each vessel, so the profit from each trip is reduced, as the bulk of revenue from each trip is paid to agent who funded the trip, fuel costs and fishing gear. Incomes have declined for fishermen in all coastal states, as fishers earn half the amount of money that they used to earn 10 years ago. This is due to two reasons. More crew on each boat means that the share per person is less; more time at sea means average income per day is less, and bulk of profit from trip is paid to moneylenders due to indebtedness. Throughout the Indian coast, fishermen reported that younger age classes are dominant in fish catches as smaller mesh sized nets are used in increasing numbers. This has direct implication on their profits as smaller sized fish fetch a lower price, deteriorate faster before reaching landing centres, and are only used in fish meal and dry fish sector.

In the mechanised trawl sector, depletion of local fish stocks has led to migration of crew to other coastal states where they face more risks. For example, during interviews with fishing crew working on trawlers in Gujarat and Maharashtra, it was revealed that most of the crew working on trawlers nowadays is sourced from distant states like Andhra Pradesh and Orissa. This has contributed to decrease in wages for trawler crew in Gujarat, as crews from other states are employed on a daily wage basis. In the past local crew from Gujarat working on trawlers used to get certain percentage of profit from each trip, which as stopped since the advent of daily wage system. So, increasingly local crew are reluctant to take the risks to work on trawlers, while trawler crew from Andhra Pradesh are ready to take the risks as they don't have alternate employment in their home state. So, overfishing in one state is fueling displacement and conflict with fishers from other state due to migration.

Enforcement of mesh size regulations is dismal in all states; with Fisheries Departments in all maritime state's being ill equipped to carry out surveillance or implementation of regulatory measures. Lack of will to implement existing regulations and poor planning was also evident in all coastal states with blatant violations of gear and fleet regulations. For example, artisanal fishermen in Kerala were of the opinion that every year a narrow stretch of waters between Alleppey and Neendakhara constitutes the breeding ground for the bulk of shrimps caught in the state. But the state has not protected even one quarter of this area from trawlers. Subsistence fishermen in this section of the coast state that they are not left with any other avenue except using smaller sized gillnets to catch juveniles, as larger fish are getting scarce in gillnet catches in recent years. Traditional fishermen in Kerala are also to blame for the decline of fish catches as they have allowed operation of smaller meshed ring seines which catch 0 and 1 size classes of sardines and mackerels in more numbers every year.

Interviews with fishers revealed that unreported catches from unregulated or unlicensed fishing boats in both artisanal and industrial sectors are not quantified or accounted for in the present reported Indian catch statistics. Previous studies have also thrown light on similar problems in estimates of fishing crafts taken from various state fisheries departments (Malhotra and Sinha 2007). Fish bartered at sea is substantially less now compared to earlier years. I undertook a similar survey of trawl fisheries on the northeast coast of Bay of Bengal in 2003-04 (Pramod 2005), when trawler crews used to barter approximately 10-20 kg of fish in each trip at sea in exchange for groceries and alcohol. Presently, only 2-5 kg is bartered for a 10-day trip. This decrease is mainly to compensate for the increase in fuel and trip costs in recent years.

5.12 Chapter 5 summary

Developing countries with vast coastlines and meager patrolling assets are usually confounded with the problem of monitoring landings from multiple fisheries in remote locations. Under-reporting of small-scale catches has also been a huge problem in developing countries (Pitcher *et al*., 2002; Guénette *et al*., 2006; Pauly 2006; Mills *et al.,* 2011) and India is no exception to this problem. The dispersed nature of fishing activities and weak institutional capacity have been cited as major reasons for under-reporting in small-scale fisheries of the developing world (de Graaf *et al*., 2011). Reliability of subsistence catch estimates can be improved using fish consumption data (World Bank 2010). In chapter 5, a detailed estimation of underreported catches from small-scale fisheries and commercial trawl sectors was done to provide an overview of unreported catches from the Indian EEZ.

In the current analysis a detailed estimation of each gear sector was undertaken to check for unreported catches from India's EEZ. In the trawl sector fish consumption at sea was 27,000 tonnes per year and the trawl crew take home catch was 24,700 tonnes per year (estimated through interviews at major fishing ports in 2008). Conservative estimates of small-scale fisheries revealed that 287,000 tonnes of catches remain unreported in this sector (which included take home catch of small-scale fishers: 90,000 tonnes; Reef based subsistence catches: 1516 tonnes; Landings in shallow creeks, estuaries and backwaters: 5241 tonnes; Bait fish used in hook and longline fisheries: 4300 tonnes; Unreported molluscan landings: 42,000 tonnes; Post-harvest losses: 33,000 tonnes). Discards from trawl and small-scale fisheries were around 1.2 million tonnes alluding to gravity of under-reporting in this sector. This is perhaps the first attempt to quantify unreported catches from marine fisheries in Indian waters. Significant improvement in reporting of small-scale landings centres could take place by handing over such responsibilities to fisheries co-operatives along the Indian coast.

It is pertinent to highlight that interviews with small-scale fishers during the IUU field trip to India in 2008, also gave valuable information on marginalization of fishers and how decline of fish catches has affected fish communities over the last six decades. Figure 5.1 illustrates the problems from their perspective. Interviews revealed that during the first two decades (1950-70) catches were good throughout the year; but with massive vessel, fuel subsidies and construction of new trawlers on a massive scale, catches declined for artisanal fishers due to increased incursions of trawlers for shrimps leading to dumping of massive quantities of fish and destroying inshore breeding and nursery grounds. During 1970-1980 period, as catches declined small-scale fishers were provided loans for installing outboard engines and buying bigger FRP boats for fishing farther from shore. In the last two decades, with decreasing catches are good on a seasonal basis, leading to migration of fishers from Central east coast to Andaman islands to make a living there, as catches are relatively good and under-exploited in Andaman islands. However, the cycle of poverty does not stop for fishers, as market prices for fish are very low in Andaman Islands due to low demand and high cost of living in the islands.

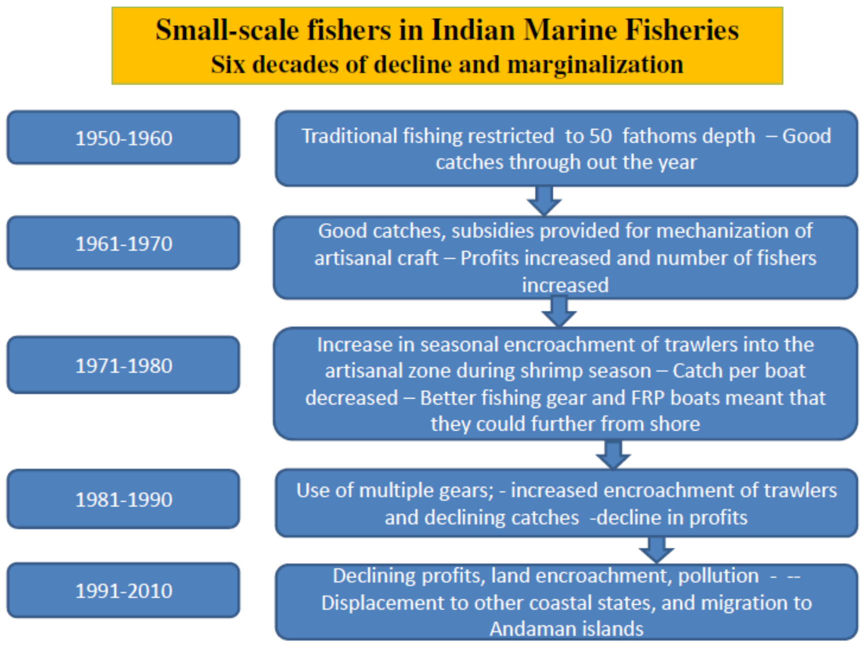

Figure 5.1: Information from IUU interviews in 2008 showing displacement of Indian fishers due to overfishing.

(See section 5.11 for detailed explanation).

Chapter 6: Illegal and unreported fish catches in the Andaman and Nicobar Islands

6.1 Introduction

The Andaman and Nicobar (A & N) Islands are one of the two overseas island territories administered through a Lt. Governor appointed by Government of India (other is the Lakshadweep islands in the Arabian Sea). With 572 islands and 1912 km coastline, a diverse range of marine habitats from fringing coral reefs and atolls to mangroves and tidal creeks are found on these islands (Anon 2008e; Ramesh *et al*., 2010). Pelagic fish resources are largely unexploited as only 39 of the 349 islands are inhabited and even among these around 34 per cent of forested area is inhabited by five indigenous tribes (Great Andamanese, Shompen, Sentinelese, Jarawa, Onge), who are the earliest known inhabitants of these islands (Anon 2004e; Anon 2008e). The islands also stand out in contrast to coastal states of mainland India as they have the highest ownership of fishing boat and gears among fisherfolk (90% of fishers own their boats) (Pramod 2008). Limited human presence allows Burmese poachers to regularly sneak into these remote islands and poach for sea cucumbers, trochus shells, corals and wildlife. With a population of 379,944 (Census of India, 2011 website) and the arrival of new immigrants from mainland (India) every year, natural resources in the islands have also been subjected to tremendous domestic pressure through illegal fishing, encroachment into forest land, wildlife hunting and displacement of indigenous tribes (Pramod 2008). Prior to 1940s there was no organised fishing activity as indigenous tribes were mostly hunter-gatherer societies, with fish forming a minor part of their subsistence needs (Pramod 2008; Rajamanickam 1997). After India's independence in 1947, the

Government of India initiated an organised fishing sector in the A&N islands by relocating fishers from West Bengal, Andhra Pradesh, Tamil Nadu and Kerala through a settlement scheme, with other fishermen moving on their own in recent years (Pramod 2008).

This chapter sets out various categories of illegal and unreported fish catches that were estimated through interviews in Andaman & Nicobar Islands. The chapter begins with an explanation of various fisheries laws that regulate fishing activities in the islands. Next, an explanation of monitoring control and surveillance assets in the islands is provided to identify drivers of illegal fishing in the islands. This is followed by an explanation of poaching activities by domestic and foreign fishing vessels in the islands. Illegal catches estimated in the chapter include (a) illegal finfish catches of domestic and foreign fishing vessels in the A&N islands EEZ (b) illegal sea cucumber catches taken by foreign fishing vessels; and (c) illegal trochus catches taken by foreign fishing boats in the A&N islands. Various unreported catch categories discussed in the current chapter include (i) Sea shell catches for ornamental trade (ii) Fish consumption among indigenous tribes (iii) Fish sold directly to tourist hotels and resorts (iv) Take home catches of domestic fishers of Indian origin (Most of domestic fishers in the islands have been relocated from mainland Indian states of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu) to encourage fisheries development in the Andaman & Nicobar islands.

A detailed explanation of various illegal and unreported catch categories is given in Chapter 4 (see section 4.2, pages 82 to 84). Interview methodology and preview of study areas is also provided in Chapter 4 (Section 4.3, pages 86 to 88).

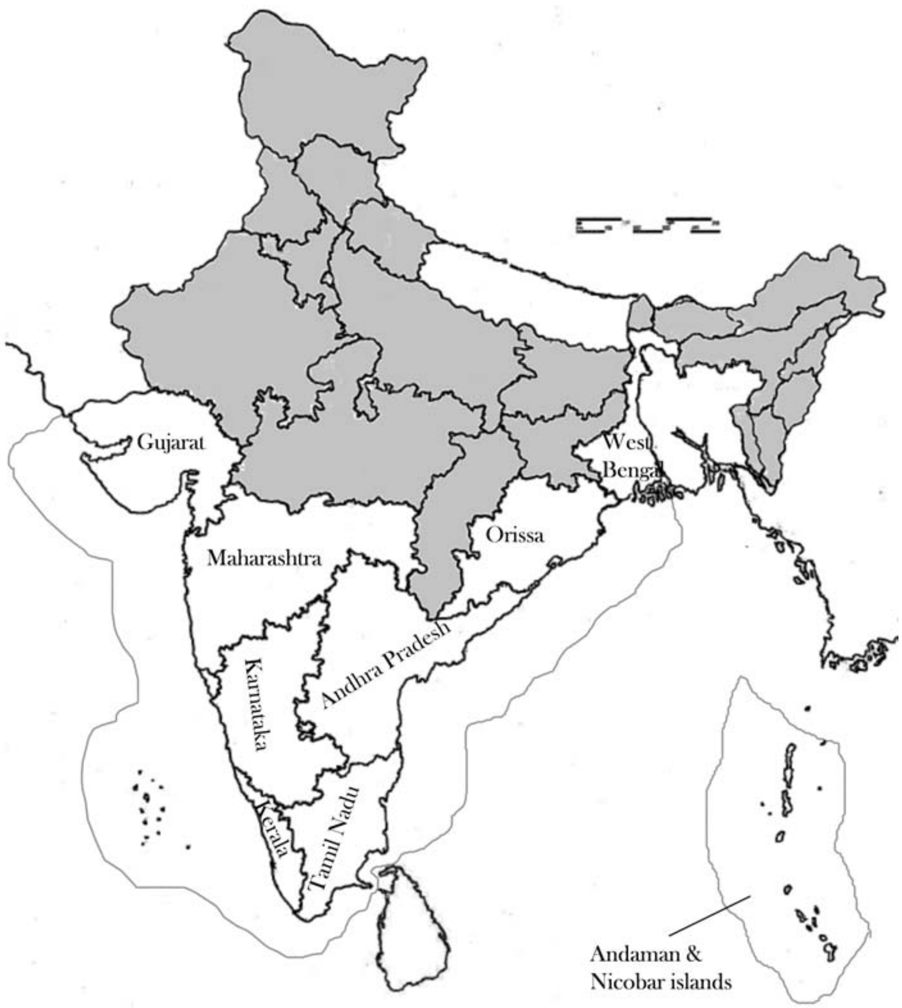

Figure 6.1: Map showing mainland India and its island territories.

Map showing nine coastal states and offshore islands (Andaman and Nicobar Islands). Grey line outside the map represents the EEZ boundary. Image Source: (Hand drawn: Pramod Ganapathiraju). Image not to scale.

6.2 Interview methodology

Interviews through a questionnaire helped to determine the total percentage of illegal and unreported catch in the Andaman and Nicobar Islands. Please refer to interview methodology in Chapter 4 for more information (Section 4.3, pages 86 to 88). Interviews in A&N islands revealed that there is under-reporting of catches by domestic Indian vessels. Respondents (196,199, 201 and 202) stated that the government staff rarely come to landing centres to collect fish landings data, instead the fishers are handed paper forms to fill catch data whenever they go to department offices to renew their fishing boat licenses. This leads to submission of catch data that is both erroneous and flawed as assigning random catches for various fish species leads to under-reporting of catch data. Fisheries Department staff in the islands failed to respond to our inquiries regarding the collection of catch data.

6.3 Monitoring control and surveillance in Andaman and Nicobar Islands

The Indian Coast Guard (ICG) is the primary monitoring agency responsible for control and scrutiny of fishing vessels operating within the Indian Exclusive Economic Zone (EEZ). It is also responsible for boarding and inspection of domestic and foreign deep-sea vessels operating under charter agreements within the Indian EEZ (Indian Coast Guard, 2009). The Maritime Zones of India Act, 1976 and the Coast Guard Act, 1978 give ICG exclusive rights for inspection, protection and management of living and non-living resources within the Indian EEZ. The Andaman and Nicobar Command of Indian Coast Guard is modestly equipped for patrolling the A& N islands.

Remoteness of the islands coupled with sparse population give rise to immense monitoring problems for the A&N Administration, Police and the Indian Coast Guard[64]. In the first two

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[64] The Indian Coast Guard has three Fast Patrol Ships (ICGS *Akka Devi*, ICGS *Lakshmi Bhai*), with the induction of ICGS "*Durgabhai Deshmukh*" in March 2009 (Anon 2009f). The Coast Guard base in Port Blair also received an advanced offshore patrol vessel '*Sankalp*" on May 5, 2009. The vessel has an endurance limit of 6500 nautical miles, can operate for 25 days without replenishment at sea and is designed to carry one twin engine ALH helicopter and five high speed boats during maritime patrols (Anon 2009g). The Diglipur base of

decades after independence from 1950-1970, the Indian Navy had a minimal presence in the islands due to shortage of patrol vessels[65] and infrastructure for patrolling the vast coastline (Anon, *pers. Comm.* 2008). The transfer of surveillance duties from Indian Navy to the Coast Guard in late seventies paved way for a more rigorous patrolling and enforcement in the islands (Anon, *pers. comm.* 2008; Pramod 2008). To confront growing influence of China in Burmese territory, off Coco islands (North of Andaman Islands) from the year 2000 onwards the Indian Government increased its naval presence in the A&N islands (Das 2010; Anon,

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northern Andaman's received a high-speed interceptor boat (ICGS C-140) on July 12, 2009, which will substantially improve surveillance capabilities of Coast Guard fleet in this region (Anon 2009h). Coast Guard's enforcement in A&N Islands EEZ is also enhanced through 2 fixed wing aircrafts and 2 helicopters for patrolling 1912 km coastline (Anon 2009f). With 600,000 km of EEZ area (29.4% of Indian EEZ), the Coast Guard's patrolling abilities are clearly overstretched in the Andaman and Nicobar Islands (Anon 2008e).

[65] In 1984, Coast Guard's aerial surveillance capability was constrained as only one Fokker aircraft operated from Calcutta to monitor the entire East coast (Mohan 1984). In 1995, the ICG had four inshore patrol vessels and 2 fixed wing aircraft (Anon 1995). During 1999, Coast Guard had 3 inshore patrol vessels, one offshore patrol vessel (Anon 1999). In 2002, they had one offshore patrol vessel, two fast patrol boats, 3 inland patrol vessels, 1 Dornier aircraft and 1 Chetak helicopter. By 2007, the Coast Guard's patrolling assets in A&N Islands included 1 offshore patrol vessel, 2 fast patrol vessels, 3 inshore patrol vessels, 2 fixed-wing Dornier aircraft and 1 Chetak helicopter (Murthy 2007). Recently, the Police Marine Force (PMF) of the A & N Police received four Fast Interceptor Boats. Each interceptor boat has a speed of 35 knots per hour even with full load and will be deployed at Diglipur, Campbell Bay, Hut Bay and South Andaman (Anon 2010i). The Indian Naval ships, INS *Tarasa* and INS *Battimalv* have also assisted in the surveillance and apprehension of foreign fishing vessels in the islands' waters in recent years on an intermittent basis.

pers. comm. 2008). Since its inception in early 1950s, the Andaman and Nicobar Marine Police has also grown in strength with inception of its own patrol fleet in the last decade (although the Marine Police did not have a single patrol boat until 2002) for safeguarding shallow water creeks, inland waters and strategic points of far flung islands (Pramod 2008). Until 2002, the Marine Police used local fishing boats for patrolling operations, with such operations constrained by daylight, speed of local fishing boats and location of fishing villages. Often such missions were conducted using smaller fishing boats and restricted to shallow waters in the vicinity of police outposts (Pramod 2008).

6.4 Fisheries regulations in the Andaman and Nicobar Islands

Important fisheries regulations in Andaman and Nicobar Islands include: The Andaman and Nicobar Fishing Rules 1939 (Anon 1939); The Andaman and Nicobar Islands Marine Fishing Regulation 2003 (Anon 2004d); and the Andaman and Nicobar Islands Shell Fishing Rules 1978 (Anon 1979). Under the Andaman and Nicobar Islands Marine Fishing Regulation 2003, coastal waters are divided into two zones for fisheries activities. Zone A is exclusively allocated for motorised and non-motorised boats and extends up to 6 nautical miles from the baseline (the 0-6 nautical mile zone is allocated for fishing vessels fitted with engine power of less than 30 HP and non-motorised dinghies without engine). Fishing by mechanised trawlers is banned in Zone A. Fishing in creeks is also banned in this zone as per this advisory. Mechanised trawlers are allowed to fish in Zone B, which extends beyond 6 nautical miles from the baseline (Fishing vessels fitted with more than 30 HP are only allowed to fish between 6 and 12 nautical miles from the baseline). Under Section 17(a)(i) of the Andaman and Nicobar Islands Marine Fishing Rules, 2004, closed Season is implemented for trawlers and shark fishing from April 15 to May 31 every year. Shark fin traders are required to provide a declaration of their stock and get it inspected through the Fisheries Administration before the start of the ban period by April 15 every year (Pramod 2008).

Turban shell (*Turbo marmoratus*), five-finger chank (*Lambis lambis*), scorpion shell (*L. chiragra*), cowries (*Cypraea sp*.) and pearly nautilus (*Nautilus sp.*) are the principal species collected by licensed shellfish fishers within A&N Islands (Pramod 2008). The Island's waters have been demarcated into 9 shellfish zones and each zone is auctioned and leased to the highest bidder for a two-year period (Pramod 2008). Interviews with shellfish traders in Andaman Islands revealed that licensed fishers in the islands land around 500 tonnes of shells, which is never reported in national fisheries statistics (Pramod 2008). Exploitation of Top shell (*Trochus niloticus*) and Sea Cucumbers (*Holothuria sp.*) is banned in Andaman and Nicobar Islands as they are classified as endangered under Schedule IV (*Trochus sp.*) and Schedule I (Sea cucumbers) of the Wildlife Protection Act, 1972 (James 2001; Anon 2003). Under Section 3 (ii) of the Andaman and Nicobar Shell Fishing Rules, 1978, a closed Season is also implemented for shellfish extraction every year from May 1 to September 30 (Anon 1979).

6.5 Nature of poaching activities in Andaman and Nicobar waters

Foreign poachers target a wide variety of fish and invertebrates in the Andaman and Nicobar islands. Burmese target sea cucumbers, Trochus shells, and corals; Thai boats target reef fish, tuna, sharks, ornamental fish and sea cucumbers; Sri Lankan and Taiwanese vessels target yellowfin tuna and sharks; and Indonesian boats target sharks. From 1980-1999, Burmese trawlers were frequently observed fishing in the northern Andaman islands, but due to increasing enforcement by Coast Guard, since late nineties Burmese vessels have been observed poaching further south as far as Tilanchang and Kamorta off Nicobar islands (Pramod 2008). Burmese poachers have also set up settlements in these islands threatening many wildlife species as they often target Trochus and sea cucumbers, but also decimate wildlife (birds, deer, crocodiles) of islands before moving to other islands (Pramod 2008). Crocodile skins can be sold for as much as US$ 20,000, while sea cucumbers can fetch up to 100$ a kilo in Thailand. If their presence is not detected, they continue operations on these islands with impunity for days together leading to immense destruction of wildlife (Pramod 2008). Coast Guard, Andaman and Nicobar Police and Indian Reserve Battalion Force conduct regular patrols to spot and destroy these camps and apprehended poachers are taken to Port Blair for judicial proceedings (Pramod 2008). However, Coast Guard and the A&N Police often face a daunting task searching for poaching activities in a vast maritime area (Das 2010). As one official noted, "*When you are patrolling at sea, chances of apprehending Burmese poachers are high but when you have to look for poacher camps in remote islands with dense forests, it is as hard as looking for a needle in a haystack*" (Respondent: 199). Often, data from aerial patrols and information provided by local fishers is conveyed to surface units for physical interception and arrest of poachers (Pramod 2008). Current threats to fishery resources arise from Burmese fishing boats targeting shellfish in coastal waters, while offshore fishery resources are under threat from Thai and Indonesian trawlers (Murthy 2007).

Interviews in 2008 revealed the extent of poaching by Burmese and Thai fishing boats in the islands. "*During the last two decades we have increasingly seen that Burmese poachers use smaller boats that sneak in at nights and set up camps in remote uninhabited islands, they sneak in from Coco Islands in the north where a supposedly mother boat provides supplies for each trip. While off South Andaman and Nicobar islands, Thai boats that are much bigger, come with more supplies such as onboard compressors and diving equipment for poaching sea cucumbers on 5-10 day trips and they have been occasionally found to set up camps in the islands. Fishermen have also reported witnessing Indonesian fishing boats targeting sharks in Nicobar Islands. The apprehension rate for Burmese boats varied from 5-10 per cent during nineties and 10-20 percent in recent decades. The Coast Guard has increased number of patrols as well as regular operations to apprehend these poachers. This year (2008) they have apprehended up to 25 per cent of the poaching boats from Burma"* (Respondent: 193). Reports from other sources also substantiate this information on the extent of foreign fishing vessels arrested by Coast Guard and Police within the Island's EEZ (Suri 2001; Roy 2007).

6.5.1 Extent of poaching by foreign fishing vessels

Existing literature (Kakar 1989; Sharma 1991) and interviews during 2008 revealed that poaching of fish and shellfish was at its peak from 1960-1980. According to interviews, in the mid-eighties after a series of arrests of Taiwanese and Thai trawlers by the Coast Guard, poaching decreased in offshore waters, but Burmese and Thai trawlers continued to poach in northern waters, while Thai and Indonesian boats brazenly fished in Nicobar waters where patrolling was less pronounced (Pramod 2008). Patrolling vessels often found it difficult to control poaching as they had very few vessels, and poachers often sneaked in and out of the EEZ with impunity (Pramod 2008). Moreover, according to local officials some of the arrested Thai and Taiwanese illegal fishing trawlers had sophisticated radar to detect patrol vessels as far as 50 km away often leading to evasion tactics to avoid apprehension (Pramod 2008). According to one local official "*during the seventies and eighties, for every one Thai and Taiwanese trawler we arrested around 10 to 20 managed to get away*" (Respondent: 196). Since the late nineties active pursuit of poachers and series of successful apprehensions by Coast Guard has sent a strong signal to poachers and most big foreign trawlers have kept away from the Indian EEZ with occasional EEZ incursions observed off Nicobar Islands in recent years (Anon, *pers. comm*. 2008; Pramod 2008). The issue of security in Andaman and Nicobar Islands received a boost after the visit of Indian Home Minister to the Islands in 2001, where he aptly stated, "*Poaching is an economic issue, but soon it could turn into a security issue*" (Suri 2001).

After setting up a permanent Coast Guard base in Port Blair, two additional bases were set up by the Coast Guard, one in Diglipur (North Andaman) and another one in 2010 in Campbell Bay, (Nicobar Islands) in recent decades (Pramod 2008). This has sent a very strong signal, and poaching by big trawlers has declined in the last decade, thanks to increasing fleet strength of Coast guard and presence of Indian Reserve Battalion (IRBn) in the remote islands to provide intelligence and assist Andaman Marine Police (Pramod 2008). Majority of Burmese boat interceptions have been successful in recent years as joint operations with all four surveillance agencies is making it difficult for poachers to escape. In the past, poachers often sneaked into numerous shallow creeks on being sighted by Coast Guard, but in recent years, aerial patrol data is passed to nearest Coast Guard ships, A & N Marine Police and IRBn force for active pursuit of poachers even into shallow creeks as the Police and IRBn have the necessary manpower to engage in combing operations inside creeks and forests to destroy camps and arrest poachers (Pramod 2008). Coast Guard's efforts at sea are also constrained by wooden boats used by Burmese poachers, which are not easy to identify as they have very low physical profile, and small heat signature, which make them difficult to identify on the patrol ship's radar. Topography of the land is also affecting apprehension of poachers as majority of fishers and active human population is located on the Eastern side of the Andaman Islands, leaving the western side exposed to poachers (Respondent: 199, 201, 202).

6.5.2 Incentives for domestic Indian poachers in the islands

Nearly one fourth of cultivable land in the islands was damaged during the 2004 Tsunami. Although the majority of land loss occurred in Nicobar Islands, nearly 2000 hectares of land was submerged due to seawater ingress in Andaman Islands (Pramod 2008). The loss of agricultural land (Subsidence in Nicobar islands and uplift by nearly in one metre in Andaman Islands (Chia *et al.,* 2005), and subsequent increase in food prices has led to more fish consumption in recent years, as fish are cheap compared to other food commodities in the Islands. In this context, it is important to note that majority of food commodities are very expensive in the islands as they are imported from Mainland India (Pramod 2008). Demand for fish has also increased due to spike in number of tourists visiting Andaman Islands from mainland India (See Figure 6.2 for more information).

Indian registered mechanised fishing boats, which are only licensed, to fish in Zone B (beyond 6 nautical miles from baseline) have been reported illegally fishing in Zone A, adversely affecting catches of motorised and non-motorised fishing crafts (Respondents: 198, 200, 201). Since 2009, local poachers have been caught transferring corals, trochus and sea cucumbers to Burmese boats off northern Andaman's alluding to a new nexus between Burmese poachers and local trochus smugglers (Anon 2009i; Anon 2010j; Anon 2010k). Local poachers collect trochus shells illegally from the Andaman Islands, and then contact Burmese poachers, who send boats to smuggle the shells from the islands (Anon 2010j). Details of illegally collected trochus shells and sea cucumbers confiscated from Indian poachers in Andaman and Nicobar Islands are given in Table 6.3.

6.6 Estimation of illegal fish catches in the Andaman and Nicobar islands

Data from government reports and interviews conducted by the author in 2008 provide estimates of illegal fishing boats operating in Andaman and Nicobar waters (Pramod 2008). Illegal Foreign fishing vessels target a wide variety of fish and invertebrates in the islands. Burmese boats target sea cucumber and trochus; Indonesian boats target sharks for the fin trade; Thai boats target sea cucumbers and ornamental fish in Nicobar waters, while the bigger Thai trawlers target snappers and tuna in offshore waters; Sri Lankan longliners target yellowfin tuna and sharks; Taiwanese trawlers target reef fish, tuna and sharks.

Illegal fishing vessels arrested each year were divided into three categories a) *Finfish vessels* (illegal catch from trawlers – by respective flag); b) *Trochus vessels* (illegal boats from Burma and Thailand); c) *Sea Cucumber boats* (illegal boats from Burma). The number of illegal fishing vessels by respective flag was divided into average illegal catch found onboard the apprehended IUU fishing vessels to calculate total illegal catch for each category. The totals for illegal catch / year were then estimated by adding illegal catch from the above three vessel categories. The upper and lower bounds for the estimates were derived from interviews in the 2008 survey. Interviews with Respondents 196, 198, 200, 201, 202 provided anchor points for number of vessels observed poaching and not apprehended during three decades from 1980-2000.

6.7 Unreported domestic catches in Andaman & Nicobar Islands

6.7.1.1 Sea shell fisheries in Andaman and Nicobar waters

Although, sea shell fishing has been existent in islands since early 1920's, and is licensed by the local Fisheries Administration, none of the gastropod catches (sea shells) are reported in existing government reports (Government of India Handbook on Fisheries Statistics). In 2008, around 36 units were licensed for a period of two years for collection and sale of seashells excluding the ones listed in scheduled IV of Wildlife Protection Act 1972. Shellfish units are required to maintain records by species of the quantities of shells harvested for inspection prior to sale and export to mainland. According to traders in the Andaman Islands licensed fishers in the islands land around 700 tonnes of shells; however none of these figures are reported in existing government catch statistics (Respondents: 196, 198, 201). According to local sources in Port Blair (Respondents: 189,194 and 198) several units continue to operate illegally, collect banned species (Trochus) and smuggle the catches from the islands through Burmese and other avenues. Several people involved in smuggling shells to the Indian mainland have also been caught at ports, but the practice continues unabated due to scattered nature of the shellfish extraction and growing nexus between foreign poachers and local communities (Respondent: 196).

6.7.1.2 Fish consumption among indigenous tribes

Domestic catches of the five indigenous tribes have also been traditionally unaccounted due to lack of information on their fishing activities. A conservative estimate of their fishing catches was computed using available literature (Sarkar 1993; Rajamanickam 1997; Mishra 2005) and information gathered from NGO's in the 2008 field trip to the Andaman Islands (Pramod 2008). The average fish consumption per household was multiplied with the number of fishing days to get total fish consumption per tribe per year (Table 6.1).

The Great Andamanese are a hunter-gatherer-fisher society restricted to Strait Island where only 25 individuals remain (Venkateshwar 1999). The Onge catch prawns and fish and even use dugout canoes to fish in inshore creeks and shallow waters (Venkateshwar 1999; Venkateshwar 2004). The Nicobarese tribes are restricted to Car Nicobar, Kamorta and Katchal islands (Gupta *et al*., 2004) and are known to engage in subsistence fishing. The Shompens number 250 and are only found on Great Nicobar Island and engage in fishing throughout the year using dugout canoes which can carry 2-7 persons (Sharief and Rao 2007; Arora 2010). The Jarawa tribe is perhaps the only tribe having the highest population among the five tribes and engages in collection of molluscs and fish in shallow intertidal zones (UNESCO 2010). Some of the marine resources consumed by Jarawa include fish, turtle, crabs (*Sesarma* sp.), prawns (*Metapenaeus* sp.), *Turbo* sp. and *Trochus niloticus* (Trochus shells) (UNESCO 2010). It is interesting to note that when men are away on hunting trips and when there is shortage of food; women rely on molluscs as major source of animal protein in Jarawa communities (UNESCO 2010; Pramod 2008). Jarawa men use bow and arrow to shoot fish, while molluscs and other shells are collected by women and children with bare hands, with both men and women relying on shellfish and fish (~37% of daily animal protein) while camping in coastal areas (UNESCO 2010). Nicobarese tribes are reported to use dugout canoes to catch fish, octopus and crabs (Sivakumar and Rajamanickam 1999). Shompe and Onge tribes are also reported to rely on fish and shellfish for their subsistence needs (Venkateshwar 2004; Patnaik 2006; Reddy *et al*., 1987).

Table 6.1: Estimates of fish consumption by indigenous tribes in Andaman and Nicobar Islands. Sources of information were FSI (2006); Andaman and Nicobar Islands Administration, Port Blair; and information collected through interviews in 2008.

Tribe	**Jarawa**	**Onge**	**Shompen**	**Sentinelese**	**Great Andamanese**	**Nicobarese**	**Total**
Fish and Shellfish consumption (in tonnes)[66]	184 (96 - 204)	24 (18-26)	160 (104-174)	22 (20-46)	2.1 (2-6)	1300 (986-1420)	1692 (1226-1876)
Population[67]	241	103	212	100	25	30000	30678
Location	Middle and South Andaman	Little Andaman, Rutland Island	Great Nicobar island	Sentinel island	Strait Island	Car Nicobar Island	Andaman & Nicobar islands

6.7.1.3 Consumption of fish in tourist resorts and local hotels

Several sport fishing charters also operate 3-5 day trips from Port Blair, and although the majority has a catch and release policy, a certain quantity of fish is kept for consumption

[66] Upper and lower limits of the unreported catch, calculated from interviews in 2008 are given in brackets.

[67] Source: Department of Information, Publicity and Tourism, ANI Administration, Port Blair, 2008

after each trip (Pramod 2008). There are 179 places to stay for tourists visiting Andaman Islands (private hotels and resorts – 157; Government Guest Accommodation – 22: Source- Andaman and Nicobar Administration 2010). Nine interviews conducted with fishermen supplying private hotels and resorts in Port Blair revealed that annually around 1023 t of fish and other seafood products are sold to resorts directly (Pramod 2008).

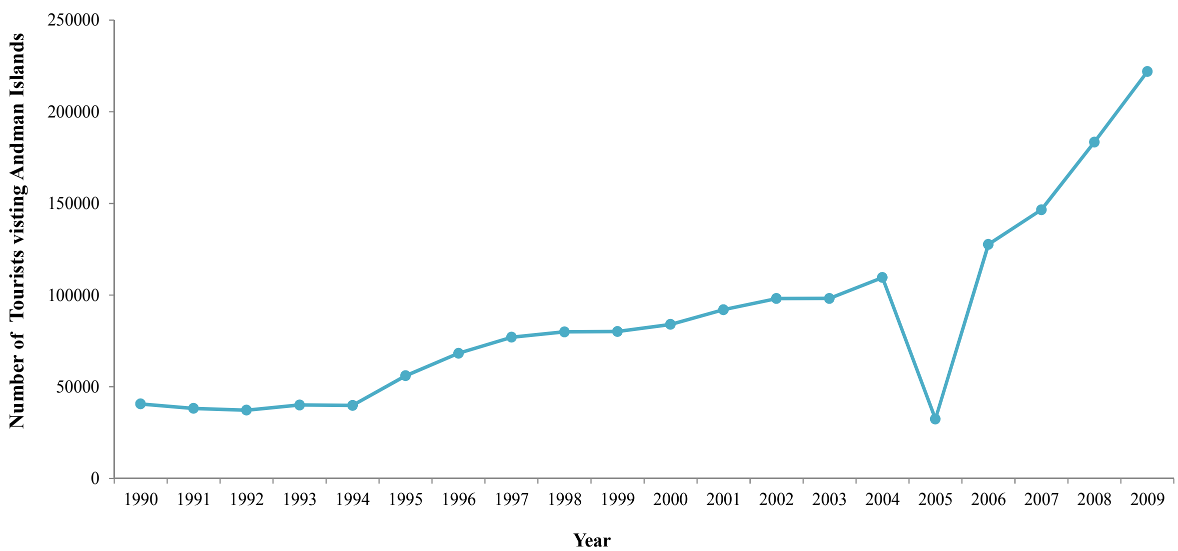

Figure 6.2: Number of tourists visiting Andaman & Nicobar Islands.

Figure showing an increase in number of tourists (domestic and foreign) visiting Andaman Islands (Source: Department of Information, Publicity and Tourism, ANI Administration, Port Blair, 2010).

6.7.1.4 Take home catch of island fishers

Interviews with fishermen in the Andaman Islands also revealed that reef-based fish catches using cast nets, traps, hook and line from shore are never accounted as the fisheries department mostly take fish catches from licensed fishing boats and motorised vessels into account in the catch statistics (Respondents: 186, 188, 192; Anon, *pers comm*. 2008). 9

interviews with fishermen in Andaman Islands revealed that about 1367 tonnes of fish are consumed in fishing households of Andaman and Nicobar Islands (See Table 6.2). Since the interviews were conducted in Andaman Islands only, estimates of fish consumption from these islands had to be used to extrapolate fish consumption in Nicobar Islands. The number of fishermen households in A & N Islands (FSI 2006) was multiplied with average household consumption per year (Pramod 2008) to get total take home catches in A & N Islands. Average household consumption per year was estimated by multiplying average take home per catch per trip into number of fishing trips per year (Pramod 2008). The totals for each fishing village, by district were added to get total take home catch for the Andaman and Nicobar islands (See Table 6.2).

Table 6.2: Household consumption of fish among fishermen communities of Indian origin in the Andaman and Nicobar Islands.

Source: Interviews with fishers in 2008.

Island group	Number of households[68]	Average Household consumption / Year (t)[69]	Lower Limit	Upper Limit	Ethnicity[70]
North Andaman (Mayabundar)	149	53.6	39.5	56.6	Bengali, Tamil, Telugu, Hindi, Indian Burmese
Diglipur	664	285.2	260.3	318.7	Bengali, Tamil, Malayalam, Telugu, Hindi
Middle Andaman (Rangat)	870	217.5	174	261	Bengali, Tamil, Malayalam, Telugu, Hindi
Neil Island	75	22.5	15	30	Hindi and Bengali
Havelock Island	119	42.1	35.7	47.6	Hindi, Bengali, Tamil and Telugu
South Andaman					
(Port Blair – Urban)	530	185.5	132.5	331.2	Hindi, Bengali, Tamil, Urdu, Telugu, Malayalam, Punjabi and Uraon
(Port Blair – Rural)	745	284.6	186.2	372.5	Hindi, Bengali, Telugu
Little Andaman	311	93.3	77.8	109	Nicobarese, Hindi, Bengali, Tamil, Telugu and Malayalam
Baratang	9	3.2	2.7	3.6	Hindi, Bengali, Tamil, Telugu, Malayalam and Uroan
Long Island	18	6.4	5.4	7.2	Hindi, Ber
Car Nicobar	195	58.5	48.7	68.2	Nicobarese and Ranchi
Great Nicobar	45	16	13.5	18	Hindi, Tamil, Telugu, Punjabi, Nicobari and Tribal Language of Shompen
Nancowry	98	29.4	24.5	34.3	Nicobarese, Tan
Campbell Bay	124	44	37.2	49.6	Nicobari, Hindi, Tamil and Telugu
Katchal	69	24.5	20.7	27.6	Nicobari, Hindi, Tamil and Telugu
Rutland	3	1	0.9	1.2	Hindi, Bengali, Tamil, and Uroan
Total	**4024**	**1367 (tonnes)**	**1075**	**1736**	

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[68] Source: FSI (2006).

[69] This estimate includes consumption of fish during festivals and dryfish consumed during lean periods.

[70] Estimates of fish catches and household consumption of the six indigenous tribes (Jarawa, Onge, Shompen, Nicobarese, Sentinelese, and Great Andamanese) are presented separately in Table 6.1.

Although, reef based fish catches contribute less into the local economy, they are vital sources of animal protein for many impoverished communities in the islands. Moreover, in many communities during the monsoon season, when prices of pulses and other food commodities are higher as commercial ships ply less often from mainland, reefs in vicinity of the community are used more often to catch fish, as even the local boats go less often for fishing due to rough weather conditions prevailing at sea (Pramod 2008). Preliminary estimates off Port Blair region alone suggest that 164 tonnes (range of 142-296 tonnes) of fish and invertebrates are taken from intertidal reefs (Respondents 193 to 197)). More studies are necessary to conduct a much deeper analysis of such reef based subsistence catches for remaining jurisdictions in the islands.

Other categories of unreported catches include dried fish, known within the fishermen and local population of islands as "*nappi*", a traditional dish made from dried fish or salted dried prawn relished by the local Burmese community of the islands. Shrimps are caught in lagoons; creeks and mangroves by fishermen in most islands, while carangids, mackerels and sardines are dried for consumption during lean seasons. In all the islands, boat owners and crew keep a certain percentage of catch for consumption by their families (Pramod 2008). During good fishing trips, fishermen also give part of their catch to elders, widows and impoverished people of the local fishing communities as a goodwill gesture. Fishermen in many communities reported that they also give fish to government officials to get favours such as renewal of license, admission for their children to schools, government work etc. Fishing communities in Port Blair also reported that government officials regularly take fish from them at landing centres without paying any money, and fishermen often do not resist such attempts due to fear of government officials. Fish consumption was highest among the Bengali community whose diet was dominated by rice and fish, followed by Tamil, Malayalam, Telugu and indigenous tribes. The annual consumption of mollusc meat, prawns and octopus was highest among indigenous tribes compared to settlers from mainland (Respondents: 198, 199, 202; Pramod 2008) and it ranged from 26-92 tonnes.

6.7.1.5 Baitfish used by domestic vessels in the islands

Bait fish used in longliners and motorised boats was also estimated in the current study for the first time. There are 5 mechanised longliners targeting tuna, sharks and reef fish operating from Port Blair and Havelock Island, which use around 80 tonnes (16 tonnes bait fish / boat / year), which is caught through trawl net (Respondent 193). Motorised hook and line boats use around 10-20 kg sardines as bait fish per trip with the quantity used depending on catches from previous trip, giving an average of 47 tonnes of bait fish for 397 boats in the islands (Respondents: 193, 195, 198, 202). Table 6.3 gives the total estimate for bait fish used by fishing vessels in the islands. Fishers in the Andaman and Nicobar islands use 127 tonnes of bait fish every year, and this has been estimated for the first time as such estimates have never been formally quantified in previous studies.

6.8 Conclusion

In data poor fisheries, such as in the Andaman and Nicobar Islands, this is perhaps the first study to use knowledge of fishermen to provide a comprehensive picture of foreign and domestic illegal and unreported catches. Estimates from this study show an illegal and unreported catch of about 40,000 tonnes every year from the Andaman and Nicobar islands EEZ. A detailed explanation of these catches is given below in Table 6.3.

Table 6.3: Total estimate of illegal and unreported catches in the EEZ of Andaman and Nicobar islands. Derived from interviews in the 2008 IUU trip to the Andaman Islands.

Category	Illegal or Unreported	Total (in tonnes)	Lower limit (in tonnes)	Upper Limit (in tonnes)
Molluscan Shell fish catches	Unreported	700	520	740
Fish consumption among indigenous tribes	Unreported	1692	1200	1870
Fish sold to Tourist resorts and hotels	Unreported	1023	890	1400
Fishermen take home catch	Unreported	1367	1075	1736
Reef based subsistence catch (Port Blair only)	Unreported	164	142	296
Bait fish fisheries	Unreported	127	120	180
Illegal Trochus catch by foreign boats	Illegal	244	195	294
Illegal Sea Cucumbers catch by foreign boats	Illegal	247	123	494
Illegal finfish catch by foreign trawlers	Illegal	34000	16100	44200
Total		**39564**	20365	51200

A detailed quantitative estimate of illegal catches of Trochus, Sea cucumbers and Finfish from foreign fishing vessels was calculated using illegal catch confiscated from arrested vessels, and number of vessels arrested in the islands (GIUFI 2010). The upper and lower limits of illegal catch were estimated using data collected through interviews (Pramod 2008) with fishers operating in the islands waters.

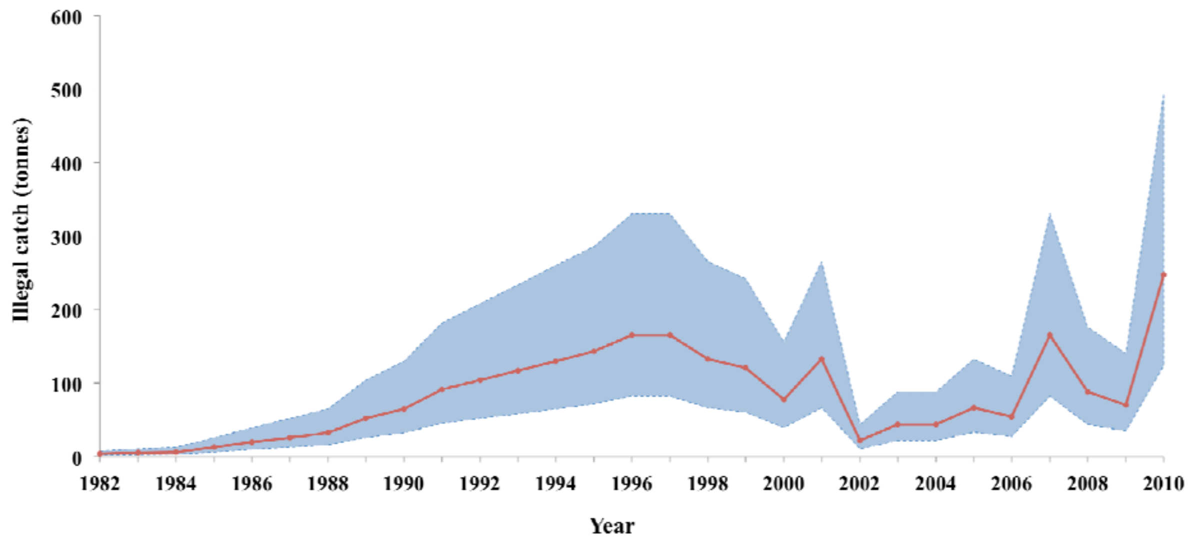

Figure 6.3: Estimates of sea cucumbers catch taken by illegal foreign fishing vessels in the Andaman & Nicobar Islands.

Estimated total illegal catch (t) taken by foreign fishing vessels in the Andaman and Nicobar islands EEZ (1970-2010). The red line in the figure represents the estimated illegal catch that was confiscated from vessels that were arrested in Andaman & Nicobar waters from 1982-2010. The lower and upper bound estimates were derived from IUU fishing trip interviews (Pramod 2008), surveillance data in GIUFI (2010), Industry and Government records of vessels that were observed poaching in Andaman & Nicobar EEZ territory.

During the 1980-1990 period, foreign fishing vessels (mostly Burmese and Thai boats) illegally took at least 10 to 50 tonnes of sea cucumbers in the Islands EEZ (Figure 6.3). Lack of enforcement encouraged more fishing boats to enter unhindered in the next decade from 1990-2000, increasing illegal sea cucumbers catch to around 170 tonnes every year. In the subsequent decade from 2000-2004 poaching declined in some island territories, before increasing to 247 tonnes in 2010 (Respondents: 193, 195).

Illegal trochus catch (mostly Burmese boats) ranged from 8 to 20 tonnes in the eighties, before increasing to around 40 to 150 tonnes in the nineties (Figure 6.4). Illegal trochus catch increased further from 150 to 200 tonnes each year during the last decade. Notably, the increase in trochus catches during the last decade were largely due to change in poaching strategies by Burmese poachers using each boat to target both sea cucumbers and trochus for each trip whereas in prior decades (1980-2000) majority of Burmese boats targeted both trochus and sea cucumbers exclusively using separate boats. A spike in illegal trochus catch in recent years was also due to the ability of Burmese poachers to form nexus with local trochus smugglers of Indian origin in the Andaman Islands (Anon 2009i; Anon 2010j; Anon 2010k). Illegal catch of trochus, sea cucumbers and other marine wildlife products confiscated from arrested domestic poachers at Port Blair port (residents of Andaman & Nicobar islands) was also quantified and presented in Table 6.4. These domestic Indian poachers on the islands smuggle sea cucumbers to India through passenger vessels that commute between mainland and the islands every week. The sea cucumbers are then smuggled to Sri Lanka through Tamil Nadu. Trochus shells are illegally trafficked to Burmese poachers through northern Andaman.

Table 6.4: Sea cucumbers, gastropods and corals seized by Andaman and Nicobar Police.

Marine products seized from Indian smugglers in the Andaman and Nicobar Islands (Source: GIUFI (2010).

Year	Wildlife Product	Quantity of illegal shells and Sea cucumbers confiscated
1978	Turbo Shells	2000 Turbo shells
1993	Red Corals	12 bags red corals
1993	Trochus	420 kg Trochus shells
1995	Trochus	600 kg Trochus shells
1997	Trochus	2 bags Trochus shells
1998	Trochus	6 gunny bags Trochus
1999	Sea Cucumbers	150 kg Sea Cucumbers
2001	Trochus	4182 Trochus shells (worth Rs. 2 lakh)
2001	Sea Cucumbers	40 kg Sea cucumbers
2003	Sea Cucumbers	105 kg Sea cucumbers
2003	Trochus	98 kg Trochus shells
2004	Trochus	300 kg Trochus shells
2004	Trochus	244 bags (5.6 tonnes)
2006	Trochus	11 bags Trochus
2007	Trochus	400 numbers Trochus
2007	Sea Cucumbers	95 kg Sea Cucumbers
2007	Sea Cucumbers	3 kg Sea cucumbers
2007	Trochus	2200 kg Trochus
2008	Red Corals	16 kg Red Corals
2008	Trochus	950 kg Trochus shells (worth Rs. 50,000)
2009	Trochus	2560 numbers Trochus shells
2009	Turbo shells	100 kg Turbo shells
2009	Cowries	35 kg Cowry Black shells
2009	Cowries	3 kg Cowry Brown shells
2009	Button Shells	15 kg Button shells
2010	Olive Ridley turtles	5 Olive Ridley Turtles
2010	Trochus	80 kg Trochus
2011	Turbo shells	147 kg Turbo shells

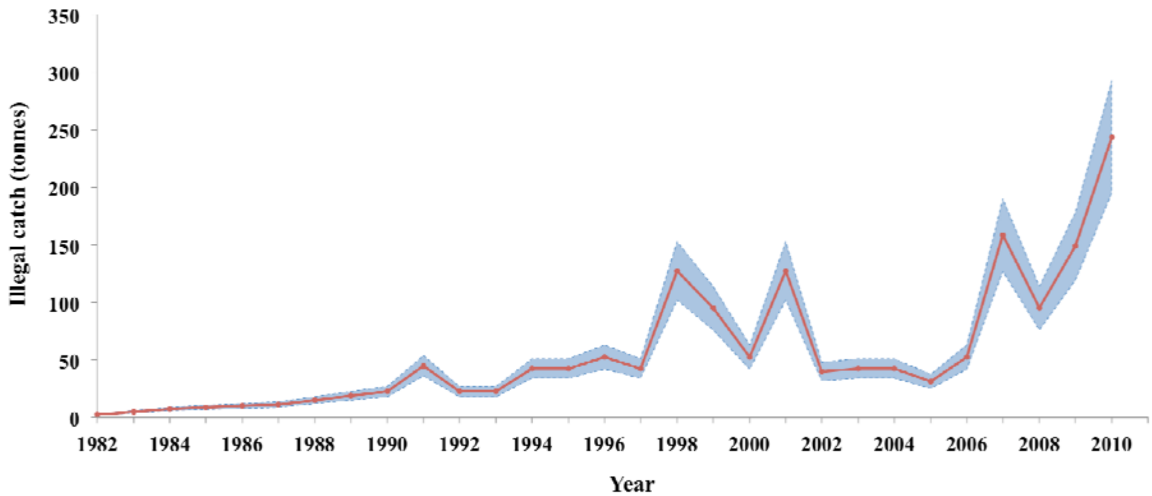

Figure 6.4: Estimates of illegal trochus catch taken by foreign fishing vessels in the Andaman and Nicobar Islands.

Estimated total illegal catch (t) taken by foreign fishing vessels in the Andaman and Nicobar islands EEZ (1970-2010). The red line in the figure represents the estimated illegal catch that was confiscated from vessels that were arrested in Andaman & Nicobar waters from 1982-2010. The lower and upper bound estimates were derived from IUU fishing trip interviews (Pramod 2008), surveillance data in GIUFI (2010), Government records of trochus vessels that were observed poaching in Andaman & Nicobar EEZ territory.

Estimates of illegal catches by foreign trawlers targeting finfish such as tuna, sharks and reef fish involved boats of different countries, with their number and illegal catch per vessel depending on their flag, size and tonnage. Foreign trawlers target different species within the Andaman and Nicobar islands EEZ. Indonesian trawlers target finfish while the smaller boats target sharks for the fin trade; Thai boats target sea cucumbers and ornamental fish in Nicobar waters, while the bigger Thai trawlers target snappers, tuna and sharks in offshore waters; Burmese trawlers target tuna and reef fish; Sri Lankan longliners target yellowfin tuna and sharks; Taiwanese trawlers target reef fish, tuna and sharks. Further, the illegal catch for each vessel by respective flag differed by season, location and tonnage of the boats.

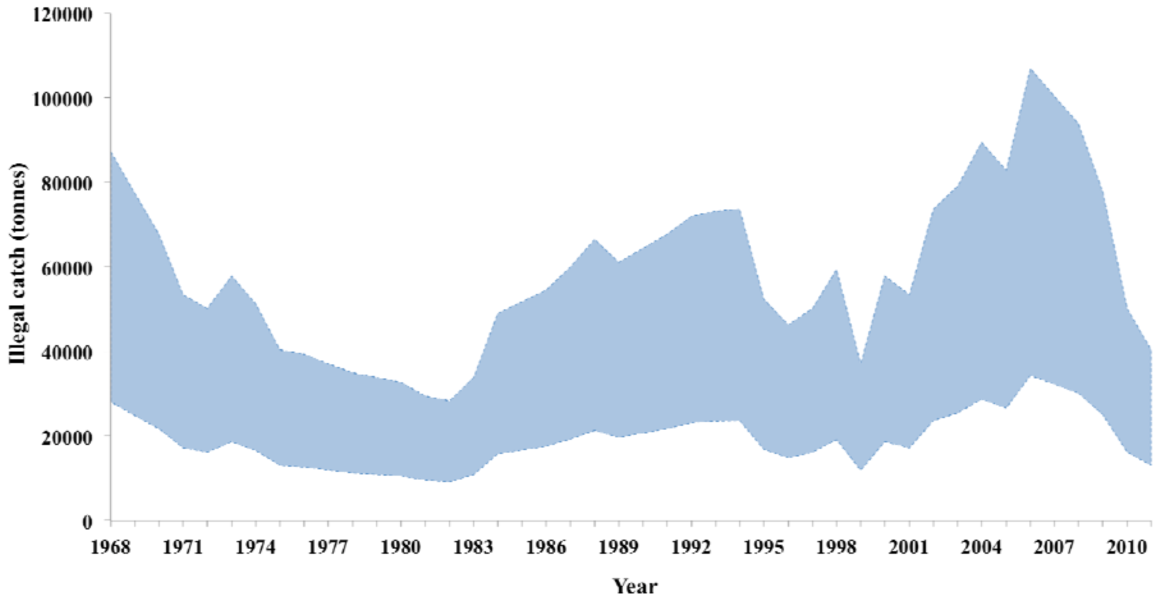

Figure 6.5: Estimates of illegal finfish catch taken by foreign fishing vessels in the Andaman and Nicobar Islands.

The illegal finfish catch was estimated from number of illegal fishing vessels arrested in the island's EEZ. Upper and lower limits reflect illegal catch estimates using data of number of boats observed poaching in island waters collected through interviews with skippers of Indian trawlers, crew of LoP longliners and small-scale fishers operating in A & N islands EEZ. The illegal catches for the period 1968-1980 were for foreign vessels observed poaching within 12 nautical miles from the shore.

Illegal finfish vessels caught 20,000 to 85,000 tonnes in the first decade from 1970-1980 (Figure 6.5). Poaching only declined in the post-1980 period, with illegal catch decreasing to a range of 18,000 to 70,000 tonnes alluding to improvement in monitoring control and surveillance by Indian Coast Guard limiting such incursions into the Indian EEZ. In the next decade due to presence of Coast Guard and A&N Marine Police vessels poaching decreased in the northern Andaman waters. During 1990-2000, illegal catch ranged from 23,000 to

60,000 tonnes, followed by a spike in incursions for tuna and sharks in offshore waters off the islands leading to illegal catch in the range of 40,000 to 84,000 tonnes (Respondents: AN13, AN18, AN23). The finfish catches of illegal foreign fishing vessels are a conservative estimate, as most of the sources were from interviews with skippers of Indian fishing vessels, which seldom operated beyond 20 miles from the islands EEZ. So, there is shortage of reliable estimates of upper and lower bounds for the illegal finfish trawlers operating within the offshore waters of the Andaman and Nicobar Islands EEZ.

According to local sources (Respondents: 196,199), Coast Guard and other surveillance agencies face a daunting task of protecting natural resources in these islands due to five reasons. Firstly, the Coast Guard often finds it difficult to apprehend poachers as they often sneak into shallow creeks and mangrove areas on sighting patrol ships to avoid apprehension, as Coast Guard ships have draught restriction and cannot enter shallow waters. Secondly, the Burmese poachers often hide their boats and contraband in numerous shallow creeks and mangroves making them difficult to sight during routine aerial and sea based patrols. Most of the smuggling of illegal fishing products is undertaken at night, with most interceptions only viable during routine sighting at sea or during transit towards Burmese waters from the Islands (Respondent: 197, 199). Thirdly, poachers routinely construct illegal camps in the forests, making it difficult to stop their operations unless detected during patrols at sea. Fourthly, even if the Coast Guard makes a physical interception at sea, its boats cannot engage in active pursuit if the poachers flee towards inland creeks and mangroves, and often have to wait for reinforcements from Marine Police and IRBn to arrest poachers from the wilderness of the remote islands (Pramod 2008).

Illegal and unreported catches in Andaman and Nicobar islands were estimated for the first time and interviews with fishers revealed that 40,000 tonnes remain unaccounted each year. Conservative estimates from interviews in 2008 revealed that illegal fish catches by foreign fishing vessels in Andaman Islands were 34,000 tonnes per year and were primarily directed at sea cucumbers, trochus and finfishes. Conservative estimates of unreported catches from five different sectors (See Table 6.3) puts estimate at 5700 tonnes each year (Molluscan shell fish catches: 700 tonnes; Fish consumption among indigenous tribes: 1692 tonnes; Fish sold to tourist hotels and resorts: 1023 tonnes; Take home catch of Indian fishers in the islands: 1307 tonnes; Reef based subsistence catch: 164 tonnes and bait fish catch: 847 tonnes per year).

6.9 Chapter 6 summary

Illegal fishing continues to persist in Andaman and Nicobar islands due to loss of deterrence, mainly due to repatriation of Burmese and Thai poachers on a regular basis. Interviews in 2008 revealed that during short prison sentence in the Andaman Islands, poachers come in contact with locals and learn the language to act as contacts for smuggling trochus and sea cucumbers during subsequent illegal trips. The poachers return to continue poaching in the remote islands, with some Respondents (189.192, 199 and 201) stating that poachers know more about local topography and fishing activities of locals and use them to their advantage in coordinating smuggling operations. Respondent 198 stated that people of the northern Andaman Islands (who speak Burmese) often provide local support for Burmese poachers to conduct smuggling operations.

The Andaman and Nicobar Command (ANC) comprised of Indian Navy and the Indian Coast Guard is the only Joint Command, which plays an active role in coordinating surveillance operations with Andaman and Nicobar Marine Police and IRBn to apprehend foreign fishing vessels at regular intervals. However, their efforts can only pay dividends if more stringent action is taken against arrested poachers as they are regularly repatriated by the Indian Government, only to return and continue their poaching operations in the islands. Other issues plaguing enforcement include unavailability of proper patrol boats for apprehending poachers operating in shallow waters. Community based policing and closer co-ordination with marine police can help in better enforcement and protection of islands resources from foreign poachers. Das (2010) attributes continuation of poaching in the islands to three factors, namely underdevelopment of fishing industry, existence of scattered uninhabited islands serving as hideouts for poachers and loss of element of deterrence due to regular repatriation of the Burmese poachers.

Most of the islands in the Andaman and Nicobar islands are densely forested making it difficult to detect illegal poacher camps in remote islands. Most of the remote islands used by Burmese poachers are uninhabited with routine anti-poaching operations at sea and observations of small-scale fishers the only modes to detect violations in the remote islands. Majority of the islands in the northern Andaman, western side of Jarawa tribal reserve are virtually unpatrolled as there are no Indian fisher settlements or any other human settlement in these islands (Respondents: 196,199, 201, 202). During interviews in 2008, people working for NGO's and researchers in Government establishments noted that Jarawa areas have been plundered on a large-scale by Burmese poachers due to absence of Indian small-scale fisheries in these jurisdiction and low physical presence of tribes along the large coastline in central and northern Andaman islands (Respondents: 195, 196). They also noted that Jarawa men often complain about presence of Burmese poachers in their territories during routine food distribution by Government officers, and such information is conveyed to Indian Coast Guard for further action. Often, such information is difficult to comprehend for local government authorities due to presence of few translators (the tribes speak a different language from the local Indians) during food distribution or contact during specific period.

Chapter 7: Conclusion

This thesis is focused on addressing two aspects of illegal and unreported fishing. Chapters 1 to 3 have a global perspective, looking at incentives that drive illegal and unreported fishing, while chapters 4 to 6 are focused on estimating different categories of illegal and unreported catches that are poorly quantified in Indian fisheries. Chapter 1 provides an overview of different incentives for illegal fishing such as governance, corruption, low penalties, subsidies, organized crime, fleet overcapacity, flags of convenience, poor monitoring, control and surveillance (MCS) etc. In Chapters 2 and 3, I chose two of these incentives, namely illegal fishing penalties and MCS for an in-depth global analysis. For the work in India reported in Chapters 4, 5 and 6, I use data collected through field interviews in 2008 to estimate illegal and unreported catches in the Indian EEZ.

I will now summarize the main research findings and discuss the relevance of my results in the context of illegal and unreported fishing. Next, I will discuss limitations of the research and provide suggestions to apply this research in future studies.

7.1 Main findings

7.1.1 Incentives that allow illegal fishing to persist in the world's EEZs

The estimated worldwide extent of losses from illegal and unreported fish catches (excluding discards) ranges from 11 to 26 million tonnes, resulting in economic loss of $10 bn to 23.5 bn annually (Agnew *et al*., 2009). The dynamics of fishing fleets; gears and people involved in the fisheries sector differ from country to country. These dynamics are influenced by different financial, social and political incentives in each country, which necessitates effective management policy for both domestic and foreign fleets operating within their EEZ. My findings from Chapter 1 suggest that the incentives for illegal fishing depend on the efficacy of institutions and MCS assets allocated to address this issue in each jurisdiction. Incentives such as corruption and poor MCS are important drivers in developing countries (other incentives in the developing world include weak governance, subsidies, poverty, indebtedness etc.), while fleet overcapacity and subsidies assume importance in the developed world. In countries where the scale of illegal fishing problems are identified, a range of other factors like low prosecution rate (e.g., India) (Pramod 2010) and lack of accountability (Sembony 2009; Murias 2010; Anon 2010b) in the judicial process (e.g., Tanzania, Peru) have been identified as stumbling blocks to controlling illegal fishing. The complexities involved in controlling illegal catch within the whole supply chain from vessel, to markets and the buyer need significant improvement in the next step towards efforts in controlling illegal fishing.

7.1.2 Is monitoring control and surveillance adequate in world's fisheries?

My findings in Chapter 3 show that, although major strides have been initiated in developing good MCS infrastructure, such measures have not been backed by effective implementation of national and international laws, leading to poor compliance. My findings also suggest that developed countries with better MCS capabilities might gradually overcome these shortfalls, but developing countries with growing population, large EEZs and poor MCS infrastructure would be the most affected due to pilferage of fishery resources with long-term implications to food security. In the resource rich, yet poor economies of West Africa, findings suggest lack of financial resources as major constraint to deter illegal fishing.

7.1.3 Are illegal fishing penalties a significant deterrent to poachers?

Analysis of illegal fishing penalties in 109 countries over a three-decade period (reported in Chapter 2) shows that current penalties do not pose a significant deterrent to poachers (See illegal fishing cases in Appendix A and Chapter 2) and in many cases the penalty levied on illegal fishing was not even worth the illegal catch found on the offending vessel. On the other hand, for instance, illegal fishing cases in Australia illustrate that confiscation of catch and vessel engaged in the illegal activity can send a strong signal to the IUU vessel operators and to a certain extent would also assist in recovering high costs associated with patrolling vast EEZs. The current analysis is to my knowledge, the first global analysis covering a 30 year period (1980-2009) to track over 1211 illegal fishing cases (Shellfish, Mollusks, Finfishes etc.) from the time of the actual incident to its final prosecution in court, potentially providing valuable data to enforcement agencies. This data can help in identifying shortcomings in the existing penalty framework in many of these countries to improve the penalty regime.

7.1.4 Factors driving illegal and unreported catch in the Indian EEZ

The 7-month field trip, during which I interviewed 203 respondents, gave a very good opportunity to look at factors driving illegal and unreported fishing in Indian waters. While the main focus of the interviews was to estimate the quantity of illegal and unreported catches (Chapters 4,5, and 6), interviews also provided information on some of the issues that drive these activities. Some of the main findings are explained below. Categories discussed here include a) Weak governance; b) controlling illegal catches on foreign chartered vessels operating in Indian EEZ; c) Overcapacity in artisanal and industrial fisheries and; d) influence of peer behavior.

7.1.4.1 Weak governance

Interviews with fishers along the eight coastal states showed that institutional failure is prevalent in all the coastal states, *esp.*, in controlling illegal fishing. With the exception of Orissa, State fisheries departments and Federal government agencies in all the eight coastal states do not have the resolve to implement existing state and federal fisheries legislations. Interviews reveal that existing laws are not being enforced through formal or informal norms leading to poor compliance. The main flaw with fisheries policy in Indian waters is that coastal states (e.g., Andhra Pradesh) have the mandate to manage fisheries in 0-12 nautical mile limit, with the federal government responsible for managing resources beyond 12 miles. This essentially leaves bulk of small-scale fisheries and significant part of industrial fisheries within a state's responsibility. However, most coastal states in India do not allocate adequate funds for the fisheries sector, as there is hardly any revenue in the open access Indian fisheries. Moreover, the state's resources are overstretched for providing fuel subsidies, which are severely straining their annual budgets due to rising fuel prices.

In many states, Fisheries Department staff stated that there is very high overcapacity in the trawl sector and State cannot afford to give subsidized fuel to all the vessels. Four respondents (5, 46, 67, 84, 92) in coastal states (Andhra Pradesh, Tamil Nadu, Gujarat and Maharashtra) stated that, due to declining profits many trawler owners are retaining their vessel permits and selling the allocated subsidized fuel to black markets as they are not making profits from fishing trips anymore. Government and international donor projects should concentrate on restoration of commercial fish stocks (For e.g., Hilsha fish stock[71] if managed sustainably is worth US$ 260 million each year (Mome 2007) in Bangladesh itself) as a means to provide sustainable livelihood to coastal communities.

7.1.4.2 Controlling illegal catches from chartered foreign tuna longliners

My findings are to my knowledge, the first in highlighting the extent of illegal catches taken by Taiwanese tuna longliners operating under LoP (Letter of Permission) permits in Indian waters. My findings clearly suggest that the current LoP scheme is not working. Data from interviews suggest that during the year 2007 alone, Indian government lost around 24,000 tonnes through illegal transshipments by the Taiwanese owned tuna longliners operating under the LoP scheme. The LoP tuna longliners from Taiwan fish in the Indian EEZ from November to April each year, and subsequently leave Indian EEZ for the next 6 months. If the vessels are registered and sold to the Indian company under the LoP scheme, this shouldn't be happening. My findings suggest that tuna longliners operating under LoP permit should be first asked to land their catch in Indian ports before transshipment to foreign ports. This can curtail the huge economic loss due to illegal transshipments and massive under-reporting of tuna catches, esp., by Taiwanese longliners. The excuse used by joint venture companies that Indian ports do not have capacity to process tuna for the Japanese sashimi market is flawed as Indian longliners (around 40 longliners) are landing and exporting processed tuna caught from the same fishing grounds through Indian ports. This can stop the

[71] The Hilsha (Indian Shad) is a highly migratory species that is found in coastal waters of Myanmar, Bangladesh and India. In Indian waters, the Hilsha stock is present in waters from Orissa to West Bengal, but the stock has declined due to poor management and harvest practices over the past three decades. Almost 90% of the stock is currently exploited in Bangladesh and Indian EEZ.

pilferage and under-reporting of tuna caught in the Indian EEZ. Public disclosure of LoP agreements can help in making these agreements more transparent.

Vessel monitoring system should be installed as a condition for the license on all LoP vessels to monitor their movements in the Indian EEZ. The VMS data should be monitored by the Coast Guard to ensure immediate action for illegal activities. These actions are necessary, as current measures do not seem to be effective in monitoring entry exit requirements for Taiwanese tuna longliners. Recent report from Indian Coast Guard in 2009 corroborate the extent of illegal tuna transshipments by LoP vessels in Indian waters, with as many as 22 LoP vessels recalled by Coast Guard (Period: Nov 1, 2008 to Jan 31, 2009) for not fulfilling the conditions of LoP license and exiting Indian EEZ without prior clearance from Coast Guard and Indian Customs (Anon 2009e).

My findings also suggest that the Indian Government lacks the accountability and political will to act against poachers apprehended in Indian EEZ. When foreign fishing vessels are arrested, more media attention needs to be focused on action taken by courts and the government to act as a deterrent from releasing illegal vessels without proper prosecution or fines. As Ostrom's study suggests, rules can be only effective if they are reinforced through monitoring and sanctions on offending free riders (Ostrom 2000).

7.1.4.3 Overcapacity in trawl and artisanal fisheries

The open access nature of fisheries management in Indian waters has contributed to a "*race to money*" among both small-scale and commercial sectors. Since the mechanization of the Indian fishing sector in the early sixties, State funds have been poured into increasing fishing capacity without studies to assess its impacts on coastal habitats and fisher's catches. Allocation of property rights to village councils could alleviate problems due to gear conflicts and clashes between neighbouring villages over fishing grounds. During the interviews in 2008, fishers stated that overcapacity was one of the main issues affecting resource use in Indian small-scale fisheries. Similar observations have been made in other Southeast Asian countries like Cambodia, Thailand and Philippines (Salayo *et al*., 2008; Pomeroy 2012), where overcapacity has been identified as a major policy concern. Pomeroy (2012) suggests an integrated approach of resource conservation, restoration and community development as solution to the overcapacity problem in Southeast Asian fisheries. Small-scale fishers in Andhra Pradesh suggested that state and federal government should tax ("*Polluter's pay tax*") industries or commercial enterprises like power plants, industries and pharma plants which release effluents into coastal waters; and those funds should be used for restoration of coastal habitats as well as communities affected by such activities.

My findings suggest that the Indian Government laws should also regulate the sale of smaller meshed fishing gears as easy availability of illegal fishing gears is also undermining compliance in small-scale fisheries. Inadequate enforcement of state and federal laws had contributed to widespread use of smaller meshed nets. Smaller meshed gears contribute to bycatch of juvenile fish (recruitment overfishing) with major impact on fishers' income (low price for smaller fish) and lower standards of living in the long run. My findings suggest that it would also be helpful if State governments should enact size limits for major commercial species, and raise public awareness on the need for such management actions.

State and Federal Government should also realize that there is an immediate need to reduce overcapacity in both small-scale and industrial fishing sectors, as overcapacity has led to increase of smaller meshed gears in artisanal fisheries, while overcapacity in the industrial sector has contributed to increasing incursions of trawlers into (i) inshore grounds allocated for artisanal fishers (ii) encroachment of trawlers into fishing grounds in neighbouring states (Andhra Pradesh trawlers fishing in Orissa's marine sanctuaries) and (iii) and illegal incursions into foreign EEZs (e.g., Tamil Nadu trawlers into Sri Lankan EEZ; Gujarat trawlers into Pakistan EEZ). Recently, the small-scale fishermen's union in Tamil Nadu have filed public interest litigation (PIL) in Madras high court seeking action against use of trawlers and prohibited nets in the inshore artisanal zone (Anon 2012). This measure is largely seen as last-ditch effort by small-scale fishers to protect their interests, as their repeated grievances to the state government have remained unanswered.

7.1.4.4 Influence of peer behavior

Fisher's behavior is of immense importance for individuals to engage in illegal activity (Pramod 2010; Hauck 2008). In the Indian state of Orissa, fishers were of the opinion that there was a marked increase in use of smaller meshed gillnets when fishers noticed an increase in catches from one group of fishers using illegal gears in the fishing village, which eventually spread to other fishers, with the whole village using smaller meshed gillnets within a span of five years. In the Indian State of Kerala, fishers were of the opinion that easy availability of illegal fishing gears motivated them to engage in illegal fishing activity. Small-scale fishers in the State of Kerala (India) also engaged in illegal activity, which arose out of a decline of resource due to depletion of fish stocks by trawler intrusions into artisanal fishing grounds. Lack of enforcement was evident as subsistence and full-time artisanal fishers found it more profitable to switch to smaller mesh gillnets arguing that increased encroachment of trawlers has resulted in such actions (Pramod 2010). In the state of West Bengal (India), it was observed that part-time fishers engage more often in illegal activity, with their actions influencing catches of full-time fishers. In the Indian States of Maharashtra and Gujarat, small-scale fishers stated that in the past they were interested in protecting the resource as the whole community depended entirely on fishing. In recent years due to increasing indebtedness, fishers work as daily labour, with gear and fuel costs funded by agents and moneylenders who encourage them to catch more to make profit from each fishing trip. Fishers stated that in the past as a community, decisions were taken to manage the resource (e.g. fishing ban during full moon period and area closures to protect spawning aggregations); in recent decades most of fishing trips are funded by moneylenders and boat owners who provide incentives to use illegal fishing gear more often, in comparison to frequency of appropriate traditional fishing gears used during different periods in a year in the past (Pramod 2010).

Co-management, with partnership between government agencies, fishers and other stakeholders would help in improving compliance in the small-scale fisheries (Jentoft 1989; Kuperan *et al*., 2003; Berkes *et al*., 2001). By any count, state and federal governments lack the capacity to monitor numerous small-scale landing centres along India's vast coastline. Fishing co-operatives and village councils should be empowered to fathom the losses due to use of illegal fishing gears and awareness campaigns need to be conducted to improve compliance. During the interviews in 2008, I was surprised to see that in many fishing villages, small-scale fishers were not aware of the existing laws that prohibit destructive fishing practices. Creation of group-based or community property rights (gillnet fishers, hook and longline fishers, subsistence fishers, shellfish fishers etc.) were suggested as solution by most fishers to address the compliance issues.

7.2 Future directions

The purpose of the thesis was to provide information on key issues such as illegal fishing penalties, poor monitoring control and surveillance (MCS) that are plaguing sustainable management of fish stocks worldwide. Illegal and unreported fishing is a problem that does not recognize national boundaries or international laws. The thesis shows that illegal fishing thrives in regions where penalties are weak and is one of the main impediments to sustainable management of fish stocks in many jurisdictions. My findings in Chapter 1 suggest that it would be useful to expand study to evaluate other incentives such as governance, corruption, and fleet overcapacity to facilitate a greater understanding of the IUU problem. The analysis on illegal fishing penalties in Chapter 2 can be extended to many other countries, esp., in Africa, Middle East and South America if governments come forward to share this information through government websites and publications. While the thesis has contributed to understanding two main incentives namely penalties and MCS, I noticed that there are a plethora of other incentives, which contribute to this problem globally. When more data becomes available, the current evaluation for Monitoring control and surveillance in Chapter 3 can also be extended to more countries to provide a global perspective on this intriguing problem.

Achieving compliance is an overarching goal of many coastal nations, and although countries have signed several international fisheries laws (UNCLOS, UNFSA, IPOA on IUU Fishing etc.) to meet these goals, compliance with these international fisheries laws is voluntary and United Nations has no means to check their effectiveness. Studies to measure the effectiveness of these laws should be conducted every 3-5 years (e.g., Pitcher *et al*., 2009, also see Chapter 3) by UN or other international agencies to serve as leverage to measure compliance of signatory nations.

As aptly stated by India's founding leader Mahatma Gandhi "*'There is enough for everyone's need but not for everyone's greed*" commercialization with gross disregard to laws has led to decline in Indian fisheries. Indian fisheries exhibits all the signs of 'tragedy of commons' (Hardin 1968), where individuals have pursued self-interest at the expense of other users. Initiatives with a greater political will, policy reform and commitment are needed to implement strategies that promote fisheries compliance (Hauck and Kroese 2006). Small-scale fishers interests have been largely neglected with fishers in all coastal states affected by displacement (from industrial development and land reclamation), pollution from industries causing anoxic zones, and declining catches due to use of destructive fishing gears. In conclusion, analyses in my thesis suggests that a serious management plan taking all stakeholders inputs into consideration is needed to promote compliance in the small-scale fisheries, while a buyback scheme to reduce excess fleet capacity could alleviate problems in the trawl sector.

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Appendix A: Cost benefit analysis for 1211 illegal and unreported fishing penalty incidents in 109 countries.

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
Canada							**1980-1994**							
1	Canada	Fishing trawler	Atlantic Cod	2	1.7	691	622	346	0.1	14614	1461	1807	2.91	0.09
2	Canada	Fishing trawler	Atlantic Cod	1	8.5	5635	5072	2884	0.1	18853	1885	4769	0.94	0.58
3	Canada	Fishing trawler	Atlantic Cod	1	100	109890	98901	18000	0.1	21978	2198	20198	0.20	18.40
4	Canada	Fishing trawler	Atlantic Cod	1	2	788	709	412	0.1	3663	366	778	1.10	0.41
5	Canada	Fishing trawler	Atlantic Cod	1	17	7376	6638	4892	0.1	36564	3656	8548	1.29	0.24
6	Canada	Fishing trawler	Finfishes nei	1	7.5	3278	2950	1432	0.1	30957	3096	4528	1.53	0.25
7	Canada	Fishing trawler	Finfishes nei	1	12.4	30165	27149	10606	0.1	59121	5912	16518	0.61	1.40
8	Canada	Scallop dragger	Scallops	2	3.5	11519	10367	1010	0.1	64794	6479	7489	0.72	0.72
9	Canada	Scallop dragger	Scallops	1	10.9	19000	17100	8398	0.1	119000	11900	20298	1.19	0.37
10	Canada	Scallop dragger	Scallops	1	0.3	2197	1977	331	0.1	98000	9800	10131	5.12	0.08
11	Canada	Fishing vessel	Finfishes nei	1	9.3	3664	3298	1422	0.1	500	50	1472	0.45	18.76
12	Canada	Fishing vessel	Sockeye Salmon	1	3.6	14617	13155	1173	0.1	12864	1286	2459	0.19	4.66
13	Canada	Longliners	Tuna	3	57	137883	124095	39134	0.1	219699	21970	61104	0.49	1.93
USA														
1	USA	Fishing trawler	Finfishes nei	1	54	122850	110565	10834	0.1	700000	70000	80834	0.73	0.71
2	USA	Fishing trawler	Finfishes nei	2	12	27300	24570	1596	0.1	400000	40000	41596	1.69	0.29
3	USA	Fishing trawler	Finfishes nei	5	30	89670	80703	7210	0.1	363300	36330	43540	0.54	1.01
4	USA	Fishing trawler	Finfishes nei	2	12	30660	27594	3132	0.1	300000	30000	33132	1.20	0.41
5	USA	Fishing trawler	Finfishes nei	1	12	30300	27270	9048	0.1	325000	32500	41548	1.52	0.28
6	USA	Fishing vessel	Finfishes nei	6	36	102060	91854	8060	0.1	855000	85500	93560	1.02	0.49
7	USA	Fishing vessel	Finfishes nei	3	18	51030	45927	10170	0.1	650000	65000	75170	1.64	0.28
8	USA	Fishing vessel	Finfishes nei	3	18	51030	45927	4894	0.1	400000	40000	44894	0.98	0.51
9	USA	Fishing vessel	Finfishes nei	3	18	51030	45927	3696	0.1	255000	25500	29196	0.64	0.83
10	USA	Fishing vessel	Finfishes nei	3	3	8505	7655	732	0.1	5816	582	1314	0.17	5.95

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
11	USA	Fishing vessel	Finfishes nei	2	12	34020	30618	2640	0.1	387000	38700	41340	1.35	0.36
12	USA	Fishing vessel	Finfishes nei	2	12	34020	30618	13020	0.1	300000	30000	43020	1.41	0.29
13	USA	Fishing vessel	Finfishes nei	19	114	323190	290871	65094	0.1	3400000	340000	405094	1.39	0.33
14	USA	Fishing vessel	Finfishes nei	5	723	3000000	2700000	495978	0.1	4330000	433000	928978	0.34	2.55
15	USA	Fishing vessel	Finfishes nei	3	60	154260	138834	45660	0.1	825000	82500	128160	0.92	0.56
16	USA	Fishing vessel	Finfishes nei	4	24	79896	71906	18264	0.1	100000	10000	28264	0.39	2.68
17	USA	Fishing trawler	Salmon	1	3.6	21171	19054	1173	0.1	5000	500	1673	0.09	17.88
18	USA	Fishing vessel	Tuna	1	18	90054	81049	4338	0.1	1120000	112000	116338	1.44	0.34
19	USA	Anchovy Seiner	Anchovies	1	65	10140	9126	7800	0.1	14000	1400	9200	1.01	0.47
20	USA	Fishing trawler	Shrimps	6	36	836172	752555	15336	0.1	90000	9000	24336	0.03	40.96
Mexico														
1	Mexico	Purse Seiner	Tuna	1	84.3	100000	90000	20569	0.1	313000	31300	51869	0.58	1.11
2	Mexico	Purse Seiner	Tuna	3	252	298872	268985	61488	0.1	39900	3990	65478	0.24	26.00
3	Mexico	Purse Seiner	Tuna	1	15	17790	16011	4890	0.1	55147	5514.7	10404.7	0.65	1.01
4	Mexico	Purse Seiner	Tuna	2	831	986000	887400	270906	0.1	14000	1400	272306	0.31	220.18
5	Mexico	Purse Seiner	Tuna	1	350	300,000	270000	114100	0.1	306700	30670	144770	0.54	2.54
6	Mexico	Purse Seiner	Tuna	1	410	465760	419184	133660	0.1	403000	40300	173960	0.41	3.54
7	Mexico	Longliner	Sharks	1	200	82200	73980	52894	0.1	85000	8500	61394	0.83	1.24
8	Mexico	Longliner	Squids	2	800	1058400	952560	657600	0.1	180000	18000	675600	0.71	8.19
Argentina														
1	Argentina	Fishing trawler	Finfishes nei	1	570	677160	609444	131100	0.1	300000	30000	161100	0.26	7.97
2	Argentina	Fishing trawler	Finfishes nei	1	140	376110	338499	32200	0.1	120000	12000	44200	0.13	12.76
3	Argentina	Fishing trawler	Finfishes nei	1	250	147500	132750	36400	0.1	150000	15000	51400	0.39	3.21
4	Argentina	Fishing trawler	Finfishes nei	1	8.7	5275	4748	1331	0.1	50000	5000	6331	1.33	0.34
5	Argentina	Fishing trawler	Finfishes nei	1	5	2635	2372	2100	0.1	150000	15000	17100	7.21	0.0091
6	Argentina	Fishing trawler	Finfishes nei	1	1.5	819	737	642	0.1	200000	20000	20642	28.00	0.0024

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
7	Argentina	Fishing trawler	Finfishes nei	1	0.9	970	873	764	0.1	450000	45000	45764	52.42	0.0012
8	Argentina	Fishing trawler	Finfishes nei	1	4	4312	3881	3256	0.1	450000	45000	48256	12.43	0.007
9	Argentina	Fishing trawler	Finfishes nei	1	40	43120	38808	16000	0.1	450000	45000	61000	1.57	0.25
10	Argentina	Fishing trawler	Finfishes nei	1	0.03	35	32	23	0.1	850000	85000	85023	2699.14	0.00005
11	Argentina	Fishing trawler	Finfishes nei	1	0.3	275	248	207	0.1	450000	45000	45207	182.65	0.0005
12	Argentina	Fishing trawler	Hake	1	3.4	1791	1612	1426	0.1	150000	15000	16426	10.19	0.0062
13	Argentina	Fishing trawler	Hake	1	0.02	15	14	9	0.1	450000	45000	45009	3334.00	0.00005
14	Argentina	Fishing trawler	Squids	1	35	167895	151106	26635	0.1	50000	5000	31635	0.21	12.45
15	Argentina	Fishing trawler	Squids	1	50	239850	215865	25550	0.1	50000	5000	30550	0.14	19.03
16	Argentina	Fishing trawler	Squids	1	66	515922	464330	61776	0.1	15000	1500	63276	0.14	134.18
17	Argentina	Fishing trawler	Squids	1	150	1172550	1055295	134100	0.1	250000	25000	159100	0.15	18.42
18	Argentina	Fishing trawler	Squids	1	280	2188760	1969884	250320	0.1	350000	35000	285320	0.14	24.57
19	Argentina	Fishing trawler	Squids	1	205	1602485	1442237	235955	0.1	250000	25000	260955	0.18	24.13
20	Argentina	Fishing trawler	Squids	1	72	562824	506542	26064	0.1	250000	25000	51064	0.10	9.61
21	Argentina	Fishing trawler	Squids	1	62.6	377415	339674	55964	0.1	300000	30000	85964	0.25	4.73
22	Argentina	Fishing trawler	Squids	1	100	602900	542610	89400	0.1	400000	40000	129400	0.24	5.67
23	Argentina	Fishing trawler	Squids	1	75	452175	406958	56550	0.1	500000	50000	106550	0.26	3.50
24	Argentina	Fishing trawler	Squids	1	0.001	8	7	4	0.1	700000	70000	70004	9722.78	0.00002
25	Argentina	Fishing trawler	Squids	1	1.5	11878	10690	1141	0.1	700000	70000	71141	6.65	0.07
26	Argentina	Fishing trawler	Squids	1	41.5	328638	295774	6349	0.1	100000	10000	16349	0.06	14.47
27	Argentina	Fishing trawler	Squids	1	1.2	9502	8552	198	0.1	50000	5000	5198	0.61	0.84
28	Argentina	Fishing trawler	Squids	1	150	1041150	937035	172650	0.1	100000	10000	182650	0.19	38.22
29	Argentina	Fishing trawler	Squids	1	4	948	853	562	0.1	300000	30000	30562	35.82	0.005
30	Argentina	Fishing trawler	Squids	1	1	237	213	136	0.1	450000	45000	45136	211.61	0.001
31	Argentina	Fishing trawler	Squids	1	0.2	43	39	21	0.1	150000	15000	15021	388.14	0.0006
32	Argentina	Fishing trawler	Squids	1	0.1	23	21	12	0.1	450000	45000	45012	2174.49	0.0001
33	Argentina	Squid jigger	Squids	1	0.5	2046	1841	598	0.1	300000	30000	30598	16.62	0.02

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
34	Argentina	Squid jigger	Squids	1	1	7817	7035	1151	0.1	350000	35000	36151	5.14	0.08
35	Argentina	Squid jigger	Squids	1	0.8	265	239	142	0.1	500000	50000	50142	210.24	0.001
Peru														
1	Peru	Factory Trawler	Mackerel	13	2200	906400	815760	540600	0.1	2600000	260000	800600	0.98	0.35
2	Peru	Purse seiner	Tuna	3	400	145600	131040	114200	0.1	102000	10200	124400	0.95	0.11
3	Peru	Longliner	Tuna	1	100	41200	37080	30000	0.1	200000	20000	50000	1.35	0.07
4	Peru	Squid jigger	Squids	4	100	26900	24210	16120	0.1	280000	28000	44120	1.82	0.10
Ecuador														
1	Ecuador	Purse Seiner	Tuna	9	1500	1500000	1350000	1167000	0.1	901000	90100	1257100	0.93	1.02
Guyana														
1	Guyana	Fishing trawler	Finfishes nei	6	12	15072	14318	5532	0.05	25083	1254.15	6786.15	0.47	1.75
Costa Rica														
1	Costa Rica	Purse Seiner	Tuna	1	400	908000	862600	144000	0.05	250000	12500	156500	0.18	14.37
Nicaragua														
1	Nicaragua	Fishing vessel	Red Snapper	2	9	40000	38000	4500	0.05	140000	7000	11500	0.30	1.20
Guatemala														
1	Guatemala	Fishing vessel	Finfishes nei	2	12	95148	90391	3914	0.05	200	10	3924	0.04	2161.92
St. Vincent														
1	St. Vincent	Longliner	Tuna	1	3	3252	3089	956	0.05	30000	1500	2456	0.79	0.36
Greenland														
1	Greenland	Fishing trawler	Shrimps	1	36	90010	72008	26236	0.2	18002	3600	29836	0.41	12.71
Falkland Islands – British Overseas Territory														
1	UK	Fishing trawler	Finfishes nei	1	24	16344	14710	9894	0.1	176631	17663	27557	1.87	0.14
2	UK	Fishing trawler	Finfishes nei	1	100	243700	219330	32000	0.1	1779	178	32178	0.15	526.50
3	UK	Fishing trawler	Toothfish	1	20	35340	31806	8340	0.1	212355	21236	29576	0.93	0.55
4	UK	Longliner	Toothfish	1	2	3534	3181	482	0.1	45630	4563	5045	1.59	0.30
5	UK	Squid Jigger	Squids	1	100	898000	808200	115100	0.1	177872	17787	132887	0.16	19.48

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
6	UK	Squid Jigger	Squids	1	10	89800	80820	6900	0.1	88936	8894	15794	0.20	4.16
7	UK	Squid Jigger	Squids	1	10	89800	80820	6900	0.1	17787	1779	8679	0.11	20.78
8	UK	Squid Jigger	Squids	1	317	85273	76746	64264	0.1	82808	8281	72545	0.95	0.75
9	UK	Squid Jigger	Squids	1	3594	887784	799006	703684	0.1	1242897	124290	827974	1.04	0.38
10	UK	Fishing trawler	Squids	1	100	330400	297360	101500	0.1	2500	250	101750	0.34	391.72
South Georgia – British Antarctic Territory														
1	UK	Longliner	Toothfish	1	6	10602	10072	1920	0.05	110679	5534	7454	0.74	0.37
2	UK	Longliner	Toothfish	1	12	21204	20144	1484	0.05	107150	5358	6842	0.34	0.87
St. Paul Island – French Antarctic Territory														
1	France	Fishing trawler	Toothfish	1	3	6678	5342	900	0.1	9581	958	1858	0.31	2.67
Seychelles														
1	Seychelles	Longliner	Tuna	1	442	126000	119700	80246	0.05	356000	17800	98046	0.82	0.47
2	Seychelles	Longliner	Tuna	1	24	6840	6498	2384	0.05	150000	7500	9884	1.52	0.13
Maldives														
1	Maldives	Fishing trawler	Finfishes nei	1	100	206100	195795	83100	0.05	200000	10000	93100	0.48	2.82
2	Maldives	Longliner	Tuna	1	50	156200	148390	19000	0.05	1250000	62500	81500	0.55	0.52
Chagos Islands – British Overseas Territory														
1	UK	Longliner	Tuna	1	326	453792	431102	41000	0.05	1717000	85850	126850	0.29	1.14
2	UK	Longliner	Tuna	1	6	15864	15071	1026	0.05	15000	750	1776	0.12	4.68
Tunisia														
1	Tunisia	Fishing trawler	Finfishes nei	12	60	65520	62244	10890	0.05	700000	35000	45890	0.74	0.37
2	Tunisia	Fishing trawler	Tuna	1	12	5420	5149	1264	0.05	100000	5000	6264	1.22	0.19
3	Tunisia	Fishing vessel	Tuna	1	100	28500	27075	17000	0.05	2400000	120000	137000	5.06	0.02
Somalia														
1	Somalia	Fishing trawler	Finfishes nei	2	60	81060	77007	32040	0.05	300000	15000	47040	0.61	0.75
2	Somalia	Fishing vessel	Finfishes nei	1	12	13560	12882	9600	0.05	180	9	9609	0.75	91.17

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
Namibia														
1	Namibia	Fishing trawler	Hake	5	2400	6000000	5400000	269600	0.1	53660052	5366005	5635605	1.04	0.48
Congo														
1	Congo	Fishing vessel	Finfishes nei	1	12	12228	11617	1204	0.05	270000	13500	14704	1.27	0.19
Nigeria														
1	Nigeria	Fishing trawler	Shrimps	1	192	220000	209000	142894	0.05	20000	1000	143894	0.69	16.53
Guinea Bissau														
1	G. Bissau	Fishing trawler	Finfishes nei	6	180	169340	160873	71000	0.05	4883664	244183	315183	1.96	0.09
Gambia														
1	Gambia	Fishing trawler	Finfishes nei	1	207	273240	259578	88769	0.05	168000	8400	97169	0.37	5.08
2	Gambia	Fishing trawler	Finfishes nei	1	103	136586	129757	39000	0.05	432000	21600	60600	0.47	1.05
3	Gambia	Fishing vessel	Finfishes nei	53	636	805176	764917	145200	0.05	1210790	60540	205740	0.27	2.56
4	Gambia	Fishing vessel	Finfishes nei	1	12	15840	15048	7800	0.05	1000	50	7850	0.52	36.24
5	Gambia	Fishing vessel	Finfishes nei	1	30	36900	35055	19000	0.05	39215	1961	20961	0.60	2.05
Morocco														
1	Morocco	Fishing trawler	Finfishes nei	1	30	30350	28833	6080	0.05	547899	27395	33475	1.16	0.21
Ireland														
1	Ireland	Fishing trawler	Finfishes nei	1	7.5	19335	17402	4820	0.1	44723	4472	9292	0.53	1.41
2	Ireland	Fishing trawler	Finfishes nei	1	7.2	18706	16835	4739	0.1	43559	4356	9095	0.54	1.39
3	Ireland	Fishing trawler	Finfishes nei	1	7.3	18921	17029	5832	0.1	52483	5248	11080	0.65	1.07
4	Ireland	Fishing trawler	Finfishes nei	1	7.2	20000	18000	6739	0.1	34850	3485	10224	0.57	1.62
5	Ireland	Fishing trawler	Finfishes nei	1	2	5160	4644	2808	0.1	299	30	2838	0.61	30.70
6	Ireland	Fishing trawler	Finfishes nei	61	427	1101660	991494	369700	0.1	1495662	149566	519266	0.52	2.08
Latvia														
1	Latvia	Fishing boat	Plaice	1	2	4956	4460	2040	0.1	14	1	2041	0.46	864.43
Bulgaria														
1	Bulgaria	Fishing trawler	Turbot	1	8	23770	21393	8568	0.1	4260	426	8994	0.42	15.05

No.	Arresting Country	Vessel / Gear	Illegal Catch / Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
2	Bulgaria	Fishing vessel	Turbot	12	120	260400	234360	128520	0.1	51060	5106	133626	0.57	10.36
3	Bulgaria	Fishing vessel	Turbot	16	160	347200	312480	173120	0.1	68080	6808	179928	0.58	10.24
4	Bulgaria	Fishing vessel	Turbot	1	10	28524	25672	7800	0.1	1848428	184843	192643	7.50	0.05
United Kingdom														
1	UK	Fishing trawler	Atlantic Cod	1	2.4	4331	3898	1242	0.1	5757	576	1818	0.47	2.31
2	UK	Fishing trawler	Atlantic Cod	1	6	10740	9666	3200	0.1	45000	4500	7700	0.80	0.72
3	UK	Factory trawler	Finfishes nei	1	12	25380	22842	6572	0.1	23670	2367	8939	0.39	3.44
4	UK	Fishing trawler	Finfishes nei	1	12	26748	24073	6572	0.1	16077	1608	8180	0.34	5.44
5	UK	Fishing trawler	Finfishes nei	1	2.7	6033	5430	1527	0.1	38183	3818	5345	0.98	0.51
6	UK	Fishing trawler	Finfishes nei	1	12	23736	21362	1800	0.1	45000	4500	6300	0.29	2.17
7	UK	Fishing trawler	Finfishes nei	1	3	5712	5141	4110	0.1	3334	333	4443	0.86	1.55
8	UK	Fishing trawler	Finfishes nei	1	50	104500	94050	70200	0.1	79484	7948	78148	0.83	1.50
9	UK	Fishing trawler	Finfishes nei	1	36	73332	65999	28800	0.1	19000	1900	30700	0.47	9.79
10	UK	Fishing trawler	Finfishes nei	1	36	73332	65999	28800	0.1	514439	51444	80244	1.22	0.36
11	UK	Fishing trawler	Finfishes nei	1	10.8	22849	20564	15163	0.1	78396	7840	23003	1.12	0.34
12	UK	Fishing trawler	Finfishes nei	1	7	32000	28800	9828	0.1	24000	2400	12228	0.42	3.95
13	UK	Fishing vessel	Finfishes nei	1	0.5	963	867	424	0.1	982	98	522	0.60	2.25
14	UK	Fishing vessel	Finfishes nei	1	0.4	1197	1077	374	0.1	1415	142	516	0.48	2.49
15	UK	Fishing vessel	Finfishes nei	70	840	1770720	1593648	756000	0.1	490837	49084	805084	0.51	8.53
Channel Islands														
1	Channel Is.	Fishing trawler	Finfishes nei	1	12	24468	22021	15600	0.1	5500	550	16150	0.73	5.84
France														
1	France	Fishing trawler	Tuna	2	11.2	26742	24068	10483	0.1	13731	1373	11856	0.49	4.95
2	France	Fishing trawler	Tuna	1	10	23480	21132	14040	0.1	57000	5700	19740	0.93	0.62
3	France	Fishing trawler	Tuna	1	10	23480	21132	14000	0.1	28000	2800	16800	0.80	1.27
Norway														
1	Norway	Fishing trawler	Finfishes nei	2	24	24984	22486	18360	0.1	20096	2010	20370	0.91	1.03

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2	Norway	Purse Seiner	Finfishes nei	2	2	916	824	546	0.1	22285	2229	2775	3.37	0.06
3	Norway	Fishing trawler	Atlantic Cod	1	50	55450	49905	40000	0.1	205365	20537	60537	1.21	0.24
4	Norway	Fishing trawler	Atlantic Cod	1	50	55450	49905	40000	0.1	279112	27911	67911	1.36	0.18
Myanmar														
1	Myanmar	Fishing trawler	Finfishes nei	4	208	200000	180000	75504	0.1	126000	12600	88104	0.49	4.15
2	Myanmar	Fishing boat	Finfishes nei	22	11	38192	34372.8	5379	0.1	11400	1140	6519	0.19	12.72
3	Myanmar	Fishing boat	Finfishes nei	7	3.5	12152	10936.8	1711	0.1	17160	1716	3427	0.31	2.69
Palau														
1	Palau	Fishing vessel	Giant Clams	1	10.2	12699	11429	5975	0.1	50000	5000	10975	0.96	0.55
2	Palau	Fishing vessel	Tuna	1	36	329184	296266	88812	0.1	8520	852	89664	0.30	121.75
Papua New Guinea														
1	PNG	Longliner	Tuna	1	100	1102300	992070	80000	0.1	13000800	1300080	1380080	1.39	0.35
Vanuatu														
1	Vanuatu	Longliner	Tuna	1	75	847125	762413	95000	0.1	1157842	115784	210784	0.28	2.88
Solomon Islands														
1	Solomon Is.	Purse Seiner	Tuna	1	500	5511500	4960350	163000	0.1	280000	28000	191000	0.04	85.67
2	Solomon Is.	Purse Seiner	Tuna	1	550	6062650	5456385	237000	0.1	1072000	107200	344200	0.06	24.34
3	Solomon Is.	Purse Seiner	Tuna	6	1500	13357500	12021750	1467000	0.1	1000000	100000	1567000	0.13	52.77
4	Solomon Is.	Fishing vessel	Clams	1	4.5	5161	4645	1856	0.1	10403	1040	2896	0.62	1.34
Marshall Islands														
1	Marshall Islands	Live Reef Fish Carrier	Finfishes nei	1	50	46400	41760	21000	0.1	250000	64000	85000	2.04	0.42
Nauru														
1	Nauru	Purse Seiner	Tuna	2	200	2259000	2033100	155600	0.1	1000000	100000	255600	0.13	9.39
Japan														
1	Japan	Fishing vessel	Sardines	1	20	14000	12600	8258	0.1	47730	4773	13031	1.03	0.45

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Russia														
1	Russia	Fishing trawler	Pacific Cod	1	382	371686	334517.4	126772	0.1	470786	47079	173851	0.52	2.21
2	Russia	Fishing vessel	Finfishes nei	141	263000	318756000	286880400	71169000	0.1	335462988	33546299	104715299	0.37	3.22
3	Russia	Fishing vessel	Finfishes nei	15	99000	119988000	107989200	16116000	0.1	120054700	12005470	28121470	0.26	3.83
4	Russia	Fishing vessel	Red Crabs	1	10	70100	63090	9840	0.1	84926	8493	18333	0.29	3.14
Malaysia														
1	Malaysia	Fishing trawler	Finfishes nei	3	120	206280	185652	43560	0.1	21456	2146	45706	0.25	33.11
2	Malaysia	Fishing trawler	Finfishes nei	7	210	340620	306558	56230	0.1	1190948	119095	175325	0.57	1.05
3	Malaysia	Fishing trawler	Finfishes nei	1	30	48750	43875	5890	0.1	310293	31029	36919	0.84	0.61
4	Malaysia	Fishing trawler	Finfishes nei	5	100	162500	146250	16300	0.1	1142081	114208	130508	0.89	0.57
5	Malaysia	Fishing trawler	Finfishes nei	6	240	390000	351000	17120	0.1	1913190	191319	208439	0.59	0.87
6	Malaysia	Fishing trawler	Finfishes nei	5	200	325000	292500	32600	0.1	1190583	119058	151658	0.52	1.09
7	Malaysia	Fishing trawler	Finfishes nei	1	40	59680	53712	4520	0.1	715680	71568	76088	1.42	0.34
8	Malaysia	Fishing trawler	Finfishes nei	9	180	268200	241380	65340	0.1	1830079	183008	248348	1.03	0.48
9	Malaysia	Fishing trawler	Finfishes nei	1	20	27020	24318	11560	0.1	3636	364	11924	0.49	17.54
10	Malaysia	Fishing trawler	Finfishes nei	1	30	40200	36180	10890	0.1	312150	31215	42105	1.16	0.41
11	Malaysia	Fishing trawler	Finfishes nei	1	40	53600	48240	42840	0.1	434330	43433	86273	1.79	0.06
12	Malaysia	Fishing trawler	Finfishes nei	2	60	114600	103140	8650	0.1	611932	61193	69843	0.68	0.77
13	Malaysia	Fishing trawler	Finfishes nei	4	160	305600	275040	58080	0.1	2257774	225777	283857	1.03	0.48
14	Malaysia	Fishing vessel	Finfishes nei	4	120	195000	175500	78280	0.1	342928	34293	112573	0.64	1.42
15	Malaysia	Fishing vessel	Finfishes nei	4	80	119360	107424	19040	0.1	1610336	161034	180074	1.68	0.27
16	Malaysia	Fishing vessel	Finfishes nei	1	30	44700	40230	8130	0.1	481700	48170	56300	1.40	0.33
17	Malaysia	Fishing vessel	Sharks	1	0.05	24	22	4	0.1	460000	46000	46004	2129.81	0.0002
Australia														
1	Australia	Fishing trawler	Trochus	2	1	6000	5400	471	0.1	376680	37668	38139	7.06	0.07
2	Australia	Fishing vessel	Trochus	1	2	8000	7200	1256	0.1	22440	2244	3500	0.49	1.32
3	Australia	Fishing boat	Trochus	1	2	6000	5400	1256	0.1	256	26	1282	0.24	80.94

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4	Australia	Fishing boat	Trochus	1	2	6000	5400	1256	0.1	256	26	1282	0.24	80.94
5	Australia	Fishing boat	Trochus	1	1	6000	5400	392	0.1	25000	2500	2892	0.54	1.00
6	Australia	Fishing vessel	Clams	1	4.5	56000	50400	4401	0.1	83983	8398	12799	0.25	2.74
7	Australia	Fishing vessel	Clams	1	3	45000	40500	2934	0.1	115767	11577	14511	0.36	1.62
8	Australia	Fishing vessel	Bluefin Tuna	1	298	1387488	1248739	47256	0.1	6016600	601660	648916	0.52	1.00
9	Australia	Fishing vessel	Gemfish	1	3	3441	3097	1969	0.1	3902	390	2359	0.76	1.45
10	Australia	Fishing vessel	Rock Lobsters	1	0.2	260	234	74	0.1	3183	318	392	1.68	0.25
11	Australia	Fishing vessel	Finfishes nei	1	5	58000	52200	3400	0.1	139286	13929	17329	0.33	1.75
12	Australia	Fishing vessel	Finfishes nei	2	8	48000	43200	6240	0.1	139536	13954	20194	0.47	1.32
13	Australia	Fishing vessel	Finfishes nei	1	12	72000	64800	9360	0.1	172965	17297	26657	0.41	1.60
14	Australia	Fishing vessel	Finfishes nei	1	0.4	2000	1800	359	0.1	3554	355	714	0.40	2.03
15	Australia	Fishing vessel	Finfishes nei	1	0.5	2500	2250	449	0.1	6900	690	1139	0.51	1.31
16	Australia	Fishing vessel	Finfishes nei	1	1	3480	3132	978	0.1	8383	838	1816	0.58	1.28
17	Australia	Motorised Gillnetter	Finfishes nei	1	0.5	2642	2378	449	0.1	6924	692	1141	0.48	1.39
18	Australia	Gillnetter	Finfishes nei	1	1.5	5220	4698	1347	0.1	7000	700	2047	0.44	2.39
19	Australia	Gillnetter	Finfishes nei	1	1.5	5220	4698	1347	0.1	7090	709	2056	0.44	2.36
20	Australia	Longliner	Finfishes nei	1	12	60000	54000	9864	0.1	68044	6804	16668	0.31	3.24
21	Australia	Longliner	Finfishes nei	1	6	30000	27000	4232	0.1	35745	3575	7807	0.29	3.18
22	Australia	Longliner	Tuna	1	60	126600	113940	56800	0.1	4596	460	57260	0.50	62.16
23	Australia	Longliner	Tuna	1	40	84400	75960	30200	0.1	123626	12363	42563	0.56	1.85
24	Australia	Longliner	Tuna	1	175	1028481	925633	602800	0.1	1505535	150554	753354	0.81	1.07
25	Australia	Longliner	Tuna	1	13.5	62856	56570	48816	0.1	66474	6647	55463	0.98	0.58
26	Australia	Longliner	Tuna	1	235	1092896	983606	319745	0.1	1246799	124680	444425	0.45	2.66
27	Australia	Fishing boat	Sharks	2	2.5	9750	8775	2160	0.1	13652	1365	3525	0.40	2.42
28	Australia	Fishing boat	Sharks	1	0.5	3984	3586	434	0.1	4916	492	926	0.26	3.21
29	Australia	Fishing boat	Sharks	1	0.1	36	32	16	0.1	1166	117	133	4.09	0.07

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30	Australia	Fishing boat	Sharks	1	1.5	1720	1548	1246	0.1	3588	359	1605	1.04	0.42
31	Australia	Fishing boat	Sharks	5	0.5	2294	2065	409	0.1	4632	463	872	0.42	1.79
32	Australia	Fishing boat	Sharks	6	16	18000	16200	11408	0.1	37758	3776	15184	0.94	0.63
New Zealand														
1	NewZealand	Fishing trawler	Finfishes nei	1	100	255400	229860	103400	0.1	617894	61789	165189	0.72	1.02
2	NewZealand	Fishing trawler	Finfishes nei	1	30	34410	30969	24326	0.1	1323689	132369	156695	5.06	0.03
3	NewZealand	Fishing trawler	Finfishes nei	1	50	67350	60615	48964	0.1	1500000	150000	198964	3.28	0.04
4	NewZealand	Fishing trawler	Finfishes nei	1	60	78820	70938	54696	0.1	1200000	120000	174696	2.46	0.07
5	NewZealand	Fishing trawler	Finfishes nei	1	60	78820	70938	54696	0.1	1345736	134574	189270	2.67	0.06
6	NewZealand	Fishing trawler	Finfishes nei	3	698	900000	810000	642000	0.1	3741970	374197	1016197	1.25	0.22
7	NewZealand	Fishing trawler	Finfishes nei	1	30	44410	39969	34070	0.1	1500000	150000	184070	4.61	0.020
8	NewZealand	Fishing vessel	Finfishes nei	1	30	76620	68958	46020	0.1	405338	40534	86554	1.26	0.28
9	NewZealand	Fishing vessel	Finfishes nei	1	50	144200	129780	53550	0.1	147907	14791	68341	0.53	2.58
10	NewZealand	Fishing vessel	Finfishes nei	1	50	144200	129780	53550	0.1	147907	14791	68341	0.53	2.58
11	NewZealand	Fishing vessel	Finfishes nei	1	50	144200	129780	53550	0.1	149637	14964	68514	0.53	2.55
12	NewZealand	Longliner	Tuna	2	20	220460	198414	46840	0.1	499949	49995	96835	0.49	1.52

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Canada						**1995-2009**								
1	Canada	Fishing trawler	Atlantic Cod	1	47.6	50087	40070	38956	0.2	69817	13963	52919	1.32	0.08
2	Canada	Fishing vessel	Atlantic Cod	1	0.02	7	6	4	0.2	2329	466	470	83.89	0.003
3	Canada	Fishing boat	Atlantic Cod	1	0.0008	2	2	1	0.2	408	82	83	51.63	0.01
4	Canada	Fishing boat	Atlantic Cod	1	0.01	54	43	19	0.2	2040	408	427	9.88	0.06
5	Canada	Fishing vessel	Sablefish	1	0.5	758	606	244	0.2	7697	1539	1783	2.94	0.24
6	Canada	Fishing vessel	Sablefish	1	1.9	2806	2245	904	0.2	6434	1287	2191	0.98	1.04

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7	Canada	Fishing vessel	Sablefish	1	0.06	91	73	29	0.2	1274	255	284	3.90	0.17
8	Canada	Fishing vessel	Coho Salmon	1	0.05	179	161	22	0.1	1683	168	190	1.18	0.41
9	Canada	Fishing vessel	Coho Salmon	1	0.003	11	10	1.4	0.1	511	51	53	5.30	0.08
10	Canada	Fishing boat	Coho Salmon	1	0.005	19	17	2.4	0.1	319	32	34	2.01	0.23
11	Canada	Fishing vessel	Coho Salmon	1	0.3	1222	1100	278	0.1	4023	402	680	0.62	1.02
12	Canada	Fishing vessel	Chum Salmon	1	0.6	2230	2007	445	0.1	1892	189	634	0.32	4.13
13	Canada	Fishing vessel	Chum Salmon	1	1	3906	3515	890	0.1	2561	256	1146	0.33	5.13
14	Canada	Fishing vessel	Chinook Salmon	1	0.3	1171	1054	107	0.1	4987	499	606	0.57	0.95
15	Canada	Fishing vessel	Chinook Salmon	2	0.2	830	747	87	0.1	2713	271	358	0.48	1.22
16	Canada	Fishing vessel	Sockeye Salmon	1	0.3	1003	903	114	0.1	673	67	181	0.20	5.86
17	Canada	Fishing boat	Sockeye Salmon	1	2.8	6163	5547	954	0.1	3355	336	1290	0.23	6.84
18	Canada	Fishing vessel	Sockeye Salmon	1	1.2	4746	4271	868	0.1	7802	780	1648	0.39	2.18
19	Canada	Fishing vessel	Salmon	1	1	3906	3515	490	0.1	1720	172	662	0.19	8.79
20	Canada	Fishing vessel	Salmon	1	1	1633	1470	401	0.1	3807	381	782	0.53	1.40
21	Canada	Fishing boat	Salmon	1	0.7	2422	2180	323	0.1	2052	205	528	0.24	4.52
22	Canada	Fishing vessel	Salmon	1	0.09	295	266	60	0.1	912	91	151	0.57	1.13
23	Canada	Fishing vessel	Salmon	1	1	3906	3515	190	0.1	904	90	280	0.08	18.39
24	Canada	Fishing boat	Salmon	1	1	3460	3114	160	0.1	5746	575	735	0.24	2.57
25	Canada	Fishing vessel	Salmon	1	0.2	781	703	78	0.1	2041	204	282	0.40	1.53
26	Canada	Fishing vessel	Salmon	1	0.2	781	703	78	0.1	741	74	152	0.22	4.22
27	Canada	Fishing vessel	Salmon	2	0.1	390	351	49	0.1	1854	185	234	0.67	0.81
28	Canada	Fishing vessel	Salmon	1	0.1	390	351	49	0.1	1854	185	234	0.67	0.81
29	Canada	Fishing vessel	Salmon	1	0.3	1171	1054	97	0.1	2051	205	302	0.29	2.33
30	Canada	Fishing vessel	Salmon	1	2	7812	7031	380	0.1	6305	631	1011	0.14	5.27
31	Canada	Fishing boat	Salmon	1	0.004	15	14	1.9	0.1	468	47	49	3.61	0.12
32	Canada	Fishing vessel	Salmon	1	0.005	19	17	2.4	0.1	749	75	77	4.52	0.10
33	Canada	Fishing vessel	Salmon	1	0.02	78	70	16	0.1	5606	561	577	8.21	0.05

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34	Canada	Fishing vessel	Salmon	1	0.58	2289	2060	83	0.1	5319	532	615	0.30	1.86
35	Canada	Fishing vessel	Rock fish	1	0.7	603	482	347	0.2	3367	673	1020	2.12	0.29
36	Canada	Fishing vessel	Rockfish	2	2.5	6437	5150	1222	0.2	5180	1036	2258	0.44	3.79
37	Canada	Fishing vessel	Rockfish	1	1.6	14960	11968	4436	0.2	18537	3707	8143	0.68	2.03
38	Canada	Fishing vessel	Lingcod	1	2.4	2410	1928	1124	0.2	2020	404	1528	0.79	1.99
39	Canada	Fishing vessel	Lingcod	1	10.3	10423	8338	8264	0.2	12319	2464	10728	1.29	0.03
40	Canada	Fishing trawler	Flounder	1	0.5	1341	1073	714	0.2	2586	517	1231	1.15	0.69
41	Canada	Fishing vessel	Finfishes nei	1	0.2	101	81	74	0.2	4710	942	1016	12.57	0.01
42	Canada	Fishing vessel	Finfishes nei	1	0.2	420	336	274	0.2	1696	339	613	1.83	0.18
43	Canada	Fishing vessel	Finfishes nei	5	0.2	470	376	134	0.2	3905	781	915	2.43	0.31
44	Canada	Fishing vessel	Skate	1	0.6	185	148	98	0.2	2624	525	623	4.21	0.10
45	Canada	Fishing vessel	Wolf fish	1	0.07	19	15	14	0.2	2457	491	505	33.25	0.002
46	Canada	Fishing trawler	Grey Cod	1	26	15895	12716	12684	0.2	60606	12121	24805	1.95	0.003
47	Canada	Fishing vessel	Lobsters	1	0.01	65	52	36	0.2	3135	627	663	12.75	0.03
48	Canada	Fishing vessel	Red Sea Urchins	1	1.7	2942	2648	831	0.1	1912	191	1022	0.39	4.75
49	Canada	Fishing vessel	Dungeness crab	1	0.8	3038	2734	697	0.1	1909	191	888	0.32	5.34
50	Canada	Fishing vessel	Dungeness crab	1	0.3	2589	2330	158	0.1	939	94	252	0.11	11.57
51	Canada	Fishing vessel	Dungeness crab	1	0.2	1925	1733	596	0.1	6661	666	1262	0.73	0.85
52	Canada	Fishing vessel	Tanner Crabs	1	1	2919	2627	489	0.1	6195	620	1109	0.42	1.73
53	Canada	Crabber	Crabs	1	1	7467	6720	489	0.1	1457	146	635	0.09	21.38
54	Canada	Fishing vessel	Crabs	1	4.5	11326	10193	3896	0.1	31488	3149	7045	0.69	1.00
55	Canada	Fishing vessel	Crabs	1	4.5	11326	10193	3896	0.1	6289	629	4525	0.44	5.01
56	Canada	Fishing vessel	Crabs	1	1	2098	1888	968	0.1	1148	115	1083	0.57	4.01
57	Canada	Fishing vessel	Crabs	1	1	7763	6987	489	0.1	1346	135	624	0.09	24.14
58	Canada	Fishing boat	Crabs	1	0.3	755	680	384	0.1	5275	528	912	1.34	0.28
59	Canada	Fishing trawler	Shrimps	1	3	23904	19123	3000	0.2	1453	291	3291	0.17	55.48
60	Canada	Fishing vessel	Shrimps	1	1	7763	6210	1200	0.2	774	155	1355	0.22	32.37

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61	Canada	Fishing vessel	Shrimps	1	2	11756	9405	3414	0.2	10434	2087	5501	0.58	2.87
62	Canada	Fishing vessel	Shrimps	1	1	5878	4702	1707	0.2	9106	1821	3528	0.75	1.64
63	Canada	Fishing vessel	Shrimps	1	1.5	8817	7054	2560	0.2	7422	1484	4044	0.57	3.03
64	Canada	Fishing vessel	Shrimps	1	0.009	71	57	15	0.2	1616	323	338	5.95	0.13
65	Canada	Fishing vessel	Shrimps	1	0.001	7.9	6	1.7	0.2	1542	308	310	49.07	0.01
66	Canada	Fishing vessel	Shrimps	1	5	29390	23512	8535	0.2	14145	2829	11364	0.48	5.29
67	Canada	Fishing vessel	Shrimps	1	1	5878	4702	1707	0.2	6118	1224	2931	0.62	2.45
68	Canada	Fishing vessel	Shrimps	1	0.6	3526	2821	1024	0.2	3331	666	1690	0.60	2.70
69	Canada	Fishing vessel	Shrimps	1	0.2	1175	940	341	0.2	749	150	491	0.52	4.00
70	Canada	Dive Gear	Abalone	0	0.4	488	439	349	0.1	800	80	429	0.98	0.56
71	Canada	Dive Gear	Abalone	0	0.1	714	643	133	0.1	1362	136	269	0.42	1.87
72	Canada	Dive Gear	Abalone	0	0.3	785	707	332	0.1	3622	362	694	0.98	0.52
73	Canada	Dive Gear	Abalone	0	1.7	2052	1847	1632	0.1	101396	10140	11772	6.37	0.01
74	Canada	Dive Gear	Abalone	0	0.1	131	118	101	0.1	5355	536	637	5.40	0.02
75	Canada	Dive Gear	Abalone	0	0.1	66	59	46	0.1	2008	201	247	4.15	0.03
76	Canada	Dive Gear	Abalone	0	0.1	250	225	111	0.1	20523	2052	2163	9.61	0.03
77	Canada	Dive Gear	Abalone	0	0.1	133	120	53	0.1	30466	3047	3100	25.89	0.01
USA														
1	USA	Fishing trawler	Finfishes nei	1	1	243	194	119	0.2	760276	152055	152174	782.79	0.0005
2	USA	Fishing trawler	Finfishes nei	1	3	7689	6151	3116	0.2	6000	1200	4316	0.70	2.53
3	USA	Fishing trawler	Finfishes nei	1	3	7767	6214	3116	0.2	5000	1000	4116	0.66	3.10
4	USA	Fishing trawler	Alaska Pollack	1	0.02	3	2	1.2	0.2	180000	36000	36001	15000.50	0.00003
5	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	49500	4950	5445	1.85	0.25
6	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	46500	4650	5145	1.75	0.26
7	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	39000	3900	4395	1.50	0.31
8	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	38750	3875	4370	1.49	0.32
9	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	35500	3550	4045	1.38	0.34

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10	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	30000	3000	3495	1.19	0.41
11	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	28000	2800	3295	1.12	0.44
12	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	27500	2750	3245	1.10	0.44
13	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	26500	2650	3145	1.07	0.46
14	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	22500	2250	2745	0.93	0.54
15	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	16645	1665	2160	0.73	0.73
16	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	15000	1500	1995	0.68	0.81
17	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	8950	895	1390	0.47	1.37
18	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	7500	750	1245	0.42	1.63
19	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	7190	719	1214	0.41	1.70
20	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	6750	675	1170	0.40	1.81
21	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	4500	450	945	0.32	2.72
22	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	4140	414	909	0.31	2.95
23	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	3750	375	870	0.30	3.26
24	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	3000	300	795	0.27	4.07
25	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	3000	300	795	0.27	4.07
26	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	3000	300	795	0.27	4.07
27	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	2500	250	745	0.25	4.89
28	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	1500	150	645	0.22	8.15
29	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	1310	131	626	0.21	9.33
30	USA	Fishing vessel	Red Snapper	1	0.6	3265	2939	495	0.1	1000	100	595	0.20	12.22
31	USA	Fishing vessel	Red Snapper	5	4.3	24156	21740	5885	0.1	800000	80000	85885	3.95	0.10
32	USA	Fishing vessel	Red Snapper	1	0.2	1268	1141	294	0.1	18000	1800	2094	1.83	0.24
33	USA	Fishing vessel	Red Snapper	2	0.5	2949	2654	686	0.1	12500	1250	1936	0.73	0.79
34	USA	Fishing vessel	Red Snapper	1	0.01	56	50	17	0.1	4000	400	417	8.27	0.04
35	USA	Fishing vessel	Red Snapper	1	0.01	56	50	17	0.1	1500	150	167	3.31	0.11
36	USA	Fishing vessel	Red Snapper	1	0.01	59	53	17	0.1	4500	450	467	8.79	0.04

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37	USA	Fishing vessel	Red Snapper	1	0.3	1812	1631	411	0.1	3000	300	711	0.44	2.03
38	USA	Fishing vessel	Red Snapper	1	0.2	1125	1013	274	0.1	1980	198	472	0.47	1.86
39	USA	Fishing vessel	Red Snapper	1	0.4	2303	2073	1093	0.1	1500	150	1243	0.60	3.27
40	USA	Fishing vessel	Red Snapper	1	0.1	562	506	277	0.1	1500	150	427	0.84	0.76
41	USA	Sport fishing vessel	Red Snapper	1	0.2	1161	1045	546	0.1	750	75	621	0.59	3.33
42	USA	Refrigerated Freighter vessel	Yellow fin Sole	1	12	1224	1102	896	0.1	150000	15000	15896	14.43	0.01
43	USA	Fishing vessel	Rock fish	1	2.7	2782	2504	2108	0.1	40000	4000	6108	2.44	0.05
44	USA	Fishing vessel	Sharks	1	600	714600	643140	420000	0.1	620000	62000	482000	0.75	1.80
45	USA	Fishing vessel	Black Cod	3	3	9084	8176	4116	0.1	24899	2490	6606	0.81	0.82
46	USA	Sport fishing vessel	Halibut	1	3.2	11462	10316	8608	0.1	3000	300	8908	0.86	2.85
47	USA	Fishing vessel	Halibut	1	3.8	27000	24300	5268	0.1	52000	5200	10468	0.43	1.83
48	USA	Fishing vessel	Vermillion Snapper	1	0.01	64	58	15	0.1	2044	204	219	3.81	0.10
49	USA	Fishing vessel	Chinook Salmon	1	0.02	60	54	16	0.1	11000	1100	1116	20.67	0.02
50	USA	Fishing vessel	Salmon	1	3	4761	4285	2058	0.1	10000	1000	3058	0.71	1.11
51	USA	Fishing vessel	Black tip Sharks	1	5	4905	4415	2842	0.1	380000	38000	40842	9.25	0.02
52	USA	Fishing vessel	Amberjack	1	1.4	2654	2389	2100	0.1	10100	1010	3110	1.30	0.14
53	USA	Fishing vessel	Bluefin Tuna	1	100	483100	434790	97800	0.1	280000	28000	125800	0.29	6.02
54	USA	Longliner	Tuna	1	42	205000	184500	108612	0.1	105000	10500	119112	0.65	3.61
55	USA	Longliner	Finfishes nei	1	2.9	7500	6750	5484	0.1	4000	400	5884	0.87	1.58
56	USA	Longliner	Finfishes nei	1	0.003	8	7	6	0.1	32098	3210	3216	446.64	0.0002
57	USA	Longliner	Finfishes nei	1	0.07	170	153	132	0.1	41069	4107	4239	27.71	0.0026
58	USA	Longliner	Red Grouper	1	1.9	11192	10073	5192	0.1	21092	2109	7301	0.72	1.16
59	USA	Fishing vessel	Grouper	1	0.6	3396	3056	1639	0.1	23000	2300	3939	1.29	0.31
60	USA	Fishing vessel	Grouper	1	0.01	566	509	27	0.1	30000	3000	3027	5.94	0.08
61	USA	Fishing vessel	Herring	1	6803	1204131	1083718	887894	0.1	510000	51000	938894	0.87	1.92
62	USA	Fishing vessel	Finfishes nei	1	1.5	3901	3511	2058	0.1	25000	2500	4558	1.30	0.29

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63	USA	Fishing vessel	Finfishes nei	1	15	66555	59900	20580	0.1	269000	26900	47480	0.79	0.73
64	USA	Fishing vessel	Finfishes nei	1	0.05	130	117	68	0.1	2000	200	268	2.29	0.12
65	USA	Fishing vessel	Finfishes nei	1	0.3	1127	1014	444	0.1	22000	2200	2644	2.61	0.13
66	USA	Fishing vessel	Finfishes nei	1	0.1	358	322	145	0.1	2100	210	355	1.10	0.42
67	USA	Fishing vessel	Finfishes nei	1	2.9	7644	6880	4033	0.1	15000	1500	5533	0.80	0.95
68	USA	Fishing vessel	Finfishes nei	1	3	7539	6785	4116	0.1	250000	25000	29116	4.29	0.05
69	USA	Fishing vessel	Finfishes nei	1	4.4	12000	10800	6036	0.1	37500	3750	9786	0.91	0.64
70	USA	Fishing vessel	Finfishes nei	1	2.2	9693	8724	1990	0.1	25000	2500	4490	0.51	1.35
71	USA	Fishing vessel	Finfishes nei	1	3	7767	6990	4116	0.1	11500	1150	5266	0.75	1.25
72	USA	Fishing trawler	Finfishes nei	1	3	4458	4012	3284	0.1	190000	19000	22284	5.55	0.02
73	USA	Fishing trawler	Shrimps	1	1.4	6122	5510	2389	0.1	10122	1012	3401	0.62	1.54
74	USA	Fishing trawler	Shrimps	1	1	10124	9112	1637	0.1	18424	1842	3479	0.38	2.03
75	USA	Fishing trawler	Shrimps	1	3.8	30433	27390	11600	0.1	45433	4543	16143	0.59	1.74
76	USA	Fishing trawler	Shrimps	1	18.9	78399	70559	32296	0.1	78399	7840	40136	0.57	2.44
77	USA	Fishing vessel	Lobsters	1	0.3	3846	3461	1124	0.1	10000	1000	2124	0.61	1.17
78	USA	Fishing vessel	Lobsters	1	10	111410	100269	5600	0.1	68000	6800	12400	0.12	6.96
79	USA	Fishing vessel	Lobsters	1	0.3	3044	2740	826	0.1	68000	6800	7626	2.78	0.14
80	USA	Fishing vessel	Dungeness crab	1	0.3	439	417	94	0.05	9965	498	592	1.42	0.16
81	USA	Fishing vessel	Dungeness crab	1	0.1	218	207	75	0.05	7311	366	441	2.13	0.09
82	USA	Fishing vessel	Dungeness crab	1	3	4329	4113	1087	0.05	16994	850	1937	0.47	0.89
83	USA	Fishing vessel	Dungeness crab	1	1.5	2638	2506	998	0.05	6741	337	1335	0.53	1.12
84	USA	Fishing vessel	Dungeness crab	1	1	1586	1507	784	0.05	14565	728	1512	1.00	0.25
85	USA	Fishing vessel	Dungeness crab	1	1	1589	1510	848	0.05	13150	658	1506	1.00	0.25
86	USA	Fishing vessel	Red King Crabs	1	33	30618	27556	14564	0.1	30000	3000	17564	0.64	2.17
87	USA	Crab catcher / Processor	Red King Crabs	1	21	282597	254337	69426	0.1	19100	1910	71336	0.28	48.41
88	USA	Fishing vessel	Stone crabs	1	0.6	919	827	546	0.1	4500	450	996	1.20	0.31

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Howland & Baker Islands														
1	USA	Purse Seiner	Skipjack Tuna	1	500	350000	315000	196000	0.1	850000	85000	281000	0.89	0.70
Marianas Islands														
1	USA	Longliner	Tuna	1	50	5511150	4960035	117000	0.1	152000	15200	132200	0.03	159.31
2	USA	Longliner	Tuna	2	10	110230	99207	11420	0.1	260000	26000	37420	0.38	1.69
3	USA	Longliner	Tuna	1	25	275575	248018	38550	0.1	130000	13000	51550	0.21	8.06
4	USA	Longliner	Sharks	1	10	18050	16245	9880	0.1	500000	50000	59880	3.69	0.06
5	USA	Fishing Catamaran	Finfishes nei	1	0.05	80	72	16	0.1	100000	10000	10016	139.11	0.003
Guam														
1	USA	Longliner	Sharks	1	1.4	11000	9900	1130	0.1	31000	3100	4230	0.43	1.41
2	USA	Longliner	Sharks	1	68	77996	70196	28984	0.1	10000	1000	29984	0.43	20.61
American Samoa														
1	USA	Longliner	Tuna	1	18.3	200000	160000	22563	0.2	300000	60000	82563	0.52	2.29
2	USA	Longliner	Tuna	1	3	32622	26098	3513	0.2	61000	12200	15713	0.60	1.85
3	USA	Longliner	Tuna	1	18.8	205000	164000	13180	0.2	310000	62000	75180	0.46	2.43
4	USA	Longliner	Albacore Tuna	1	40	434960	347968	39320	0.2	105000	21000	60320	0.17	14.70
5	USA	Fishing vessel	Albacore Tuna	1	0.5	5437	4350	489	0.2	5000	1000	1489	0.34	3.86
6	USA	Fishing vessel	Albacore Tuna	1	28	44569	35655	22000	0.2	120000	24000	46000	1.29	0.57
7	USA	Fishing vessel	Finfishes nei	1	9.4	18000	14400	4209	0.2	100000	20000	24209	1.68	0.51
8	USA	Fishing Catamaran	Lobsters	1	0.09	185	148	72	0.2	3500	700	772	5.22	0.11
Guyana														
1	Guyana	Fishing trawler	Finfishes nei	3	18	44280	39852	8298	0.1	16844	1684	9982	0.25	9.37
2	Guyana	Fishing trawler	Finfishes nei	4	12	28092	25283	5532	0.1	5263	526	6058	0.24	18.76
Brazil														
1	Brazil	Fishing trawlers	Finfishes nei	4	18	39456	37483	4476	0.05	290787	14539	19015	0.51	0.57
2	Brazil	Fishing vessel	Finfishes nei	1	1.2	2630	2499	304	0.05	10590	530	834	0.33	1.04

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3	Brazil	Fishing vessel	Sardines	2	39	205301	195036	10338	0.05	280848	14042	24380	0.13	3.29
4	Brazil	Fishing vessel	Catfish	1	5	7290	6926	1910	0.05	67266	3363	5273	0.76	0.37
5	Brazil	Fishing vessel	Yellow Croaker	1	6	13566	12888	2092	0.05	72000	3600	5692	0.44	0.75
6	Brazil	Fishing vessel	Lobsters	2	0.1	1682	1598	38	0.05	11806	590	628	0.39	0.66
7	Brazil	Fishing vessel	Lobsters	2	0.05	841	799	19	0.05	36000	1800	1819	2.28	0.11
8	Brazil	Fishing vessel	Lobsters	4	0.3	5516	5240	114	0.05	24363	1218	1332	0.25	1.05
9	Brazil	Fishing vessel	Lobsters	3	0.2	3364	3196	77	0.05	26000	1300	1377	0.43	0.60
10	Brazil	Fishing vessel	Lobsters	1	0.006	109	104	9	0.05	6200	310	319	3.08	0.08
11	Brazil	Fishing vessel	Lobsters	5	0.4	6728	6392	104	0.05	28000	1400	1504	0.24	1.12
Peru														
1	Peru	Fishing vessel	Finfishes nei	1	0.2	190	171	62	0.1	13000	1300	1362	7.96	0.04
2	Peru	Squid jigger	Squids	6	690	185610	167049	85380	0.1	600000	60000	145380	0.87	0.68
Argentina														
1	Argentina	Fishing trawler	Finfishes nei	1	22	24926	19941	15864	0.2	200000	40000	55864	2.80	0.10
2	Argentina	Fishing trawler	Finfishes nei	1	163	191000	152800	101126	0.2	1350000	270000	371126	2.43	0.19
3	Argentina	Fishing trawler	Finfishes nei	1	50	59100	47280	23600	0.2	1500000	300000	323600	6.84	0.08
4	Argentina	Fishing trawler	Finfishes nei	1	24	28994	23195	17960	0.2	2400000	480000	497960	21.47	0.01
5	Argentina	Fishing trawler	Finfishes nei	1	25	30698	24558	11525	0.2	1200000	240000	251525	10.24	0.05
6	Argentina	Fishing trawler	Finfishes nei	1	22	26312	21050	14084	0.2	563500	112700	126784	6.02	0.06
7	Argentina	Fishing trawler	Finfishes nei	1	50	59800	47840	36700	0.2	647284	129456.8	166156	3.47	0.09
8	Argentina	Fishing trawler	Finfishes nei	1	39	50000	40000	28808	0.2	1549237	309847.4	338655	8.47	0.04
9	Argentina	Fishing trawler	Finfishes nei	1	22	25268	20214	10142	0.2	275268	55053.6	65195	3.23	0.18
10	Argentina	Fishing trawler	Hake	1	150	143100	114480	49150	0.2	487581	97516.2	146666	1.28	0.67
11	Argentina	Fishing trawler	Squids	1	20	6740	5392	4000	0.2	57000	11400	15400	2.86	0.12
12	Argentina	Squid jigger	Squids	1	60	416460	333168	107240	0.2	600000	120000	227240	0.68	1.88
13	Argentina	Squid jigger	Squids	1	50	11850	9480	6890	0.2	350000	70000	76890	8.11	0.04
14	Argentina	Squid jigger	Squids	1	100	23700	18960	13200	0.2	400000	80000	93200	4.92	0.07

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15	Argentina	Squid jigger	Squids	1	0.5	123	98	58	0.2	300000	60000	60058	610.35	0.0007
16	Argentina	Squid jigger	Squids	1	0.5	130	104	51	0.2	700000	140000	140051	1346.64	0.0004
17	Argentina	Squid jigger	Squids	1	0.4	106	85	41	0.2	700000	140000	140041	1651.43	0.0003
18	Argentina	Squid jigger	Squids	1	190	45030	36024	26004	0.2	700000	140000	166004	4.61	0.07
19	Argentina	Squid jigger	Squids	1	200	1388200	1110560	236600	0.2	700000	140000	376600	0.34	6.24
20	Argentina	Squid jigger	Squids	1	8	55528	44422	10288	0.2	700000	140000	150288	3.38	0.24
21	Argentina	Squid jigger	Squids	1	5	34705	27764	1035	0.2	700000	140000	141035	5.08	0.19
22	Argentina	Squid jigger	Squids	1	12	2844	2275	1452	0.2	500000	100000	101452	44.59	0.008
23	Argentina	Squid jigger	Squids	1	3	2133	1706	306	0.2	510000	102000	102306	59.95	0.01
24	Argentina	Squid jigger	Squids	1	0.8	189	151	58	0.2	450000	90000	90058	595.62	0.001
25	Argentina	Squid jigger	Squids	1	3	711	569	220	0.2	450000	90000	90220	158.61	0.004
26	Argentina	Squid jigger	Squids	1	0.5	124	99	45	0.2	650000	130000	130045	1310.94	0.0004
Panama														
1	Panama	Shrimp trawler	Shrimps	1	0.5	500	450	198	0.1	1000	100	298	0.66	1.26
Costa Rica														
1	Costa Rica	Purse Seiner	Tuna	1	230	471270	424143	124840	0.1	668000	66800	191640	0.45	2.24
2	Costa Rica	Fishing vessel	Tuna	1	100	204900	184410	38200	0.1	331500	33150	71350	0.39	2.21
Nicaragua														
1	Nicaragua	Fishing vessel	Finfishes nei	2	0.3	1035	932	106	0.1	4000	400	506	0.54	1.03
2	Nicaragua	Fishing boat	Finfishes nei	3	0.1	283	255	47	0.1	18000	1800	1847	7.25	0.06
3	Nicaragua	Fishing boat	Finfishes nei	12	1	2838	2554	478	0.1	9600	960	1438	0.56	1.08
4	Nicaragua	Fishing vessel	Lobsters	4	0.8	7260	6534	722	0.1	200000	20000	20722	3.17	0.15
5	Nicaragua	Fishing vessel	Lobsters	4	0.8	6292	5663	520	0.1	5000	500	1020	0.18	5.14
El Salvador														
1	El Salvador	Fishing vessel	Finfishes nei	1	0.2	618	556	108	0.1	8008	801	909	1.63	0.28
2	El Salvador	Fishing vessel	Finfishes nei	1	3.2	8689	7820	1463	0.1	16589	1659	3122	0.40	1.92

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3	El Salvador	Tuna vessel	Tuna	3	8.2	16728	15055	7984	0.1	24000	2400	10384	0.69	1.47
Belize														
1	Belize	Fishing boat	Finfishes nei	9	4.5	9049	8597	1074	0.05	70070	3504	4578	0.53	0.54
British Virgin Islands														
1	UK	Fishing vessel	Finfishes nei	1	3	6549	5894	2219	0.1	15000	1500	3719	0.63	1.23
2	UK	Fishing trawler	Finfishes nei	1	0.5	1091	982	364	0.1	1000	100	464	0.47	3.09
Cuba														
1	Cuba	Fishing vessel	Lobsters & Finfishes nei	34	16	118572	112643	8416	0.05	970000	48500	56916	0.51	0.54
2	Cuba	Fishing vessel	Lobsters & Finfishes nei	26	8.5	16677	15843	3533	0.05	307000	15350	18883	1.19	0.20
Bahamas														
1	Bahamas	Fishing vessel	Finfishes nei	1	1.2	2727	2591	872	0.05	50000	2500	3372	1.30	0.17
2	Bahamas	Fishing vessel	Finfishes nei	1	1.2	2871	2727	872	0.05	29850	1493	2365	0.87	0.31
3	Bahamas	Fishing vessel	Finfishes nei	1	3	4443	4221	1430	0.05	29700	1485	2915	0.69	0.47
4	Bahamas	Fishing vessel	Nassau Grouper	1	1.09	9710	9225	825	0.05	37695	1885	2710	0.29	1.11
5	Bahamas	Fishing vessel	Groupers	1	0.001	2	2	0.7	0.05	52613	2631	2631	1384.92	0.0001
6	Bahamas	Fishing vessel	Lobsters & Finfishes nei	1	0.2	515	489	75	0.05	8955	448	523	1.07	0.23
7	Bahamas	Fishing vessel	Lobsters & Finfishes nei	1	0.2	540	513	75	0.05	56715	2836	2911	5.67	0.04
8	Bahamas	Fishing vessel	Lobsters & Finfishes nei	1	30	71831	68239	11300	0.05	155560	7778	19078	0.28	1.83
Jamaica														
1	Jamaica	Fishing vessel	Conch	1	1	2193	2083	778	0.05	54000	2700	3478	1.67	0.12
2	Jamaica	Fishing vessel	Conch & Lobsters	1	0.5	1009	959	395	0.05	153475	7674	8069	8.42	0.02
3	Jamaica	Fishing vessel	Conch & Lobsters	1	0.3	695	660	310	0.05	21272	1064	1374	2.08	0.08
Trinidad & Tobago														
1	Trinidad & Tobago	Fishing vessel	Flying fish	1	1.7	1035	983	584	0.05	420	21	605	0.62	4.75
2	Trinidad & Tobago	Fishing vessel	Flying fish	1	1.7	1035	983	584	0.05	1600	80	664	0.68	1.25

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3	Trinidad & Tobago	Fishing vessel	Flying fish	1	1.7	1035	983	584	0.05	1600	80	664	0.68	1.25
4	Trinidad & Tobago	Fishing vessel	Finfishes nei	1	1	2285	2171	461	0.05	1123	56	517	0.24	7.61
5	Trinidad & Tobago	Fishing vessel	Finfishes nei	2	0.2	371	352	14	0.05	2234	112	126	0.36	0.76
6	Trinidad & Tobago	Fishing vessel	Finfishes nei	1	1	2294	2179	461	0.05	1889	94	555	0.25	4.55
7	Trinidad & Tobago	Fishing trawler	Finfishes nei	1	3	5544	5267	1383	0.05	2500	125	1508	0.29	7.77
Greenland														
1	Greenland	Purse seiner	Capelin	3	1020	2100000	1680000	406000	0.2	300408	60082	466082	0.28	21.20
Falkland Islands – British Overseas territory														
1	UK	Fishing trawler	Rays	1	85	59965	53969	36584	0.1	114500	11450	48034	0.89	0.76
2	UK	Fishing trawler	Rays	1	85	60000	54000	36584	0.1	39937	3994	40578	0.75	2.18
3	UK	Longliner	Toothfish	1	2	3534	3181	796	0.1	13163	1316	2112	0.66	0.91
4	UK	Longliner	Toothfish	1	3	5301	4771	1984	0.1	37470	3747	5731	1.20	0.37
5	UK	Squid Jigger	Squids	1	469	254000	228600	200104	0.1	68575	6858	206962	0.91	2.08
South Georgia – British Antarctic Territory														
1	UK	Longliner	Toothfish	1	75	132525	119273	32475	0.1	135000	13500	45975	0.39	3.21
2	UK	Longliner	Toothfish	1	80	141360	127224	12600	0.1	3700000	370000	382600	3.01	0.15
3	UK	Longliner	Toothfish	1	40	70680	63612	5800	0.1	560000	56000	61800	0.97	0.52
4	UK	Longliner	Toothfish	1	73	129125	116213	8842	0.1	570870	57087	65929	0.57	0.94
5	UK	Longliner	Toothfish	1	15	26505	23855	10000	0.1	146848	14685	24685	1.03	0.47
6	UK	Longliner	Toothfish	1	10	17670	15903	7084	0.1	4589	459	7543	0.47	9.61
Kerguelen Islands – French Antarctic Territory														
1	France	Fishing Vessel	Toothfish	1	170	300390	240312	56300	0.2	538474	107695	173995	0.72	0.81
2	France	Fishing vessel	Toothfish	1	80	163760	131008	31000	0.2	245942	49188	81188	0.62	1.01
3	France	Fishing Vessel	Toothfish	1	158	340806	272645	170956	0.2	177873	35575	206531	0.76	1.43
4	France	Longliner	Toothfish	1	45	92115	73692	16000	0.2	500000	100000	118000	1.60	0.28

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5	France	Longliner	Toothfish	1	6	12942	10354	2400	0.2	1200000	240000	242400	23.41	0.02
6	France	Longliner	Toothfish	1	60	327000	261600	42720	0.2	8957680	1791536	1864256	7.13	0.05
Crozet islands – French Antarctic Territory														
1	France	Fishing trawler	Toothfish	1	3	6048	4838	2212	0.2	78023	15605	17817	3.68	0.17
2	France	Longliner	Toothfish	1	200	409400	327520	90284	0.2	8000000	1600000	1690284	5.16	0.15
3	France	Longliner	Toothfish	1	2.3	4634	3707	1684	0.2	78670	15734	17418	4.70	0.13
St. Paul Island – French Antarctic territory														
1	France	Longliner	Toothfish	1	1.5	3022	2720	1556	0.1	2400	240	1796	0.66	2.42
Heard & Mc Donald Islands – Australian Antarctic territory														
1	Australia	Longliner	Toothfish	1	116	813760	732384	104000	0.1	3069169	306917	410917	0.56	0.51
2	Australia	Longliner	Toothfish	1	80	480222	432200	80000	0.1	3053358	305336	385336	0.89	0.29
3	Australia	Longliner	Toothfish	1	21	90300	81270	5720	0.1	5869600	586960	592680	7.29	0.03
4	Australia	Longliner	Toothfish	1	25	100000	90000	7000	0.1	732976	73298	80298	0.89	0.28
5	Australia	Longliner	Toothfish	1	145	930000	837000	199500	0.1	564660	56466	255966	0.31	2.82
6	Australia	Longliner	Toothfish	1	122	524600	472140	168400	0.1	212932	21293	189693	0.40	3.57
7	Australia	Longliner	Toothfish	1	500	3000000	2700000	491000	0.1	69500	6950	497950	0.18	79.46
8	Australia	Longliner	Toothfish	1	4	24000	21600	2408	0.1	62962	6296	8704	0.40	0.76
Seychelles														
1	Seychelles	Fishing vessel	Finfishes nei	1	0.6	337	303	98	0.1	100000	10000	10098	33.29	0.01
2	Seychelles	Fishing vessel	Finfishes nei	1	0.5	431	388	84	0.1	12000	1200	1284	3.31	0.13
3	Seychelles	Fishing vessel	Finfishes nei	1	0.5	431	388	84	0.1	25000	2500	2584	6.66	0.06
4	Seychelles	Fishing vessel	Finfishes nei	1	1	863	777	246	0.1	25000	2500	2746	3.54	0.11
5	Seychelles	Fishing vessel	Finfishes nei	1	0.5	530	477	112	0.1	45285	4529	4641	9.73	0.04
6	Seychelles	Longliner	Finfishes nei	1	0.1	106	95	22	0.1	95000	9500	9522	99.81	0.004
7	Seychelles	Longliner	Finfishes nei	1	0.8	976	878	164	0.1	100000	10000	10164	11.57	0.04
8	Seychelles	Fishing vessel	Sea Cucumbers	1	150	172050	154845	122300	0.1	24384	2438	124738	0.81	6.67
9	Seychelles	Fishing vessel	Sharks	1	32.5	2860	2574	1100	0.1	50892	5089	6189	2.40	0.14

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10	Seychelles	Longliner	Sharks	1	0.3	26	23	7	0.1	460000	46000	46007	1966.11	0.0002
11	Seychelles	Purse seiner	Tuna	4	1156	329460	296514	136876	0.1	200000	20000	156876	0.53	3.99
12	Seychelles	Purse seiner	Tuna	1	262	74670	67203	18962	0.1	50000	5000	23962	0.36	4.82
13	Seychelles	Purse seiner	Tuna	1	1	300	270	136	0.1	2981	298	434	1.61	0.22
14	Seychelles	Longliner	Tuna	1	6	1710	1539	812	0.1	1828	183	995	0.65	1.99
15	Seychelles	Longliner	Tuna	1	24	6840	6156	3214	0.1	100000	10000	13214	2.15	0.15
16	Seychelles	Longliner	Tuna	1	24	6888	6199	3214	0.1	33170	3317	6531	1.05	0.45
17	Seychelles	Longliner	Tuna	1	6	1722	1550	826	0.1	175021	17502	18328	11.83	0.02
Comoros Islands														
1	Comoros Is.	Longliner	Tuna	1	36	10260	9234	6894	0.2	59944	5994	12888	1.40	0.20
Madagascar														
1	Madagascar	Fishing vessel	Sharks	1	30	2640	2376	1486	0.1	121140	12114	13600	5.72	0.04
2	Madagascar	Fishing vessel	Sharks	1	34.6	16246	3284	2980	0.1	122685	12269	15249	4.64	0.47
Tromelin														
1	France	Fishing trawler	Tuna	2	886	254540	229086	74986	0.1	528171	52817	127803	0.56	1.46
Chagos Islands – British Indian Ocean territory														
1	UK	Fishing vessel	Finfishes nei	1	20	22940	20646	10894	0.1	14705	1471	12365	0.60	3.32
2	UK	Drift netter	Finfishes nei	1	30	22640	20376	12899	0.1	29720	2972	15871	0.78	1.26
3	UK	Longliner	Tuna	1	100	264400	237960	87100	0.1	1600000	160000	247100	1.04	0.47
4	UK	Longliner	Tuna	1	10	2850	2565	886	0.1	17668	1767	2653	1.03	0.48
5	UK	Tuna vessel	Tuna	1	3	23112	20801	2493	0.1	18606	1861	4354	0.21	4.92
6	UK	Tuna vessel	Tuna	1	1.5	115556	104000	2308	0.1	35212	3521	5829	0.06	14.44
7	UK	Fishing vessel	Sharks	1	2	176	158	82	0.1	29410	2941	3023	19.08	0.01
8	UK	Longliner	Sharks	1	2	176	158	82	0.1	126871	12687	12769	80.61	0.003
9	UK	Longliner	Sharks	1	3.2	1609	1448	394	0.1	6955	696	1090	0.75	0.76
10	UK	Longliner	Sharks	1	5.5	2766	2489	894	0.1	6955	696	1590	0.64	1.15
11	UK	Fishing vessel	Sea Cucumbers	1	20	22940	20646	4894	0.1	22015	2202	7096	0.34	3.58

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12	UK	Fishing vessel	Sea Cucumbers	1	20	22940	20646	4894	0.1	18364	1836	6730	0.33	4.29
Sri Lanka														
1	Sri Lanka	Fishing trawler	Finfishes nei	1	20	34480	32756	10680	0.05	39480	1974	12654	0.39	2.80
2	Sri Lanka	Fishing boat	Finfishes nei	1	0.1	204	194	36	0.05	73	4	40	0.20	10.85
3	Sri Lanka	Fishing boat	Finfishes nei	1	0.1	282	268	18	0.05	5400	270	288	1.08	0.23
4	Sri Lanka	Fishing boat	Finfishes nei	5	0.5	1412	1341	98	0.05	8550	428	526	0.39	0.73
5	Sri Lanka	Fishing boat	Finfishes nei	2	0.2	565	537	55	0.05	1500	75	130	0.24	1.61
6	Sri Lanka	Fishing boat	Finfishes nei	3	0.6	1695	1610	135	0.05	600	30	165	0.10	12.29
7	Sri Lanka	Fishing boat	Finfishes nei	3	0.6	1695	1610	135	0.05	3450	173	308	0.19	2.14
Egypt														
1	Egypt	Fishing vessel	Shrimps	1	0.04	46	44	24	0.05	10	1	25	0.56	9.85
2	Egypt	Fishing vessel	Shrimps	1	0.02	25	24	5	0.05	85	4	9	0.39	1.10
3	Egypt	Fishing vessel	Shrimps	1	0.003	4	4	2	0.05	128	6	8	2.08	0.09
4	Egypt	Fishing vessel	Shrimps	1	0.02	18	17	9	0.05	15	1	10	0.57	2.70
Eritrea														
1	Eritrea	Fishing boat	Finfishes nei	1	1.2	4003	3603	1285	0.1	2573	257	1542	0.43	4.50
Somalia														
1	Somalia	Fishing trawler	Skipjack tuna	1	100	28500	25650	11894	0.1	1200000	120000	131894	5.14	0.06
2	Somalia	Fishing trawler	Finfishes nei	2	60	90780	81702	34000	0.1	130000	13000	47000	0.58	1.83
3	Somalia	Fishing trawler	Finfishes nei	1	30	40800	36720	12894	0.1	230000	23000	35894	0.98	0.52
4	Somalia	Fishing trawler	Finfishes nei	1	30	27210	24489	12894	0.1	230000	23000	35894	1.47	0.25
5	Somalia	Fishing trawler	Finfishes nei	1	50	45600	41040	22846	0.1	850000	85000	107846	2.63	0.11
6	Somalia	Fishing trawler	Finfishes nei	3	3	3348	3013	1600	0.1	450000	45000	46600	15.47	0.02
7	Somalia	Fishing trawler	Finfishes nei	1	50	55800	50220	22890	0.1	800000	80000	102890	2.05	0.17
8	Somalia	Fishing trawler	Finfishes nei	3	60	66960	60264	34896	0.1	503065	50307	85203	1.41	0.25
9	Somalia	Fishing boat	Finfishes nei	4	4	7348	6613	986	0.1	21000	2100	3086	0.47	1.34

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10	Somalia	Deep-sea Longliner	Sharks	1	50	88400	79560	16550	0.1	300000	30000	46550	0.59	1.05
11	Somalia	Deep-sea trawler	Sharks	1	2500	1257500	1131750	485000	0.1	867000	86700	571700	0.51	3.73
Tanzania														
1	Tanzania	Fishing vessels	Finfishes nei	15	150	172050	163448	69500	0.05	300000	15000	84500	0.52	1.57
Mozambique														
1	Mozambique	Shrimp trawler	Finfishes nei	4	130	150000	142500	47190	0.05	333500	16675	63865	0.45	1.43
2	Mozambique	Fishing vessel	Tuna	1	12.3	18869	17926	5894	0.05	400000	20000	25894	1.44	0.15
3	Mozambique	Purse seiner	Guitar fish	1	2030	1021090	970036	315340	0.05	1333500	66675	382015	0.39	2.45
4	Mozambique	Fishing trawler	Sharks	2	70	300000	285000	50510	0.05	660000	33000	83510	0.29	1.78
5	Mozambique	Longliner	Sharks	1	145	5000000	4750000	190870	0.05	4500000	225000	415870	0.09	5.07
South Africa														
1	South Africa	Fishing vessel	Finfishes nei	1	30	25470	22923	6846	0.1	142000	14200	21046	0.92	0.57
2	South Africa	Fishing vessel	Finfishes nei	1	53	87537	78783	21896	0.1	90170	9017	30913	0.39	3.15
3	South Africa	Fishing vessel	Tuna	1	49.3	14068	12661	11095	0.1	58587	5859	16954	1.34	0.13
4	South Africa	Fishing trawler	Hake	1	2225	1751820	1576638	807450	0.1	346000	34600	842050	0.53	11.12
5	South Africa	Fishing boat	Brindle Bass Fish	1	0.1	32	29	11	0.1	26704	2670	2681	93.10	0.003
6	South Africa	Squid Jigger	Squids	1	10	9540	8586	2894	0.1	74339	7434	10328	1.20	0.38
7	South Africa	Longliner	Sharks	1	10	880	792	684	0.1	7500	750	1434	1.81	0.07
8	South Africa	Fishing trawler	Lobsters	2	200	2172200	1954980	196400	0.1	4000000	400000	596400	0.31	2.20
9	South Africa	Carrier Fishing Vessel	Lobsters	1	100	1086100	977490	71900	0.1	885640	88564	160464	0.16	5.11
10	South Africa	Dive gear	Abalone	0	2.8	3211	2569	1294	0.2	4464	893	2187	0.85	1.43
11	South Africa	Dive gear	Abalone	0	1.5	5161	4129	1467	0.2	5623	1125	2592	0.63	2.37
12	South Africa	Dive gear	Abalone	0	3	12312	9850	1934	0.2	73795	14759	16693	1.69	0.54
Namibia														
1	Namibia	Fishing trawler	Finfishes nei	1	1	1623	1298	760	0.2	7741	1548	2308	1.78	0.35
2	Namibia	Fishing trawler	Finfishes nei	1	1	1623	1298	760	0.2	4644	929	1689	1.30	0.58

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3	Namibia	Fishing trawler	Finfishes nei	1	3	4869	3895	2106	0.2	464	93	2199	0.56	19.28
4	Namibia	Fishing trawler	Finfishes nei	1	3	4869	3895	2246	0.2	4644	929	3175	0.82	1.78
5	Namibia	Fishing trawler	Finfishes nei	1	12	19476	15581	11600	0.2	3488	698	12298	0.79	5.71
6	Namibia	Fishing trawler	Finfishes nei	1	12	17160	13728	11600	0.2	1548	310	11910	0.87	6.87
7	Namibia	Fishing trawler	Finfishes nei	1	3	4290	3432	2486	0.2	7815	1563	4049	1.18	0.61
8	Namibia	Fishing trawler	Finfishes nei	1	12	20184	16147	11689	0.2	19686	3937	15626	0.97	1.13
9	Namibia	Factory Fishing trawler	Finfishes nei	1	12	19476	15581	9842	0.2	464	93	9935	0.64	61.84
10	Namibia	Longliner	Finfishes nei	1	6.2	2378	1902	1289	0.2	51816	10363	11652	6.13	0.06
11	Namibia	Fishing vessel	Finfishes nei	1	35	33950	27160	18940	0.2	7501	1500	20440	0.75	5.48
12	Namibia	Fishing vessel	Finfishes nei	7	168	47880	38304	17896	0.2	2400000	480000	497896	13.00	0.04
13	Namibia	Fishing vessel	Finfishes nei	4	4	5816	4653	4076	0.2	1114	223	4299	0.92	2.59
Angola														
1	Angola	Fishing trawler	Finfishes nei	1	100	71800	64620	52146	0.1	4000000	400000	452146	7.00	0.02
2	Angola	Fishing trawler	Finfishes nei	2	36	34884	31396	10890	0.1	40000	4000	14890	0.47	2.56
3	Angola	Fishing trawler	Finfishes nei	4	72	70920	63828	32894	0.1	60000	6000	38894	0.61	2.58
4	Angola	Fishing trawler	Finfishes nei	18	324	319140	287226	210894	0.1	600000	60000	270894	0.94	0.64
5	Angola	Fishing trawler	Finfishes nei	1	24	23640	21276	9896	0.1	150000	15000	24896	1.17	0.38
6	Angola	Fishing trawler	Finfishes nei	2	36	35460	31914	11890	0.1	40000	4000	15890	0.50	2.50
7	Angola	Pair trawler	Finfishes nei	2	24	23640	21276	9896	0.1	138000	13800	23696	1.11	0.41
8	Angola	Purse seiners	Finfishes nei	3	36	35460	31914	11890	0.1	120000	12000	23890	0.75	0.83
Equatorial Guinea														
1	Equatorial Guinea	Refrigerated Cargo Ship	Finfishes nei	1	2789	2041548	1939471	965600	0.05	500000	25000	990600	0.51	9.74
Cameroon														
1	Cameroon	Fishing trawler	Finfishes nei	2	100	136500	129675	70300	0.05	98000	4900	75200	0.58	3.03
Ghana														
1	Ghana	Fishing trawler	Finfishes nei	2	30	24210	21789	6896	0.1	20000	2000	8896	0.41	3.72

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2	Ghana	Fishing trawler	Finfishes nei	2	30	24210	21789	6896	0.1	48000	4800	11696	0.54	1.55
3	Ghana	Fishing trawler	Finfishes nei	2	30	24210	21789	6896	0.1	20000	2000	8896	0.41	3.72
4	Ghana	Fishing trawler	Finfishes nei	2	30	24210	21789	6896	0.1	100000	10000	16896	0.78	0.74
5	Ghana	Fishing trawler	Finfishes nei	2	30	24210	21789	6896	0.1	100000	10000	16896	0.78	0.74
Liberia														
1	Liberia	Fishing trawler	Finfishes nei	1	30	25800	24510	4324	0.05	327000	16350	20674	0.84	0.31
Sierra Leone														
1	Sierra Leone	Fishing trawler	Finfishes nei	3	36	34164	32456	7954	0.05	200000	10000	17954	0.55	0.61
2	Sierra Leone	Fishing trawler	Finfishes nei	1	12	11256	10693	2840	0.05	30000	1500	4340	0.41	1.31
3	Sierra Leone	Fishing trawler	Finfishes nei	1	12	11256	10693	2840	0.05	35000	1750	4590	0.43	1.12
4	Sierra Leone	Fishing trawler	Finfishes nei	1	12	11256	10693	2840	0.05	30000	1500	4340	0.41	1.31
5	Sierra Leone	Fishing vessel	Finfishes nei	2	24	22512	21386	6896	0.05	11000	550	7446	0.35	6.59
6	Sierra Leone	Fishing vessel	Finfishes nei	1	18	16884	16040	4846	0.05	2600000	130000	134846	8.41	0.02
7	Sierra Leone	Fishing trawler	Finfishes nei	1	18	16884	16040	4846	0.05	40000	2000	6846	0.43	1.40
8	Sierra Leone	Fishing trawler	Finfishes nei	4	21	9000	8550	6192	0.05	2145000	107250	113442	13.27	0.005
9	Sierra Leone	Purse Seiner	Tuna	1	220	300000	285000	58000	0.05	600000	30000	88000	0.31	1.89
Guinea Bissau														
1	Guinea Bissau	Reefer fishing vessel	Finfishes nei	1	1295	1160320	1102304	78200	0.05	234703	11735	89935	0.08	21.82
2	Guinea Bissau	Fishing trawler	Finfishes nei	4	48	65184	61925	6000	0.05	1505980	75299	81299	1.31	0.19
3	Guinea Bissau	Fishing trawler	Finfishes nei	5	60	81480	77406	10234	0.05	3187350	159368	169602	2.19	0.11
4	Guinea Bissau	Fishing trawler	Finfishes nei	20	120	107520	102144	34890	0.05	1530000	76500	111390	1.09	0.22
5	Guinea Bissau	Fishing trawler	Finfishes nei	5	60	53760	51072	12891	0.05	2500000	125000	137891	2.70	0.08
6	Guinea Bissau	Fishing trawler	Finfishes nei	1	12	11760	11172	1244	0.05	315865	15793	17037	1.52	0.16
7	Guinea Bissau	Fishing trawler	Finfishes nei	44	528	473088	449434	220410	0.05	7000000	350000	570410	1.27	0.16
8	Guinea Bissau	Fishing trawler	Finfishes nei	1	3	2688	2554	872	0.05	150000	7500	8372	3.28	0.06

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9	Guinea Bissau	Fishing trawler	Finfishes nei	2	24	21504	20429	9892	0.05	400000	20000	29892	1.46	0.13
10	Guinea Bissau	Fishing vessel	Finfishes nei	4	48	65184	61925	21000	0.05	1075700	53785	74785	1.21	0.19
11	Guinea Bissau	Fishing Canoes	Finfishes nei	80	16	14336	13619	424	0.05	60000	3000	3424	0.25	1.10
Gambia														
1	Gambia	Fishing trawler	Finfishes nei	1	30	35880	34086	6200	0.05	1320000	66000	72200	2.12	0.11
2	Gambia	Fishing trawler	Finfishes nei	3	18	22014	20913	8890	0.05	147644	7382	16272	0.78	0.41
3	Gambia	Fishing trawler	Finfishes nei	4	24	28080	26676	6300	0.05	98900	4945	11245	0.42	1.03
4	Gambia	Fishing vessel	Finfishes nei	6	180	215280	204516	13200	0.05	805432	40272	53472	0.26	1.19
5	Gambia	Fishing vessel	Finfishes nei	1	12	14352	13634	1942	0.05	46979	2349	4291	0.31	1.24
6	Gambia	Fishing vessel	Finfishes nei	1	30	34680	32946	4000	0.05	126529	6326	10326	0.31	1.14
7	Gambia	Fishing vessel	Finfishes nei	4	48	55488	52714	4286	0.05	241375	12069	16355	0.31	1.00
8	Gambia	Fishing vessel	Finfishes nei	3	18	22014	20913	1896	0.05	216780	10839	12735	0.61	0.44
9	Gambia	Fishing vessel	Finfishes nei	1	12	14040	13338	1942	0.05	2259	113	2055	0.15	25.22
Mauritania														
1	Mauritania	Fishing trawler	Hake	1	100	81800	73620	32890	0.1	62593	6259	39149	0.53	3.25
2	Mauritania	Fishing trawler	Finfishes nei	1	12	9816	8834	1612	0.1	28451	2845	4457	0.50	1.27
Morocco														
1	Morocco	Fishing trawler	Finfishes nei	4	120	159240	151278	118480	0.05	120000	6000	124480	0.82	1.37
2	Morocco	Fishing trawler	Finfishes nei	1	12	16356	15538	6204	0.05	150000	7500	13704	0.88	0.31
3	Morocco	Fishing trawler	Finfishes nei	1	30	42390	40271	13852	0.05	37368	1868	15720	0.39	3.53
4	Morocco	Fishing vessel	Finfishes nei	1	30	34980	33231	13852	0.05	33000	1650	15502	0.47	2.94
5	Morocco	Freezer vessel	Octopus	1	100	95400	90630	22895	0.05	653940	32697	55592	0.61	0.52
6	Morocco	Fishing vessel	Clams	1	0.03	45	43	9	0.05	28219	1411	1420	33.22	0.006
Sudan														
1	Sudan	Fishing vessel	Finfishes nei	1	2	1772	1683	482	0.05	3759	188	670	0.40	3.20
2	Sudan	Fishing boat	Finfishes nei	1	0.5	253	240	19	0.05	2300	115	134	0.56	0.96

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3	Sudan	Fishing boat	Finfishes nei	5	2.5	1267	1204	88	0.05	34570	1729	1817	1.51	0.32
Yemen														
1	Yemen	Fishing vessel	Finfishes nei	1	140	308280	292866	111480	0.05	1150000	57500	168980	0.58	0.79
2	Yemen	Fishing boat	Finfishes nei	3	36	89064	84610.8	26684	0.05	150000	7500	34184	0.40	1.93
Qatar														
1	Qatar	Fishing boat	Finfishes nei	7	3.5	5260	4734	911	0.1	96064	9606	10517	2.22	0.20
2	Qatar	Fishing boat	Finfishes nei	6	3	4509	4058.1	867	0.1	82340	8234	9101	2.24	0.19
3	Qatar	Fishing Dhow	Finfishes nei	8	2	3006	2705.4	678	0.1	45000	4500	5178	1.91	0.23
Bahrain														
1	Bahrain	Fishing vessel	Finfishes nei	2	24	55440	49896	15968	0.1	130000	13000	28968	0.58	1.30
2	Bahrain	Fishing boat	Finfishes nei	1	1	2310	2079	489	0.1	795	79.5	568.5	0.27	10.00
Malta														
1	Malta	Fishing trawler	Shrimps	1	3.6	75763	60610	10108	0.2	35356	7071	17179	0.28	7.14
2	Malta	Fishing vessel	Finfishes nei	1	0.6	894	715	410	0.2	49000	9800	10210	14.28	0.03
Croatia														
1	Croatia	Fishing trawler	Pilchards	2	5.6	10378	9340	4200	0.1	18368	1837	6037	0.65	1.40
2	Croatia	Fishing trawler	Finfishes nei	1	10	19980	17982	9896	0.1	12600	1260	11156	0.62	3.21
Spain														
1	Spain	Drift netter	Tuna	1	6	6990	6291	4214	0.1	2731	273	4487	0.71	3.80
2	Spain	Fishing vessel	Finfishes nei	1	100	278600	250740	181300	0.1	38758	3876	185176	0.74	8.96
3	Spain	Fishing vessel	Finfishes nei	1	40	224280	201852	18440	0.1	15614	1561	20001	0.10	58.73
4	Spain	Fishing vessel	Finfishes nei	1	1100	3088800	2779920	1002300	0.1	3153861	315386	1317686	0.47	2.82
Ukraine														
1	Ukraine	Fishing Schooner	Finfishes nei	1	12	28608	25747	6984	0.1	115542	11554	18538	0.72	0.81
2	Ukraine	Fishing Schooner	Finfishes nei	2	3	7152	6437	1513	0.1	40000	4000	5513	0.86	0.62
3	Ukraine	Fishing Schooner	Finfishes nei	1	1.5	3576	3218	906	0.1	9306	931	1837	0.57	1.24

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4	Ukraine	Fishing Schooner	Turbot	1	0.8	1973	1776	586	0.1	10721	1072	1658	0.93	0.55
Ireland														
1	Ireland	Tuna vessel	Bluefin Tuna	1	8.5	96000	76800	4120	0.2	244723	48945	53065	0.69	1.48
2	Ireland	Tuna vessel	Bluefin Tuna	1	80	960000	768000	57600	0.2	1090960	218192	275792	0.36	3.26
3	Ireland	Fishing trawler	Finfishes nei	1	8	20224	16179	5120	0.2	326540	65308	70428	4.35	0.17
4	Ireland	Fishing trawler	Finfishes nei	1	8	19016	15213	6464	0.2	71167	14233	20697	1.36	0.61
5	Ireland	Fishing trawler	Mackerel	1	180	417060	333648	80200	0.2	138504	27701	107901	0.32	9.15
6	Ireland	Fishing trawler	Hake	1	7	34965	27972	12315	0.2	138	28	12343	0.44	567.28
7	Ireland	Fishing trawler	Monkfish	2	3	10980	8784	3705	0.2	122538	24508	28213	3.21	0.21
Sweden														
1	Sweden	Fishing trawler	Atlantic Cod	1	6	11286	9029	1800	0.2	213	43	1843	0.20	169.69
2	Sweden	Fishing trawler	Atlantic Cod	1	1	2040	1632	325	0.2	213	43	368	0.23	30.68
3	Sweden	Fishing vessel	Herring	4	403	106800	85440	44863	0.2	107969	21594	66457	0.78	1.88
Georgia														
1	Georgia	Fishing vessel	Anchovies	1	6.8	2502	2252	1296	0.1	62808	6281	7577	3.36	0.08
2	Georgia	Fishing Seiner	Finfishes nei	1	12	13392	12053	2852	0.1	120000	12000	14852	1.23	0.38
3	Georgia	Fishing Seiner	Finfishes nei	1	6	6696	6026	4926	0.1	28000	2800	7726	1.28	0.20
4	Georgia	Fishing vessel	Finfishes nei	1	23	33442	30098	24633	0.1	92000	9200	33833	1.12	0.30
5	Georgia	Fishing vessel	Finfishes nei	13	600	872400	785160	342600	0.1	380000	38000	380600	0.48	5.82
6	Georgia	Fishing vessel	Finfishes nei	1	46	51336	46202	14642	0.1	120000	12000	26642	0.58	1.32
7	Georgia	Fishing vessel	Finfishes nei	1	46	51336	46202	14642	0.1	156527	15653	30295	0.66	1.01
8	Georgia	Fishing vessel	Finfishes nei	1	46	51336	46202	14642	0.1	125000	12500	27142	0.59	1.26
9	Georgia	Fishing vessel	Finfishes nei	1	6	6696	6026	2214	0.1	125000	12500	14714	2.44	0.15
10	Georgia	Fishing vessel	Finfishes nei	3	180	200880	180792	92780	0.1	260000	26000	118780	0.66	1.69
11	Georgia	Fishing vessel	Finfishes nei	1	6	6696	6026	3214	0.1	27000	2700	5914	0.98	0.52
12	Georgia	Fishing vessel	Finfishes nei	2	90	100440	90396	40852	0.1	135656	13566	54418	0.60	1.83

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13	Georgia	Fishing vessel	Finfishes nei	1	6	6696	6026	1226	0.1	23148	2315	3541	0.59	1.04
14	Georgia	Fishing vessel	Finfishes nei	4	24	26784	24106	8814	0.1	109588	10959	19773	0.82	0.70
15	Georgia	Fishing vessel	Finfishes nei	1	24	26784	24106	8814	0.1	27397	2740	11554	0.48	2.79
16	Georgia	Fishing vessel	Finfishes nei	1	6	6696	6026	3120	0.1	27272	2727	5847	0.97	0.53
17	Georgia	Fishing vessel	Finfishes nei	2	0.5	558	502	412	0.1	69	7	419	0.83	6.54
18	Georgia	Fishing vessel	Finfishes nei	1	24	26784	24106	9864	0.1	23148	2315	12179	0.51	3.08
19	Georgia	Fishing vessel	Finfishes nei	1	12	13392	12053	4842	0.1	23500	2350	7192	0.60	1.53
20	Georgia	Fishing vessel	Finfishes nei	1	6	6696	6026	3120	0.1	23500	2350	5470	0.91	0.62
21	Georgia	Fishing vessel	Finfishes nei	3	150	167400	150660	120650	0.1	88495	8850	129500	0.86	1.70
22	Georgia	Fishing vessel	Finfishes nei	1	50	55800	50220	23550	0.1	42373	4237	27787	0.55	3.15
23	Georgia	Fishing vessel	Finfishes nei	1	2.3	2589	2330	1896	0.1	17751	1775	3671	1.58	0.12
United Kingdom														
1	UK	Fishing trawler	Hake	1	14	64358	51486	17600	0.2	146666	29333	46933	0.91	1.16
2	UK	Fishing trawler	Hake	1	3	13791	11033	4705	0.2	2415	483	5188	0.47	13.10
3	UK	Fishing trawler	Hake	1	2	9623	7698	2526	0.2	38082	7616	10142	1.32	0.68
4	UK	Fishing trawler	Atlantic Cod	1	12	28176	22541	13808	0.2	13401	2680	16488	0.73	3.26
5	UK	Fishing trawler	Atlantic Cod	1	12	28176	22541	13808	0.2	29472	5894	19702	0.87	1.48
6	UK	Fishing trawler	Atlantic Cod	1	4.8	11285	9028	8956	0.2	43854	8771	17727	1.96	0.01
7	UK	Fishing trawler	Atlantic Cod	1	2.9	6869	5495	5396	0.2	27467	5493	10889	1.98	0.02
8	UK	Fishing trawler	Atlantic Cod	1	36	84528	67622	52460	0.2	75387	15077	67537	1.00	1.01
9	UK	Beam trawler	Atlantic Cod	1	12	304864	243891	34584	0.2	47181	9436	44020	0.18	22.18
10	UK	Beam trawler	Atlantic Cod	1	12	32664	26131	13452	0.2	75696	15139	28591	1.09	0.84
11	UK	Fishing trawler	Anglerfish	1	24	89088	71270	70080	0.2	400736	80147	150227	2.11	0.01
12	UK	Fishing trawler	Monk fish	1	3	10137	8110	8024	0.2	20500	4100	12124	1.50	0.02
13	UK	Fishing trawler	Megrim	1	5.2	15431	12345	4834	0.2	17664	3533	8367	0.68	2.13
14	UK	Fishing trawler	Flatfish	6	167	518456	414765	402733	0.2	23928	4786	407519	0.98	2.51
15	UK	Fishing trawler	Sole	1	36	111456	89165	79620	0.2	40154	8031	87651	0.98	1.19

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16	UK	Beam trawler	Sole	1	100	309600	247680	224500	0.2	54369	10874	235374	0.95	2.13
17	UK	Beam trawler	Sole	1	0.2	758	606	284	0.2	41765	8353	8637	14.24	0.04
18	UK	Beam trawler	Sole	1	2.2	6894	5515	3416	0.2	47408	9482	12898	2.34	0.22
19	UK	Scallop dragger	Sole	1	0.6	1857	1486	933	0.2	48995	9799	10732	7.22	0.06
20	UK	Scallop dragger	Sole	1	25	77400	61920	38050	0.2	96619	19324	57374	0.93	1.24
21	UK	Scallop dragger	Finfishes nei	1	4.6	29880	23904	10221	0.2	47648	9530	19751	0.83	1.44
22	UK	Fishing trawler	Finfishes nei	6	55.3	176694	141355	138250	0.2	261303	52261	190511	1.35	0.06
23	UK	Fishing trawler	Finfishes nei	1	12	23340	18672	17432	0.2	24234	4847	22279	1.19	0.26
24	UK	Fishing trawler	Finfishes nei	1	36	70020	56016	46800	0.2	36013	7203	54003	0.96	1.28
25	UK	Fishing trawler	Finfishes nei	1	12	23136	18509	18024	0.2	1569	314	18338	0.99	1.54
26	UK	Fishing trawler	Finfishes nei	1	12	23136	18509	17584	0.2	45055	9011	26595	1.44	0.10
27	UK	Fishing trawler	Finfishes nei	1	3	5595	4476	3028	0.2	5200	1040	4068	0.91	1.39
28	UK	Fishing trawler	Finfishes nei	1	5.3	10000	8000	4892	0.2	44820	8964	13856	1.73	0.35
29	UK	Fishing trawler	Finfishes nei	1	36	102456	81965	33752	0.2	7576	1515	35267	0.43	31.82
30	UK	Fishing trawler	Finfishes nei	1	24	44760	35808	14640	0.2	27077	5415	20055	0.56	3.91
31	UK	Fishing trawler	Finfishes nei	1	12	22380	17904	7540	0.2	35005	7001	14541	0.81	1.48
32	UK	Beam trawler	Finfishes nei	1	36	66708	53366	32620	0.2	20221	4044	36664	0.69	5.13
33	UK	Fishing vessel	Finfishes nei	2	216	423144	338515	108800	0.2	365112	73022	181822	0.54	3.15
34	UK	Fishing vessel	Finfishes nei	1	21	38856	31085	20945	0.2	47165	9433	30378	0.98	1.07
35	UK	Crabber	Crabs	1	50	88500	70800	49750	0.2	101409	20282	70032	0.99	1.04
Isle of Man – British Territory														
1	UK	Fishing trawler	Scallops	1	0.1	203	183	82	0.1	2248	225	307	1.68	0.22
2	UK	Fishing trawler	Scallops	1	0.5	783	705	410	0.1	11184	1118	1528	2.17	0.13
3	UK	Scallop dragger	Scallops	1	0.1	187	168	136	0.1	1627	163	299	1.77	0.10
4	UK	Scallop dragger	Scallops	1	0.2	250	225	152	0.1	3658	366	518	2.30	0.10
5	UK	Scallop dragger	Scallops	1	0.001	2	1	1	0.1	2362	236	237	175.33	0.002
6	UK	Scallop dragger	Scallops	2	2	3132	2819	1346	0.1	23178	2318	3664	1.30	0.32

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7	UK	Fishing trawler	Nephrops	1	0.5	3000	2700	1031	0.1	2403	240	1271	0.47	3.47
Shetland Islands- British Territory														
1	UK	Factory trawler	Finfishes nei	1	12	26352	23717	9572	0.1	23670	2367	11939	0.50	2.99
2	UK	Fishing trawler	Finfishes nei	1	12	24492	22043	11400	0.1	8407	841	12241	0.56	6.33
3	UK	Fishing trawler	Monkfish	1	13	28496	25646	16800	0.1	9973	997	17797	0.69	4.44
Channel Islands														
1	Channel Is.	Fishing trawler	Finfishes nei	1	6	13854	22021	12600	0.1	6000	550	13150	0.60	8.56
France														
1	France	Fishing trawler	Finfishes nei	1	1	2324	1859	912	0.2	32439	6488	7400	3.98	0.15
2	France	Fishing trawler	Finfishes nei	1	0.3	639	511	372	0.2	26084	5217	5589	10.93	0.03
3	France	Fishing trawler	Finfishes nei	1	6.8	10525	8420	3022	0.2	19736	3947	6969	0.83	1.37
4	France	Fishing trawler	Finfishes nei	1	9.7	33510	26808	13536	0.2	10252	2050	15586	0.58	6.47
5	France	Fishing trawler	Burbot	1	0.5	704	563	342	0.2	41089	8218	8560	15.20	0.03
6	France	Fishing trawler	Monkfish	1	3.3	9477	7582	7028	0.2	65677	13135	20163	2.66	0.04
7	France	Fishing trawler	Hake	1	1.5	2343	1874	1642	0.2	8705	1741	3383	1.80	0.13
8	France	Fishing trawler	Nephrops	1	0.2	172	138	104	0.2	7041	1408	1512	10.99	0.02
9	France	Tuna vessel	Anchovies	2	2	562	450	326	0.2	3970	794	1120	2.49	0.16
10	France	Scallop dragger	Scallops	1	14	21868	17494	10108	0.2	13706	2741	12849	0.73	2.69
11	France	Scallop dragger	Scallops	2	28	21118	16894	13216	0.2	30010	6002	19218	1.14	0.61
Madeira Islands – Portuguese Islands Territory														
1	Portugal	Fishing vessel	Tuna	1	2	2370	2133	1484	0.1	1565	157	1641	0.77	2.07
Azores Islands – Portuguese Islands Territory														
1	Portugal	Tuna Seiner	Tuna	1	21	30681	27613	14876	0.1	976	98	14974	0.54	65.25
Norway														
1	Norway	Factory trawler	Finfishes nei	1	81	130256	104205	93303	0.2	13025	2605	95908	0.92	4.18
2	Norway	Fishing trawler	Finfishes nei	1	12	20160	16128	7524	0.2	9262	1852	9376	0.58	4.64
3	Norway	Fishing trawler	Finfishes nei	2	36	60480	48384	25896	0.2	330000	66000	91896	1.90	0.34

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4	Norway	Fishing trawler	Finfishes nei	1	48.5	81480	65184	31755	0.2	100000	20000	51755	0.79	1.67
5	Norway	Fishing trawler	Finfishes nei	1	24	40320	32256	18312	0.2	60000	12000	30312	0.94	1.16
6	Norway	Fishing trawler	Finfishes nei	1	12	20160	16128	15852	0.2	19529	3906	19758	1.23	0.07
7	Norway	Fishing trawler	Finfishes nei	2	12	37096	29677	16852	0.2	46370	9274	26126	0.88	1.38
8	Norway	Fishing trawler	Atlantic Cod	1	18	30240	24192	19984	0.2	36646	7329	27313	1.13	0.57
9	Norway	Fishing trawler	Atlantic Cod	1	36	40644	32515	29852	0.2	156641	31328	61180	1.88	0.09
10	Norway	Fishing trawler	Atlantic Cod	1	55	62095	49676	48112	0.2	97528	19506	67618	1.36	0.08
11	Norway	Fishing trawler	Atlantic Cod	1	100	186100	148880	126300	0.2	1500000	300000	426300	2.86	0.08
12	Norway	Fishing trawler	Atlantic Cod	2	36	60480	48384	45896	0.2	786000	157200	203096	4.20	0.02
13	Norway	Fishing trawler	Atlantic Cod	1	207	755000	604000	268441	0.2	1614000	322800	591241	0.98	1.04
14	Norway	Fishing trawler	Atlantic Cod	1	100	186100	148880	126300	0.2	60081	12016	138316	0.93	1.88
15	Norway	Fishing trawler	Atlantic Cod	1	3	5583	4466	3124	0.2	6500	1300	4424	0.99	1.03
16	Norway	Fishing trawler	Atlantic Cod	1	12	22332	17866	11532	0.2	8612	1722	13254	0.74	3.68
17	Norway	Fishing trawler	Herring	1	400	96400	77120	50000	0.2	100625	20125	70125	0.91	1.35
18	Norway	Fishing trawler	Herring	1	220	38720	30976	24874	0.2	233731	46746	71620	2.31	0.13
19	Norway	Fishing trawler	Herring	1	160	28160	22528	19852	0.2	83968	16794	36646	1.63	0.16
20	Norway	Pelagic Stern trawler	Herring	1	1902	334752	267802	162800	0.2	451989	90398	253198	0.95	1.16
21	Norway	Fishing trawler	Halibut	1	36	44748	35798	24852	0.2	260000	52000	76852	2.15	0.21
22	Norway	Fishing trawler	Halibut	1	363	1975809	1580647	1019304	0.2	1999500	399900	1419204	0.90	1.40
23	Norway	Fishing trawler	Halibut	1	283	1540369	1232295	794664	0.2	1770000	354000	1148664	0.93	1.24
India														
1	India	Longliners	Tuna	1	1	1601	1441	374	0.1	56605	5661	6035	4.19	0.09
2	India	Longliners	Tuna	1	0.2	320	288	36	0.1	1560	156	192	0.67	0.81
3	India	Longliners	Tuna	6	12	10140	9126	5160	0.1	1645	165	5325	0.58	12.05
4	India	Longliners	Tuna	12	12	4152	3737	2894	0.1	12097	1210	4104	1.10	0.35
5	India	Fishing trawler	Finfishes nei	2	111	100000	90000	78599	0.1	7395	740	79339	0.88	7.71

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6	India	Fishing vessel	Finfishes nei	11	33	31515	28364	17090	0.1	1125951	112595	129685	4.57	0.05
7	India	Fishing trawler	Finfishes nei	1	9.2	6171	5554	4079	0.1	35428	3543	7622	1.37	0.21
8	India	Fishing trawler	Finfishes nei	1	1	1000	900	178	0.1	205550	20555	20733	23.04	0.02
9	India	Fishing boat	Finfishes nei	1	2	1934	1741	312	0.1	11777	1178	1490	0.86	0.61
Bangladesh														
1	Bangladesh	Fishing trawler	Finfishes nei	1	57	50000	45000	8691	0.1	162000	16200	24891	0.55	1.12
2	Bangladesh	Fishing trawler	Finfishes nei	3	91.5	150000	135000	23214	0.1	80640	8064	31278	0.23	6.93
Myanmar														
1	Myanmar	Fishing trawler	Finfishes nei	2	12	41568	37411	12852	0.1	10560	1056	13908	0.37	11.63
2	Myanmar	Fishing vessel	Finfishes nei	1	25	57650	51885	42000	0.1	6720	672	42672	0.82	7.35
3	Myanmar	Longliner	Tuna	4	40	15920	14328	8312	0.1	4001520	400152	408464	28.51	0.008
New Caledonia – French Overseas Territory														
1	France	Longliner	Yellow fin tuna	1	8	68432	54746	4136	0.2	272100	54420	58556	1.07	0.93
2	France	Longliner	Tuna	1	10	60850	48680	9420	0.2	192100	38420	47840	0.98	1.02
3	France	Longliner	Tuna	1	33	633247	506598	77286	0.2	91370	18274	95560	0.19	23.49
4	France	Fishing vessel	Sharks	1	40	2294000	1835200	138160	0.2	120000	24000	162160	0.09	70.71
Tonga														
1	Tonga	Longliner	Sharks	1	6	23398	21058	6052	0.1	100000	10000	16052	0.76	0.23
2	Tonga	Longliner	Sharks	1	14.8	90053	81048	24661	0.1	22500	2250	26911	0.33	8.31
3	Tonga	Fishing vessel	Finfishes nei	1	26	158210	142389	30892	0.1	245000	24500	55392	0.39	1.34
Fiji														
1	Fiji	Fishing vessel	Tuna	1	2.2	25000	23750	5427	0.05	31600	1580	7007	0.30	2.90
2	Fiji	Fishing vessel	Tuna	1	6	66138	62831	18052	0.05	1894	95	18147	0.29	118.21
3	Fiji	Longliner	Tuna	1	3.4	9000	8550	5842	0.05	226509	11325	17167	2.01	0.06
4	Fiji	Longliner	Tuna	1	3	33069	31416	9613	0.05	2000	100	9713	0.31	54.51
5	Fiji	Longliner	Tuna	1	6.2	68362	64944	15295	0.05	4000	200	15495	0.24	62.06

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6	Fiji	Longliner	Finfishes nei	1	12	132276	125662	12104	0.05	231200	11560	23664	0.19	2.46
7	Fiji	Longliner	Sharks	1	10	11470	10897	4820	0.05	247127	12356	17176	1.58	0.12
French Polynesia														
1	France	Purse seiner	Tuna	2	1600	17636800	14109440	796800	0.2	205128	41026	837826	0.06	324.50
2	France	Purse seiner	Tuna	1	658	7253134	5802507	112518	0.2	810000	162000	274518	0.05	35.12
3	France	Fishing trawler	Tuna	1	4	44092	35274	1744	0.2	102564	20513	22257	0.63	1.63
Kiribati														
1	Kiribati	Longliner	Tuna	1	6.1	32104	28894	3521	0.1	756000	75600	79121	2.74	0.17
2	Kiribati	Longliner	Tuna	1	16.6	86427	77784	9438	0.1	329000	32900	42338	0.54	1.04
3	Kiribati	Longliner	Tuna	1	12	130488	117439	3600	0.1	2070000	207000	210600	1.79	0.27
4	Kiribati	Longliner	Tuna	1	9.9	109127	98214	9423	0.1	700000	70000	79423	0.81	0.63
5	Kiribati	Longliner	Sharks	1	12	132276	119048	12104	0.1	1022475	102248	114352	0.96	0.52
6	Kiribati	Purse Seiner	Tuna	1	20	217480	195732	19560	0.1	126	13	19573	0.10	6990.95
7	Kiribati	Purse Seiner	Tuna	1	40	440920	396828	39120	0.1	100000	10000	49120	0.12	17.89
Federated States of Micronesia														
1	Micronesia	Longliner	Tuna	4	40	309120	278208	24000	0.1	160000	16000	40000	0.14	7.94
2	Micronesia	Longliner	Tuna	6	70	771610	694449	83940	0.1	717000	71700	155640	0.22	4.26
3	Micronesia	Longliner	Tuna	3	150	1653450	1488105	170050	0.1	310000	31000	201050	0.14	21.26
4	Micronesia	Longliner	Tuna	1	12	132276	119048	18104	0.1	200000	20000	38104	0.32	2.52
Cook Islands														
1	Cook Islands	Longliner	Tuna	1	2.2	24330	21897	1520	0.1	163000	16300	17820	0.81	0.63
2	Cook Islands	Longliner	Tuna	1	25	275575	248018	40400	0.1	300000	30000	70400	0.28	3.46
3	Cook Islands	Longliner	Tuna	1	18	198414	178573	30156	0.1	69000	6900	37056	0.21	10.75
4	Cook Islands	Longliner	Tuna	1	20	262500	236250	34840	0.1	250000	25000	59840	0.25	4.03
5	Cook Islands	Longliner	Albacore Tuna	1	22	242506	218255	40524	0.1	181726	18173	58697	0.27	4.89
6	Cook Islands	Fishing vessel	Tuna	2	36	396828	357145	58812	0.1	439000	43900	102712	0.29	3.40

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Clipperton Island – French Overseas Territory														
1	France	Purse seiner	Tuna	2	1600	17636800	15873120	1564800	0.1	205128	20513	1585313	0.10	348.77
2	France	Fishing vessel	Tuna	1	4	44092	39683	2912	0.1	101000	10100	13012	0.33	1.82
Palau														
1	Palau	Fishing vessel	Finfishes nei	1	10	247250	222525	8710	0.1	25000	2500	11210	0.05	42.76
2	Palau	Fishing vessel	Tuna	1	2600	28659800	25793820	6414200	0.1	40000	4000	6418200	0.25	2422.45
3	Palau	Longliner	Tuna	1	12	130488	117439	28104	0.1	18000	1800	29904	0.25	24.82
4	Palau	Longliner	Sharks	1	50	320000	288000	117100	0.1	13000	1300	118400	0.41	65.73
5	Palau	Longliner	Sharks	1	31	21483	19335	10562	0.1	10000	1000	11562	0.60	4.39
6	Palau	Longliner	Sharks	1	57	5643	5079	4116	0.1	189035	18904	23020	4.53	0.03
Papua New Guinea														
1	PNG	Fishing trawler	Finfishes nei	3	36	159804	143824	11556	0.1	610686	61069	72625	0.50	1.08
2	PNG	Fishing trawler	Finfishes nei	2	24	106536	95882	8728	0.1	544000	54400	63128	0.66	0.80
3	PNG	Mother ship	Finfishes nei	1	45	51615	46454	18195	0.1	452000	45200	63395	1.36	0.31
4	PNG	Fishing boat	Finfishes nei	1	0.8	917	825	339	0.1	585	59	398	0.48	4.16
5	PNG	Fishing boat	Finfishes nei	4	0.4	458	412	259	0.1	16947	1695	1954	4.74	0.05
6	PNG	Fishing vessel	Finfishes nei	1	10	11470	10323	6794	0.1	3176	318	7112	0.69	5.56
7	PNG	Motorised outrigger canoe	Finfishes nei	1	0.6	688	619	138	0.1	1149	115	253	0.41	2.09
8	PNG	Outrigger canoe	Finfishes nei	3	1.8	2064	1858	716	0.1	5419	542	1258	0.68	1.05
9	PNG	Fishing vessel	Tuna	1	36	186732	168059	27600	0.1	115162	11516	39116	0.23	6.10
10	PNG	Longliner	Tuna	2	72	556416	500774	45200	0.1	2077182	207718	252918	0.51	1.10
11	PNG	Longliner	Tuna	3	45	496035	446432	162720	0.1	468180	46818	209538	0.47	3.03
12	PNG	Refrigerated Mother ship	Tuna	1	1190	13117370	11805633	908670	0.1	1340000	134000	1042670	0.09	40.66
13	PNG	Longliner	Sharks	2	12	13764	12388	3002	0.1	447700	44770	47772	3.86	0.10
14	PNG	Longliner	Sharks	1	1	1147	1032	531	0.1	16000	1600	2131	2.06	0.16
15	PNG	Longliner	Sharks	1	1.2	1376	1238	497	0.1	16000	1600	2097	1.69	0.23

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16	PNG	Fishing vessel	Sharks	3	7.5	8602	7742	3232	0.1	10900	1090	4322	0.56	2.07
17	PNG	Fishing vessel	Sharks	1	5	5735	5162	3455	0.1	42399	4240	7695	1.49	0.20
18	PNG	Fishing boat	Sharks	5	250	286750	258075	147750	0.1	39132	3913	151663	0.59	14.10
19	PNG	Outrigger motor boat	Sea Cucumbers	1	0.1	114	103	21	0.1	1323	132	153	1.49	0.31
Vanuatu														
1	Vanuatu	Fishing vessel	Finfishes nei	3	30	34410	30969	14000	0.1	18000	1800	15800	0.51	4.71
2	Vanuatu	Longliner	Sharks	1	12	13764	12388	1972	0.1	45000	4500	6472	0.52	1.16
3	Vanuatu	Longliner	Sharks	1	12	13764	12388	1972	0.1	50000	5000	6972	0.56	1.04
Tuvalu														
1	Tuvalu	Purse Seiner	Tuna	1	50	457200	411480	48900	0.1	122000	12200	61100	0.15	14.86
2	Tuvalu	Purse Seiner	Tuna	1	25	228600	205740	24500	0.1	40000	4000	28500	0.14	22.66
3	Tuvalu	Purse Seiner	Tuna	1	20	171080	153972	21560	0.1	167208	16721	38281	0.25	3.96
4	Tuvalu	Fishing vessel	Tuna	1	10	85540	76986	24670	0.1	10000	1000	25670	0.33	26.16
Solomon Islands														
1	Solomon Is.	Purse Seiner	Tuna	1	250	16660250	14994225	244500	0.1	212500	21250	265750	0.02	347.05
2	Solomon Is.	Purse Seiner	Tuna	1	250	16660250	14994225	244500	0.1	600000	60000	304500	0.02	122.91
3	Solomon Is.	Purse Seiner	Tuna	1	50	259350	233415	48900	0.1	130000	13000	61900	0.27	7.10
4	Solomon Is.	Purse Seiner	Tuna	1	250	2286000	2057400	244500	0.1	200000	20000	264500	0.13	45.32
5	Solomon Is.	Purse Seiner	Tuna	1	25	271850	244665	24450	0.1	75000	7500	31950	0.13	14.68
6	Solomon Is.	Purse Seiner	Tuna	2	300	3306900	2976210	293400	0.1	52320	5232	298632	0.10	256.38
7	Solomon Is.	Purse Seiner	Tuna	1	100	1102300	992070	97800	0.1	11660	1166	98966	0.10	383.48
8	Solomon Is.	Pole & Line Vessel	Tuna	1	50	457200	411480	48900	0.1	100000	10000	58900	0.14	18.13
9	Solomon Is.	Fish Carrier Vessel	Tuna	1	250	2174800	1957320	571000	0.1	869145	86915	657915	0.34	7.98
10	Solomon Is.	Fish Carrier Vessel	Tuna	1	200	2174800	1957320	456800	0.1	433109	43311	500111	0.26	17.32
11	Solomon Is.	Fishing vessel	Tuna	7	350	2324350	2091915	819700	0.1	2884350	288435	1108135	0.53	2.21
12	Solomon Is.	Fishing vessel	Tuna	1	50	543700	489330	114200	0.1	548000	54800	169000	0.35	3.42

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13	Solomon Is.	Fishing vessel	Tuna	1	12	130488	117439	29604	0.1	47000	4700	34304	0.29	9.34
14	Solomon Is.	Longliner	Tuna	2	24	260976	234878	11568	0.1	180000	18000	29568	0.13	6.20
15	Solomon Is.	Longliner	Tuna	1	50	551150	496035	24100	0.1	88000	8800	32900	0.07	26.81
16	Solomon Is.	Longliner	Tuna	1	400	4409200	3968280	986800	0.1	300000	30000	1016800	0.26	49.69
Marshall Islands														
1	Marshall Is.	Live Reef Fish Carrier	Finfishes nei	1	50	46400	41760	24560	0.1	1000000	100000	124560	2.98	0.09
2	Marshall Is.	Fishing vessel	Sharks	1	25	28175	25358	11000	0.1	200000	20000	31000	1.22	0.36
Niue														
1	Niue	Longliner	Tuna	1	25	271850	244665	38550	0.1	296850	29685	68235	0.28	3.47
Philippines														
1	Philippines	Fishing trawler	Finfishes nei	3	36	52308	49693	20808	0.05	7090	354.5	21162.5	0.43	20.37
2	Philippines	Fishing vessel	Finfishes nei	1	50	65000	61750	48000	0.05	2019	100.95	48100.95	0.78	34.05
3	Philippines	Fishing vessel	Finfishes nei	4	100	140700	133665	34200	0.05	300242	15012.1	49212.1	0.37	1.66
4	Philippines	Fishing vessel	Finfishes nei	1	10	14070	13367	9620	0.05	3600	180	9800	0.73	5.20
5	Philippines	Fishing vessel	Finfishes nei	14	28	39732	37745	13692	0.05	110645	5532.25	19224.25	0.51	1.09
6	Philippines	Fishing vessel	Finfishes nei	1	0.3	425	404	112	0.05	50000	2500	2612	6.47	0.03
7	Philippines	Fishing vessel	Finfishes nei	1	10	8320	7904	6612	0.05	12000	600	7212	0.91	0.54
8	Philippines	Fishing boat	Finfishes nei	1	10	10560	10032	6984	0.05	1312	65.6	7049.6	0.70	11.62
9	Philippines	Fishing boat	Finfishes nei	1	0.3	363	345	122	0.05	89	4.45	126.45	0.37	12.52
10	Philippines	Fishing boat	Finfishes nei	1	0.5	1453	1380	344	0.05	29	1.45	345.45	0.25	178.68
11	Philippines	Fishing boat	Finfishes nei	1	0.1	141	134	48	0.05	172	8.6	56.6	0.42	2.50
12	Philippines	Fishing boat	Finfishes nei	2	0.5	1453	1380	244	0.05	138	6.9	250.9	0.18	41.17
13	Philippines	Pump boat	Finfishes nei	4	2	2906	2761	400	0.05	117	5.85	405.85	0.15	100.88
14	Philippines	Pump boat	Finfishes nei	3	0.1	141	134	20	0.05	267	13.35	33.35	0.25	2.13
15	Philippines	Longliner	Finfishes nei	1	1	17785	16896	842	0.05	100000	5000	5842	0.35	0.80
16	Philippines	Fishing vessel	Bluefin Tuna	1	25	34425	32704	21540	0.05	30000	1500	23040	0.70	1.86

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17	Philippines	Fishing vessel	Tuna	1	12	14136	13429	9869	0.05	25000	1250	11119	0.83	0.71
18	Philippines	Fishing vessel	Sharks	1	0.3	390	371	104	0.05	115000	5750	5854	15.80	0.01
19	Philippines	Fishing vessel	Sharks	1	0.8	723	687	396	0.05	200000	10000	10396	15.14	0.007
China														
1	China	Fishing vessel	Finfishes nei	1	2	2918	2626	1832	0.1	38316	3831.6	5663.6	2.16	0.10
2	China	Fishing vessel	Finfishes nei	1	2	4708	4237	2068	0.1	8622	862.2	2930.2	0.69	1.26
3	China	Fishing vessel	Finfishes nei	5	2.5	5885	5297	2632	0.1	7820	782	3414	0.64	1.70
4	China	Fishing vessel	Tuna	1	1.7	7587	6828	4193	0.1	13042	1304.2	5497.2	0.81	1.01
Japan														
1	Japan	Fishing vessel	Finfishes nei	1	25	7525	6020	4894	0.2	4640	928	5822	0.97	1.21
2	Japan	Fishing vessel	Finfishes nei	1	12	69924	55939	8104	0.2	35228	7046	15150	0.27	6.79
3	Japan	Fishing vessel	Finfishes nei	1	8	9408	7526	4120	0.2	34164	6833	10953	1.46	0.50
4	Japan	Fishing vessel	Finfishes nei	1	4	4800	3840	2060	0.2	46632	9326	11386	2.97	0.19
Republic of Korea														
1	South Korea	Fishing trawler	Finfishes nei	2	4	6828	6145	3172	0.1	4334	433	3605	0.59	3.43
2	South Korea	Fishing vessel	Finfishes nei	5	5	32055	28850	4465	0.1	48000	4800	9265	0.32	2.54
3	South Korea	Fishing boat	Finfishes nei	165	330	625020	562518	206690	0.1	996962	99696	306386	0.54	1.78
4	South Korea	Fishing trawler	Marine Crabs	3	6	38466	34619	2758	0.1	120000	12000	14758	0.43	1.33
5	South Korea	Fishing vessel	Marine Crabs	11	36	230796	207716	20548	0.1	269296	26930	47478	0.23	3.48
6	South Korea	Fishing vessel	Marine Crabs	8	27	173097	155787	14911	0.1	203423	20342	35253	0.23	3.46
Russia														
1	Russia	Deep Sea Fishing trawler	Finfishes nei	3	2500	3372500	3035250	795000	0.1	2800000	280000	1075000	0.35	4.00
2	Russia	Transportation Reefer	Finfishes nei	2	44.3	99255	89330	18896	0.1	592274	59227	78123	0.87	0.59
3	Russia	Transportation Reefer	Finfishes nei	1	100	105000	94500	78988	0.1	17005	1701	80689	0.85	4.56
4	Russia	Refrigerat. Fish Transporter	Finfishes nei	1	2	1428	1285	690	0.1	5000	500	1190	0.93	0.60
5	Russia	Mother ship	Finfishes nei	1	500	858000	772200	528500	0.1	415601	41560	570060	0.74	2.93

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6	Russia	Freezer trawler	Finfishes nei	1	50	63100	56790	42890	0.1	6865	687	43577	0.77	10.12
7	Russia	Fishing trawler	Finfishes nei	1	50	62300	56070	41960	0.1	865300	86530	128490	2.29	0.08
8	Russia	Fishing trawler	Finfishes nei	1	0.4	700	630	460	0.1	15000	1500	1960	3.11	0.06
9	Russia	Fishing trawler	Finfishes nei	7	14	18270	16443	10986	0.1	2500	250	11236	0.68	10.91
10	Russia	Fishing trawler	Finfishes nei	1	6	7800	7020	5894	0.1	1000	100	5994	0.85	5.63
11	Russia	Fishing trawler	Finfishes nei	1	10	12620	11358	9890	0.1	1700	170	10060	0.89	4.32
12	Russia	Fishing trawler	Finfishes nei	1	16	16800	15120	7600	0.1	33930	3393	10993	0.73	1.11
13	Russia	Fishing trawler	Finfishes nei	1	48	33000	29700	17100	0.1	33650	3365	20465	0.69	1.87
14	Russia	Fishing trawler	Finfishes nei	1	2.4	3585	3227	2481	0.1	18985	1899	4380	1.36	0.20
15	Russia	Fishing trawler	Finfishes nei	1	24	25200	22680	13312	0.1	24171	2417	15729	0.69	1.94
16	Russia	Fishing trawler	Finfishes nei	1	12	12600	11340	8156	0.1	8978	898	9054	0.80	1.77
17	Russia	Fishing trawler	Finfishes nei	1	100	105000	94500	79856	0.1	3896	390	80246	0.85	18.79
18	Russia	Fishing trawler	Finfishes nei	1	19	19950	17955	14146	0.1	53801	5380	19526	1.09	0.35
19	Russia	Fishing Schooner	Finfishes nei	7	14	15652	14087	9541	0.1	107695	10770	20311	1.44	0.21
20	Russia	Fishing Schooner	Finfishes nei	1	6	2274	2047	1294	0.1	9694	969	2263	1.11	0.39
21	Russia	Fishing vessel	Finfishes nei	3	15	27735	24962	8860	0.1	46164	4616	13476	0.54	1.74
22	Russia	Fishing vessel	Finfishes nei	1	6	2274	2047	1796	0.1	10000	1000	2796	1.37	0.13
23	Russia	Fishing vessel	Finfishes nei	7	21	14994	13495	10523	0.1	4365	437	10960	0.81	3.40
24	Russia	Fishing vessel	Finfishes nei	600	900	1121400	1009260	694000	0.1	1106655	110666	804666	0.80	1.42
25	Russia	Fishing vessel	Finfishes nei	1500	1800	2349000	2114100	1111200	0.1	1311000	131100	1242300	0.59	3.82
26	Russia	Fishing vessel	Finfishes nei	626	751	980316	882284	699513	0.1	462156	46216	745729	0.85	1.98
27	Russia	Fishing vessel	Finfishes nei	41	2871	3500000	3150000	1403919	0.1	400000	40000	1443919	0.46	21.83
28	Russia	Fishing vessel	Finfishes nei	800	1023	1291026	1161923	196120	0.1	2611026	261103	457223	0.39	1.85
29	Russia	Fishing vessel	Finfishes nei	268	643	804393	723954	455109	0.1	409207	40921	496030	0.69	3.28
30	Russia	Fishing vessel	Finfishes nei	2	20	25020	22518	14980	0.1	130000	13000	27980	1.24	0.29
31	Russia	Fishing vessel	Finfishes nei	1	75	78750	70875	51246	0.1	1269	127	51373	0.72	77.34

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32	Russia	Fishing vessel	Finfishes nei	4	16	29584	26626	7840	0.1	16468	1647	9487	0.36	5.70
33	Russia	Fishing vessel	Finfishes nei	4	20	38961	35065	9780	0.1	16333	1633	11413	0.33	7.74
34	Russia	Fishing boat	Finfishes nei	11	100	380600	342540	48900	0.1	94716	9472	58372	0.17	15.50
35	Russia	Fishing trawler	Arctic Pollack	1	94	286000	257400	214396	0.1	1086000	108600	322996	1.25	0.20
36	Russia	Fishing trawler	Alaska Pollack	1	124	75000	67500	31236	0.1	175000	17500	48736	0.72	1.04
37	Russia	Fishing trawler	Alaska Pollack	1	33	34650	31185	16502	0.1	9500	950	17452	0.56	7.73
38	Russia	Fishing trawler	Alaska Pollack	1	50	92500	83250	24602	0.1	1200500	120050	144652	1.74	0.24
39	Russia	Fishing trawler	Alaska Pollack	1	20	21000	18900	12260	0.1	6676050	667605	679865	35.97	0.005
40	Russia	Fishing trawler	Alaska Pollack	1	230	241500	217350	180490	0.1	1507070	150707	331197	1.52	0.12
41	Russia	Fishing trawler	Alaska Pollack	1	1	8494	7645	2263	0.1	16988	1699	3962	0.52	1.58
42	Russia	Fishing trawler	Alaska Pollack	1	115	382263	344037	110245	0.1	390757	39076	149321	0.43	2.99
43	Russia	Fishing trawler	Pollack	5	250	262500	236250	205020	0.1	122500	12250	217270	0.92	1.27
44	Russia	Fishing trawler	Pollack	1	122	128100	115290	91648	0.1	88000	8800	100448	0.87	1.34
45	Russia	Fishing trawler	Walleye Pollack	1	6	6300	5670	2100	0.1	15900	1590	3690	0.65	1.12
46	Russia	Transportation Reefer	Atlantic Cod	1	100	145000	130500	112300	0.1	13814	1381	113681	0.87	6.59
47	Russia	Transportation Reefer	Atlantic Cod	1	100	145000	130500	112300	0.1	1524	152	112452	0.86	59.71
48	Russia	Transportation Reefer	Atlantic Cod	1	100	145000	130500	112300	0.1	20071	2007	114307	0.88	4.53
49	Russia	Transportation Reefer	Atlantic Cod	1	100	145000	130500	112300	0.1	10150	1015	113315	0.87	8.97
50	Russia	Fishing trawler	Atlantic Cod	1	50	52500	47250	24450	0.1	20000	2000	26450	0.56	5.70
51	Russia	Fishing trawler	Atlantic Cod	1	133	139650	125685	100979	0.1	83364	8336	109315	0.87	1.48
52	Russia	Fishing trawler	Atlantic Cod	2	150	157500	141750	125964	0.1	66799	6680	132644	0.94	1.18
53	Russia	Fishing trawler	Atlantic Cod	1	75	98750	88875	61964	0.1	1534	153	62117	0.70	87.72
54	Russia	Fishing trawler	Atlantic Cod	1	75	98750	88875	61964	0.1	1524	152	62116	0.70	88.29
55	Russia	Fishing trawler	Atlantic Cod	1	75	98750	88875	61964	0.1	75688	7569	69533	0.78	1.78
56	Russia	Fishing trawler	Atlantic Cod	1	50	98750	88875	61964	0.1	9980	998	62962	0.71	13.48
57	Russia	Fishing trawler	Atlantic Cod	1	50	98750	88875	61964	0.1	10358	1036	63000	0.71	12.99

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58	Russia	Fishing trawler	Atlantic Cod	1	50	98750	88875	61964	0.1	11987	1199	63163	0.71	11.23
59	Russia	Fishing trawler	Pacific Saury	1	6	17496	15746	8704	0.1	15000	1500	10204	0.65	2.35
60	Russia	Fishing trawler	Pacific Saury	1	0.2	583	525	206	0.1	5386	539	745	1.42	0.30
61	Russia	Fishing trawler	Flounder	2	10	23840	21456	12580	0.1	30000	3000	15580	0.73	1.48
62	Russia	Fishing trawler	Shrimps	1	0.3	784	706	312	0.1	2512	251	563	0.80	0.78
63	Russia	Fishing trawler	Shrimps	1	15	118396	106556	38250	0.1	8500	850	39100	0.37	40.18
64	Russia	Fishing vessel	Salmon	1	13.5	2376	2138	1486	0.1	15000	1500	2986	1.40	0.22
65	Russia	Fishing vessel	Halibut	1	0.3	715	644	360	0.1	888	89	449	0.70	1.60
66	Russia	Fishing vessel	Squids	1	50	157250	141525	114150	0.1	15380	1538	115688	0.82	8.90
67	Russia	Fishing vessel	Squids	1	50	157250	141525	114150	0.1	5600	560	114710	0.81	24.44
68	Russia	Squid Jigger	Squids	2	20	62900	56610	41440	0.1	3400	340	41780	0.74	22.31
69	Russia	Transportation Reefer	King Crabs	1	17	31433	29861	12207	0.05	55433	2772	14979	0.50	1.59
70	Russia	Fishing trawler	Red King Crabs	1	5.2	9614	9133	5569	0.05	9000	450	6019	0.66	1.98
71	Russia	Fishing trawler	Kamchatka Crab	1	0.2	8000	7600	384	0.05	9200	460	844	0.11	3.92
72	Russia	Fishing vessel	King Crabs	1	5.5	10169	9661	3070	0.05	31890	1595	4665	0.48	1.03
73	Russia	Fishing vessel	King Crabs	1	1	1849	1757	1095	0.05	30251	1513	2608	1.48	0.11
74	Russia	Fishing vessel	King Crabs	1	40	73960	70262	38800	0.05	491936	24597	63397	0.90	0.32
75	Russia	Fishing vessel	King Crabs	1	8.4	15531	14754	7113	0.05	22910	1146	8259	0.56	1.67
76	Russia	Fishing vessel	Snow Crabs	1	6	126083	119779	11970	0.05	18304	915	12885	0.11	29.45
77	Russia	Fishing trawler	Crabs	1	13	24037	22835	13923	0.05	28037	1402	15325	0.67	1.59
78	Russia	Fishing trawler	Crabs	1	23.3	43081	40927	11393	0.05	17371	869	12262	0.30	8.50
79	Russia	Fishing vessel	Crabs	6	45	83205	79045	20500	0.05	9615	481	20981	0.27	30.44
80	Russia	Fishing vessel	Crabs	1	60	110940	105393	38000	0.05	215000	10750	48750	0.46	1.57
81	Russia	Fishing vessel	Crabs	1	57	105393	100123	21047	0.05	237893	11895	32942	0.33	1.66
82	Russia	Fishing vessel	Crabs	1	1.5	2773	2634	886	0.05	38320	1916	2802	1.06	0.23
83	Russia	Fishing vessel	Crabs	1	3.5	6471	6147	1982	0.05	10365	518	2500	0.41	2.01

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Malaysia														
1	Malaysia	Fishing trawler	Finfishes nei	1	30	57300	51570	1890	0.1	606300	60630	62520	1.21	0.41
2	Malaysia	Fishing trawler	Finfishes nei	1	40	76400	68760	1320	0.1	336737	33674	34994	0.51	1.00
3	Malaysia	Fishing trawler	Finfishes nei	1	40	74800	67320	4520	0.1	122723	12272	16792	0.25	2.56
4	Malaysia	Fishing trawler	Finfishes nei	1	30	55320	49788	2130	0.1	576590	57659	59789	1.20	0.41
5	Malaysia	Fishing trawler	Finfishes nei	1	30	55320	49788	3890	0.1	441619	44162	48052	0.97	0.52
6	Malaysia	Fishing trawler	Finfishes nei	2	1	1813	1632	163	0.1	707536	70754	70917	43.46	0.01
7	Malaysia	Fishing trawler	Finfishes nei	2	0.5	963	867	481	0.1	621368	62137	62618	72.25	0.003
8	Malaysia	Fishing trawler	Finfishes nei	1	0.001	14	13	1	0.1	101724	10172	10173	807.41	0.001
9	Malaysia	Fishing trawler	Finfishes nei	1	0.001	143	129	0	0.1	203250	20325	20325	157.93	0.003
10	Malaysia	Fishing trawler	Finfishes nei	1	40	66520	59868	4520	0.1	501406	50141	54661	0.91	0.55
11	Malaysia	Fishing trawler	Finfishes nei	1	15	24945	22451	1670	0.1	201281	20128	21798	0.97	0.52
12	Malaysia	Fishing trawler	Finfishes nei	30	3	815	734	489	0.1	3946	395	884	1.20	0.31
13	Malaysia	Fishing trawler	Finfishes nei	17	2.8	4736	4262	1618	0.1	5867590	586759	588377	138.04	0.002
14	Malaysia	Fishing trawler	Finfishes nei	2	1.5	2631	2368	544	0.1	349822	34982	35526	15.00	0.03
15	Malaysia	Fishing trawler	Finfishes nei	1	2	3600	3240	726	0.1	103360	10336	11062	3.41	0.12
16	Malaysia	Fishing trawler	Finfishes nei	1	6	10800	9720	126	0.1	47367	4737	4863	0.50	1.01
17	Malaysia	Fishing trawler	Finfishes nei	1	10	18000	16200	710	0.1	42104	4210	4920	0.30	1.84
18	Malaysia	Fishing trawler	Finfishes nei	2	6	11268	10141	2178	0.1	755216	75522	77700	7.66	0.05
19	Malaysia	Fishing trawler	Finfishes nei	1	0.2	526	473	72	0.1	318791	31879	31951	67.49	0.01
20	Malaysia	Fishing trawler	Finfishes nei	1	6	11022	9920	2178	0.1	320986	32099	34277	3.46	0.12
21	Malaysia	Fishing trawler	Finfishes nei	3	18	33066	29759	6534	0.1	1315100	131510	138044	4.64	0.09
22	Malaysia	Fishing trawler	Turtles	1	45	80000	72000	13984	0.1	145895	14590	28574	0.40	1.99
23	Malaysia	Fishing trawler	Turtles	1	137	275000	247500	87141	0.1	447387	44739	131880	0.53	1.79
24	Malaysia	Fishing vessel	Turtles	1	80	163400	147060	39120	0.1	230263	23026	62146	0.42	2.34
25	Malaysia	Fishing vessel	Turtles	1	1.5	3000	2700	733	0.1	14300	1430	2163	0.80	0.69
26	Malaysia	Fishing vessel	Turtles	2	146	260000	234000	188778	0.1	545736	54574	243352	1.04	0.41

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27	Malaysia	Fishing vessel	Tuna	2	0.6	634	571	194	0.1	105270	10527	10721	18.79	0.02
28	Malaysia	Fishing vessel	Tuna	1	10	10580	9522	8394	0.1	208561	20856	29250	3.07	0.03
29	Malaysia	Fishing vessel	Finfishes nei	31	310	579700	521730	112530	0.1	15814	1581	114111	0.22	129.38
30	Malaysia	Fishing vessel	Finfishes nei	19	190	355300	319770	68970	0.1	5151	515	69485	0.22	243.45
31	Malaysia	Fishing vessel	Finfishes nei	3	0.01	247	222	3	0.1	2279272	227927	227930	1025.33	0.0005
32	Malaysia	Fishing vessel	Finfishes nei	3	60	112200	100980	21780	0.1	311284	31128	52908	0.52	1.27
33	Malaysia	Fishing vessel	Finfishes nei	1	0.1	294	265	189	0.1	435006	43501	43690	165.12	0.001
34	Malaysia	Fishing vessel	Finfishes nei	12	24	39912	35921	25704	0.1	103061	10306	36010	1.00	0.50
35	Malaysia	Fishing vessel	Finfishes nei	1	3	5091	4582	3213	0.1	94724	9472	12685	2.77	0.07
36	Malaysia	Fishing vessel	Finfishes nei	17	34	61200	55080	19652	0.1	20000	2000	21652	0.39	8.86
37	Malaysia	Fishing vessel	Finfishes nei	2	36	67608	60847	13068	0.1	1262990	126299	139367	2.29	0.19
38	Malaysia	Fishing vessel	Finfishes nei	4	10	18780	16902	13660	0.1	539459	53946	67606	4.00	0.03
39	Malaysia	Fishing vessel	Finfishes nei	2	8	15024	13522	8568	0.1	710499	71050	79618	5.89	0.03
40	Malaysia	Fishing vessel	Finfishes nei	16	128	240384	216346	46464	0.1	736823	73682	120146	0.56	1.15
41	Malaysia	Fishing vessel	Finfishes nei	1	3	5500	4950	3213	0.1	203829	20383	23596	4.77	0.04
42	Malaysia	Fishing vessel	Finfishes nei	4	6	11022	9920	5388	0.1	253000	25300	30688	3.09	0.09
43	Malaysia	Fishing vessel	Finfishes nei	1	0.1	184	166	16	0.1	326256	32626	32642	197.11	0.00
44	Malaysia	Fishing vessel	Finfishes nei	1	6	10980	9882	1934	0.1	157733	15773	17707	1.79	0.25
45	Malaysia	Fishing vessel	Finfishes nei	1	6	10980	9882	1934	0.1	126004	12600	14534	1.47	0.32
46	Malaysia	Fishing vessel	Finfishes nei	1	12	21960	19764	5868	0.1	139130	13913	19781	1.00	0.50
47	Malaysia	Fishing vessel	Finfishes nei	1	6	10980	9882	2934	0.1	52631	5263	8197	0.83	0.66
48	Malaysia	Fishing vessel	Finfishes nei	1	40	10527	9474	4890	0.1	76323	7632	12522	1.32	0.30
49	Malaysia	Fishing vessel	Finfishes nei	3	0.1	343	309	90	0.1	529195	52920	53010	171.72	0.00
50	Malaysia	Fishing vessel	Finfishes nei	1	30	53190	47871	41860	0.1	286000	28600	70460	1.47	0.11
51	Malaysia	Fishing vessel	Finfishes nei	1	6	10638	9574	2934	0.1	136564	13656	16590	1.73	0.24
52	Malaysia	Fishing vessel	Finfishes nei	3	690	1221980	1099782	946780	0.1	187500	18750	965530	0.88	4.08
53	Malaysia	Fishing vessel	Finfishes nei	1	6	10638	9574	2934	0.1	224450	22445	25379	2.65	0.15

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54	Malaysia	Fishing vessel	Finfishes nei	1	0.5	918	826	244	0.1	131707	13171	13415	16.24	0.02
55	Malaysia	Fishing boat	Finfishes nei	2	12	22536	20282	12852	0.1	321046	32105	44957	2.22	0.12
56	Malaysia	Fishing boat	Finfishes nei	2	18	33804	30424	1534	0.1	143012	14301	15835	0.52	1.01
57	Malaysia	Fishing boat	Finfishes nei	1	0.3	531	478	23	0.1	2813	281	304	0.64	0.81
58	Malaysia	Fishing boat	Finfishes nei	12	6	9978	8980	4356	0.1	94728	9473	13829	1.54	0.24
Indonesia														
1	Indonesia	Fishing trawler	Finfishes nei	5	22.5	12937	12290	5167	0.05	294000	14700	19867	1.62	0.12
2	Indonesia	Fishing trawler	Finfishes nei	40	800	468800	445360	160400	0.05	10549400	527470	687870	1.54	0.14
3	Indonesia	Fishing trawler	Finfishes nei	6	300	145800	138510	108900	0.05	3920	196	109096	0.79	37.77
4	Indonesia	Fishing trawler	Finfishes nei	6	240	140640	133608	108040	0.05	14400	720	108760	0.81	8.88
5	Indonesia	Fishing trawler	Finfishes nei	1	40	22000	20900	14520	0.05	5995	300	14820	0.71	5.32
6	Indonesia	Fishing trawler	Finfishes nei	2	26	14300	13585	5438	0.05	18090	905	6343	0.47	2.25
7	Indonesia	Fishing vessel	Finfishes nei	1	3	1842	1750	1067	0.05	1000	50	1117	0.64	3.41
8	Indonesia	Fishing vessel	Finfishes nei	16	480	276480	262656	220640	0.05	80640	4032	224672	0.86	2.61
9	Indonesia	Fishing vessel	Finfishes nei	1	30	17280	16416	9890	0.05	4200	210	10100	0.62	7.77
10	Indonesia	Fishing vessel	Finfishes nei	5	100	58700	55765	26300	0.05	582284	29114	55414	0.99	0.25
11	Indonesia	Fishing vessel	Finfishes nei	1	12	7044	6692	5168	0.05	2520	126	5294	0.79	3.02
12	Indonesia	Fishing vessel	Finfishes nei	2	16	9392	8922	2321	0.05	20160	1008	3329	0.37	1.64
13	Indonesia	Fishing vessel	Finfishes nei	1	6	3504	3329	1592	0.05	6720	336	1928	0.58	1.29
14	Indonesia	Fishing vessel	Finfishes nei	9	36	19800	18810	9568	0.05	17100	855	10423	0.55	2.70
15	Indonesia	Fishing vessel	Finfishes nei	1	0.1	5	5	1	0.05	232940	11647	11648	2452.27	0.00007
16	Indonesia	Fishing vessel	Finfishes nei	6	240	132000	125400	102080	0.05	15319	766	102846	0.82	7.61
17	Indonesia	Fishing vessel	Finfishes nei	7	100	55000	52250	26300	0.05	537735	26887	53187	1.02	0.24
18	Indonesia	Fishing vessel	Finfishes nei	5	75	41250	39188	30325	0.05	265000	13250	43575	1.11	0.17
19	Indonesia	Fishing vessel	Tuna	10	10	4480	4256	2984	0.05	92400	4620	7604	1.79	0.07
Cambodia														
1	Cambodia	Fishing trawler	Finfishes nei	7	70	142380	135261	29410	0.05	105000	5250	34660	0.26	5.04

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2	Cambodia	Fishing trawler	Finfishes nei	2	24	59184	56225	12704	0.05	203400	10170	22874	0.41	1.07
Vietnam														
1	Vietnam	Fishing trawler	Finfishes nei	5	64	128000	121600	82752	0.05	17500	875	83627	0.69	11.10
2	Vietnam	Fishing trawler	Finfishes nei	4	4	9600	9120	1352	0.05	14000	700	2052	0.23	2.77
3	Vietnam	Fishing trawler	Finfishes nei	6	72	172800	164160	93096	0.05	6000	300	93396	0.57	59.22
4	Vietnam	Fishing trawler	Finfishes nei	4	48	96000	91200	17424	0.05	57150	2858	20282	0.22	6.45
5	Vietnam	Fishing trawler	Finfishes nei	8	96	230400	218880	34848	0.05	250000	12500	47348	0.22	3.68
6	Vietnam	Fishing trawler	Finfishes nei	4	88	132000	125400	31944	0.05	84375	4219	36163	0.29	5.54
7	Vietnam	Fishing vessel	Finfishes nei	6	24	48000	45600	8104	0.05	85000	4250	12354	0.27	2.21
8	Vietnam	Fishing boat	Finfishes nei	1	6	12000	11400	2934	0.05	6350	318	3252	0.29	6.67
Australia														
1	Australia	Fishing trawler	Shrimps	1	5	40572	32458	6840	0.2	46049	9210	16050	0.49	2.78
2	Australia	Fishing trawler	Finfishes nei	1	1	6040	4832	363	0.2	69606	13921	14284	2.96	0.32
3	Australia	Fishing trawler	Finfishes nei	1	0.2	1204	963	193	0.2	34425	6885	7078	7.35	0.11
4	Australia	Fishing vessel	Prawns	1	0.2	230	184	124	0.2	1655	331	455	2.47	0.18
5	Australia	Fishing vessel	Finfishes nei	4	12	13764	11011	6878	0.2	1000000	200000	206878	18.79	0.02
6	Australia	Fishing vessel	Finfishes nei	1	3	18000	14400	2070	0.2	31655	6331	8401	0.58	1.95
7	Australia	Fishing vessel	Finfishes nei	1	1	5128	4102	898	0.2	512120	102424	103322	25.19	0.03
8	Australia	Fishing vessel	Finfishes nei	1	0.4	2315	1852	368	0.2	100113	20023	20391	11.01	0.07
9	Australia	Fishing vessel	Finfishes nei	1	0.3	1694	1355	269	0.2	105600	21120	21389	15.78	0.05
10	Australia	Fishing boat	Finfishes nei	31	9.3	10667	8534	6364	0.2	71807	14361	20725	2.43	0.15
11	Australia	Fishing boat	Finfishes nei	1	3	12441	9953	2694	0.2	30645	6129	8823	0.89	1.18
12	Australia	Fishing boat	Finfishes nei	1	0.3	1694	1355	269	0.2	50910	10182	10451	7.71	0.11
13	Australia	Fishing boat	Trochus	1	0.1	600	480	97	0.2	15100	3020	3117	6.49	0.13
14	Australia	Fishing boat	Trochus	1	1.5	1720	1376	1047	0.2	7462	1492	2539	1.85	0.22
15	Australia	Fishing boat	Trochus	5	1.2	7200	5760	973	0.2	9427	1885	2858	0.50	2.54
16	Australia	Fishing boat	Trochus	1	3	11612	9290	2934	0.2	200516	40103	43037	4.63	0.16

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17	Australia	Fishing vessel	Sharks	1	0.7	800	640	581	0.2	89898	17980	18561	29.00	0.00
18	Australia	Fishing vessel	Sharks	3	9	10232	8186	6479	0.2	22503	4501	10980	1.34	0.38
19	Australia	Fishing vessel	Sharks	1	0.7	802	642	581	0.2	10000	2000	2581	4.02	0.03
20	Australia	Fishing vessel	Sharks	1	0.9	1032	826	755	0.2	158509	31702	32457	39.31	0.002
21	Australia	Fishing vessel	Sharks	1	0.3	344	275	249	0.2	174374	34875	35124	127.63	0.001
22	Australia	Fishing vessel	Sharks	1	0.08	92	74	49	0.2	12570	2514	2563	34.82	0.010
23	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	162002	32400	32594	71.10	0.008
24	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	164449	32890	33084	72.17	0.008
25	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	167246	33449	33643	73.39	0.008
26	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	164100	32820	33014	72.02	0.008
27	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	167246	33449	33643	73.39	0.008
28	Australia	Fishing vessel	Sharks	1	0.5	573	458	194	0.2	167246	33449	33643	73.39	0.008
29	Australia	Fishing vessel	Sharks	1	0.5	573	458	215	0.2	294678	58936	59151	129.04	0.004
30	Australia	Fishing boat	Sharks	1	1	1147	918	831	0.2	2326	465	1296	1.41	0.19
31	Australia	Fishing boat	Sharks	1	2.5	2867	2294	1677	0.2	5094	1019	2696	1.18	0.61
32	Australia	Fishing boat	Sharks	1	2.3	2638	2110	1545	0.2	26356	5271	6816	3.23	0.11
33	Australia	Gillnetter	Sharks	1	0.6	688	550	456	0.2	106300	21260	21716	39.45	0.004
34	Australia	Fishing boat	Eels	1	0.07	80	64	46	0.2	794	159	205	3.20	0.11
35	Australia	Fishing boat	Eels	1	0.01	12	10	6	0.2	4808	962	968	100.79	0.004
36	Australia	Fishing boat	Sea Bass	1	0.03	330	264	39	0.2	2243	449	488	1.85	0.50
37	Australia	Fishing boat	Sea Cucumbers	1	0.4	460	368	212	0.2	3625	725	937	2.55	0.22
38	Australia	Fishing boat	Sea Cucumbers	1	0.5	573	458	210	0.2	3074	615	825	1.80	0.40
39	Australia	Fishing boat	Sea Cucumbers	1	1	1092	874	420	0.2	26297	5259	5679	6.50	0.09
40	Australia	Fishing boat	Rock Lobsters	1	0.3	344	275	202	0.2	1123	225	427	1.55	0.33
41	Australia	Fishing boat	Rock Lobsters	1	2.2	2523	2018	1646	0.2	9536	1907	3553	1.76	0.20
42	Australia	Fishing boat	Rock Lobsters	1	0.03	33	26	16	0.2	439	88	104	3.93	0.12
43	Australia	Fishing boat	Rock Lobsters	1	1.3	1491	1193	984	0.2	21091	4218	5202	4.36	0.05

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44	Australia	Fishing boat	Rock Lobsters	1	1.1	1261	1009	880	0.2	11114	2223	3103	3.08	0.06
45	Australia	Fishing boat	Rock Lobsters	1	0.3	344	275	146	0.2	9197	1839	1985	7.21	0.07
46	Australia	Fishing boat	Rock Lobsters	1	0.2	229	183	124	0.2	3385	677	801	4.37	0.09
47	Australia	Fishing boat	Abalone	1	1	31720	22204	978	0.3	470000	141000	141978	6.39	0.23
48	Australia	Fishing boat	Abalone	1	0.06	3277	2294	58	0.3	73391	22017	22075	9.62	0.15
49	Australia	Dinghy boat	Abalone	1	0.1	8220	5754	132	0.3	19593	5878	6010	1.04	1.43
50	Australia	Dive Gear	Abalone	-	0.05	2592	1814	47	0.3	8135	2441	2488	1.37	1.09
51	Australia	Dive Gear	Abalone	-	0.01	810	567	13	0.3	2628	788	801	1.41	1.05
52	Australia	Dive Gear	Abalone	-	0.009	518	363	9	0.3	952	286	295	0.81	1.86
53	Australia	Dive Gear	Abalone	-	0.008	432	302	7	0.3	769	231	238	0.79	1.92
54	Australia	Dive Gear	Abalone	-	0.01	810	567	13	0.3	1663	499	512	0.90	1.67
55	Australia	Dive Gear	Abalone	-	0.03	1458	1021	25	0.3	3065	920	945	0.93	1.62
56	Australia	Dive Gear	Abalone	-	0.04	2460	1722	39	0.3	4543	1363	1402	0.81	1.85
57	Australia	Dive Gear	Abalone	-	0.01	836	585	8	0.3	3470	1041	1049	1.79	0.83
58	Australia	Dive Gear	Abalone	-	0.12	7200	5040	117	0.3	108725	32618	32735	6.49	0.23
59	Australia	Dive Gear	Abalone	-	0.06	3600	2520	58	0.3	22045	6614	6672	2.65	0.56
60	Australia	Dive Gear	Abalone	-	0.07	4080	2856	61	0.3	18505	5552	5613	1.97	0.76
61	Australia	Dive Gear	Abalone	-	0.06	3420	2394	55	0.3	6300	1890	1945	0.81	1.86
62	Australia	Dive Gear	Abalone	-	0.003	192	134	3	0.3	1316	395	398	2.96	0.50
63	Australia	Dive Gear	Abalone	-	0.6	38207	26745	486	0.3	81875	24563	25049	0.94	1.60
64	Australia	Dive Gear	Abalone	-	0.01	600	420	9	0.3	8943	2683	2692	6.41	0.23
65	Australia	Dive Gear	Abalone	-	0.04	3354	2348	12	0.3	13900	4170	4182	1.78	0.84
66	Australia	Dive Gear	Abalone	-	0.3	5828	4080	300	0.3	6605	1982	2282	0.56	2.86
67	Australia	Dive Gear	Abalone	-	0.03	2264	1585	31	0.3	18118	5435	5466	3.45	0.43
68	Australia	Dive Gear	Abalone	-	0.06	2909	2036	165	0.3	24900	7470	7635	3.75	0.38

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New Zealand														
1	New Zealand	Fishing trawler	Hoki	3	500	397822	318258	200500	0.2	54369	10874	211374	0.66	10.83
2	New Zealand	Fishing trawler	Hoki	1	36.3	41669	33335	12894	0.2	93655	18731	31625	0.95	1.09
3	New Zealand	Fishing trawler	Hoki	1	44	48451	38761	18496	0.2	2358115	471623	490119	12.64	0.04
4	New Zealand	Fishing trawler	Hoki	1	12	13764	11011	5123	0.2	2429517	485903	491026	44.59	0.01
5	New Zealand	Fishing trawler	Hake	2	433	496651	397321	174222	0.2	1821541	364308	538530	1.36	0.61
6	New Zealand	Fishing trawler	Hake	1	208	203503	162802	75888	0.2	606269	121254	197142	1.21	0.72
7	New Zealand	Fishing trawler	Oreo Dory	1	290	332630	266104	151010	0.2	1404486	280897	431907	1.62	0.41
8	New Zealand	Fishing trawler	Dogfish Shark	1	6	6882	5506	3264	0.2	2366566	473313	476577	86.56	0.005
9	New Zealand	Fishing trawler	Ling	2	700	980000	784000	562000	0.2	4875580	975116	1537116	1.96	0.23
10	New Zealand	Fishing trawler	Scallops & Rock Lobsters	1	0.5	612	490	406	0.2	8540	1708	2114	4.32	0.05
11	New Zealand	Fishing trawler	Scallops	1	0.1	324	259	202	0.2	28165	5633	5835	22.51	0.01
12	New Zealand	Factory trawler	Blue Whiting	1	150	192050	153640	102600	0.2	34529	6906	109506	0.71	7.39
13	New Zealand	Surimi Ship	Blue Whiting	1	770	883190	706552	412864	0.2	8403000	1680600	2093464	2.96	0.17
14	New Zealand	Fishing trawler	Finfishes nei	1	0.1	114	91	84	0.2	2401	480	564	6.19	0.01
15	New Zealand	Fishing vessel	Finfishes nei	1	10.4	11723	9378	7264	0.2	5249	1050	8314	0.89	2.01
16	New Zealand	Fishing vessel	Finfishes nei	1	2.5	6000	4800	2355	0.2	125663	25133	27488	5.73	0.10
17	New Zealand	Fishing vessel	Finfishes nei	1	0.3	289	231	192	0.2	1890	378	570	2.47	0.10
18	New Zealand	Fishing vessel	Finfishes nei	1	0.7	757	606	494	0.2	26794	5359	5853	9.66	0.02
19	New Zealand	Fishing vessel	Finfishes nei	1	272	313000	250400	205568	0.2	682310	136462	342030	1.37	0.33
20	New Zealand	Fishing vessel	Snappers	1	0.1	207	166	114	0.2	18266	3653	3767	22.75	0.014
21	New Zealand	Fishing vessel	Snappers	1	5.1	5849	4679	2444	0.2	28000	5600	8044	1.72	0.40

No.	Arresting Country	Vessel / Gear	Fishery	Number of vessels	Catch (t)	Catch value (USD)	Expected Revenue (USD)	Variable Cost (USD)	θ	Fine (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue	New Fine
22	New Zealand	Fishing vessel	Snappers	1	0.01	200	160	23	0.2	4223	845	868	5.42	0.16
23	New Zealand	Fish Carrier	Orange Roughy	1	50	67350	53880	31200	0.2	64650	12930	44130	0.82	1.75
24	New Zealand	Squid Jigger	Squids	1	77	142065	113652	64112	0.2	335020	67004	131116	1.15	0.74
25	New Zealand	Purse Seiner	Skipjack Tuna	1	100	1102300	881840	401800	0.2	11500	2300	404100	0.46	208.71
26	New Zealand	Fishing vessel	Rock Lobsters	1	4.1	4702	3762	2824	0.2	23544	4709	7533	2.00	0.20
27	New Zealand	Fishing vessel	Rock Lobsters	1	4.8	95486	76389	17962	0.2	84899	16980	34942	0.46	3.44
28	New Zealand	Fishing vessel	Rock Lobsters	1	0.1	138	110	31	0.2	14056	2811	2842	25.74	0.03
29	New Zealand	Fishing vessel	Rock Lobsters	1	0.1	66	53	21	0.2	1426	285	306	5.80	0.11
30	New Zealand	Fishing boat	Abalone	1	0.9	43214	34571	774	0.2	16677	3335	4109	0.12	10.13
31	New Zealand	Fishing boat	Abalone	1	0.2	206	165	72	0.2	4687	937	1009	6.13	0.10
32	New Zealand	Dinghy boat	Abalone	1	0.5	18303	14642	389	0.2	119720	23944	24333	1.66	0.60
33	New Zealand	Outboard Dinghy	Abalone	6	0.02	300	240	19	0.2	18000	3600	3619	15.08	0.06
34	New Zealand	Dive gear	Abalone	-	0.2	36000	28800	195	0.2	37803	7561	7756	0.27	3.78
35	New Zealand	Dive gear	Abalone	-	0.5	13600	10880	489	0.2	35148	7030	7519	0.69	1.48
36	New Zealand	Dive gear	Abalone	-	2.1	119352	95482	1753	0.2	144000	28800	30553	0.32	3.25
37	New Zealand	Dive gear	Abalone	-	4.5	96800	77440	3701	0.2	36000	7200	10901	0.14	10.24
38	New Zealand	Dive gear	Abalone	-	0.3	8952	7162	293	0.2	13181	2636	2929	0.41	2.61
39	New Zealand	Dive gear	Abalone	-	1.8	56326	45061	4560	0.2	8000	1600	6160	0.14	25.31
40	New Zealand	Dive gear	Abalone	-	0.03	4569	3655	30	0.2	4700	940	970	0.27	3.86
41	New Zealand	Dive gear	Abalone	-	0.1	3600	2880	145	0.2	7100	1420	1565	0.54	1.93
42	New Zealand	Dive gear	Abalone	-	0.7	30000	24000	670	0.2	36878	7376	8046	0.34	3.16

Appendix B: Questionnaire for the study evaluating monitoring control and surveillance in 41 fishing countries.

<table>
<tr><td colspan="5">Rapid appraisal of compliance with international laws and related aspects of monitoring control and surveillance in global fisheries. Specific clauses in the international laws are indicated. Each question is scored on a scale of 0 to 10; 0 to 4 represent "fail" scores; Scores 7 and above were considered as "good" scores. Sources of information to justify each score are provided. For each question best estimate of score and upper and lower score range are provided. Guidelines for the analysis were derived from (Framework modified from Pitcher and Preikshot (2001). Questions and relevant attributes were designed by the author (Pramod Ganapathiraju).</td></tr>
<tr><td colspan="5">Evaluation Field 1: MCS Infrastructure</td></tr>
<tr><td colspan="2">Scores Intentions of MCS Management</td><td colspan="2">Reference Points</td><td>Clauses from International Fisheries Laws</td></tr>
<tr><td colspan="2">Attributes</td><td>Worst</td><td>Best</td><td></td></tr>
<tr><td>1</td><td>Does the country have adequate surveillance infrastructure (patrol aircraft, sea based patrol vessels and coastal patrols) to effectively patrol fisheries resources within its EEZ?

None (0); Plans / projects to improve MCS infrastructure (1.5) Limited patrolling near to the coast (3.5); Can patrol effectively up to 12 nautical miles from the shore (4.5); Regular patrolling within 12 nm and MCS operations to check fishing vessels on a regular basis (5); Regular patrolling of the domestic and foreign fishing vessels operating within the entire EEZ, including exclusive fishery patrols (10).</td><td>0</td><td>10</td><td>IPOA-IUU (Paragraph 24 – 24.10)

FAO-CCRF (Article 7.7.3)</td></tr>
<tr><td>2</td><td>Does the country have adequate trained officers to conduct MCS operations?

None (0); Limited manpower (3.5); Adequate for enforcement of all major commercial fishing vessels exploiting fish stocks (10)</td><td>0</td><td>10</td><td>FAO-CCRF</td></tr>
<tr><td>3</td><td>Does the country have adequate management plans to monitor their fishing vessels in the high seas?

None (0); Limited plans through legally binding national laws (1.5); Signatory to FAO Compliance Agreement (2.5); All vessels are required to report their catches, positions in high seas on a continuous basis and are required to be licensed for such operations (10)</td><td>0</td><td>10</td><td>UNCLOS (Articles 94.2, 117, 118, 217.1, 217.6, 217.8)

IPOA-IUU (Paragraph15)

UNFSA (Articles 7, 16, 19)

FAO-CCRF (Articles 7.6.2, 8.1.4)</td></tr>
</table>

Scores Intentions of MCS Management & Action		Reference Points		Clauses from International Fisheries Laws
	Attributes	**Worst**	**Best**	
4	What proportion of fishing vessels is equipped with vessel monitoring system (VMS) to monitor their movements on a continuous basis? None (0); 10-20% of total fishing vessels are monitored through VMS (2.5); Half of the legal vessels are monitored through VMS (5); More than 70% of vessels are covered through VMS for major commercial fisheries (8); All fishing vessels, including reefers and fish transporting vessels are required to report on a continuous basis within and outside the EEZ (10)	0	10	IPOA-IUU (Paragraph 17, 47.1) FAO-CCRF (Article 7.7.3)
5	What percentage of fishing vessels (>20 m OAL) are monitored through onboard observers at sea (for major commercial fish stocks)? None (0); 10-20% of total fishing vessels are covered through observers (3.5); Half of the legal vessels have observers during fishing trips (5); More than 70% of vessels are covered through observers for major commercial fisheries (10)	0	10	IPOA-IUU (Paragraph 24.4, 47.4) FAO-CCRF (Article 7.7.3)
Evaluation Field 2: Vessel Inspections				
Scores Intentions of MCS Management & Action		Reference Points		Clauses from International Fisheries Laws
	Attributes	Worst	Best	
6	How often fishing vessels are inspected at sea (Identification by sight and boarding for inspections)? None (0); Occasionally, two to three boarding's at sea per month (3.5); a great deal – half of the legal vessels are inspected (5); almost all the licensed vessels are inspected at least once every year (10)	0	10	IPOA-IUU (Paragraph 24.10) FAO-CCRF (Article 7.7.3)
7	How often fishing vessels are inspected by air? None (0); Occasionally, more so during the peak fishing seasons (2.5) Often, one to two times per month (5) Monitoring of all contacts in the fishing area through radar, satellites and aircraft (10)	0	10	IPOA-IUU (Paragraph 24)
8	How often are fishing vessels inspected at landing centers and docks for foreign and domestic vessels (Dockside monitoring)? None (0); Limited measures through national laws for monitoring fishing vessels using its ports (1.5); 1-2 times per fishing season (2.5); Advance notification is required before using its ports (3); 20-30% of catch is monitored (3.5); half of legal vessels operating within EEZ (5); Signatory to the FAO Agreement on Port State Measures to Prevent, Deter and Eliminate IUU Fishing, with regular inspections of foreign and domestic fishing vessels at ports (7.5); Almost all the vessels for every trip are monitored, including foreign fishing vessels (10)	0	10	UNFSA (Article 23.1) IPOA-IUU (Paragraphs 52 to 64) PSMA (Article 9) FAO-CCRF (Article 8.3)

Scores Intentions of MCS Management & Action		Reference Points		Clauses from International Fisheries Laws
	Attributes	**Worst**	**Best**	
9	Are there adequate plans to monitor catches in coastal areas through coastal patrols (beach patrols, small-scale fishing gear and catches inspections) on a regular basis? None (0); Half of the legal vessels operating within the EEZ (5) Almost all the vessels are inspected (10)	0	10	FAO-CCRF (Articles 7.7.3 & 7.4.4)
10	Are all the catches that are caught in this jurisdiction at sea accounted for (i.e., unreported Trans-shipments at sea)? None (0); Signatory to the UN Fish Stocks Agreement (2.5); Some transshipments are landed at ports and checked before being exported (3.5); Half of all the legal transshipments at sea are checked and verified before offloading to reefers, and required to report fish onboard on entry and exit (5); All transshipments at sea are monitored before being allowed to leave the EEZ (10)	0	10	IPOA-IUU (Paragraph 47.3, 49.1, 49.2, 49.3, 51.6) UNFSA (Article 23) PSMA (Article 11) FAO-CCRF (Article 7.7.5)
11	Are vessels required to undergo inspection of equipment and fishing gear for every fishing trip? None (0); Routine inspections of fishing gear (3.5); Regularly, 50% of trips are monitored through random inspections (5); All vessels need to undergo inspection before leaving on each fishing trip (10)	0	10	FAO-CCRF (Articles 7.6.4, 8.2.4)

Appendix C: List of countries scored for MCS analysis: Catches and rank order

Table shows 2005 reported marine catch in tonnes (rounded), catch rank, percentage of world total, number of pages and number of references.

Country	2005 catch, tonnes[72]	% World Total	Rank	Pages	References cited
Angola	217,000	0.2	51	5	12
Argentina	895,884	1.1	22	8	23
Australia	231,207	0.2	49	6	14
Bangladesh	474,597	0.5	32	4	12
Brazil	506,827	0.6	31	5	14
Cambodia	60,000	0.07	78	5	8
Cameroon	67,333	0.08	77	3	0
Canada	1,087,713	1.3	18	9	30
Chile	4,328,627	5.4	5	5	18
China	9,776,280	12.2	1	6	14
Ecuador	407,116	0.5	34	4	5
France	567,380	0.7	26	4	11
Ghana	316,852	0.3	38	4	11
Guinea	92,571	0.1	72	4	10
Iceland	1,660,812	2.0	13	4	12
India	3,344,484	4.1	7	6	17
Indonesia	4,389,998	5.5	4	6	25
Japan	4,020,685	5.0	6	6	16
Madagascar	104,859	0.1	70	5	15
Malaysia	1,203,269	1.5	17	5	12
Mauritania	291,878	0.3	40	5	9

[72] Source: Sea Around Us Project, Fisheries Centre, UBC.

Country	**2005 catch, tonnes**	**% World Total**	**Rank**	**Pages**	**References cited**
Mexico	1,204,822	1.5	16	6	15
Morocco	1,023,594	1.2	19	5	6
Myanmar	1,226,734	1.5	15	4	6
Namibia	551,177	0.6	28	7	14
New Zealand	543,897	0.6	30	6	18
Nigeria	284,182	0.3	41	4	7
Norway	2,391,578	2.9	10	5	16
Peru	9,317,690	11.6	2	4	14
Philippines	2,102,302	2.6	11	6	17
Russia	2,979,682	3.7	8	7	21
Sierra Leone	131,778	0.1	63	4	7
South Africa	816,256	1.0	24	5	20
South Korea	1,632,265	2.0	14	5	9
Sri Lanka	133,027	0.1	61	4	6
Sweden	254,198	0.3	46	5	4
Taiwan	996,361	1.2	20	4	12
Thailand	2,578,854	3.2	9	4	5
UK	672,215	0.8	25	5	18
USA	4,724,111	5.9	3	6	27
Vietnam	1,791,100	2.2	12	4	8
Total	**69,268,165**	**87**	**41**	**209**	**538**

Appendix D: Ease of access to data for monitoring, control and surveillance in 41 fishing countries

Monitoring Control and Surveillance access to data index	
Access to MCS information through internet, public domains, government publications, journals and books was assessed using the flowing criteria.	
(MCS ease of access to information)	
Score	**Criteria**
0	No information is available through most government or academic sources
1	Very little or scanty information is available through internet or any other government publications / journals / public resources.
2	Little to moderate information is available for some MCS aspects.
3	Moderate to good information is available for major issues related to monitoring, control and surveillance in the fisheries sector.
4	Good information is available, including detailed estimates of extent of MCS by region, sub-regions, fisheries etc. for better understanding of relevant issues.
5	Complete and comprehensive information relevant to MCS are available for performance evaluation and comparison on an annual basis for at least for 3 -10 years for analysis of long-term trends.

Country	**Ease of access to MCS Information Score**
Angola	2
Argentina	3
Australia	4
Bangladesh	1
Brazil	1
Cambodia	1
Cameroon	0
Canada	4
Chile	2
China	1
Ecuador	1
France	3
Ghana	1
Guinea	0
Iceland	3
India	2
Indonesia	2
Japan	3
Madagascar	3
Malaysia	3
Mauritania	2

Country	Ease of access to MCS Information Score
Mexico	3
Morocco	2
Myanmar	0
Namibia	4
New Zealand	5
Nigeria	0
Norway	3
Peru	2
Philippines	1
Russia	2
Sierra Leone	1
South Africa	3
South Korea	2
Sri Lanka	0
Sweden	3
Taiwan	1
Thailand	1
United Kingdom	4
USA	4

Appendix E: Indian trawlers arrested for illegal fishing in Orissa's territorial waters and marine sanctuaries.

Date / Year	Target species	Number of illegal vessels	Action taken
1997 - 98	Shrimps	78	During the period 13.12.1997 to 26.1.1998, 55 trawlers and 23 gillnetters were apprehended from Gahirmatha sanctuary.
January 30, 1998	Shrimps and Finfishes	9	6 trawlers and 3 gillnetters were apprehended from the core area of the Garhirmatha (Marine) Wildlife Sanctuary.
January 19, 2000	Shrimps and Finfishes	5	Orissa Forest Department in collaboration with the Coast Guard arrested 15 people and seized 5 trawlers for illegal fishing inside the Gahirmatha Marine sanctuary.
2000	Shrimps and Finfishes	64	64 trawlers and gillnetters were seized for illegal fishing by the Forest Department.
2002	Shrimps and Finfishes	44	Up to 44 fishing boats have been seized here by the Orissa Forest Dept. officials; 12 fishing trawlers were found near mouth of Devi river within a prohibited zone of 5 km from the coast on December 31; none of the trawlers had turtle excluder devices, which are mandatory on all trawlers operating along this coast.
February 8, 2003	Finfishes	2	3 forest guards were abducted by the crewmembers of two gill-netters that were seized for illegal fishing inside the Gahirmatha Marine Sanctuary.
December 27, 2003	Finfishes	11	Crews of 11 mechanised trawlers were fined Rs. 85,000 for illegal fishing within the Gahirmatha marine sanctuary. The catch was auctioned for Rs. 17,000. Boats were to be released after paying fine.
2004	Shrimps and Finfishes	10	Orissa Forest Department registered cases of illegal fishing in prohibited water bodies against 24 fishermen and confiscated 10 vessels for fishing in the Bhitarkanika wildlife sanctuary; fishing gear and other implements used in illegal acts were seized.
February 2, 2006	Finfishes	5	Bhitarkanika forest officials have arrested six persons and seized five trawlers from them near Chinchiri river mouth under Gahirmatha Marine Sanctuary on charge of illegal entry and catching fish in MPA.
December 23, 2005	Shrimps and Finfishes	7	A Trawler with 4 crewmembers was arrested for fishing illegally along the Dhamra coast within Gahirmatha sanctuary. Fish catch worth more than Rs 1.5 lakh, fishing implements, fishing nets and VHF set were also impounded by the patrolling squad of the forest department. Earlier 6 trawlers with 16 crew were taken into custody for similar charges.
2005	Shrimps and Finfishes	7	7 fishing trawlers and 24 crew were arrested for illegally fishing along the Dharma coast during the turtle-breeding season; fish catch, fishing implements, fishing nets and VHF set were also impounded by patrolling personnel of the forest department.
January 2, 2006	Shrimps and Finfishes	1	The Forest Department officials with the help of local police intercepted the trawler for illegally fishing inside the prohibited zone of Gahirmatha Marine Sanctuary. The fishermen allegedly attacked the patrolling party, leading to killing of one fisherman. Later 14 fishermen were arrested and trawler seized. They were in jail for 2 ½ years, before being released by a judge.
2006	Shrimps and Finfishes	>50	Trawlers fishing illegally caught 1800 endangered Olive Ridley Turtles in the Rushikulya estuary, in a marine sanctuary in Orissa state, fishing 200–300 m within the sanctuary; Fishing is prohibited in these waters during the breeding season of turtles.

Date / Year	Target Species	Number of fishing vessels	Action taken
2007	Shrimps and Finfishes	25	The Bhitarkanika forest department officials arrested 11 fishermen and seized five trawlers and their fish catch for illegal fishing. In this season the Forest Dept. officials seized 25 trawlers and arrested 70 fishermen with 10 sets of fishing nets and fish worth Rs. 50,000 from them.
March 20, 2007	Shrimps and Finfishes	9	7 deep-sea trawlers were intercepted by a joint forest-police patrol near Habelikhati off Gahirmatha marine sanctuary coast. In another mid-sea crackdown the turtle surveillance squad apprehended 12 marine fishermen along with their boats.
November 27, 2007	Shrimps and Finfishes	4	17 fishermen were intercepted along with 4 deep-sea trawlers for fishing illegally inside the Gahirmatha Marine Sanctuary. The turtle surveillance squad spotted the vessels near Satabhaya-Chinciri Island off Gahirmatha coast.
2008	Shrimps and Finfishes	12	Between November 2007 and January 2008, 72 persons were arrested and 12 fishing boats including nine trawlers and one gill-netter were seized by enforcement wing of Orissa Forest Department.
January 13, 2008	Shrimps and Finfishes	2	The turtle surveillance squad near Babuballi Island off Gahirmatha coast spotted 2 deep-sea trawlers. The Forest Department seized the two trawlers and took the crew into custody. Fish catch worth nearly two lakh rupees besides fishing nets and equipment were also seized from the trawlers.
December 2, 2008	Shrimps and Finfishes	2	The turtle surveillance squad seized 2 mechanised trawlers after spotting them near Satabhaya and Chinchiri off Gahirmatha coast. Catch worth Rs. 1 lakh besides fishing nets and implement were also seized.
December 4, 2008	Shrimps and Finfishes	3	The Coast Guard ship 'Sarojini Naidu' apprehended 3 fishing trawlers from Andhra Pradesh with 20 crewmembers while they were fishing illegally off Ganjam coast and also within the Rushikulya sanctuary.
December 13, 2008	Shrimps and Finfishes	3	18 fishermen along with three trawlers were seized at Chinchiri mouth for fishing illegally inside the Gahirmatha sanctuary.
December 19, 2008	Shrimps and Finfishes	4	Four deep-sea trawlers with 21 crew were seized by turtle surveillance patrols while fishing near Satabhaya-Chinciri Island off Garhirmatha coast. This has increased the number of trawlers apprehended since November 1, to 15 vessels and 50 fishermen.
January 17, 2009	Shrimps and Finfishes	1	The Joint Forest-Police patrol apprehended one deep-sea trawler with 6 crew for illegally fishing near Satabhaya off Gahirmatha marine sanctuary.
February 10, 2009	Shrimps and Finfishes	20	In a joint operation, Bhitarkanika forest officials and Indian Coast Guard personnel seized 4 fishing trawlers along with 24 fishermen for fishing illegally within Gahirmatha Marine Sanctuary. State Forest Department had imposed ban on fishing around 20 Km off the shore from November 1 to May 31 every year to protect Olive ridley breeding sites.
March 3, 2009	Shrimps and Finfishes	60	60 fishing vessels and 180 marine fishermen were arrested by turtle surveillance patrols of the Coast Guard, Forest Dept, Police and Fisheries Department.
December 4, 2009	Shrimps and Finfishes	3	State Forest Department apprehended 3 fishing trawlers and 16 fishermen for illegally fishing inside the Gahirmatha Marine Sanctuary.
December 5, 2009	Shrimps and Finfishes	1	1 fishing trawler along with five fishermen onboard was arrested for fishing illegally inside the Gahirmatha Marine Sanctuary.
December 13, 2009	Shrimps and Finfishes	1	1 fishing trawler along with five fishermen were detained by Bhitarkanika forest Department officials for illegally catching fish in the Gahirmatha marine sanctuary.

Appendix F: Median values of Total cost / Expected revenue for 109 countries.

No.	Country	Number of IUU Penalty cases	Median value (Total Cost / Expected Revenue)	Total Cost / Expected Revenue	
				Low	High
1.	Guatemala	1	0.04		
2.	French Polynesia	3	0.06	0.05	0.63
3.	Solomon Islands	20	0.13	0.02	0.62
4.	Nauru	1	0.13		
5.	Federated States of Micronesia	4	0.18	0.14	0.32
6.	Tuvalu	4	0.2	0.14	0.33
7.	Clipperton Islands	2	0.21	0.1	0.33
8.	Sweden	3	0.23	0.2	0.78
9.	Sri Lanka	7	0.24	0.1	1.08
10.	Guyana	3	0.25	0.24	0.47
11.	Cook Islands	6	0.27	0.21	0.81
12.	Niue	1	0.28		
13.	Vietnam	8	0.28	0.22	0.69
14.	Fiji	7	0.3	0.19	2.01
15.	Cambodia	2	0.33	0.26	0.41
16.	Greenland	2	0.34	0.28	0.41
17.	Palau	8	0.35	0.05	4.53
18.	Trinidad & Tobago	7	0.36	0.24	0.68
19.	Republic of Korea	6	0.37	0.23	0.59
20.	Marianas Islands	5	0.38	0.03	139.11
21.	Gambia	14	0.39	0.15	2.12
22.	Costa Rica	3	0.39	0.18	0.45
23.	Mozambique	5	0.39	0.09	1.44
24.	Bangladesh	2	0.39	0.23	0.55
25.	Tonga	3	0.39	0.33	0.76
26.	Bahrain	2	0.42	0.27	0.58
27.	Myanmar	6	0.43	0.19	28.51
28.	Guam	2	0.43		
29.	Brazil	11	0.43	0.13	3.08
30.	Eritrea	1	0.43		
31.	Sierra Leone	9	0.43	0.31	13.27
32.	Latvia	1	0.46		
33.	St. Paul Island	2	0.48	0.31	0.66
34.	Heard & McDonald Islands	8	0.48	0.31	7.29
35.	Yemen	2	0.49	0.4	0.58
36.	Maldives	2	0.51	0.48	0.55
37.	Vanuatu	4	0.51	0.28	0.56
38.	Mauritania	2	0.51	0.5	0.53
39.	Equatorial Guinea	1	0.51		
40.	Philippines	19	0.51	0.15	15.8
41.	Tanzania	1	0.52		
42.	Belize	1	0.53		

No.	Country	Number of IUU Penalty cases	Median value (Total Cost / Expected Revenue)	Total Cost / Expected Revenue	
				Low	High
43.	Ghana	5	0.54	0.41	0.78
44.	Azores Islands	1	0.54		
45.	Nicaragua	6	0.55	0.18	7.25
46.	Bulgaria	4	0.55	0.42	7.5
47.	British Virgin Islands	2	0.55	0.47	0.63
48.	Egypt	4	0.56	0.39	2.08
49.	Mexico	8	0.56	0.24	0.83
50.	American Samoa	8	0.56	0.17	5.22
51.	Tromelin	1	0.56		
52.	Sudan	3	0.56	0.4	1.51
53.	Shetland Islands	3	0.56	0.5	0.69
54.	Ireland	13	0.57	0.32	4.35
55.	New Caledonia	4	0.58	0.09	1.07
56.	Cameroon	1	0.58		
57.	Spain	4	0.59	0.1	0.74
58.	Chagos Islands	14	0.62	0.06	80.61
59.	Croatia	2	0.63	0.62	0.65
60.	South Georgia	8	0.65	0.34	3.01
61.	Channel Islands	2	0.66	0.6	0.73
62.	Panama	1	0.66		
63.	Papua New Guinea	20	0.67	0.09	4.74
64.	Canada	90	0.68	0.08	83.89
65.	Nigeria	1	0.69		
66.	El Salvador	3	0.69	0.4	1.63
67.	Russia	87	0.73	0.11	35.97
68.	China	4	0.75	0.64	2.16
69.	Madeira Islands	1	0.77		
70.	St. Vincent	1	0.79		
71.	Ukraine	4	0.79	0.57	0.93
72.	Kiribati	7	0.81	0.1	2.74
73.	Indonesia	19	0.81	0.37	2452.27
74.	Morocco	7	0.82	0.39	33.22
75.	Georgia	23	0.82	0.48	3.36
76.	Angola	8	0.84	0.47	7
77.	Liberia	1	0.84		
78.	Cuba	2	0.85	0.51	1.19
79.	USA	108	0.86	0.03	15000.5
80.	South Africa	12	0.88	0.16	93.1
81.	Falkland Islands	15	0.89	0.11	1.87
82.	Howland & Baker Islands	1	0.89		
83.	United Kingdom	50	0.92	0.18	14.24
84.	Ecuador	1	0.93		
85.	Namibia	14	0.94	0.56	13
86.	Bahamas	8	0.97	0.28	1384.92
87.	Somalia	13	0.98	0.47	15.47
88.	Norway	27	0.99	0.58	4.2

No.	Country	Number of IUU Penalty cases	Median value (Total Cost / Expected Revenue)	Total Cost / Expected Revenue	
				Low	High
89.	Japan	5	1.03	0.27	2.97
90.	India	9	1.1	0.58	23.04
91.	Peru	6	1.16	0.87	7.96
92.	Kerguelen Islands	6	1.18	0.62	23.41
93.	Malaysia	75	1.21	0.22	2129.81
94.	Tunisia	3	1.22	0.74	5.06
95.	Congo	1	1.27		
96.	New Zealand	54	1.36	0.12	86.56
97.	Guinea Bissau	12	1.38	0.08	3.28
98.	Comoros Islands	1	1.4		
99.	France	14	1.47	0.49	15.2
100.	Australia	100	1.77	0.24	127.63
101.	Isle of Man	7	1.77	0.47	175.33
102.	Marshall Islands	3	2.04	1.22	2.98
103.	Jamaica	3	2.08	1.67	8.42
104.	Qatar	3	2.22	1.91	2.24
105.	Seychelles	19	2.4	0.36	1966.11
106.	Crozet Islands	3	4.7	3.68	5.16
107.	Argentina	61	5.14	0.06	9722.78
108.	Madagascar	2	5.18	4.64	5.72
109.	Malta	2	7.28	0.28	14.28