

**REVIEW OF THE STATE OF THE WORLD FISHERY RESOURCES:
INLAND FISHERIES**



Copies of FAO publications can be requested from:
Office of Knowledge Exchange, Research and Extension
Food and Agriculture Organization
of the United Nations
E-mail: publications-sales@fao.org
Fax: +39 06 57053360
Web site: www.fao.org/icatalog/inter-e.htm

REVIEW OF THE STATE OF THE WORLD FISHERY RESOURCES: INLAND FISHERIES

Robin Welcomme
Imperial College, London
United Kingdom

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

ISBN 978-92-5-107078-9

All rights reserved. FAO encourages the reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to:

copyright@fao.org
or to the

Chief, Publishing Policy and Support Branch
Office of Knowledge Exchange, Research and Extension
FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy

© FAO 2011

PREPARATION OF THIS DOCUMENT

This document represents the second revision of Fisheries Circular No. 942, and is a key document in the Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department's efforts to provide accurate and timely information on fishery resources. It reviews global inland capture fisheries for food production. It also explores the increasingly important recreational fisheries sector (see Annex III), although there is no systematic reporting of this to the FAO or to any other organization with global scope. The objectives of this review are:

- to update and expand the scope of the 2003 Review of the State of World Fishery Resources: Inland Fisheries, Revision 1 (FAO, 2003);
- to place inland capture fisheries in the context of overall world fish production and other sources of animal protein;
- to review the status and trends of inland fisheries production at global, continental and subcontinental levels;
- to call attention to the importance of inland capture fisheries with respect to food security and human development; and
- to call attention to the main issues facing inland fisheries.

The present version differs from earlier versions of Circular No. 942, (Rev. 1) in the following ways:

- the continental analysis is refined to subcontinental regions;
- updating of FAO statistical information is through 2009;
- indicators of the importance of inland capture fisheries production have been added including:
 - per capita production;
 - production per unit area;
 - ten-year trends; and
 - comparisons with other animal protein sources.
- inclusion in the annex of an analysis of the effect of large changes in national reports of inland capture fisheries statistics on the global trend;
- inclusion of an annex on recreational fishing; and
- inclusion of boxes highlighting items of particular interest.

Welcomme, R.

Review of the State of the World Fishery Resources: Inland Fisheries.

FAO Fisheries and Aquaculture Circular No. 942, Rev. 2. Rome, FAO. 2011. 97 pp.

ABSTRACT

The fishery statistics reported to FAO by countries and maintained in the FishStat database are analysed for trends in quantity and composition of catches from 1950 to 2009. Catches have been increasing at a steady rate throughout the period. Fish from inland water capture fisheries are an important source of animal protein, especially in landlocked countries and for populations riparian to lakes and rivers. Finfish contribute about 90 percent of the catch together with some crustaceans and molluscs. The accuracy of reporting of catches by taxonomic group has improved with time and more groups are being reported in 2009 than in 1950. At the same time, the percentage of catches assigned to the generic “freshwater fishes NEI” category has declined. Trends in catches and taxonomic groups are analysed for subcontinental regions under a more general continental heading. The regions are divided mainly by geography, although in some cases economic and political considerations are used. Catches in the various regions of Africa, Asia and South and Central America have risen steadily over the period of the review, although there are local exceptions to the general trend. There is clear evidence that such increases are real in some individual fisheries, but generally the increases are attributed to improvements in reporting, whereby catches that were already there but previously ignored are now being incorporated into the reports. Catches in North America, and most of Europe, have declined in the same period, which is attributed to shifts in economic conditions that make fishing not longer financially viable, and a greater public demand for recreational fishing. Catches from eastern Europe and the Russian Federation declined from a maximum in the 1980s, but have shown some signs of recovery in the last decade. In general, the world’s inland fisheries still appear viable although environmental pressures, such as damming, water abstraction and overexploitation, pose a potential threat to the maintenance of present levels of reproduction and recruitment, and hence, ultimately catch.

CONTENTS

Preparation of this document	iii
Abstract	iv
Table of contents	v
List of figures, tables and boxes	vii
1. INTRODUCTION.....	1
2. GLOBAL TRENDS IN INLAND CAPTURE FISHERIES.....	3
2.1 Fish supply by origin	4
2.2 Global trends in inland fisheries	5
2.2.1 Trends in catches.....	5
2.2.2 Significance of inland fisheries in human diet in 2007	6
2.2.3 Inland Fish supply by species	7
3. TRENDS BY CONTINENT	11
3.1 Africa	13
3.1.1 North Africa	16
3.1.2 Nile River	17
3.1.3 Eastern coastal	18
3.1.4 Great Lakes	19
3.1.5 Southern Africa	20
3.1.6 Congo Basin	22
3.1.7 The Sahel.....	23
3.1.8 West African coastal.....	25
3.1.9 Islands.....	27
3.2 Asia	28
3.2.1 China	32
3.2.2 East Asia.....	34
3.2.3 South Asia	35
3.2.4 South-east Asia	36
3.2.5 West Asia	39
3.2.6 Central Asia.....	41
3.2.7 Arabia	44
3.3 Americas	44
3.3.1 Central	48
3.3.2 North America.....	50
3.3.3 South America.....	51
3.3.4 Islands.....	56
3.4 Europe	57
3.4.1 West Europe	59
3.4.2 North Europe	61
3.4.3 South Europe	62
3.4.4 East Europe.....	64
3.4.5 The Russian Federation	65
3.5 Oceania	67
4. CONCLUSIONS	71
REFERENCES.....	73

ANNEXES

Annex I–Catches for all countries reporting inland fish landings 2000–2009 (in order of magnitude of catch as of 2009).....	77
Annex II–Identification and effect of large changes in national reports of inland capture fisheries statistics on the global trend (1950–2007)	83
Annex III–Recreational fisheries	90
Annex IV–Crocodiles.....	94
Annex V–Harvest of aquatic plants	97

LIST OF FIGURES

1.	Global fish production from all sources (marine, aquaculture and inland) 1950–2009 with trend line $y = 2E+06x + 2E+07$	3
2.	Trends in fish production from the major sources from 1950 to 2009	4
3.	Global inland fish production 1950–2009 with trend line $y = 12592x + 2E+06$	5
4.	Global trends in the number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for 1950–2009	9
5.	Trends in inland fish catches by continent, 1950–2009	11
6.	Percentage contribution of various continents to world inland fisheries production in 2009	12
7.	Catches for the top 26 countries, equivalent to 90 percent of world inland catch in 2009	12
8.	Trends in reported catch for Africa, 1950–2009	13
9.	Trends in reported catch in the various African Regions, 1950–2009	13
10.	Trends in the number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for African countries 1950–2009	16
11.	Trends in catches in the countries of the North African region, 1950–2009	17
12.	Trends in catches in the countries of Nile region, 1950–2009	17
13.	Trends in catches in the Eastern region (Somalia), 1981–2009	18
14.	Trends in catches in the countries of the Great Lakes region, 1950–2009	19
15.	Trends in catches in the countries of the Southern African region, 1950–2009	22
16.	Trends in catches in the countries of the Congo basin region, 1950–2009	23
17.	Trends in catches in the countries of the Sahel region, 1950–2009	23
18.	Trends in catches in the countries of the West African coastal region, 1950–2009	26
19.	Trends in catches in Madagascar, 1950–2009	27
20.	Trends in reported catch for all regions of Asia, 1950–2009	28
21.	Trends in reported catch in the various Asian Regions, 1950–2009	30
22.	Trends in the number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for Asian countries, 1950–2009	32
23.	Trends in inland fish production from the Chinese region, 1950–2009	33
24.	Trends in inland fish production from the East Asia region, 1950–2009	34
25.	Trends in inland fish production from the South Asian region, 1950–2009	35
26.	Trends in inland fish production from the South-east Asian region, 1950–2009	38
27.	Trends in inland fish production from the West Asian region, 1950–2009	40
28.	Trends in inland fish production from the Central Asian region, 1988–2009	42
29.	Trends in reported catch for all regions of the Americas, 1950–2009	45
30.	Trends in inland fish production from each of the four regions of the Americas, 1950–2009	45
31.	Trends in number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for Latin America (Central, South and Islands) for 1950–2009	47
32.	Trends in number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for North America for 1950–2009	48
33.	Inland fish production from the Central American region, 1950–2009	49
34.	Inland fish production from the North American region, 1950–2009	50
35.	Inland fish production from the South American region, 1950–2009	51
36.	Inland fish production from the South American region by country, 1950–2009	53
37.	Inland fish production from the islands of the Americas by country or territory, 1950–2009	56
38.	Trends in reported catch from the four European regions for 1950–2009, excluding the Russian Federation. (The Russian Federation is treated separately in Figure 45)	57
39.	Trends in number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for Europe (excluding the Russian Federation) for 1950–2009	59
40.	Inland fish production from the West European region by country, 1950–2009	60
41.	Inland fish production from the North European region by country, 1950–2009	61
42.	Inland fish production from the South European region by country, 1950–2009	63

43.	Inland fish production from the East European region, 1950–2009	64
44.	Inland fish production from the Union of Soviet Socialist Republics 1950–1987(red line) and the Russian Federation 1988–2009 (blue line)	66
45.	Trends in number of taxa (red line) and the percentage of freshwater species NEI (blue line) reported by year for the Russian Federation for 1950–2009	66
46.	Inland fisheries production from Oceania by country, 1950–2009	69

LIST OF TABLES

1.	Number of countries for which the FAO had to estimate inland catches in 2009	2
2.	Global production of animal protein by source in 2009 (<i>source</i> FAOSTAT/FishStat)	4
3.	Global fish production in 2009 by source	5
4.	Contribution of inland fish to diets for countries with over 3 kilograms per capita/year in 2007 (<i>source</i> FAOSTAT)	6
5.	Main groups of organisms caught by inland fisheries from 1959 to 2009	7
6.	Families of fish and other organisms reported from inland fisheries in 2009 (excluding freshwater fishes NEI)	8
7.	Catch by continent in 2009	11
8.	Reported catches from the various African regions in 2009	15
9.	Africa – Production of animal protein by source in 2009 (<i>source</i> FAOSTAT/FishStat)	15
10.	Major taxonomic groupings of catches from Africa, 2009	16
11.	Taxonomic groupings of catches for the Nile region, 2009	18
12.	Taxonomic groupings of catches for the Great lakes region, 2009	20
13.	Taxonomic groupings of catches for the West African coastal region, 2009	27
14.	Percentage contribution of the various Asian regions to the Asian total inland catch in 2009	31
15.	Asia – Production of animal protein by source in 2007 (<i>source</i> FAOSTAT)	31
16.	Major taxonomic groupings of catches from Asia, 2009	32
17.	Main groups of organisms caught by inland fisheries in China in 2009	33
18.	Main groups of organisms caught by inland fisheries in East Asia in 2009	34
19.	Main groups of organisms caught by inland fisheries in South Asia in 2009	36
20.	Main groups of organisms caught by inland fisheries in Southeast Asia in 2009	39
21.	Main groups of organisms caught by inland fisheries in West Asia in 2009	40
22.	Main groups of organisms caught by inland fisheries in Central Asia in 1988 and 2009	44
23.	Percentage contribution of the various American regions to the American total inland catch in 2009	45
24.	North, Central and South America – Production of animal protein by source, 2009 (<i>source</i> FAOSTAT/FishStat)	46
25.	Major taxonomic groupings of catches for the Americas in 2009	47
26.	Main groups of organisms caught by inland fisheries in Central America in 2009	50
27.	Main groups of organisms caught by inland fisheries in North America in 2009	51
28.	Main groups of organisms caught by inland fisheries in South America in 2009	54
29.	Main groups of organisms caught by inland fisheries in the American islands in 2009	56
30.	Percentage contribution of the various inland European regions to the total catch in 2009	57
31.	Europe – Production of animal protein by source in 2009 (<i>source</i> FAOSTAT/FishStat)	58
32.	Main groups of organisms caught by inland fisheries in Europe in 2009 (excluding Russian Federation)	58
33.	Main groups of organisms caught by inland fisheries in Western Europe in 2009	60
34.	Main groups of organisms by family caught by inland fisheries in Northern Europe in 2009	62
35.	Main groups of organisms caught by inland fisheries in South Europe in 2009	63
36.	Main groups of organisms caught by inland fisheries in East Europe in 2009	65
37.	Main groups of organisms caught by inland fisheries in the Russian Federation in 2009	67
38.	Percentage contribution of the various countries of Oceania to the total inland catch in 2009	69
39.	Oceania – Production of animal protein by source in 2009 (<i>source</i> FAOSTAT/FishStat)	70
40.	Main groups of organisms caught by inland fisheries in Oceania in 2009	70
41.	Trends and mean early percentage growth for the continents and subcontinental regions, 2000–2009	71

LIST OF BOXES

1.	Cichlids and cyprinids – two important families of inland fish	10
2.	Catch statistics for Africa adjusted for sudden changes in magnitude	14
3.	Lake Victoria – changing species composition following introduction of Nile perch	21
4.	Sahelian climate – an indicator of the effects of climate change	24
5.	Adjusted catch statistics for Asia	29
6.	Hilsa – <i>Tenualosa ilisha</i> – an anadromous species harvested in two environments	37
7.	The Black Sea sprat – <i>Clupeonella cultriventris</i> – victim of multiple environmental impacts	43
8.	<i>Prochilodus</i> in the La Plata River system – response to environmental and fisheries mismanagement	55
9.	Salmon – rise and fall of a group of commercially important fishes	68

1. INTRODUCTION

Current views on inland fisheries are contradictory. There is the “inland fisheries are doomed” view (see Friend *et al.*, 2009), which assumes that the numerous threats to aquatic ecosystems posed by man’s activities will inevitably lead to a decline of aquatic resources. This view is supported by many individual studies and reports from all continents, which allege that catches are falling, species disappearing, and that there are many of the symptoms of chronic overfishing at the level of individual species or whole communities (see, for example: Thorpe *et al.*, 2009, for Kyrgyzstan and other countries of the former Union of Soviet Socialist Republics (USSR), and Aps, Sharp and Kutonova, 2004, for Central and Eastern Europe; other examples see footnote¹). The foundation of this view is the large number of threats to inland aquatic systems, including:

- Bad or inexistent fishery management – including uncontrolled and excessive fishing, fishing with inappropriate or illegal mesh sizes, and introductions of exotic and invasive species.
- Water abstractions – there is a growing trend in Africa for river flow to be diverted for irrigation either directly or from reservoirs.
- Land drainage – there is an increasing trend to drain wetlands and separate floodplains from the river channel. This results in a loss of living area and threats to many guilds of fish.
- Dam construction – with the fuel crisis facing the world there has been an increase in proposals for construction of large dams. For example, there is a project for the construction of a major dam at Ayourou in the Niger and another for a main stem dam across the Congo River. The impacts of such dams on the fish fauna downstream have usually not been assessed as it is believed all too often that the creation of the reservoir upstream of the dam has a compensatory effect through the creation of new fisheries in this reservoir. However, this effect does not offset the negative effect of the damming.
- Pollution/eutrophication – pollution has important local effects in rivers and in lakes. In lakes, eutrophication is an increasing threat from the growing levels of human population around their shores and a lack of proper wastewater treatment systems in place in many areas.
- Climatic variability/change – climatic variation has always been a severe problem, especially in the drought-prone belts of the Sahel and southern African region. These effects are likely to become more severe as global warming progresses.

In contrast to this pessimistic view of the present status and future of inland fisheries resources, catches are still recorded as rising at an apparently linear rate of increase of about 3 percent per year globally. There is also widespread expert opinion that much of the catch from inland fisheries is unrecorded. As a result, inland fishery catches are generally underestimated, and in some of the most productive fisheries seriously so. This is mainly because of the diffuse and small-scale nature of individual fisheries where there are no definable landings and much of the catch goes directly into domestic consumption. Typical examples of such catches are the fisheries on the numerous low order rivers and streams, which together may contribute a considerable amount of fish. This was noted by Welcomme as early as 1976 (Welcomme, 1976) and has not generally been rectified, although it is admitted by several countries. Specific examples include the general omission of wild fish catches in rice fields. Studies such as that of Hortle, Troeung and Lieng (2008) show production levels for rice fields to be high and, given their total area, the accumulative fish production is very significant. Indeed, where rice fish yields have been incorporated into the statistics, such as in Bangladesh and Cambodia, reported catches have increased. Similarly, under-reporting may occur in the regular collection of statistics. For example, in Africa, Braimah (2000, 2001, 2003) estimated that the catches from Lake Volta are considerably underestimated. In Asia, Lymer *et al.* (2008a) review the inland and marine statistics reported by Thailand and note that considerable underestimation of inland waters may be occurring, and Van Zahlinge *et al.* (2004) and Hortle (2007) increased the estimates on production from the lower Mekong basin by a factor of about three. More recently, the Big Numbers Project estimated that inland fishery catches were about 14 million tonnes.

¹ See, for example: www.bowdoin.edu/news/archives/1academicnews/004631.shtml for Lake Mweru in Africa; and <http://news.bbc.co.uk/1/hi/world/africa/6261447.stm> for Lake Chad in Africa.

Inland fishery statistics are generally submitted to the Statistics and Information Service (FIPS) of the Fisheries and Aquaculture Department of FAO by national correspondents in the appropriate ministry of Member Countries. Data reported by countries are carefully checked, and when the figures are questionable the national correspondent is consulted for clarification. The statistics made available by the national authorities can be complemented or replaced if better data from other origins are available. If a country does not report its catches despite several reminders, or if those provided are considered not to be reliable, FAO estimates the missing data and marks them in the database with an “F”. In 2009, FAO estimated catches in 38 percent of countries (see Table 1). However, the quality of the FAO statistics depends upon the accuracy and reliability of the data collected nationally and provided to FAO. The data compiled are stored in the FishStat database and are available for analysis. Catches for all countries reporting catches over the last ten years are listed in Annex 1.

Table 1: Number of countries for which the FAO had to estimate inland catches in 2009

Continent	Countries with inland fish catches	Countries for which catch was estimated (No.)	Countries for which catch was estimated (%)	Tonnage reported	Tonnage estimated	Total tonnage estimated (%)
Africa	43	22	51.16	2 502 570	1 134 880	45.35
Asia	31	9	29.03	6 740 366	58 014	0.86
Europe, including the Russian Federation	40	8	20.00	403 355	11 670	2.89
North America	2	0	0.00	55 644	0	0.00
Oceania	7	4	57.14	17 786	15 706	88.31
South and Central America	22	12	54.55	500 908	405 486	80.95
Total	145	55	37.93	10 220 629	1 625 756	15.91

The accuracy of inland fisheries statistics has long been questioned; see, for example, Coates (2002), in his discussion on the deficiencies of inland catch recording for Southeast Asia, as well as the comments in FAO Fisheries Circular No. 942, Rev. 1, and the annotations in the *The State of World Fisheries and Aquaculture* (SOFIA) sections on inland fisheries (FAO, 2002, 2004, 2007, 2009). Recent studies (World Bank, 2010; Mills *et al.*, 2011) conclude that world inland fish catch is between 11 and 14 million tonnes/year, and the FAO Big Numbers Project supported the larger of these estimates. Thus, some of the increases registered appear to be through better reporting of data and the inclusion of the so far unreported fisheries, such as floodplains and rice fields, in the statistics, consistent with this higher estimate.

These various factors make it difficult to determine whether there are actual increasing trends in the fisheries or whether the fisheries have been at a higher level of real production for some time and the trends are only a statistical artefact tending towards this higher estimate. Therefore, all discussions of trends in this document refer to the trends in the statistics appearing in FishStat and do not necessarily reflect actual increases or decreases in production.

In order to adjust for the effects of irregularities in reporting by individual countries on regional trends, the year-to-year changes in catch (per country) were analysed by looking at the percentage change since the previous year by Lymer & Funge-Smith (2009) for the Indo-Pacific countries and by Welcomme and Lymer (2009) for Africa. This used two criteria to detect large irregularities in reporting:

- criterion 1: any year-on-year change greater than 40 percent, which is considered a significant change from the previous year; and
- criterion 2: individual country changes of more than 30 percent when compared with the regional average change.

Catches for countries that were selected using criterion 2, together with those showing reports of large negative changes of more than 30 percent (absolute value) of the average regional increase, were adjusted to smooth out any individual large increases backwards across the data series. The adjusted trends at continental level are presented in the relevant section of this circular for comparison. An analysis of the effect of large changes in national reports of inland capture fisheries statistics on the global trends is presented in Annex 2.

In this fisheries circular, inland fisheries are taken to include finfish, molluscs and crustaceans, and exclude crocodiles,² other reptiles and mammals.

2. GLOBAL TRENDS IN INLAND CAPTURE FISHERIES

Global reported fish production from all sources (marine, aquaculture and inland) has been increasing at a linear rate of 3.78 percent per year from 1950 to the current (2009) level of 158 159 993 tonnes (Figure 1).

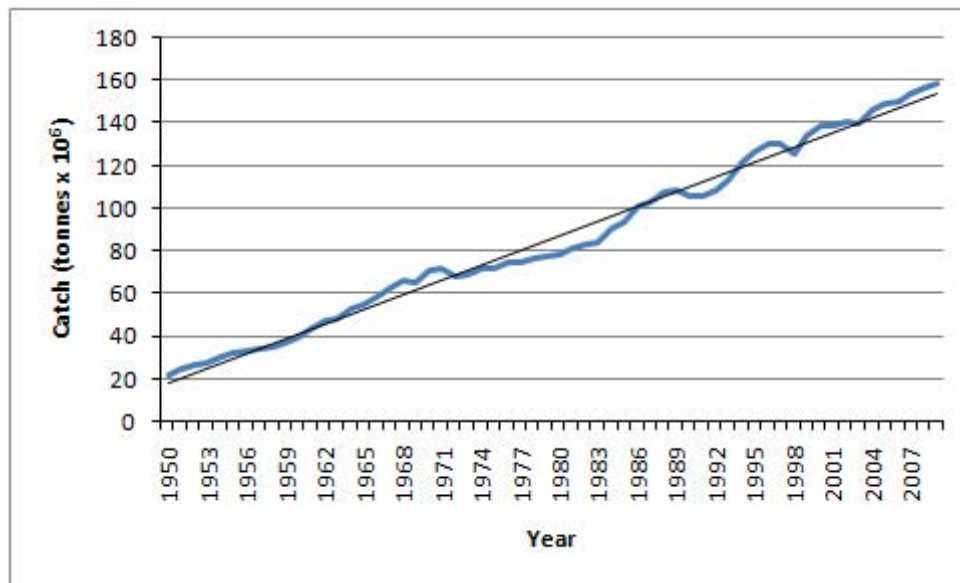


Figure 1: Global fish production from all sources (marine, aquaculture and inland) 1950–2009 with trend line $y = 2E+06x + 2E+07$

² Crocodile catches are the subject of a short note in Annex 4.

Table 2 shows the contribution of the various sources of animal protein to world consumption in 2009. This places fish from all sources as the major single source of animal protein worldwide, accounting for over one-third (37.42 percent) of global production in 2009. In reality, not all of this fish is directly eaten by humans, as much of the marine catch is transformed into fishmeal for use in agricultural and aquacultural feeds. The contribution of fish to overall animal production varies considerably by continent.

Table 2: Global production of animal protein by source in 2009 (aquatic plants are excluded from the aquaculture figures)

Protein source	Catch (tonnes)	%
Pig meat	106 069 157	23.68
Marine fish (capture fisheries)	88 942 948	19.86
Chicken meat	79 595,987	17.77
Aquaculture fish (all sources)	68 348 943	15.26
Cattle meat	61 837 770	13.80
Freshwater fish (capture fisheries)	10 323 905	2.30
Sheep meat	8 109 219	1.81
Turkey meat	5 319 748	1.19
Goat meat	4 938 655	1.10
Duck meat	3 845 443	0.86
Buffalo meat	3 307 818	0.74
10 other categories	7 301 670	1.63
Total	447 941 263	100.00

Source: FAOSTAT; FishStat.

2.1 Fish supply by origin

Figure 2 shows the trends in production classified by the origin of the fish produced for 1950–2009. This indicates clearly that marine catches have stabilized around their 1996 peak of about 87 million tonnes to the present (2009) value of just over 89 million tonnes. It also shows the rapid growth of aquaculture production since 1990 to its present level of about 36 percent of the total production (Table 3).

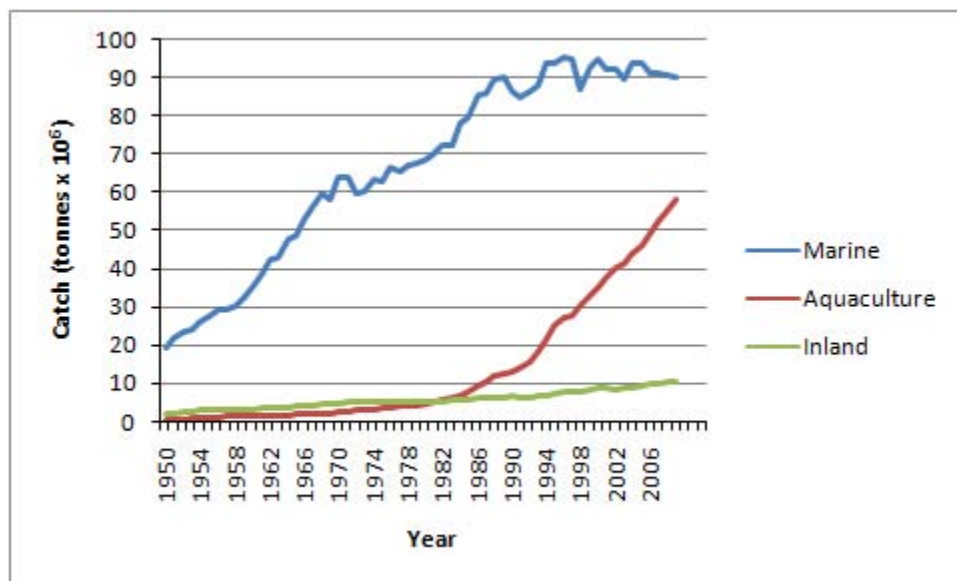


Figure 2: Trends in fish production from the major sources from 1950 to 2009 (aquatic plants are excluded from the aquaculture figures)

Table 3: Global fish production in 2009 by source

Sector	Catch (tonnes)	%
Marine capture	89 848 004	56.81
Freshwater aquaculture	33 833 863	21.39
Marine aquaculture	20 179 876	12.76
Inland capture	10 323 905	6.53
Brackish-water aquaculture	4 231 843	2.68
Total	158 159 993	100.00

It is worth noting that fish from all inland sources (capture and aquaculture combined) make up about 28 percent of all fish produced as against the combined production of capture and culture from marine waters of 69 percent. The remaining 3 percent comes from brackish-water aquaculture. It is, perhaps, legitimate to combine the inland sources because of the many practices that are intermediate between capture and culture in inland waters, including various types of enhancement, gears such as fish parks, capture-based aquaculture, culture-based capture fisheries, and fisheries in rice fields and in small dams and reservoirs, that may be reported either as culture or capture dependent on local usage.

Inland capture fisheries currently contribute 6.5 percent to total fish production, which is only about 2.3 percent of the global protein production; they differ somewhat from other fisheries in that all produce is eaten either fresh as some form of salted or dried product or as a variety of fish sauces and pastes that are essential ingredients to many local cuisines. With few exceptions, such as the Amazonian large boat fishery, the Lake Victoria fisheries, the “sábalo” fishery of Argentina and the fishery concessions of the Mekong and Ayerwaddy, inland fisheries are small scale, involving large numbers of artisanal or subsistence fishers, and their products are usually marketed and consumed locally at the point of capture.

2.2 Global trends in inland fisheries

2.2.1 Trends in catches

Catches of fish and other organisms from inland water appear to have increased linearly by 2.93 percent per year since 1950 (Figure 3) to the present (2009) total of 10 323 905 tonnes.

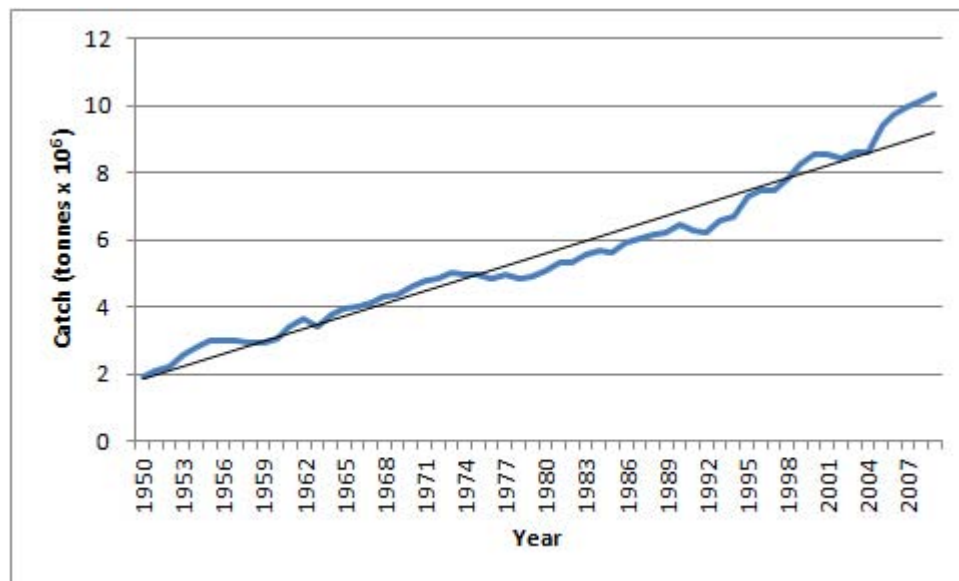


Figure 3: Global inland fish production 1950–2009 with trend line $y = 12592x + 2E+06$

2.2.2 Significance of inland fisheries in the human diet in 2007

Production of fish by capture from inland water remains relatively low compared with other sources of fish at 6.46 percent of the total. However, it is still the sixth major supplier of animal protein globally (Table 2). This global figure conceals considerable local variation, and in some countries fish caught

from inland water is the major source of animal protein available to the local population. For example, in Bangladesh, the inland catch of 1 006 761 tonnes in 2007 represents over 64 percent of all animal protein produced. Similar high figures apply to Uganda (66 percent), Cambodia (64 percent) and Malawi (44 percent). Slightly lower but still very important contributions are made in many other countries.

Nearly 38 percent of the inland fish captured comes from the 71 low-income food deficit countries (LIFDCs) as defined by FAO (see www.fao.org/countryprofiles/lifdc.asp for complete list).

While the unweighted mean level of production for all countries is equivalent to only 1.48 kg/ha globally, some countries depend heavily on inland fish for their protein needs.

Table 4 shows the consumption equivalents in kilograms per capita per year (2007) for all countries with over 3 kilograms per capita per year.

Table 4: Contribution of inland fish to diets for countries with over 3 kilograms per capita/year in 2007

Country	Annual consumption (kg/capita)
Cambodia	31.37
Uganda*	15.29
Myanmar	14.35
Republic of the Congo	8.18
Mali	7.69
Finland	6.78
United Republic of Tanzania	6.50
Gabon	6.44
Chad	6.25
Bangladesh	6.21
Zambia	5.03
Mauritania	4.56
Malawi	4.36
Lao People's Democratic Republic	4.26
Senegal	3.99
Cameroon	3.81
Thailand	3.53
Democratic Republic of the Congo	3.48
Central African Republic	3.39
Paraguay	3.15
Ghana	3.15
Egypt	3.14
Kenya	3.12

*Not all fish produced in some countries is consumed locally. For example, the Lake Victoria countries export a significant proportion of their Nile perch catch to Europe.

Source: FAOSTAT.

2.2.3 Inland fish supply by species

Of the 220 countries and political groupings reporting fish catches from all sources in 2009, 72 mostly arid or small-island countries did not report any inland catches; fairly complete lists of species are available for 52 (of which FAO estimated eight); restricted lists, including identification of important fish groups are available for 26 (of which FAO estimated six); and no breakdown at all were available for 34 (of which FAO estimated 21).

The main groups of species recorded as being caught by inland fisheries are listed in Table 5. This indicates that the majority of organisms caught (over 90 percent) were finfish throughout most of the 50+ year period. However, the relative proportions of the groups changed during the evolution of the fishery since 1950 with a slight decrease in the proportion of finfish and increases in the proportion of crustaceans and molluscs. There are indications from a range of detailed surveys and studies on consumption patterns (e.g. Hortle, 2007) that actual catches of crustaceans and molluscs have been considerably under-reported, at least in the Mekong basin and parts of China and Southeast Asia (Balzer *et al.*, 2006; Halwart *et al.*, 2006). This is probably driven by a tendency to focus on fish catches rather than on other species in official reporting systems. These other aquatic animals, therefore, probably comprise a far greater proportion of actual catches in other parts of the world where they form part of the informal, subsistence and artisanal fisheries that are frequently unreported.

Table 5: Main groups of organisms caught by inland fisheries from 1959 to 2009

Group	Year					
	1959	1969	1979	1989	1999	2009
	Catch (tonnes)					
Finfish	2 907 188	4 277 886	4 519 374	5 711 242	7 298 244	9 343 658
Crustaceans	19 618	59 885	95 088	160 118	471 450	556 912
Molluscs	33021	54492	275120	335531	501 910	373 275
Aquatic invertebrates	100	100	1075	3543	2665	47 477
Amphibians	1 050	1 435	7 427	4 739	1 823	2 488
Aquatic plants*	800	1 000	706	4817	83	190
Total	2 962 077	4 394 898	4 898 790	6 219 990	8 276 175	10 324 000
	Percentage					
Finfish	98.15	97.34	92.25	91.82	88.18	90.50
Crustaceans	0.66	1.36	1.94	2.57	5.70	5.39
Molluscs	1.11	1.24	5.62	5.39	6.06	3.62
Aquatic invertebrates	0.00	0.00	0.02	0.06	0.03	0.46
Amphibians	0.04	0.03	0.15	0.08	0.02	0.02
Aquatic plants	0.03	0.02	0.01	0.08	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

* The statistics for aquatic plants are reviewed in Annex 5.

Inland waters are among the most species-rich habitats on the planet, and some river basins such as the Amazon and Mekong have several thousand species (see Amarasinghe and Welcomme, 2002, for lakes and Oberdorff, Guegan and Hugueny, 1995, for rivers). Identifying and recording such diversity is clearly impractical in most fisheries, so in the FAO statistics species are generally reported either as individual species (in the case of the most significant) or under a series of taxonomic groups including by family. Many countries do not report their catches by grouping, preferring to use a general category such as “freshwater fishes NEI”.³ Fifty-five percent of the total tonnage caught in 2009 were not recorded by species category or assigned to the general category.

When the “freshwater fishes NEI” category is eliminated from the calculations, the remaining families together contribute about 95 percent of the catch; Table 6 lists the families.

³ Freshwater fishes nei = freshwater fishes not elsewhere indicated.

Table 6: Families of fish and other organisms reported from inland fisheries in 2009 (excluding “freshwater fishes NEI”)

Family	Catch (tonnes)	%
Cyprinidae	861 546	22.23
Cichlidae	789 989	20.38
Centropomidae	354 917	9.16
Palaemonidae	304 465	7.86
Clupeidae	217 315	5.61
Clariidae	174 648	4.51
Channidae	156 886	4.05
Salmonidae	113 545	2.93
Characidae	89 631	2.31
Curimatidae	82 241	2.12
Bagridae	61 920	1.60
Grapsidae	52 495	1.35
Pimelodidae	41 999	1.08
Belontiidae	41 152	1.06
Percidae	40 752	1.05
Mugilidae	39 500	1.02
Mormyridae	35 685	0.92
Coregonidae	32 950	0.85
Siluridae	30 389	0.78
Esocidae	28 329	0.73
Anabantidae	24 591	0.63
Mochokidae	20 905	0.54
Osteoglossidae	20 628	0.53
Protopteridae	20 247	0.52
Pangasiidae	19 760	0.51
Penaeidae	18 447	0.48
Citharinidae	17 155	0.44
Atherinidae	17 080	0.44
Osmeridae	13 981	0.36
Gymnarchidae	13 901	0.36
45 other families	138 697	3.21

Petersson (2009) identified a trend in the reporting by statistical grouping whereby the diversity index has increased over time, whereas the similarity index shows that the composition of the catch has changed progressively, indicating that catches in 2005 were very different from those in 1950.

This may be due to a greater number of taxonomic groups entering the catch with time, or to improvements in the identification and reporting of taxonomic groups. Figure 4 shows that there has been a steady increase in the number of taxonomic groups reporting each year since 1950. The accuracy of identification is indicated by the percentage of the catch that is assigned to the “freshwater species NEI” category. In Figure 4, this category fell slightly from 1965 to 1990 indicating improved identification of species in the reports but, globally, the trend has since reversed. The steady increase in the number of taxa reported is consistent with the fishing-down process, which predicts that increasing numbers of small species will enter the fishery as fishing pressure increases, although it could also be due to better reporting.

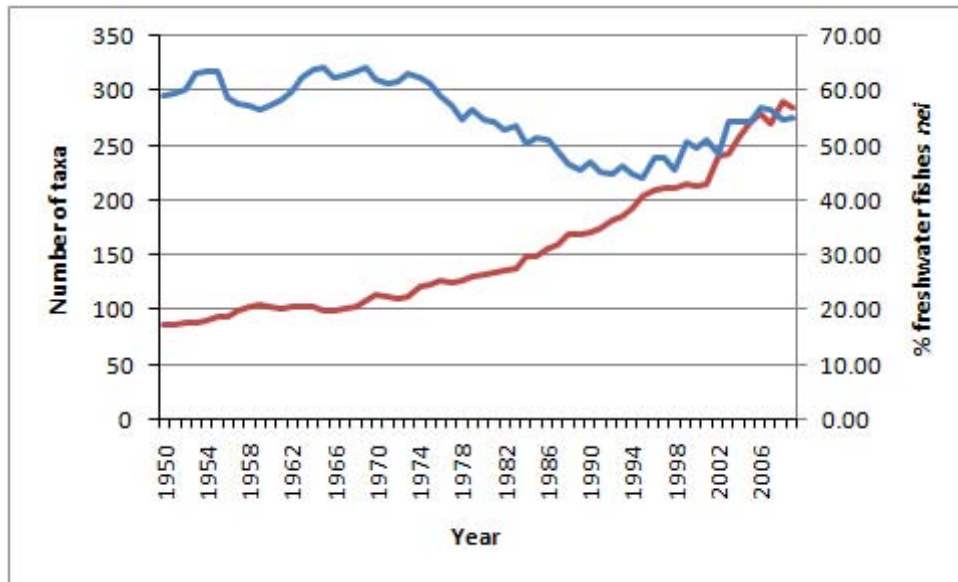


Figure 4: Global trends in the number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for 1950–2009

Of the 301 taxonomic categories of fish⁴ and other aquatic organisms reported from inland water catches other than “freshwater fishes NEI”, 76 groups contribute over 95 percent of world catches. Of these, two are particularly conspicuous: the cichlids, represented mainly by Nile tilapia (*Oreochromis niloticus*), at 20.38 percent, and the cyprinids, represented mainly by the common carp, Chinese carps and Indian major carps, at 22.23 percent. The significance of the tilapias in global inland fish catches is that tilapias are the major species used in freshwater aquaculture throughout the tropics and have been widely introduced across the tropical world to populate reservoirs where native riverine faunas have been unsuccessful in providing high production (Box 1) (see Database on Introductions of Aquatic Species [DIAS]⁵ for information on species introductions).

There is considerable variation between continents and regions, which will be explored in the following sections.

⁴ Unless otherwise stated, “taxonomic group” is equivalent to the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) group.

⁵ www.fao.org/fishery/dias/en

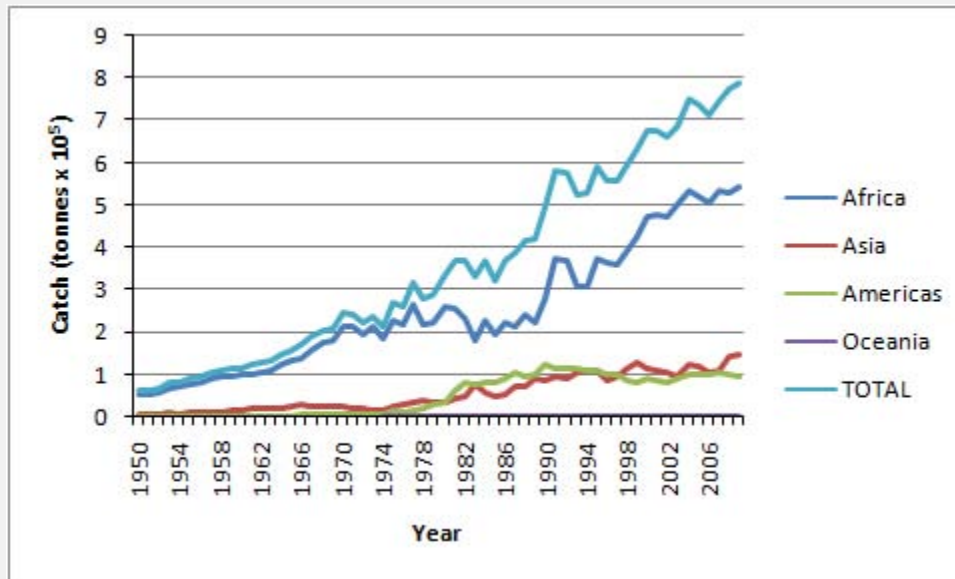
BOX 1
CICHLIDS AND CYPRINIDS – TWO IMPORTANT FAMILIES OF INLAND FISH

Cichlids

Ten categories of cichlids are reported, of which the tilapias make up 87 percent. Tilapias, mainly in the form of Nile tilapia (*Oreochromis niloticus*), have been introduced widely around the tropical world from their origins in Africa. Many introductions were originally made for aquaculture, but later escaped into the wild. Others were introduced for stocking of dams and reservoirs.

Since their introduction, tilapias have enjoyed great success in all tropical continents, and contribute significantly to the yields of most still waters and some rivers.

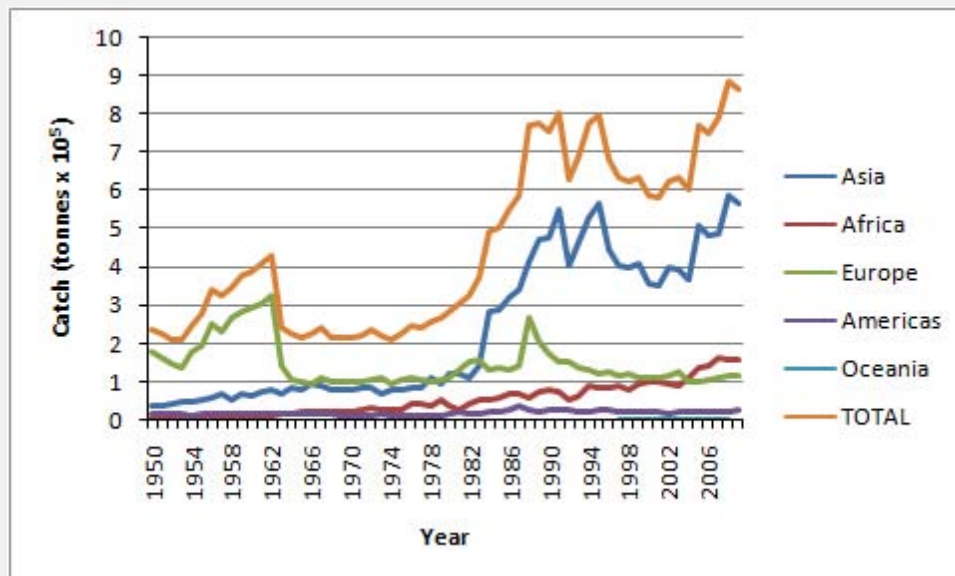
Growth in the tonnage of tilapias reported from the various continents, 1950–2009



Cyprinids

Fifty-three taxonomic categories of cyprinids are reported in the catches of various countries. Of these, the common carp, grass carp, and big head and silver carps have been widely distributed for aquaculture and have been introduced for stocking into reservoirs. They have been most successful in Asia and, to a lesser degree, in Europe. They are becoming more important in Africa but are largely absent from the Americas.

Growth in the tonnage of cyprinids reported from the various continents, 1950–2009



3. TRENDS BY CONTINENT

Within the general trend of about 3 percent annual growth in catches, there is considerable variation between continents (Figure 5).

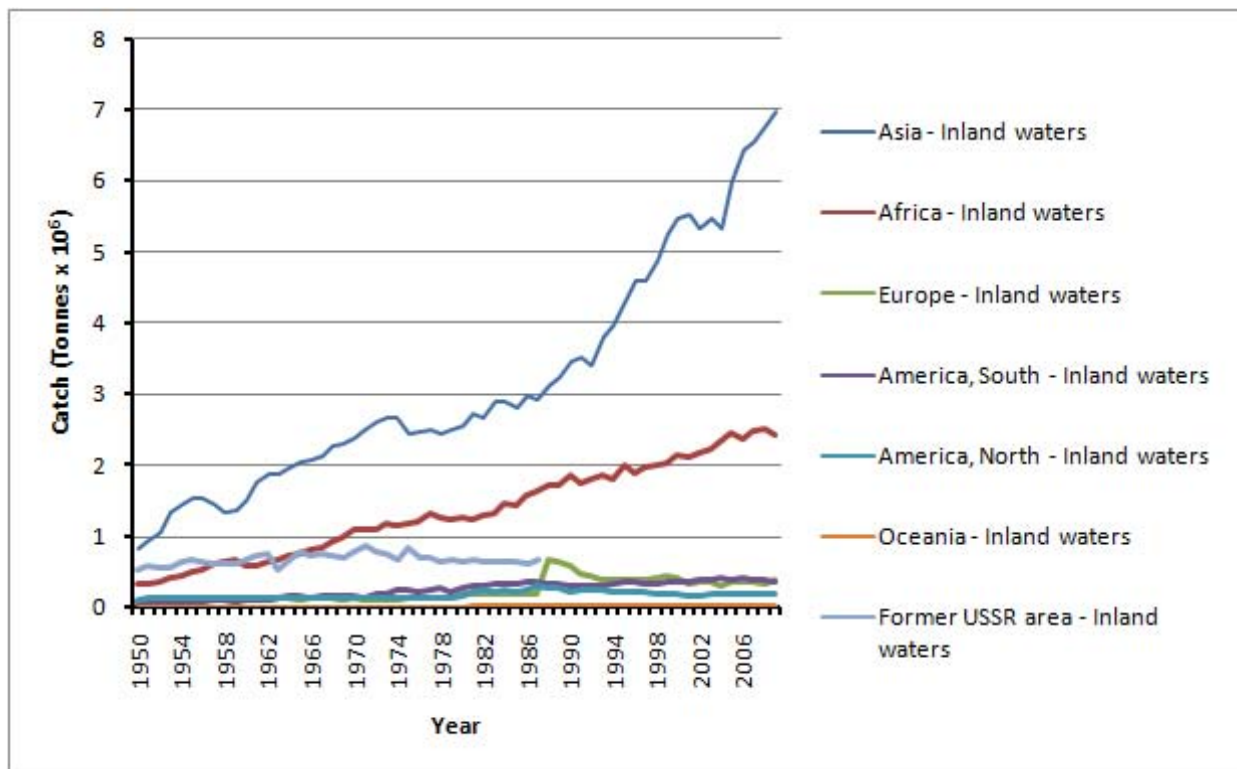


Figure 5: Trends in inland fish catches by continent, 1950–2009

Note that the FAO data set is discontinuous for catches in the former USSR area, which were reported in the group “Other” until 1987. Thereafter, the former USSR area provided individual reports. Here, the catches (including the former countries of Belarus, Moldova, Russia and Ukraine) were combined with those of Europe, causing the rise in European catches at that time. The remaining countries in “Other” were added to the Asian total.

In 2009, Asia contributed the greater part of the production at 67.4 percent, followed by Africa at 23.5 percent (Figure 6; Table 7). Note that the countries that formerly comprised the USSR only began reporting their data as individual States after 1987. The Russian Federation is included under Europe after 1988.

Table 7: Catch by continent in 2009

Continent	Catch (tonnes)	%
Asia – inland waters	6 962 672	67.44
Africa – inland waters	2 423 711	23.48
Europe – inland waters	379 958	3.68
America, South – inland waters	359 948	3.49
America, North – inland waters	179 532	1.74
Oceania – inland waters	18 084	0.18
Total	10 323 905	100.00

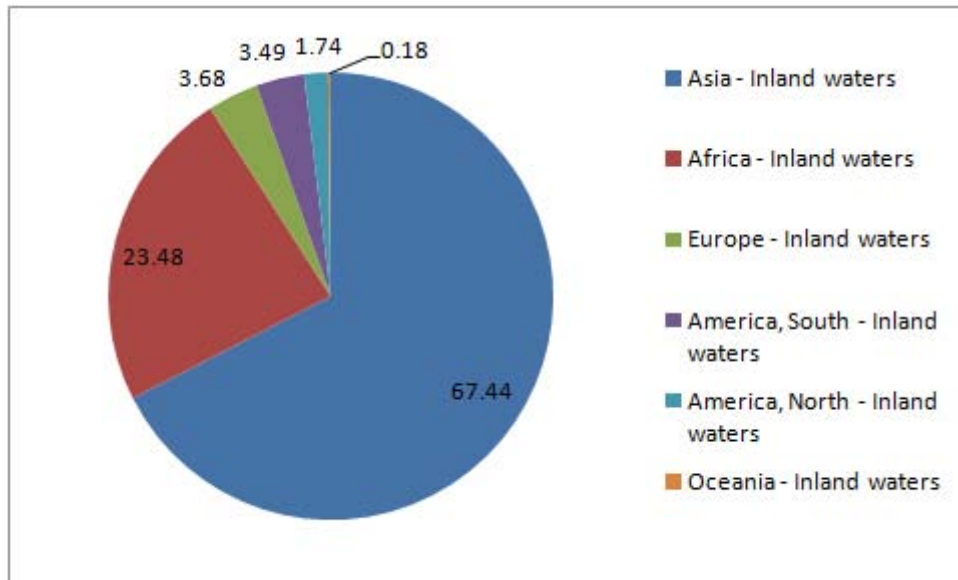


Figure 6: Percentage contribution of various continents to world inland fisheries production in 2009

The trends in production of the various continents are examined in more detail in the following sections. Because the various continents are not geographically or climatically homogeneous, they will be subdivided into subcontinental regions in this review. The regions are based mainly on geography, although in some cases economic or political considerations have been used.

Catches by country for the ten years from 2000 to 2009 are shown in Annex 1, and those for the top 26 countries (which together represent 90 percent of world inland fish catches) are shown in Figure 7.

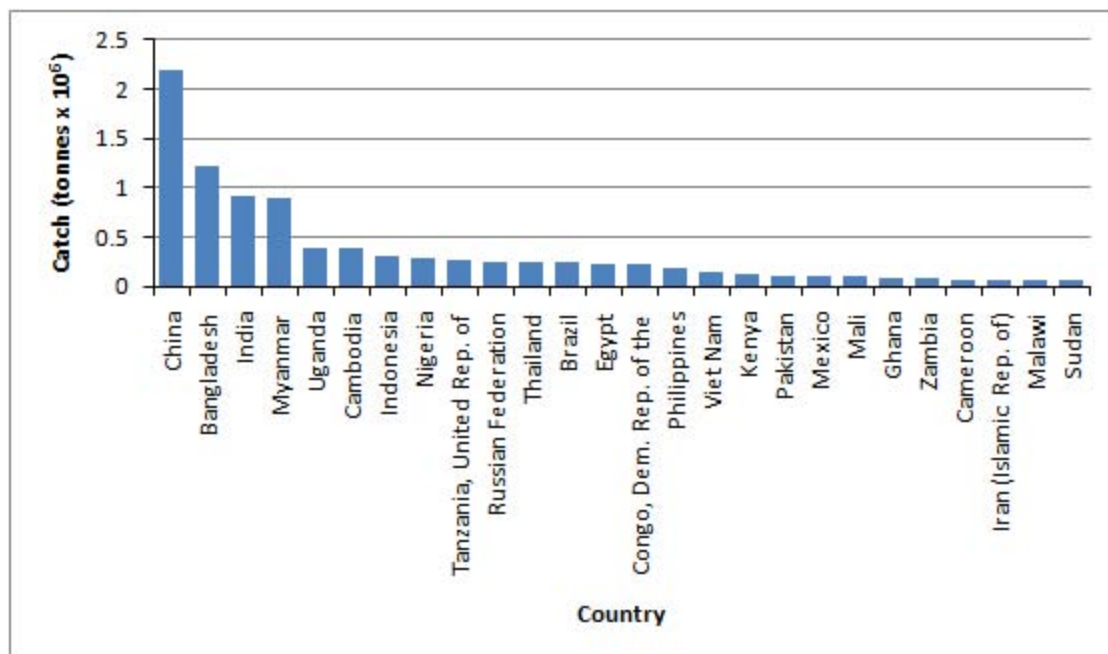


Figure 7: Catches for the top 26 countries, equivalent to 90 percent of world inland catch in 2009

3.1 Africa

African catches have risen steadily at about 3.5 percent per year, from 325 787 tonnes in 1950 to 2 423 711 in 2009 (Figure 8). The continental trend adjusted for irregularities of reporting are given in Box 2. The FAO FishStat catch statistics for Africa have been audited by Welcomme and Lymer (2009) to indicate the sort of clarifications that are needed for a better understanding of the statistics, and similar reviews will be carried out for the other continents.

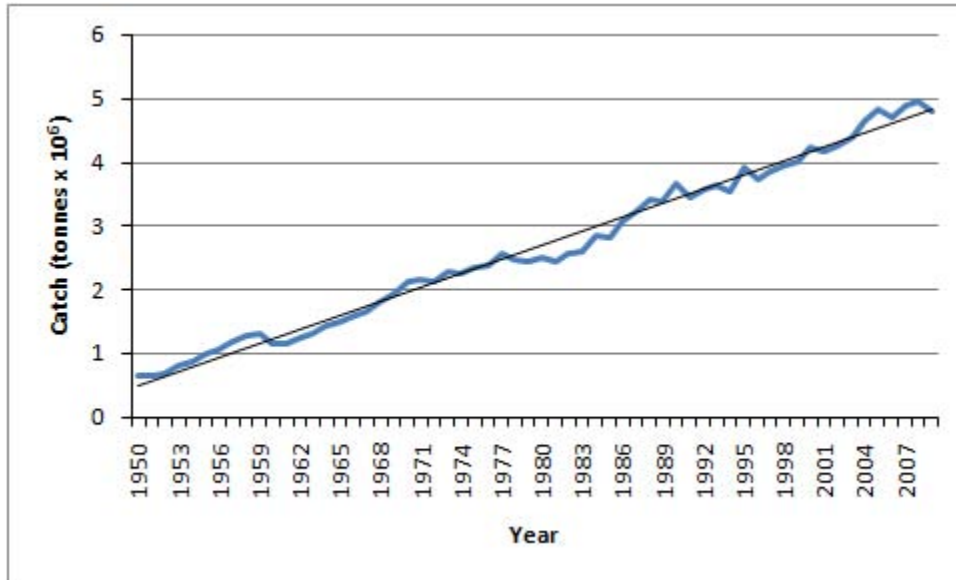


Figure 8: Trends in reported catch for Africa, 1950–2009

Africa is divided into nine regional groupings based on climate and geography, although some countries bridge two or more regions. For example, Ethiopia lies partly in the Nile, East African coastal and Great Lakes regions; the Central African Republic lies in both the Sahel and Congo regions; and Nigeria lies in the Sahel and West African coastal regions. The contribution of the different regions over time is illustrated in Figure 9 and quantified for 2009 in Table 8.

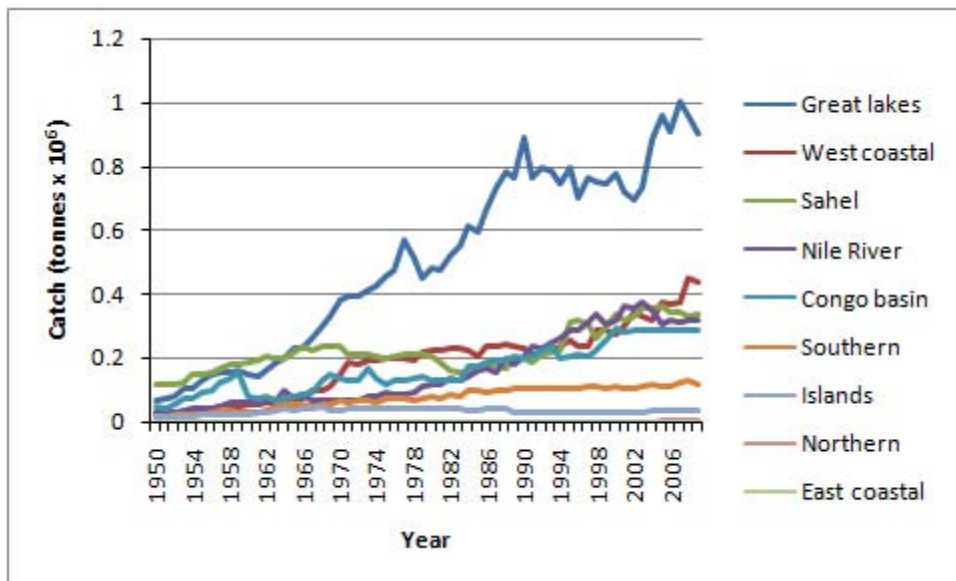
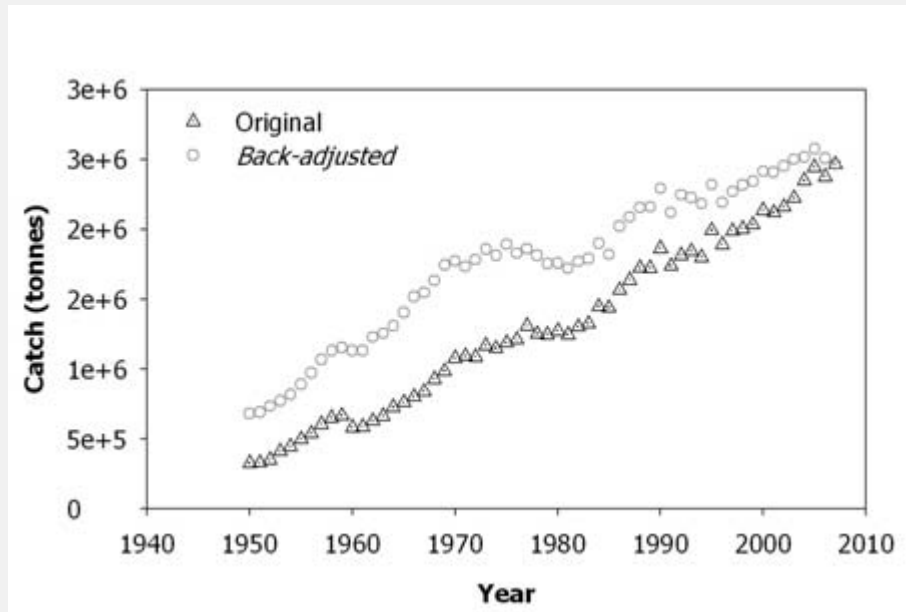


Figure 9: Trends in reported catch in the various African regions, 1950–2009

BOX 2
CATCH STATISTICS FOR AFRICA ADJUSTED FOR SUDDEN CHANGES IN
MAGNITUDE



Historically modelled data of inland water capture fisheries catch in Africa (based on the changes identified from the original FishStat statistics by Welcomme and Lymer, 2009)

The reported statistics in this box, Box 5 and Annex 2 include many jumps in catch that are due to changes in reporting systems and in back calculation for non-reported catches, so these analyses attempt to rectify this situation by statistically smoothing the figures. Thus, the evolution of the back-adjusted catches over time described in the figure probably corresponds better to what is known of African inland fish catches than the original reported catch statistics. Catches from nearly all the major waterbodies appeared to be at their maximum potential as estimated by the then existing models by the time Van den Bossche and Bernacsek (1990) reviewed the literature, which were mostly drawn from surveys and reports for the 1970s and 1980s. This implied a period of relatively stable catches until the 1990s, when fish production from the continent was raised by the development of the Nile perch and dagaa fisheries in Lake Victoria, which, at 1 000 000 tonnes, now represent about 40 percent of the continental total. Furthermore, the increases in estimates from the Congo River fisheries since 1985 and improved reporting on subsistence fisheries from some countries would also contribute to the upward trend since 1990.

Table 8: Reported catches from the various African regions in 2009

Region	Catch (tonnes)	%
Great Lakes	898 763	37.08
West coastal	432 821	17.86
Sahel	333 945	13.78
Nile River	320 547	13.23
Congo basin	282 885	11.67
Southern	114 511	4.72
Islands	32 828	1.35
Northern	7 211	0.30
East coastal	200	0.01
Total	2 423 711	100.00

Fish from all sources is by far the most important animal protein source at 36 percent. Inland fisheries are particularly important for food security in Africa as they are the fourth most important source of animal protein after cattle, marine fish and chicken and contribute overall some 10.66 percent of the protein diet continent-wide (Table 9). In some riparian communities along the major rivers and lakes of the continent, fish is probably the major protein source. Although most inland fish is consumed locally, some such as the Nile perch from Lake Victoria is exported to Europe (approximately 52 800 tonnes of fillets of the 268 152 tonnes caught in 2005) and does not figure in the local dietary balance.

Table 9: Africa – Production of animal protein by source in 2009 (aquatic plants are excluded from the aquaculture figures)

Protein source	Catch (tonnes)	%
Cattle meat	5 013 482	22.04
Marine fish	4 800 579	21.10
Chicken meat	3 591 620	15.79
Inland fish	2 423 711	10.66
Sheep meat	1 260 474	5.54
Goat meat	1 200 805	5.28
Pig meat	1 168 138	5.14
Aquaculture	1 103 492	4.85
Game meat	1 012 893	4.45
10 other categories	1 171 895	5.15
Total	22 747 088	100.00

Source: FAOSTAT; FishStat.

Reporting by taxonomic group has improved considerably and progressively since 1950 as the percentage of the catch assigned to the “freshwater fishes NEI” category has declined steadily to 38 percent in 2009. At the same time, the number of taxonomic groups reported rose from 18 to 58 (Figure 10).

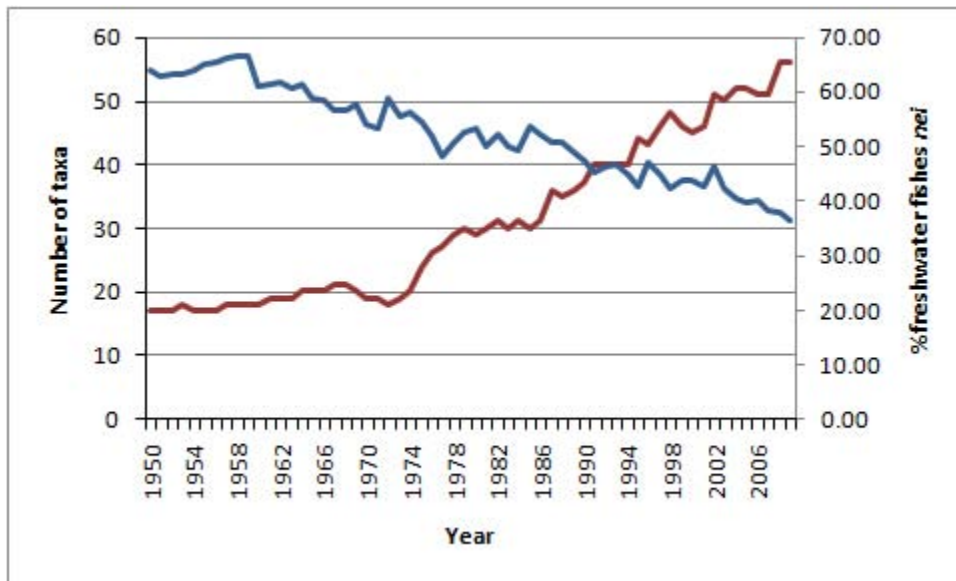


Figure 10: Trends in the number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for African countries, 1950–2009

Catches by main group in Africa are mostly finfish (Table 10) with very few crustaceans and molluscs recorded.

Table 10: Major taxonomic groupings of catches from Africa, 2009

Main group	Catch (tonnes)	%
Finfish	240 1823	99.10
Crustaceans	17 525	0.72
Molluscs	4 363	0.18
Total	2 423 711	100.00

3.1.1 North Africa

(Algeria, Libya, Morocco, Tunisia)

The North African region is extremely arid with few permanent rivers and freshwater lakes. There are, however, a number of reservoirs and coastal lagoons that support small fisheries in Morocco and Tunisia. Some intermittent catches were reported by Algeria before 1968.

Catches are reported to have risen in Tunisia, and in Morocco there has been an increase in the last five years after higher levels had been maintained through the 1990s with some decline in 2005 (Figure 11).

Catches consisted of cyprinids NEI 72 percent, freshwater species NEI 27 percent, with eels contributing the remaining 1 percent.

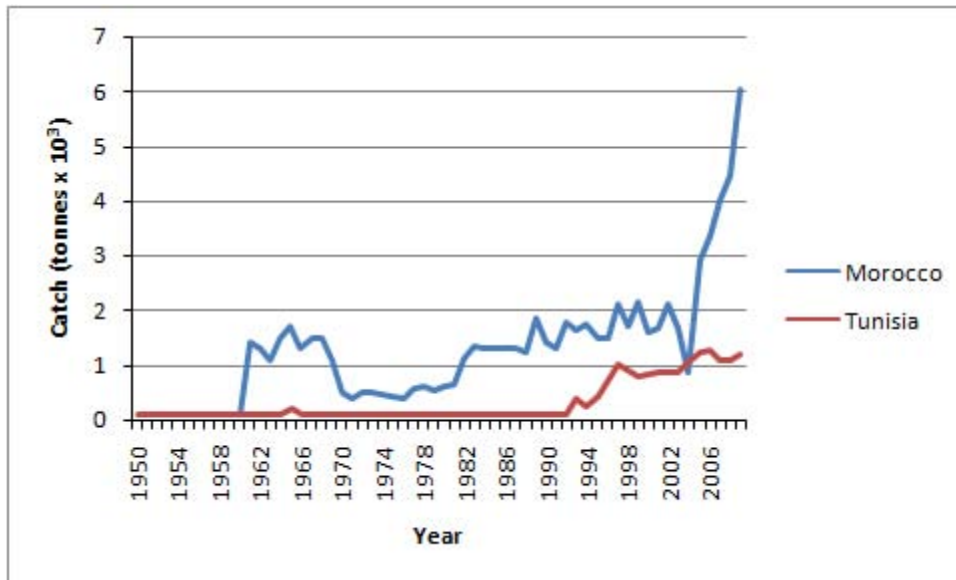


Figure 11: Trends in catches in the countries of the North African region, 1950–2009

3.1.2 Nile River

(Egypt, Ethiopia, the Sudan)

This region includes most of the Nile River and tributaries except for the headwaters in Uganda. It contains the Blue Nile, White Nile, Sudd, Lake Nasser/Lake Nubia, minor reservoirs, the Egyptian coastal lagoons, Lake Tana and the Ethiopian Rift Valley lakes.

Catches from this region are dominated by Egypt at 74 percent in 2009 (Figure 12). Catches from Ethiopia and the Sudan have generally increased steadily since 1950. However, Egyptian catches have declined since 2003 for reasons that are not yet understood.

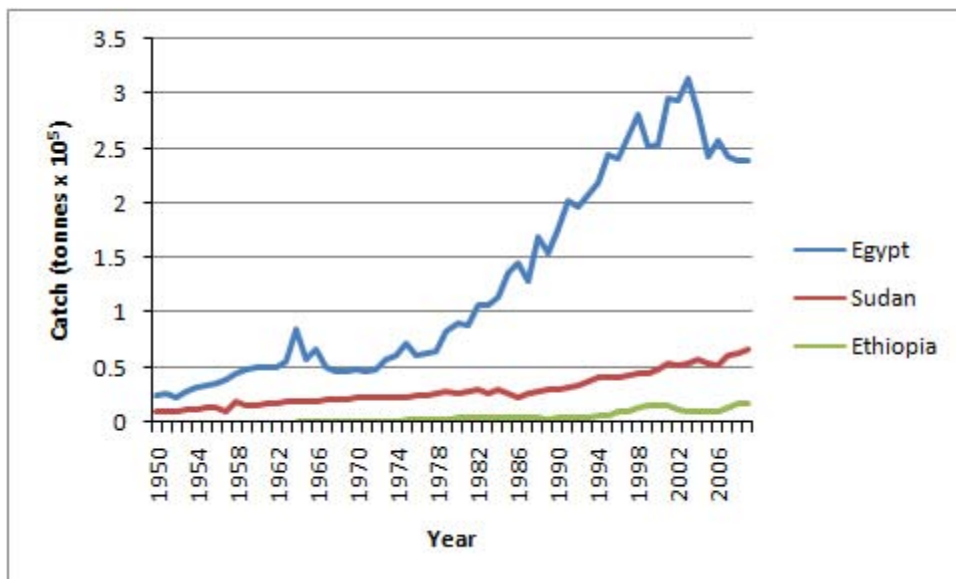


Figure 12: Trends in catches in the countries of Nile region, 1950–2009

Nile tilapia is the most important species in catches in Egypt and Ethiopia (Table 11). The high percentage of “freshwater fishes NEI” originates mainly from the Sudan, which does not report catch by taxonomic grouping. There is also a significant percentage of brackish-water species from the Egyptian coastal lagoons, although some species, particularly mullets, have been collected as fry for aquaculture (Saleh, 2008).

Table 11: Taxonomic groupings of catches for the Nile region, 2009

Taxonomic group	Catch (tonnes)	%
Nile tilapia	132 190	41.24
Freshwater fishes NEI*	66 771	20.83
Mudfish	32 350	10.09
Grass carp (= white amur)	21 180	6.61
Mulletts NEI	18 770	5.86
Nile perch	7 770	2.42
Tilapias NEI	7 554	2.36
Silversides (= sand smelts) NEI	5 450	1.70
Freshwater prawns, shrimps NEI	5 400	1.68
Cyprinids NEI	4 466	1.39
Seabasses NEI	3 960	1.24
12 other taxa*	14 686	4.58
Total	320 547	100.00

*Note: Fishes NEI are those fishes not reported by species to FAO: “other taxa” represents the sum of minor contributors to the catches reported by species but grouped here for economy of space.

3.1.3 Eastern coastal

(Djibouti, Eritrea, Somalia)

This is an arid zone with few rivers and lakes. The only major system is the Webe Shebelle that originates in Ethiopia and flows to the sea through the Sudan. This is a large but seasonal river that maintains a fishery. Its fisheries have not been studied and Somalia has not reported any catches. The present estimates have been made by FAO since 1986 (Figure 13).

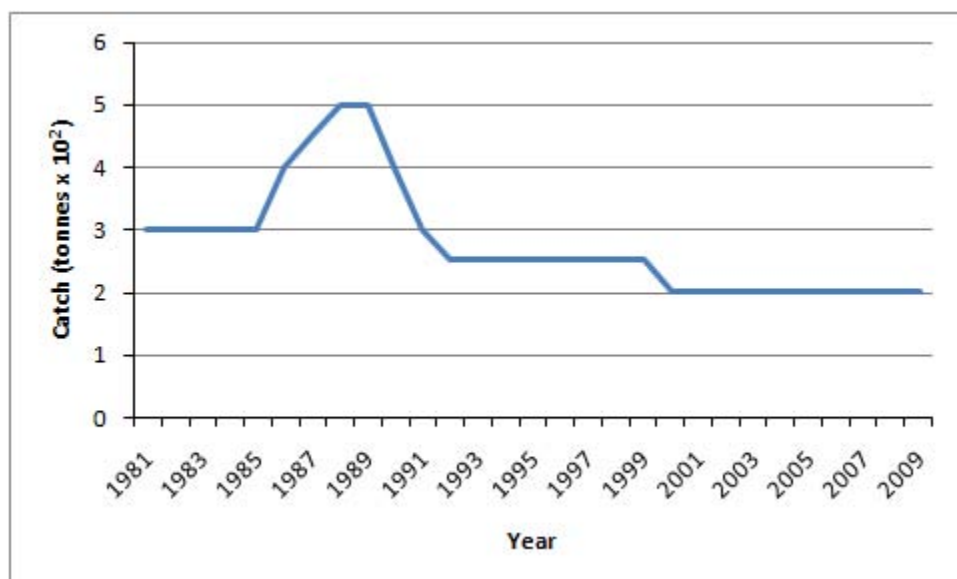


Figure 13: Trends in catches in the Eastern coastal region (Somalia), 1981–2009

3.1.4 Great Lakes

(Burundi, Kenya, Malawi, Rwanda, United Republic of Tanzania, Uganda)

The Great Lakes region includes some of the largest lakes in the world – Lake Turkana, Lake Victoria, Lake Kivu, Lake Tanganyika and Lake Malawi – and several lesser lakes.

Figure 14 shows that catches increased in all the region's countries until the 1990s and thereafter remained stable or declined slightly. There have been dramatic increases in “dagaa” (small pelagic cyprinid) catches in Lake Victoria over the last few years, possibly owing to increased productivity through eutrophication (Box 3), which have possibly not yet been incorporated into the Kenyan and Tanzanian statistics.

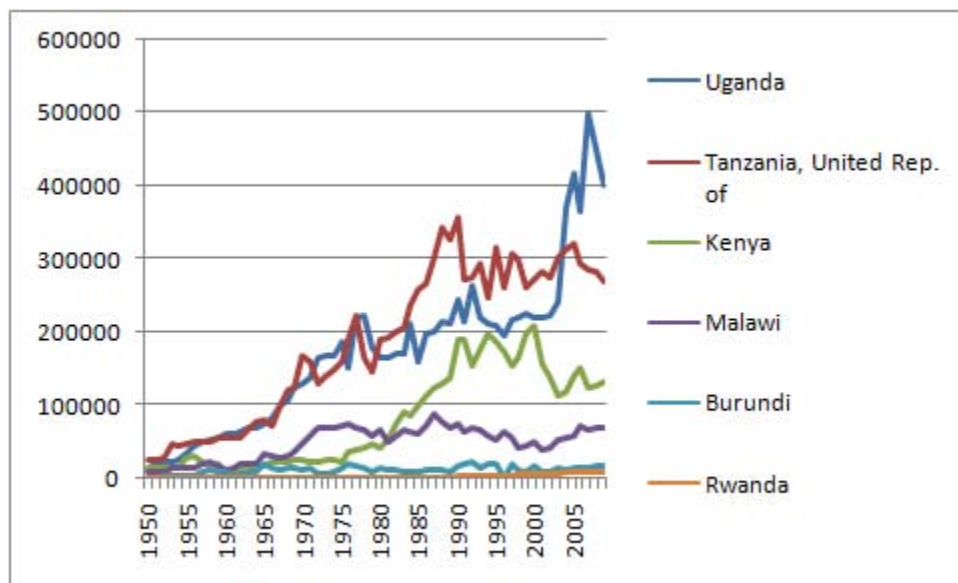


Figure 14: Trends in catches in the countries of the Great Lakes region, 1950–2009

Catches from the Great Lakes are heavily weighted towards Nile perch in 2009 at 35 percent of the catch (Table 12) because of the expansion of the Lake Victoria fishery. Cichlids form a second important group at 29.5 percent because of the complex haplochromine species flocks in Lake Malawi and Lake Victoria. Dagaa and silver cyprinids (*Rastrineobola*) together are very low at 11 percent as they are now the mainstay of the Lake Victoria and Lake Tanganyika fisheries. Box 3 indicates, for example, that 600 000 tonnes of dagaa were caught in Lake Victoria in 2007, but apparently these research-based figures have not yet reached the officially reported statistics.

The significance of these fisheries to local populations is shown by the fact that inland fish comprises 66 percent of the Ugandan animal protein production, despite the fact that a proportion of this is exported.

Table 12: Taxonomic groupings of catches for the Great Lakes region, 2009

Taxonomic group	Catch (tonnes)	%
Nile perch	318 008	35.38
Tilapias NEI	203 256	22.62
Freshwater fishes NEI	128 725	14.32
Silver cyprinid	75 547	8.41
Cyprinids NEI	26 862	2.99
Dagaa	23 410	2.60
Characins NEI	21 600	2.40
Nile tilapia	20 804	2.31
Cichlids NEI	20 187	2.25
African lungfishes	16 560	1.84
Mouthbrooding cichlids	14 401	1.60
Torpedo-shaped catfishes NEI	13 630	1.52
Naked catfishes	9 428	1.05
7 other taxa	63 45	0.71
Total	898 763	100.00

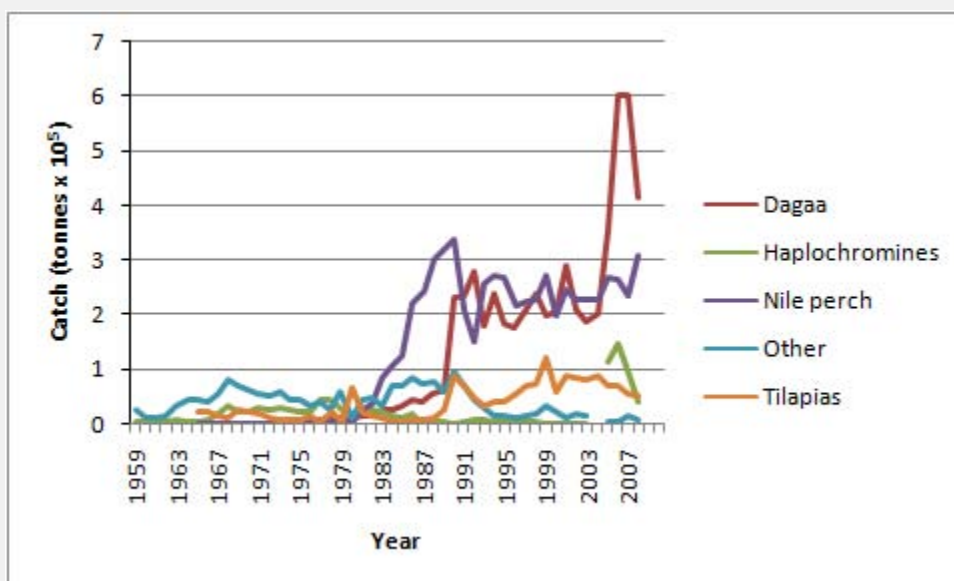
3.1.5 Southern Africa

(Angola, Botswana, Mozambique, Namibia, South Africa, Lesotho, Swaziland, Zambia, Zimbabwe)

Southern Africa is rich in river and lake resources. It is centred on the Zambezi system with the Kariba and Cahora Bassa reservoirs, the Okavango and other river systems, and the major lakes of Mweru, Mweru wa Ntipa, and Bangweulu in Zambia. Catches for the region (Figure 15) are dominated by Zambia at (74 percent of the total), where catches have risen sharply since 2006. Catches in Angola and Mozambique rose, consistent with the magnitude of the aquatic resources of those countries and where civil unrest has made it difficult to document inland fisheries in the past. However, in 2009, Angola reported much lower figures than those that had been estimated for the previous two years. Catches from Mozambique had also declined to a third of their 2009 value. No explanation is yet available for these declines. Catches from Zimbabwe have fallen from a high in 1990 consistent with the breakdown of civil administration, although these have been estimated by FAO since 2001.

Catches from most of the Southern African countries are not reported by taxonomic grouping.

BOX 3
LAKE VICTORIA – CHANGING SPECIES COMPOSITION FOLLOWING THE
INTRODUCTION OF NILE PERCH



Trends in Lake Victoria fisheries by species group, 1959–2008

Note: Dagaa = silver cyprinid in FISHSTAT classification.

Source: Lake Victoria Fisheries Organization.

Lake Victoria is now the single largest fishery on the African continent, having surpassed 1 million tonnes in 2006.

Until the end of the 1970s, the Lake Victoria fishery was based on a group of native species, which were subsequently supplanted by Nile perch and Nile tilapia that were introduced in the 1950s. The evolution of the fishery (see figure) from 1980 onwards has been characterized by the rapid growth of the Nile perch fishery, much of whose product is exported as fillets to Europe. The Nile perch fishery stabilized in the early 1990s, fluctuating around 250 000 tonnes. As the Nile perch were heavily fished, the native haplochromines have made a comeback and the introduced tilapias increased in the fishery. At the same time, changes to the ecology of the lake allowed a small native pelagic cyprinid species (dagaa) to expand its populations, which now support a major fishery for local consumption. This has encouraged an inflation in the riparian population of the lake and formed the basis for a thriving economy. Developments in the last few years show some reversal of these trends, with a decline in the catches of dagaa, tilapias and haplochromines and an apparent relative stability in Nile. Such oscillations will doubtless continue.

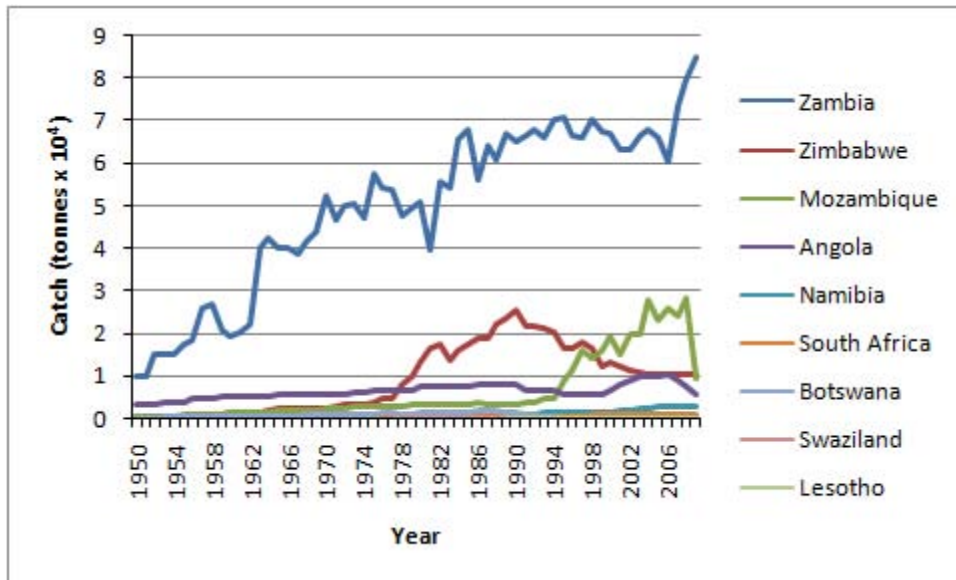


Figure 15: Trends in catches in the countries of the Southern African region, 1950–2009

3.1.6 Congo basin

(Central African Republic, the Congo, Democratic Republic of the Congo, Gabon)

The Congo basin consists of the central African rivers system consisting of the Congo and Ubangi Rivers and the associated tributary river basins. There are some reservoirs, and the region also borders the Great Lakes to the east and the Sahel region to the north, where rivers of part of the Central African Republic are tributaries of the Chari system.

Scientific knowledge of the Congo basin and its rivers is very poor, and FAO has estimated catches for the Central African Republic and the Democratic Republic of Congo for the last ten years. At 81 percent of the total, catches from the Democratic Republic of the Congo, which controls the major part of the basin, dominate the catches from the Congo River system. FAO has estimated catches from this basin for the last 11 years at a stable level. The general rising trend as described (Figure 16) for the period up to 2000 is probably consistent with the extensive nature of the Congo River resources and with what is known of the productivity of large rivers systems in general. However, the relatively low population density, isolation of communities, poor security and infrastructure make it extremely difficult to verify the true situation of this region. Catches from most of the Congo basin countries are not reported by taxonomic grouping.

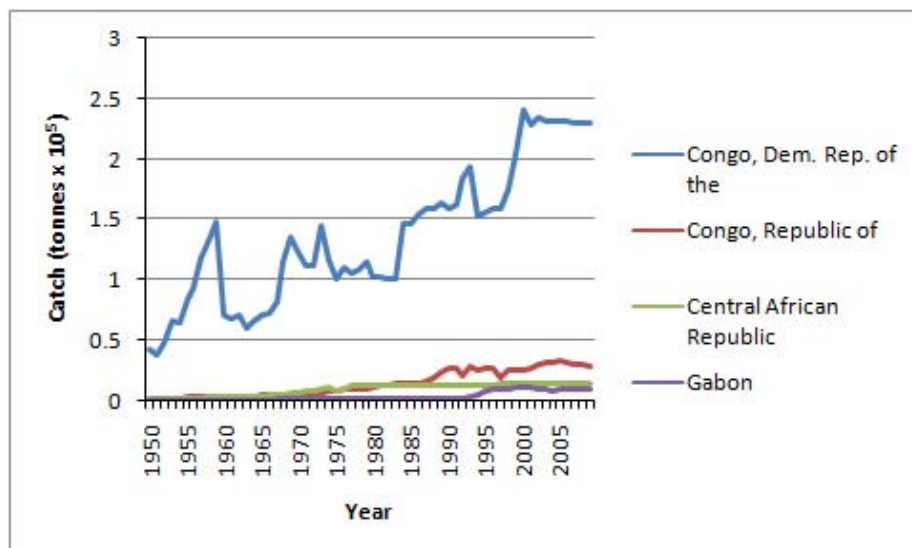


Figure 16: Trends in catches in the countries of the Congo basin region, 1950–2009

3.1.7 The Sahel

(Burkina Faso, Cameroon, Chad, the Gambia, Mali, Mauritania, the Niger, Senegal)

The Sahel is a climatically unstable region (see Box 4) that includes some of the richest fishery resources of the continent, including the Niger, Senegal, Chari and Logone River systems as well as Lake Chad.

Catches from individual countries of the region (Figure 17) show the variable trends characteristic for fisheries based mainly on rivers where year-to-year variations in rainfall and flooding produce similar variations in the catches of fish in following years. However, the recent history of this critical region is somewhat obscure as FAO has had to estimate catches for several of the major producers – Chad (9 years), the Gambia and Senegal (10 years), Mauritania (18 years), although in 2009 some of these countries reported catches. Furthermore, Mali reported a steady, but unlikely, 100 000 tonnes (30 percent of 2009 regional total) for the last eight years.

Catches from the Sahel are not reported by taxonomic grouping in the majority of countries.

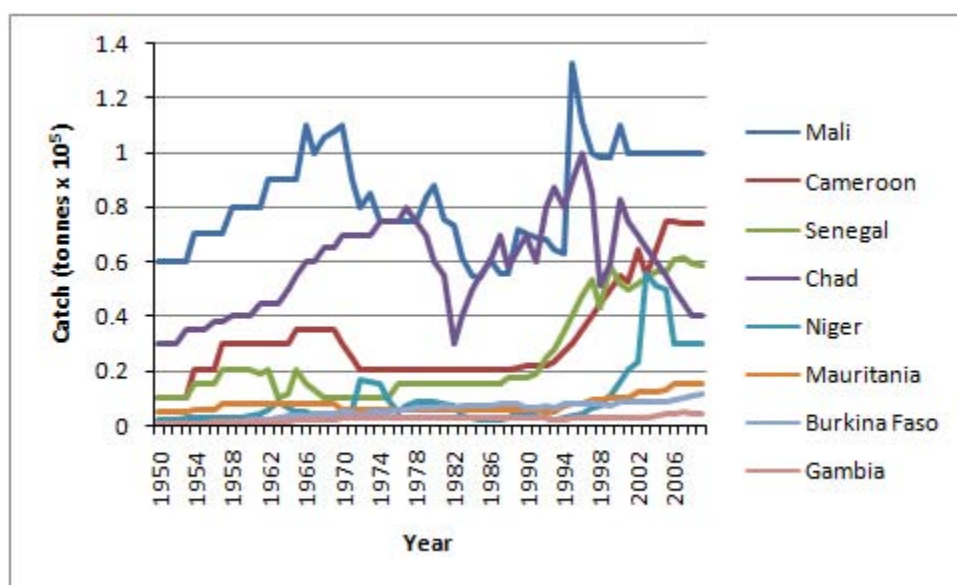
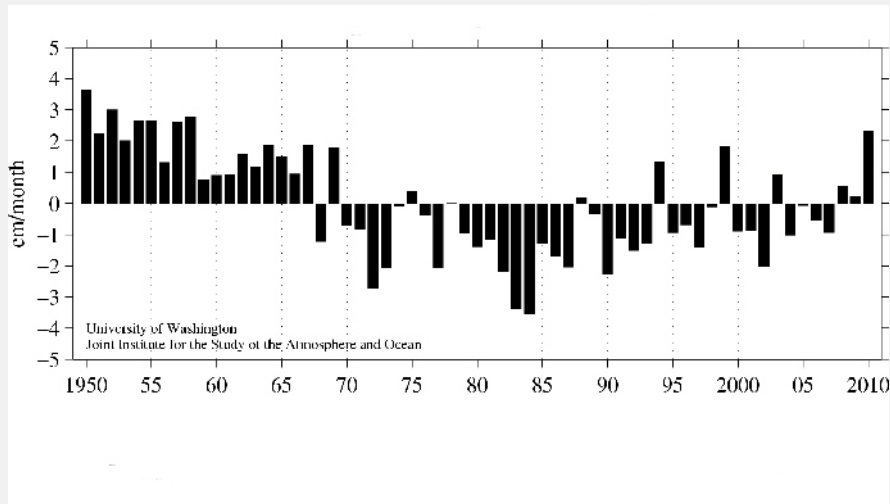


Figure 17: Trends in catches in the countries of the Sahel region, 1950–2009

BOX 4

SAHELIAN CLIMATE – AN INDICATOR OF THE EFFECTS OF CLIMATE CHANGE

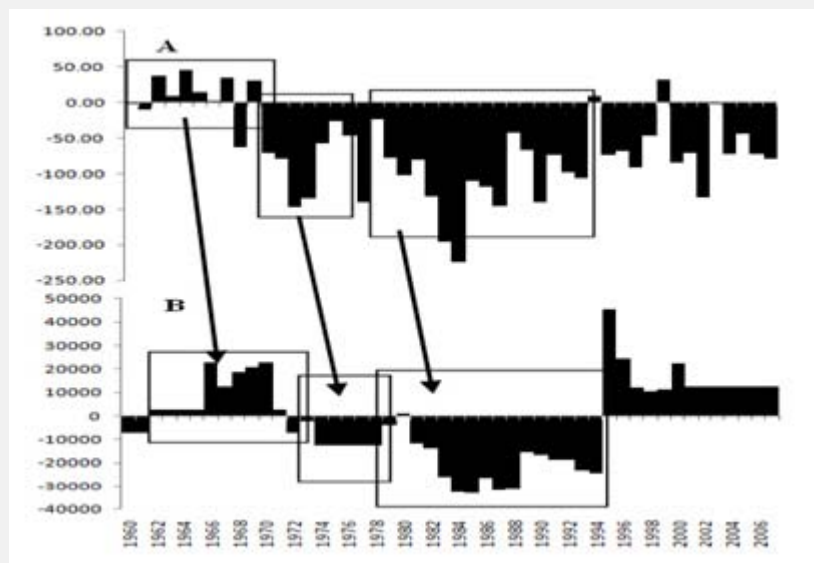
The Sahelian zone runs across Africa from Senegal to Ethiopia and is defined by the rainfall limits of 200 mm (north) and 600 mm (south) mean twentieth century annual rainfall. The area is climatically unstable with episodes of drought and more copious precipitation. The figure below shows these in terms of the deviation for the 1950–2008 mean rainfall. The area passed through a period of good rainfall in the 1960s only to suffer a severe drought from 1968 to 1974. The below average precipitation has continued to 2007, resulting in the desiccation of much of the Central Delta floodplain and the drying out of Lake Chad from an area of 26 000 km² in the 1960s to 1 500 km² in 2000 and 1 425 km² in 2003.



Years of above and below average rainfall in the Sahel region based on deviations from 1950–2010 mean

Source: <http://jisao.washington.edu/data/sahel/>

Changes in flow and the resulting area of flooding produce changes in the abundance and composition of the fish fauna of the region (see, for example, Lae, 1995; and the figure below), although the relationship has broken down since 1995, possibly owing to reporting errors (FAO has estimated catches for seven out of the last ten years).



Comparison of fish catch and rainfall between 1960 and 2007. A: Years of above and below average rainfall in the Sahel region (relative to 1950–2009 mean). B: Years of above and below average catch (relative to the 1960–2007 mean).

3.1.8 West African coastal

(Benin, Côte d'Ivoire, Equatorial Guinea, Ghana, Guinea, Guinea-Bissau, Liberia, Nigeria, Sierra Leone, Togo)

The West African coastal region groups those countries lying along the West African coast, which include a large number of relatively short rivers with the exception of the Niger River, that flow southwards into the Atlantic Ocean. Many of these rivers have been impounded, and the Volta system includes the largest reservoir in the world by area. Many rivers also terminate in coastal lagoon complexes.

Many countries in the West African coastal region are heavily influenced by the Sahelian climate as they extend northwards into the arid zone; this is especially the case with Ghana, Guinea and Nigeria.

Catches from the West African coastal region are dominated by those of Nigeria, which accounted for 66 percent of reported catches in 2009 (Figure 18). Ghana provided 20 percent of catches, although estimates have had to be made for this country by FAO for the last four years. Braimah (2000) considered that catches from Ghana are underestimated as the actual yield of the Volta reservoir (Lake Akosombo) (about 250 000 tonnes) is likely to far exceed existing estimates. Benin provided 7 percent and Sierra Leone about 3 percent. Other countries in the region reported relatively small catches, although in some, such as Guinea, actual catches are probably much larger.

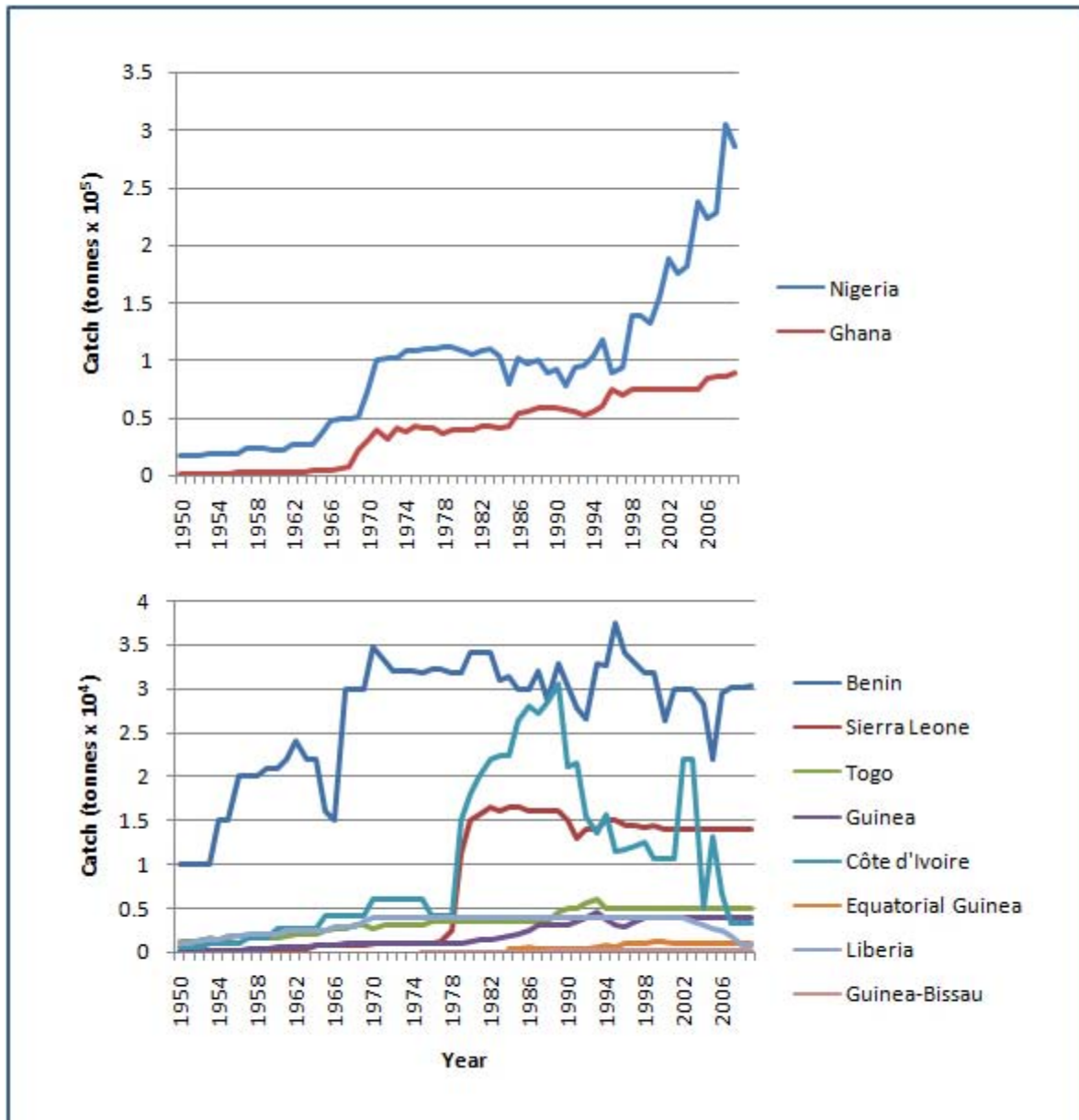


Figure 18: Trends in catches in the countries of the West African coastal region, 1950–2009

The catches from the region consist of a large number of species (Table 13), partly because of the high degree of endemism in the various rivers and partly because of the large contribution of brackish-water coastal systems to the catch.

Table 13: Taxonomic groupings of catches for the west African coastal region, 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	129 127	29.83
Tilapias NEI	68 671	15.87
Torpedo-shaped catfishes NEI	36 672	8.47
North African catfish	23 146	5.35
Elephant snout fishes NEI	22 564	5.21
Bagrid catfish	17 541	4.05
Characins NEI	15 987	3.69
African bony tongue	15 439	3.57
Cyprinids NEI	14 261	3.29
Aba	13 363	3.09
Upside-down catfishes	13 329	3.08
Nile perch	11 542	2.67
Citharinus NEI	11 395	2.63
Naked catfishes	7 788	1.80
Grass-eaters NEI	5 760	1.33
Snakeheads (= murrels) NEI	5 515	1.27
Freshwater crustaceans NEI	4 610	1.07
12 other taxa	16 111	3.72
Total	432 821	100.00

3.1.9 Islands

(Cape Verde, the Comoros, Madagascar, Mauritius, Réunion, Saint Helena, Ascension and Tristan da Cunha, Sao Tome and Principe, Seychelles)

Many islands fall within the African area, but of these only Madagascar reports any fisheries.

As Madagascar is an island, the fisheries are quite different from those of the mainland. It has several systems of coastal lagoons, rivers, and natural and man-made lakes. There is considerable population pressure leading to overfishing and environmental degradation.

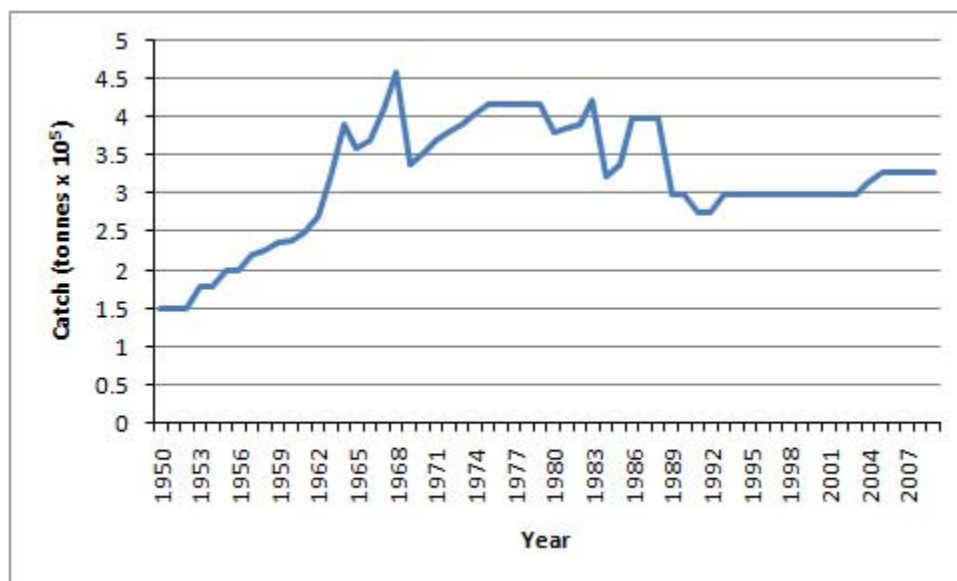


Figure 19: Trends in catches in Madagascar, 1950–2009

Catches from Madagascar are reported to have risen to a peak production of around 40 000 tonnes/year but have declined more recently to a stable level of around 30 000 tonnes/year (Figure 19). However, Madagascar has not reported catches for the last twelve years, so FAO estimated the values.

3.2 Asia

Asia is a large and varied continent, which can be divided into seven regions. Of these, three are among the most productive in the world, whereas the other groupings are of somewhat lesser importance mainly because of their arid nature and relatively poor aquatic resources.

The total production for all regions (Figure 20) increased steadily throughout the period at a mean rate of 3.8 percent per year, from 808 011 tonnes in 1950 to 6 962 482 tonnes in 2009.

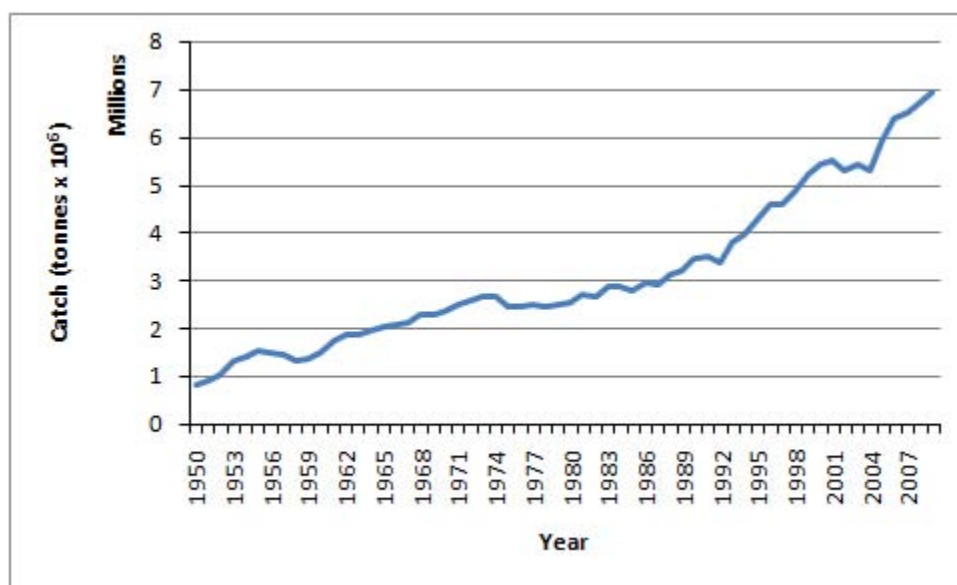
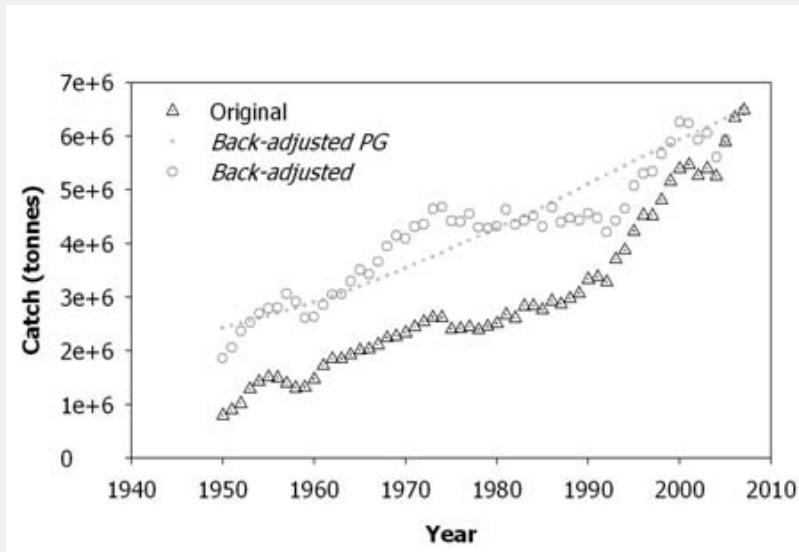


Figure 20: Trends in reported catch for all regions of Asia, 1950–2009

Adjusted catches according to Lymer and Funge-Smith (2009) indicate that the situation may have been more complicated with at least four separate phases in the development of the fisheries (Box 5).

BOX 5
ADJUSTED CATCH STATISTICS FOR ASIA

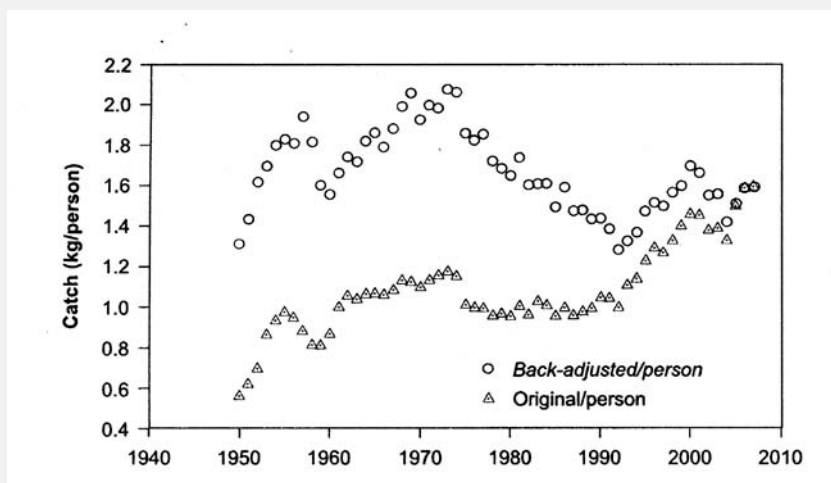


Historically modelled data of inland water capture fisheries catch in the Asia-Pacific Fishery Commission (APFIC) region. Based on the changes identified using criteria 2 and 3 and the original inland water capture statistics (original) (see Annex 2 for details).

Catches for the Asia-Pacific region adjusted for irregularities in reporting according to Lymer and Funge-Smith (2009) (see figure above).

According to the historically back-adjusted data, the total regional production has experienced four different periods: (1) a period of rapid growth between 1950 and the mid-1970s; (2) a relatively stable plateau from the mid-1970s until the early 1990s; (3) a rapid growth period until the turn of the century; and (4) then again a relatively stable period from 2000 onwards.

This indicates a very different trend to the consistent increase shown by the original FAO data in that the revised data set indicates a rapid increase in production (and production/fisher) (see figure below) until the mid-1970s, a falling catch/fisher until the mid-1990s and a rise thereafter.



Historically modelled data of inland water capture fisheries catch in the APFIC region. Based on the changes identified using criteria 1 and 2 and the original inland water capture statistics (original) (see Annex 2 for details).

The trends in the fisheries in the various regions of Asia are shown in Figure 21, and their percentage contribution to the Asian total is shown in Table 14.

Figure 21 shows that there are two distinct blocks within the Asian region: those with very high levels of capture and those where inland fisheries are considerably less important. Table 14 shows that China, South Asia and South East Asia all had very similar levels of production in 2009, together contributing 95 percent of the continental catch and together contributing about 60 percent to the world inland catch.

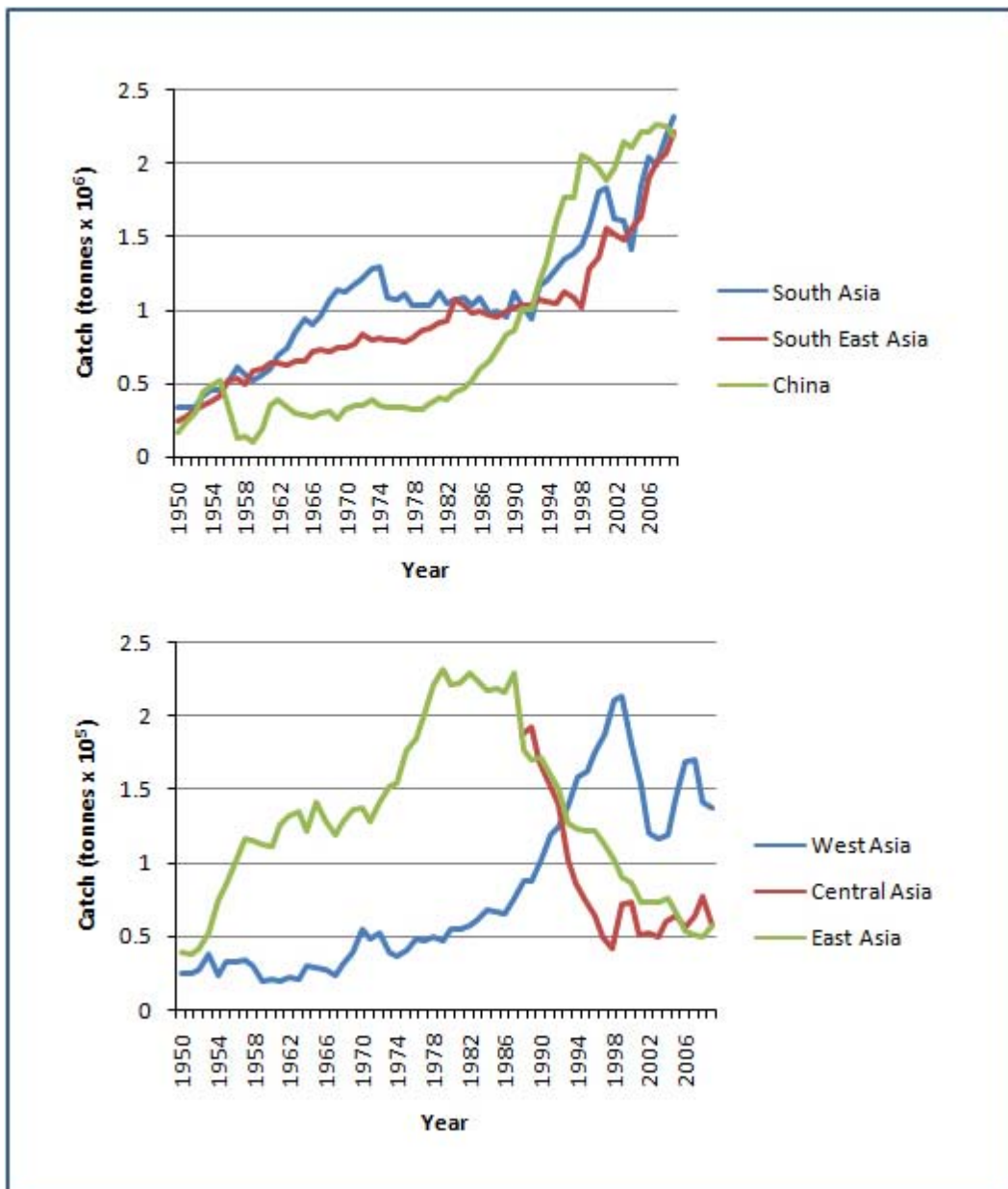


Figure 21 : Trends in reported catch in the various Asian regions, 1950–2009
(Note: Statistics for the Central Asian region only began being reported by country after the dissolution of the USSR)

Table 14: Percentage contribution of the various Asian regions to the Asian total inland catch in 2009

Region	Catch (tonnes)	%
South Asia	2 315 499	33.26
South-east Asia	2 210 508	31.75
China	2 184 049	31.37
West Asia	137 748	1.98
Central Asia	57 805	0.83
East Asia	56 884	0.82
Arabia	0	0.00
Total	6 962 482	100.00

Table 15 shows that fish is the single biggest source of animal protein in Asia, and at 49 percent accounts for nearly half the supply. Inland fish, at 3 percent, is the sixth most important source of animal protein on the continent.

Table 15: Production of animal protein by source in Asia in 2009 (aquatic plants are excluded from the aquaculture figures)

Protein source	Catch (tonnes)	%
Aquaculture	66 670 226	28.91
Pig meat	59 997 700	26.01
Marine fish	39 952 069	17.32
Chicken meat	25 623 677	11.11
Cattle meat	12 792 493	5.55
Inland fish	6 962 672	3.02
Sheep meat	4 293 533	1.86
Goat meat	3 527 983	1.53
Duck meat	3 193 771	1.38
Buffalo meat	3 030 368	1.31
Goose and guinea fowl meat	2 338 617	1.01
8 other categories	2 254 281	0.98
Total	230 639 399	100.00

Source: FAOSTAT.

Asian catches consist of a very large number of species, partly because of the extent and diversity of the continent (Figure 22). The number of taxonomic groups reported in the catches has risen from 39 in 1950 to 120 in 2009. At the same time, the proportion of the catch assigned to the “freshwater fishes NEI” category fell until 1995, but has since risen indicating, perhaps, that efforts to identify the catches to species have declined in recent years.

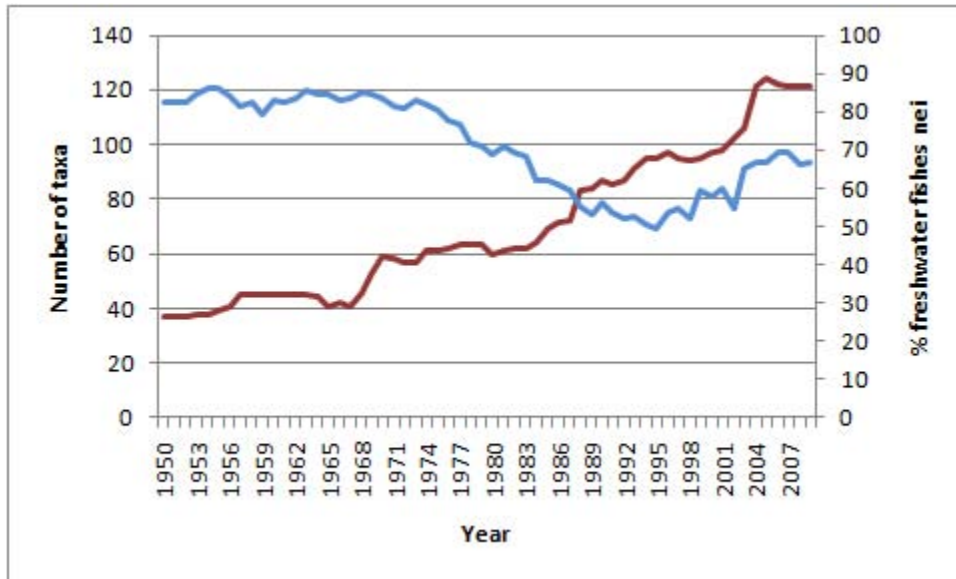


Figure 22: Trends in the number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for Asian countries, 1950–2009

Catches from Asia consist mainly of finfish, but they also contain a higher proportion of other major groups (Table 16).

Table 16: Major taxonomic groupings of catches from Asia, 2009

Major grouping	Catch (tonnes)	%
Finfish	6 031 545	86.63
Crustaceans	516 303	7.42
Molluscs	365 688	5.25
Aquatic invertebrates	46 774	0.67
Amphibians	2 172	0.03
Total	6 962 482	100.00

3.2.1 China

(China; Hong Kong Special Administrative Region; China, Macao Special Administrative Region; Taiwan Province of China)

The Chinese region is distinguished because it is the major single producer of inland aquatic products in Asia and the world. The main resources are based on several large river systems, including the Yangtze and Yellow Rivers, numerous natural lakes, and artificial reservoirs and ponds, as well as rice fields.⁶

China's catch statistics are currently under review. Figure 23 illustrates the growth of the sector since 1950, and shows an exponential trend in growth between 1975 and 2000. This has since slowed down, and indicates that the fisheries may have reached a stable level.

⁶ Catches from rice fields are reported as coming from aquaculture in some countries.

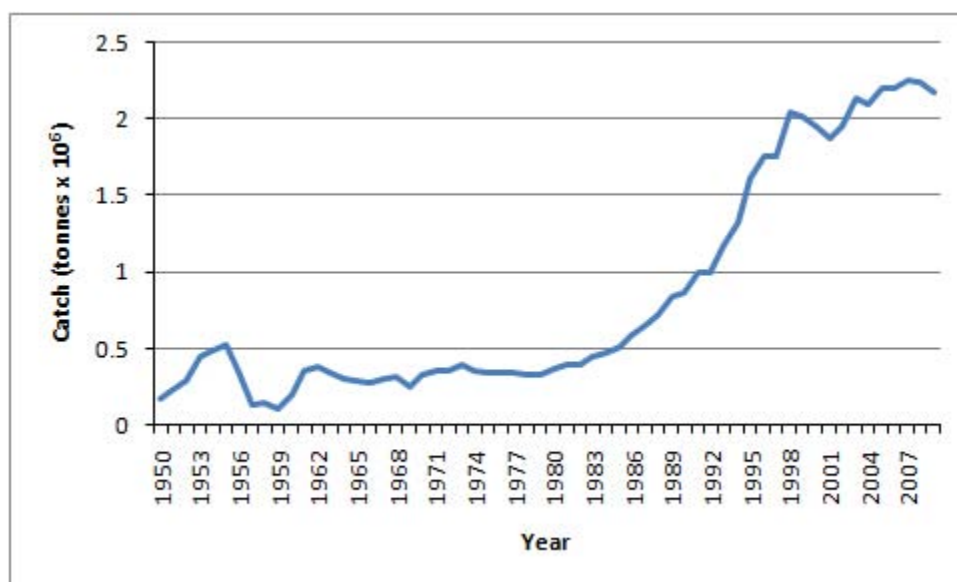


Figure 23: Trends in inland fish production from the Chinese region, 1950–2009

The major groups of organisms caught by Chinese inland water fisheries are shown in Table 17. Finfish are not generally reported individually in China, which assigns them to “freshwater fishes NEI”. The table indicates that, while fishes still comprise the majority of the catch (70 percent), other groups of organisms, especially crustaceans (15 percent) and molluscs (13 percent), are caught at above the global average rates.

Table 17: Main groups of organisms caught by inland fisheries in China in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	1 526 339	69.89
Freshwater molluscs NEI	284 331	13.02
Oriental river prawn	137 659	6.30
Siberian prawn	137 659	6.30
Chinese mitten crab	52 495	2.40
Aquatic invertebrates NEI	45 430	2.08
Bighead carp	52	0.00
Common carp	13	0.00
Natantian decapods NEI	13	0.00
Grass carp (= white amur)	10	0.00
Black carp	9	0.00
Tilapias NEI	8	0.00
Total	2 184 018	100.00

3.2.2 East Asia

(Democratic People's Republic of Korea, Japan, Republic of Korea)

The East Asian region comprises the countries of the Democratic People's Republic of Korea, Japan and the Republic of Korea. All have a high dependency on aquatic foods and have developed intensive aquaculture systems. They have characteristically short, steep river systems, few natural lakes and a number of reservoirs.

Catches in the East Asian region rose steadily to a maximum of around 220 000 tonnes between 1980 and 1987. They have since declined drastically in all three of the countries to reach a combined total of 42 980 tonnes in 2009 (Figure 24) with a very slight recovery to 53 969 in 2009. The reasons for this decline are not apparent, but may be due to the relative unprofitability of inland fisheries compared with aquaculture and to pollution and environmental degradation.

Catches mainly consist of salmonids (Table 18), but characteristic of the general decline in inland fish catch is that this group declined from a high of 41 679 tonnes in Japan in 1994 to 19 505 in 2009. The main major taxa caught are finfish (77 percent) and molluscs (20 percent).

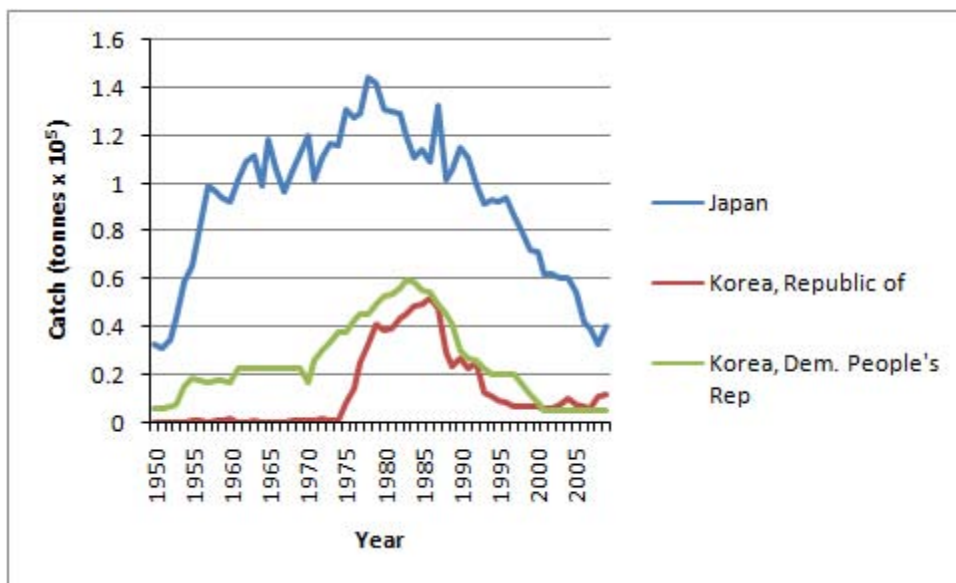


Figure 24: Trends in inland fish production from the East Asia region, 1950–2009

Table 18: Main groups of organisms caught by inland fisheries in East Asia in 2009

Taxonomic group	Catch (tonnes)	%
Chum (= keta = dog) salmon	11 886	22.02
Japanese corbicula	11 495	21.30
Freshwater fishes NEI	10 660	19.75
Freshwater molluscs NEI	5 031	9.32
Ayu sweet fish	3 632	6.73
Cyprinids NEI	3 350	6.21
Common carp	2 213	4.10
Japanese smelt	2 043	3.79
Mullets NEI	1 152	2.13
Pink (= humpback) salmon	912	1.69
Crucian carp	850	1.57
Japanese ice fish	745	1.38
10 other taxa	2 915	5.12
Total	53 969	100.00

3.2.3 South Asia

(Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka)

The South Asian region groups the rivers and reservoirs of the Indian subcontinent. The major single fishery here is that of the Ganges-Brahmaputra delta, although there are a number of other large river systems in India (including the Godavari, Krishna and Cauvery Rivers) and the Indus River in Pakistan.

Catches for both Bangladesh and India have continued to rise throughout the history of the fishery (Figure 25), although more recently catches from India appear to have stabilized. Other fisheries have continued to increase (Nepal and Sri Lanka) or have declined slightly (Pakistan) in the same period. Much of the apparent increase in Bangladesh may be the result of better reporting, as many floodplain and lake fisheries have been included into the estimates as well as production from rice field fisheries.

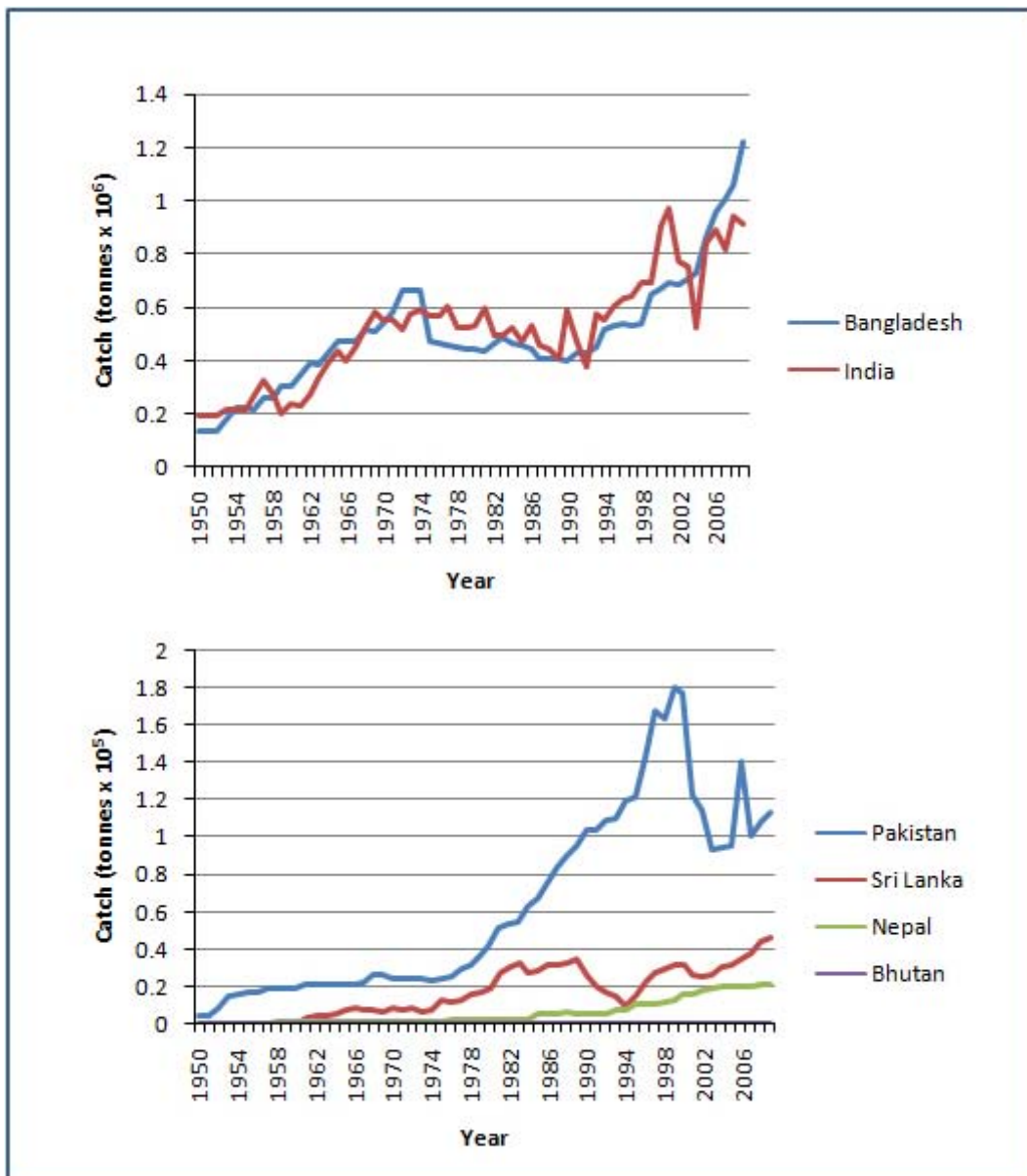


Figure 25: Trends in inland fish production from the South Asian region, 1950–2009

There are important religious and cultural issues affecting the consumption of aquatic organisms in South Asia: vegetarians in large parts of India avoid most non-fish aquatic animals, as Islamic tradition designates that some aquatic products are not *halal* (permitted) and are to be avoided; in addition, other religious or cultural traditions prevent the killing or capturing of fish (Azad, Jensen and Kwei Lin, 2009).

Over sixty percent of catches are not identified to species, and of the remainder 14 percent are cyprinids (Table 19). Very few organisms other than fish are reported in the catches, except for crustaceans (6.35 percent). Recently, exports of frogs have been banned from Bangladesh owing to fears that declining frog populations would lead to an explosive growth in insect pests. There is some evidence that some fisheries in South Asia are heavily fished as catches in Bangladesh consist mainly of young-of-the-year (0+) fish (Halls, Hoggarth and Debnath, 1999). One species of major cultural significance in the region is the hilsa shad (*Tenulosa ilisha*), which has seen declines in inland and estuarine fisheries of Bangladesh and India over a number of years, although this species now appears to be increasing in the freshwater catches (Box 6).

Table 19: Main groups of organisms caught by inland fisheries in South Asia in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	1 491 974	64.43
Cyprinids NEI	327 717	14.15
Freshwater siluroids NEI	112 775	4.87
Hilsa shad	95 970	4.14
Freshwater crustaceans NEI	95 362	4.12
Snakeheads (= murrels) NEI	82 142	3.55
Natantian decapods NEI	36 317	1.57
Tilapias NEI	26 320	1.14
9 other taxa	46 922	2.03
Total	2 315 499	100.00

3.2.4 Southeast Asia

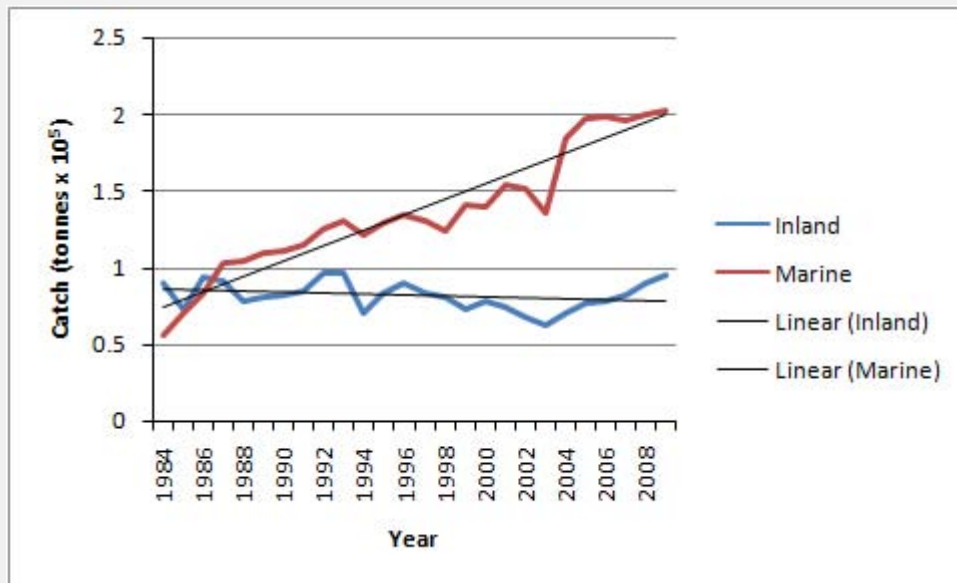
(Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, Viet Nam)

The Southeast Asian region combines two main areas, i.e. first, the Southeast Asian area proper centred around the Mekong, Salween and Irrawaddy river systems and their deltas as well as a number of other rivers, and second, the islands of Indonesia, Malaysia and the Philippines.

The period under review has seen considerable increases in catch in some countries (Figure 26), particularly Cambodia, Myanmar and Thailand. Catches in Indonesia have remained reasonably stable and even risen slightly since 1974. Catches from the Philippines have declined from a peak of 369 000 tonnes in 1983 to 186 444 000 tonnes in 2009. Of particular interest here are the Mekong basin group of countries where reported catches are considerably less than current estimates (Hortle, 2007; Lymer *et al.*, 2008a). In particular, Viet Nam, with a reported catch of only 144 800 tonnes in 2009, was estimated to have catches closer to 852 000 tonnes. Lymer *et al.* (2008a) estimate that actual catches in Thailand are some five times greater than those reported in the official statistics.

BOX 6
HILSA SHAD (*TENUALOSA ILISHA*) – AN ANADROMOUS SPECIES
HARVESTED IN TWO ENVIRONMENTS

This anadromous shad species is of major cultural significance in Bangladesh and Bengal (India) where it forms the basis of an important seasonal fishery. Catches of hilsa from inland waters have declined slightly or not at all since the construction of the Farraka Barrage on the Hooghly River. This is despite a popular perception that catches have declined considerably. Marine catches have been increasing throughout the recorded period at about 6.1 percent/year. The species was first recorded separately in the FAO statistics in 1984 (see figure below).



Catches of *Tenualosa ilisha* from inland and marine habitats, 1984–2009

Total catches from Myanmar were also reported to be low compared with the potential as calculated by area,⁷ although reporting over the last five years seems to have rectified this. However, the considerable increases reported by Cambodia from 1999 probably arose from the incorporation of floodplain fisheries following reports by the Mekong River Commission, and Cambodia itself has declared its statistics not to be backwardly compatible before this date. The dramatic increases in the catches in Myanmar are also probably due to the re-estimation of the contribution of floodplain fisheries, although also attributed to improved management measures, such as the enhancement by inland fishing concessions.

Per capita consumption is also high in this region, with Cambodia being the highest, where detailed analysis by Hortle (2007) shows that annual consumption patterns vary between provinces, from 105.2 kg per capita in riparian provinces to 43.4 kg per capita in those that are less dependent on the river.

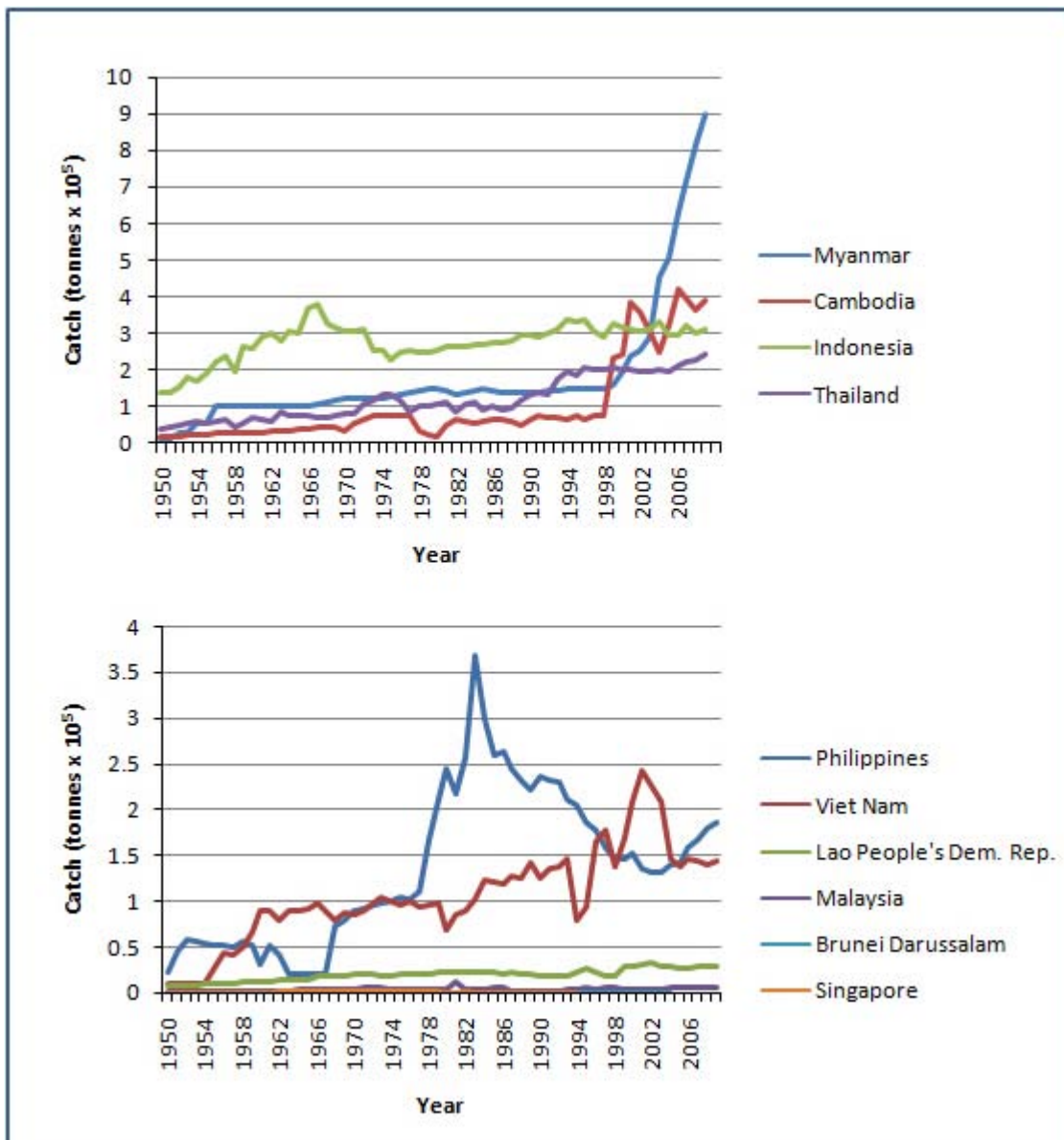


Figure 26: Trends in inland fish production from the Southeast Asian region, 1950–2009

⁷ www.fao.org/docrep/004/ad497/ad497e04.htm

Catches from the Southeast Asian region are varied with a reported 63 taxa, some of which are groupings of species (Table 20). The major part of the catch consists of finfish with very small amounts of crustaceans (1.7 percent) and molluscs (2.8 percent). There are, however, indications from studies carried out by Hortle (2007) in the Lower Mekong that much of the catch of organisms other than finfish is unreported and that, in reality, the contribution of crustaceans and molluscs to diets is considerably higher than reports would suggest (Halwart *et al.*, 2006; Meusch *et al.*, 2003). Few countries report their catches at the family level, and many that do assign the majority of the catch to “freshwater fishes NEI” (72 percent), possibly because of the great fish biodiversity of the region, which means that catches consist of numerous species. The remaining 26 percent are distributed among 27 family groupings, including frogs and shrimps. The dominant species groups identified are cichlids (5.0 percent), cyprinids (4.2 percent), catfishes (3.0 percent) and snakeheads (2.9 percent). Fishing pressure has produced a noticeable diminution of the mean length of fish caught in the Mekong basin, indicating severe fishing pressure (Van Zalinge *et al.*, 2004).

Table 20: Main groups of organisms caught by inland fisheries in Southeast Asia in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	1 604 595	72.59
Nile tilapia	67 040	3.03
Freshwater molluscs NEI	61 452	2.78
Striped snakehead	61 030	2.76
Silver barb	51 090	2.31
Tilapias NEI	43 463	1.97
Torpedo-shaped catfishes NEI	33 015	1.49
Snakeskin gourami	32 052	1.45
Cyprinids NEI	26 210	1.19
Climbing perch	24 591	1.11
Natantian decapods NEI	23 512	1.06
50 other taxa	182 458	8.25
Total	2 210 508	100.00

3.2.5 West Asia

(Islamic Republic of Iran, Iraq, Israel, Jordan, Lebanon, Occupied Palestinian Territory, the Syrian Arab Republic, Turkey)

This region consists of mainly arid lands with a few important rivers such as the Tigris and Euphrates as well as part of the Caspian Sea. There are large and small lakes in Iraq and Turkey as well as numerous dams and reservoirs.

Figure 27 shows that the catch history in the three major inland fisheries producing countries differs widely. Turkey showed a fairly consistent increase until about 1984, when they stabilized around 46 000 tonnes per year thereafter. Catches were fairly stable in Iraq until the southern marshes were drained, but the fishery has apparently recovered after the partial refilling of the wetlands. Catches in the Islamic Republic of Iran reached a peak in 1999, collapsed to less than half by 2003, and have since recovered slightly. The decline of the Iranian fishery corresponds to a general decline in the clupeoid group (mostly *Clupeonella*) in the Caspian Sea fishery (see Box 7).

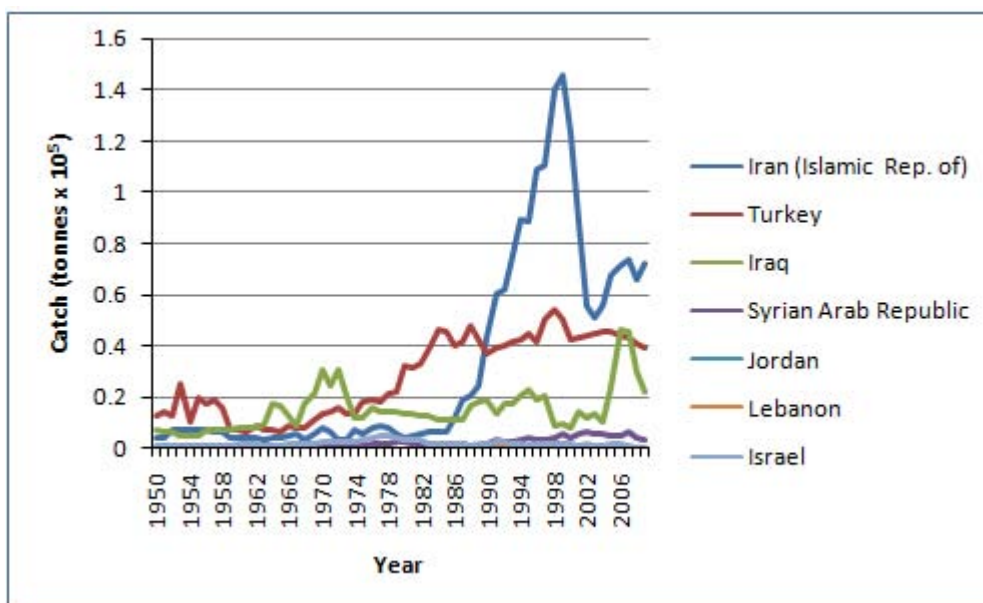


Figure 27: Trends in inland fish production from the West Asian region, 1950–2009

Catches in the West Asian area are heavily dependent on cyprinids (37.5 percent), with clupeids playing a secondary role in 2009 at 18.5 percent (Table 21). In 1998, clupeids contributed 40.33 percent of the catch against 31.55 percent of cyprinids, which provides further witness to the collapse of the *Clupeonella* stocks over the last decade (analysed in Box 7).

Table 21: Main groups of organisms caught by inland fisheries in West Asia in 2009

Taxonomic group	Catch (tonnes)	%
Black Caspian Sea sprats NEI	25 483	18.50
Common carp	18 723	13.59
Cyprinids NEI	18 133	13.16
Freshwater fishes NEI	15 506	11.26
Kutum	12 495	9.07
Tarek	10 685	7.76
Silver carp	9 154	6.65
Silversides (= sand smelts) NEI	6 184	4.49
Mulletts NEI	4 547	3.30
Grass carp (= white amur)	2 750	2.00
Freshwater siluroids NEI	2 709	1.97
Freshwater molluscs NEI	2 227	1.62
Tench	1 482	1.08
21 other taxa	7 670	5.57
Total	137 748	100.00