3.2.6 Central Asia

(Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan, Uzbekistan)

This central Asian grouping contains most of the Aral Sea basin with the Aral Sea and the Syr Darya and Amu Darya Rivers. It also includes Lake Balkhash (Kazakhstan). The statistical data set for this grouping is shorter than most, as before 1988 it was reported as a homogenous group within the former USSR area. During Soviet times, people were strongly encouraged to eat fish once a week. During these "fish days", restaurants served mainly fish dishes. This tradition disappeared when the USSR collapsed and fish became less readily available.

The major producers of inland fish in this region are Kazakhstan, which represented 58.2 percent of the catch from the region in 2009, and Turkmenistan (25.9 percent), because of their association with Lake Balkhash, the Caspian Sea and the Sea of Azov (Figure 28). Catches declined from 1989 (193 081 tonnes) to 1998 (41 966 tonnes) because these countries began recording fisheries data separately. These trends in catch can be attributed to the drying out and pollution of the Aral Sea from the water abstractions for cotton culture; Lake Balkhash is following a similar trajectory because of dams on inflowing rivers. This has damaged the important stocks of "kilka" (*Clupeonella cultriventris*) that previously formed a staple of the fishery, which had reached some 450 000 tonnes in 1974 (Box 7). The reasons for the collapse of fisheries in this region during this period have been explored by Thorpe *et al*. (2009). However, trends over the last ten years have been for a slight renewal of the fisheries, at least in Kazakhstan, although fisheries in Turkmenistan have remained relatively stable (FAO estimate) and those of Azerbaijan have continued to decline. Of the minor countries, most have remained stable or even increased, as in the case of Uzbekistan.

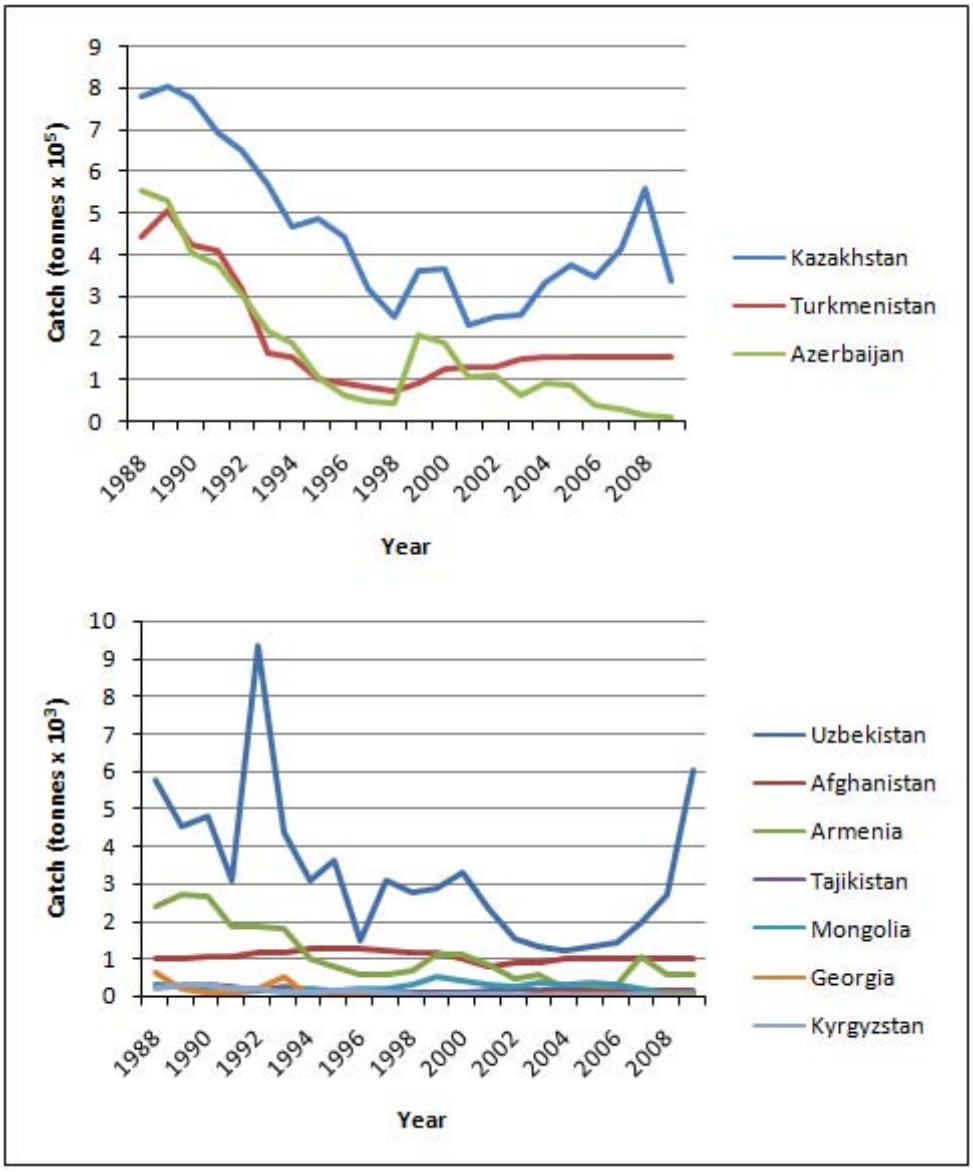


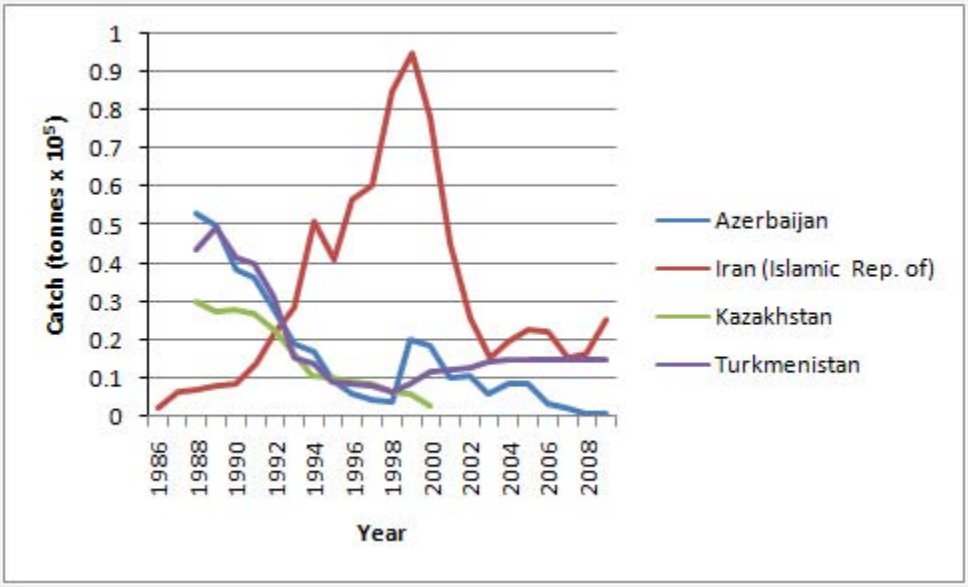
Figure 28: Trends in inland fish production from the Central Asian region, 1988–2009

BOX 7

THE BLACK SEA SPRAT (*CLUPEONELLA CULTRIVENTRIS*) – VICTIM OF MULTIPLE ENVIRONMENTAL IMPACTS

The history of the Black Sea sprat illustrates the effect of multiple environmental pressures on a species and its fishery. The Black Sea sprat is found in the Black Sea and the Sea of Azov, the Caspian and the Aral Seas, as well as in their affluent rivers. It formed a mainstay of the fisheries of the Caspian and Aral Seas and had wide-ranging economic value. The species and its fishery in Kazakhstan and Uzbekistan were severely damaged by the desiccation of the Aral Sea. The pollution of the Caspian Sea and Sea of Azov and their inflowing rivers and the accidental introduction into the Caspian of the comb jelly *Mnemiopsis leidyi* (Daskalov and Mamedov, 2007) has provoked the collapse of the fishery for this species in the Islamic Republic of Iran since 2000 and earlier in Turkmenistan (see figures below).

Trends in catch of the Black Sea sprat (*Clupeonella cultriventris)* in Central Asian countries from 1950–2009



Trends in catch of the Black Sea sprat (*Clupeonella cultriventris*) by country, 1986–2009

Further evidence for the decline in kilka is seen when the catch composition of 1988 is compared with that of 2009 (Table 22), where clupeids contributed 62.2 percent of the catch in 1988 as opposed to only 26.8 percent in 2009. These have been replaced by cyprinids (53.6 percent of 2009 total catch), pike-perch and "freshwater fishes NEI" in the rising catches of the last ten years. Other major reasons for the collapse in the fisheries in Central Asia were that, recently, no public funds have been available for the fisheries sector and thus stocking programmes have been discontinued. In addition, many of the species used in stocking programmes under the USSR were exotic and had to a large extent replaced the indigenous fauna; however, when stocking programmes stopped, the exotics were not able to maintain their populations because of the lack of suitable spawning grounds. A further aggravating factor is the lack of fisheries inspection together with large-scale unemployment, which has led to an explosion in illegal fishing.

Table 22: Main groups of organisms caught by inland fisheries in Central Asia in 1988 and 2009

Taxonomic group	1988 (tonnes)	2009 (tonnes)	1988 (%)	2009 (%)
Freshwater bream	27 227	17 464	13.37	30.21
Black and Caspian Sea sprat	126 580	15 519	62.16	26.85
Pike-perch	7 888	4 192	3.87	7.25
Roaches NEI	6 327	4 162	3.11	7.2
Crucian carp	2 364	2 806	1.16	4.85
Wels (= som) catfish	3 764	2 670	1.85	4.62
Silver carp		1 994	0.00	3.45
Common carp		1 927	0.00	3.33
Freshwater fishes NEI	1 364	1 800	0.67	3.11
Asp	410	1 441	0.20	2.49
Northern pike	1 762	1 345	0.87	2.33
Grass carp (= white amur)	1	607	0.00	1.05
18 other taxa	25 957	1 878	12.75	3.25
Total	203 644	57 805	100.00	100.00

3.2.7 Arabia

(Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, Yemen, United Arab Emirates)

This region is almost totally arid and has no reported inland catch.

3.3 Americas

The Americas are divided into four regions that are classified by state of development as much as geographical affiliation. Thus, Mexico is situated with the Central American group rather than North America.

Total catches from the four areas combined (Figure 29) rose until about 1988, and has fluctuated around a mean of about 600 000 tonnes. This is largely because gains in some countries have been offset by losses from the North American region.

The four regions of the Americas each shows a different pattern of exploitation (Figure 30), which will be commented in the appropriate section. South America contributes the most to the total production (66.7 percent) (Table 23), although administrators and researchers have admitted that estimates of production levels are low as there is a general failure to report any but the most significant landings from the main commercial markets. This leaves the commercial fisheries of some major tributaries unrecorded. Similarly, the artisanal and subsistence sectors have generally not been researched, although these may be considerable, especially among poorer riparian populations.

Figure 29: Trends in reported catch for all regions of the Americas, 1950–2009

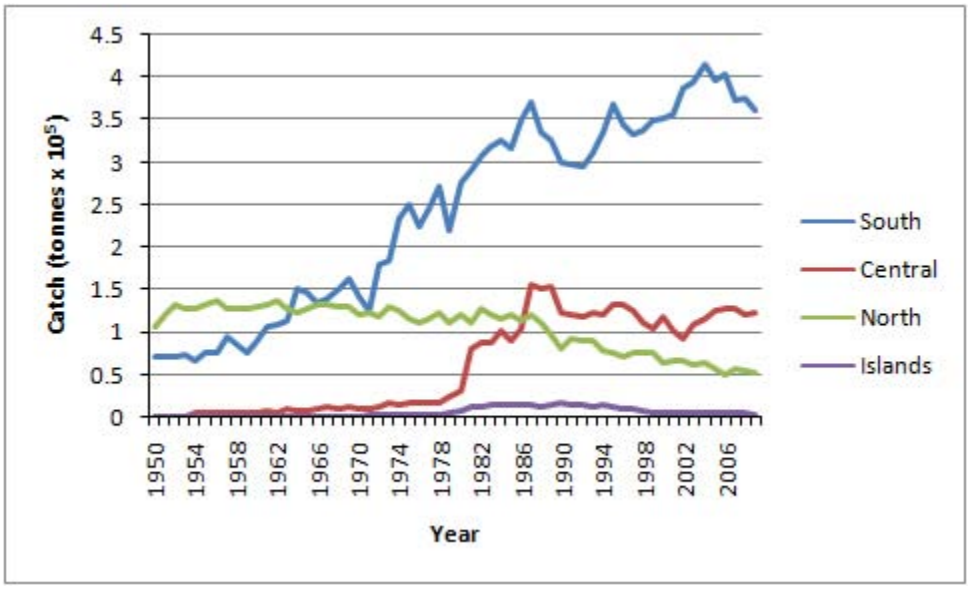


Figure 30: Trends in inland fish production from each of the four regions of the Americas, 1950–2009

Table 23: Percentage contribution of the various American regions to the American total inland catch in 2009

Subregion	Catch (tonnes)	% share
South	359 947	66.72
Central	122 013	22.62
North	53 861	9.98
Islands	3 659	0.68
Total	539 480	100.00

Inland fish is not an important component in the total animal protein resources of the continent (0.52 percent of the total supply), although fish from all sources contributed 28 percent to South and

Central American protein balances in 2009 and only 11 percent in North America, one of the lowest contributions of fish overall to protein diets of any continent (Table 24). This is because there is a distinct preference for chicken among the poor and beef among the better off. In the strongly Catholic countries of Latin America, there is a peak in fish consumption around Easter. However, this source of protein is much more significant among the people riparian to the major river and lake systems, as marketing chains to deliver fish to the wider rural are often poor. For example, in Central America inland fish contributes 1.68 percent, or more than double the continental average.

Table 24: North, Central and South America – production of animal protein by source, 2009
(aquatic plants are excluded from the aquaculture figures)

Item	Central and South America		Canada and United States of America	
	Production	%	Production 2009	%
Chicken meat	19 369 028	30.41	17 371 530	33.65
Cattle meat	18 255 648	28.67	13 146 370	25.47
Marine fish	15 363 596	24.13	5 129 458	9.94
Pig meat	6 309 641	9.91	12 387 100	24.00
Aquaculture	2 283 877	3.59	326 053	0.63
Turkey meat	589 368	0.93	2 734 953	5.30
Freshwater fish	485 619	0.76	53 861	0.10
Sheep meat	314 179	0.49	96 907	0.19
Rabbit meat	263 443	0.41	–	–
Horse meat	167 636	0.26	63 558	0.12
Goat meat	129 835	0.20	–	–
Game meat	59 301	0.09	249 561	0.48
Duck meat	41 512	0.07	57 383	0.11
Meat of other rod	17 875	0.03	–	–
Meat other camelids	17 500	0.03	–	–
Meat nes*	14 472	0.02	–	–
Total	63 682 530	100.00	51 616 734	100.00

*Not elsewhere specified.
Source: FAOSTAT; FishStat.

Catches over the whole continent consist almost entirely of fish (96.3 percent) with a few crustaceans also being caught (Table 25).

Table 25: Major taxonomic groupings of catches for the Americas in 2009

Major group	Catch (tonnes)	%
Finfish	519 740	96.34
Crustaceans	17 356	3.22
Molluscs	1 724	0.32
Aquatic invertebrates	439	0.08
Amphibians	221	0.04
Total	539 480	100.00

Figures 31 and 32 show the number of taxa and the percentage of "freshwater fishes NEI" reported for Latin America (excluding Canada and the United States of America) and North America (Canada and the United States of America), respectively. The number of species in the catch each year has risen in Latin America, where 73 taxa were reported by 2009, but has fallen since 1992 in North America.

The proportion of "freshwater fishes NEI" was highly variable from year to year in both cases, albeit with a slightly declining trend.

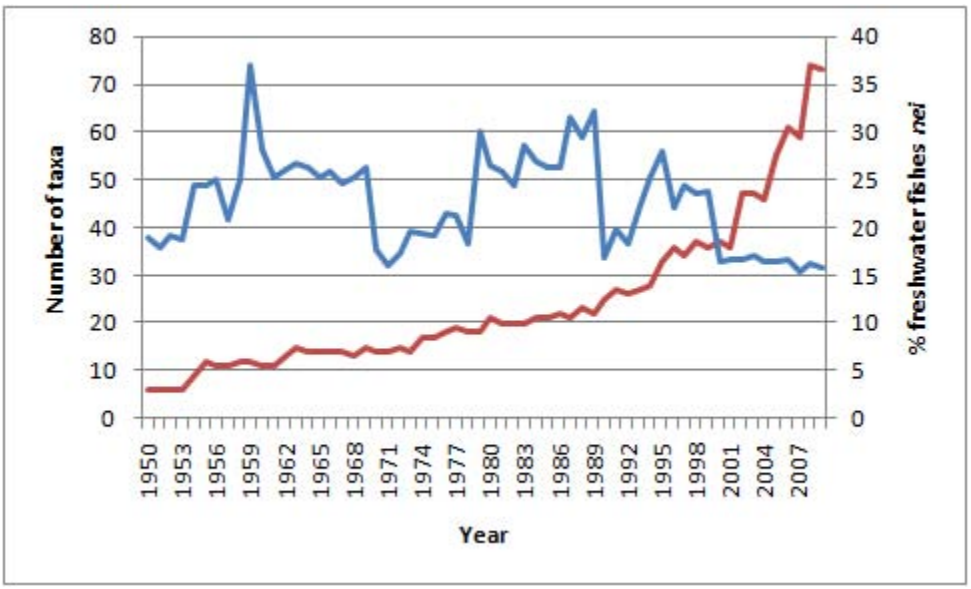


Figure 31: Trends in number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for Latin America (Central, South and islands) for 1950–2009

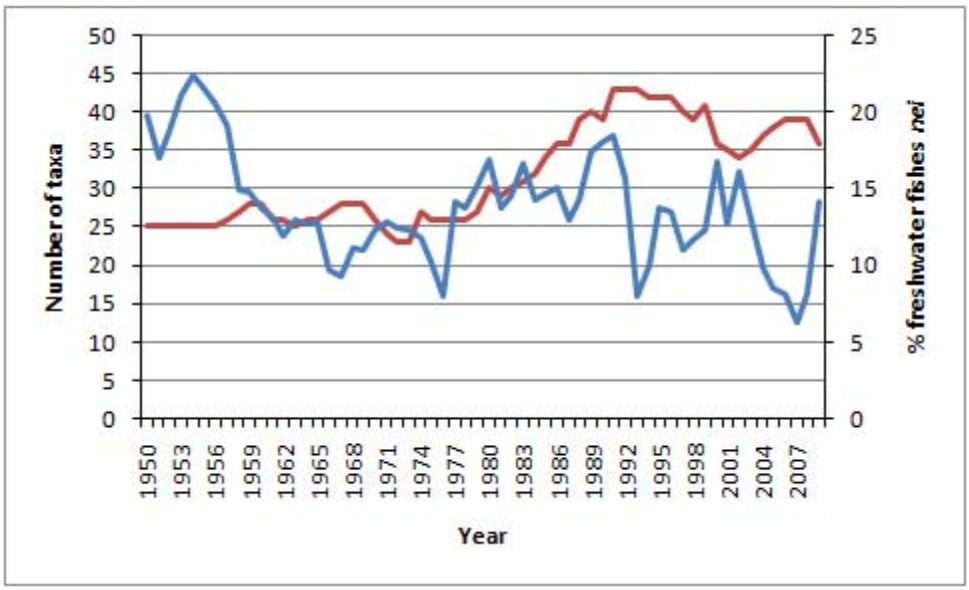


Figure 32: Trends in number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for North America for 1950–2009

3.3.1 Central America

(Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama)

The fisheries of Central America are based on a few large rivers such as the Usumacinta system in Mexico, and lakes such as Lake Nicaragua. There are also numerous reservoirs, especially in Mexico, whose fisheries are often maintained by stocking. Over 90 percent of the current Central American production comes from Mexico, with roughly 2.65 percent coming from Panama, 1.96 percent from El Salvador and 1.92 percent from Guatemala.

Mexican inland fisheries production (Figure 33) reached a peak of 147 000 tonnes in 1987, and has since fluctuated about 100 000 tonnes with a slight decline in the earlier years. The reasons for the fluctuations are unclear but may be linked to changes in stocking policy. Catches from the other countries have fluctuated wildly over the past 20 years and have tended to decline in almost all cases except for El Salvador.

Reporting of catches to taxonomic category is good with only 6.6 percent reported under the general "freshwater fishes NEI" category. Catches are a mixture of North American and South American categories with the exception of Tilapias (Table 26). The predominance of the introduced tilapias (53.3 percent) rather than native cichlids indicates the importance of stocked lake fisheries in the region. Other main taxa include the exotic cyprinids (20 percent), of which the introduced common carp is also used for stocking cooler reservoirs and dams.

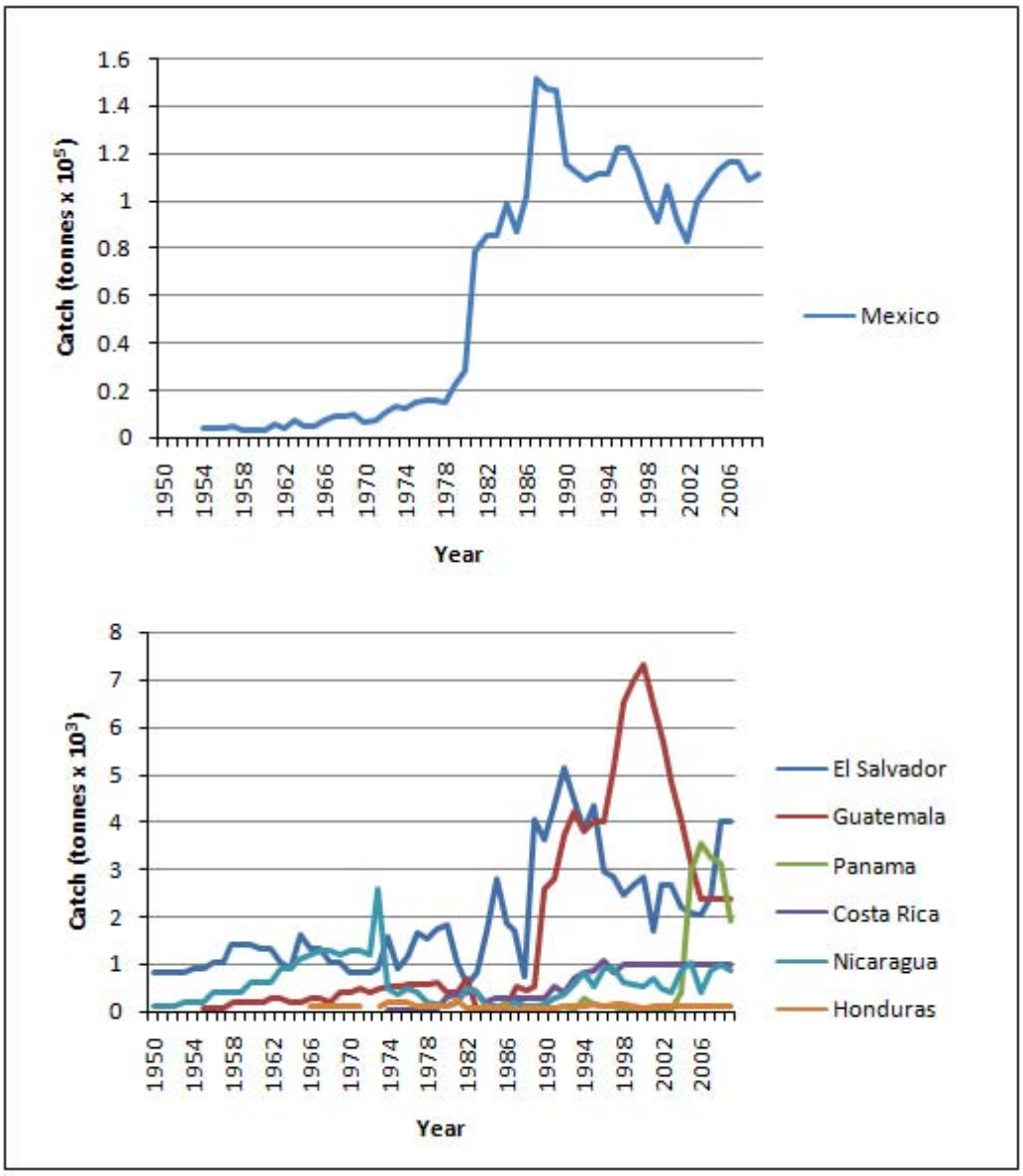


Figure 33: Inland fish production from the Central American region, 1950–2009

Table 26: Main groups of organisms caught by inland fisheries in Central America in 2009

Taxonomic group	Catch (tonnes)	%
Tilapias NEI	65 017	53.29
Common carp	24 450	20.04
Freshwater fishes NEI	8 050	6.60
Nile tilapia	3 977	3.26
River prawns NEI	3 092	2.53
Snooks (= robalos) NEI	2 593	2.13
Chirostoma spp	2 372	1.94
Cyprinids NEI	2 119	1.74
Silversides (= sand smelts) NEI	1 937	1.59
Freshwater molluscs NEI	1 723	1.41
Catfishes NEI	1 619	1.33
Cichlids NEI	1 466	1.20
17 other taxa	3 598	2.95
Total	122 013	100.00

3.3.2 North America

(Canada, the United States of America)

The fisheries of North America are based on the extensive Great Lakes system in the north, the Mississippi River and tributaries centrally and to the south, and the west-flowing rivers. Numerous other rivers and lakes are situated throughout the countries. Reported catches of inland fish in the Canada and the United States of America have declined steadily since the late 1950s (Figure 34). This is probably due to the uneconomic nature of inland fisheries compared with other types of fish production. Furthermore, management of inland fisheries for recreation (see Annex 3) and conservation have assumed progressively more importance as time goes on.

A wide range of fish are caught, particularly coregonids (21.6 percent) and percids (black bass, walleye and sunfishes, 18.9 percent) (Table 27), which form the mainstay of the Great Lakes fisheries, and salmonids, which are important in the west-flowing rivers. Salmonids formed up to 19 percent of catch in 1988, but have fallen to 1.67 percent by 2009 (see Box 9).

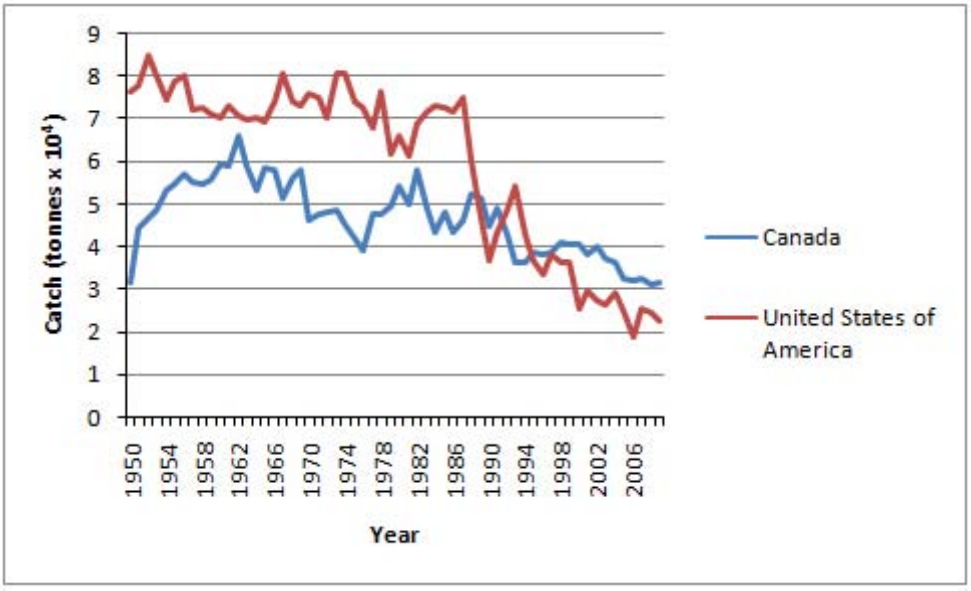


Figure 34: Inland fish production from the North American region, 1950–2009

Table 27: Main groups of organisms caught by inland fisheries in North America in 2009

Taxonomic group	Catch (tonnes)	%
Lake (= common) whitefish	11 076	20.56
Euro-American crayfishes NEI	8 536	15.85
Walleye	7 689	14.28
Freshwater fishes NEI	7 603	14.12
Pond smelt	3 585	6.66
American yellow perch	1 957	3.63
Northern pike	1 955	3.63
Catfishes NEI	1 866	3.46
Buffalo fishes NEI	1 420	2.64
Blue catfish	1 242	2.31
Alewife	955	1.77
Lake trout (= char)	841	1.56
Common carp	792	1.47
American gizzard shad	669	1.24
Lake cisco	640	1.19
20 other taxa	3 034	5.63
Total	53 861	100.00

3.3.3 South America

(Argentina, Plurinational State of Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, the Bolivarian Republic of Venezuela)

South American inland fisheries are based on the large river systems of the Amazon, Orinoco and La Plata, the Pantanal wetlands of the upper Paraguay River, the Andean lakes of Argentina and Chile, Lake Titicaca and a number of reservoirs in Brazil, and the Bolivarian Republic of Venezuela. There are also many important secondary river systems such as the Essequibo in Guyana, the São Francisco in Brazil and the Magdalena in Colombia. Overall, South American inland fish production has increased by 1.75 percent/year between 1950 and 2004, but has since declined (Figure 35).

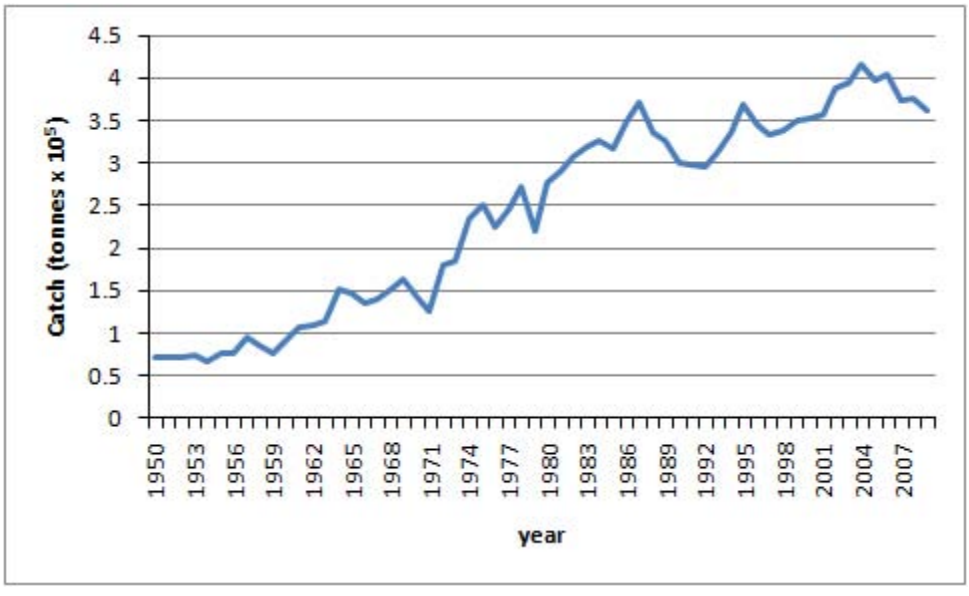


Figure 35: Inland fish production from the South American region, 1950–2009

Brazil is the major producer of inland fish in South America, contributing 66.5 percent to the 2009 total of 359 947 tonnes, and has shown the fastest consistent growth (Figure 36). Much of this is based on the commercial urban-based fleets of the Amazon (Almeida, Lorenzen and McGrath , 2004), but this only records catches by the commercial fleets operating in the main stem of the river and Amazonian catches are thus probably underestimated. Colombia was temporarily the largest producer in 1970, but the fishery has since declined considerably owing to the reclamation of the Magdalena delta floodplain, pollution and increased siltation through deforestation of the Andean slopes. Venezuelan catches increased until 1996 and have since fluctuated with a restoration in production in 2002 and a subsequent decline in production. Argentine and Paraguayan catches rose in response to an export demand for "sábalo" (*Prochilodus platensis*), but fell as stocks were adversely affected by deteriorating conditions in the Paraná River because of the numerous upstream dams (see Box 8). Catches are now dominated by medium- to small-sized species such as the Curimatidae and Characidae (33 percent), whereas some years ago the proportion of large catfishes (Pimelodidae) was somewhat higher – in 2004, for example, the pimelodid catfishes formed 27.5 percent of the catches as compared with 1.9 percent in 2009 (Table 28). The decline is probably due to local overfishing of the larger catfish species around the main urban centres of the Amazon and Orinoco Rivers as well as damming in the case of the Paraná River.

In recent years, there has been an increase in recreational fisheries, particularly in the southern part of the region. This is particularly important to the economies of the Andean lakes of Argentina and Chile. Some areas of Brazil, such as the Pantanal in Mato Grosso do Sul, are also dedicated to recreational fishing.

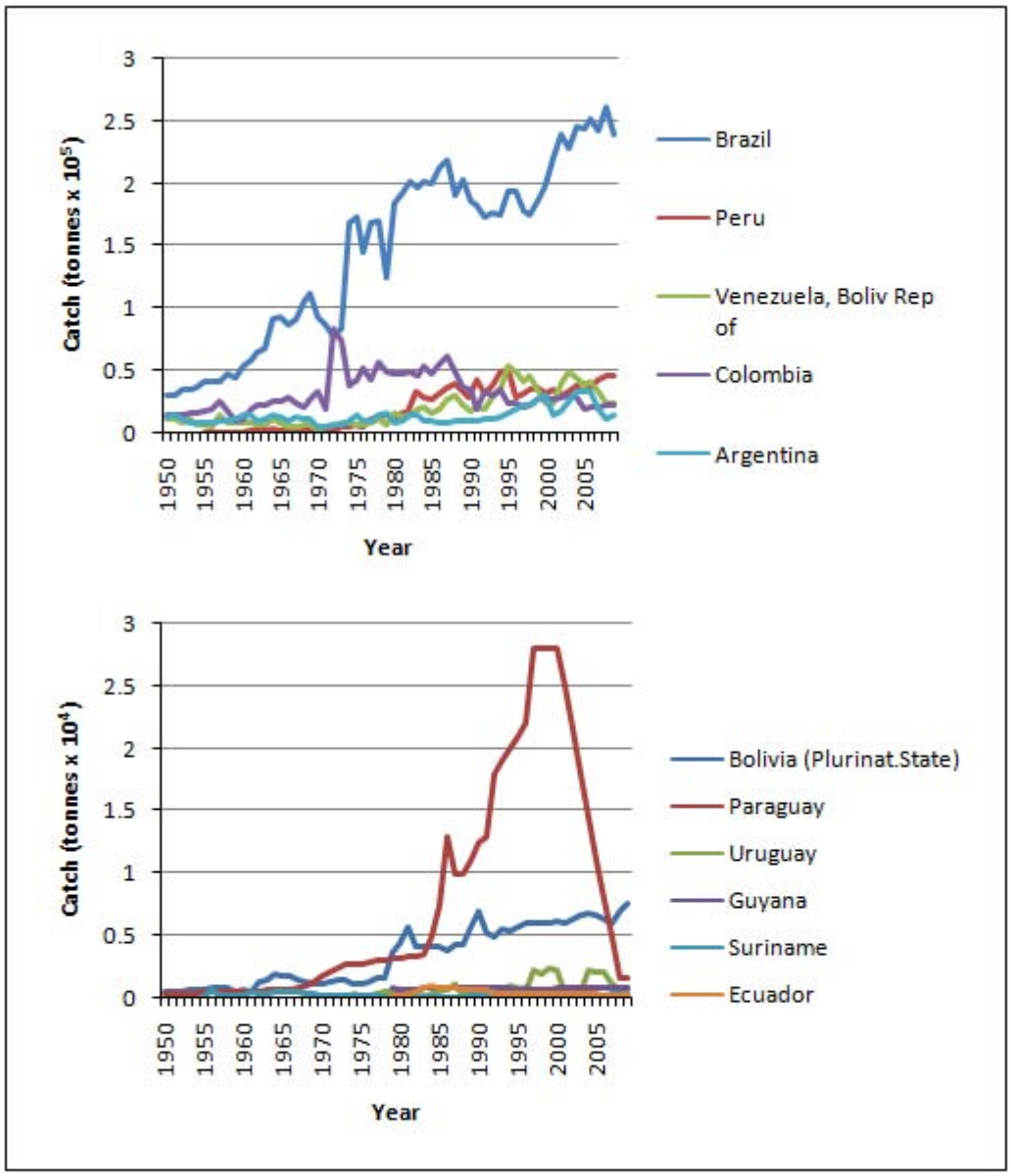


Figure 36: Inland fish production from the South American region by country, 1950–2009

Table 28: Main groups of organisms caught by inland fisheries in South America in 2009

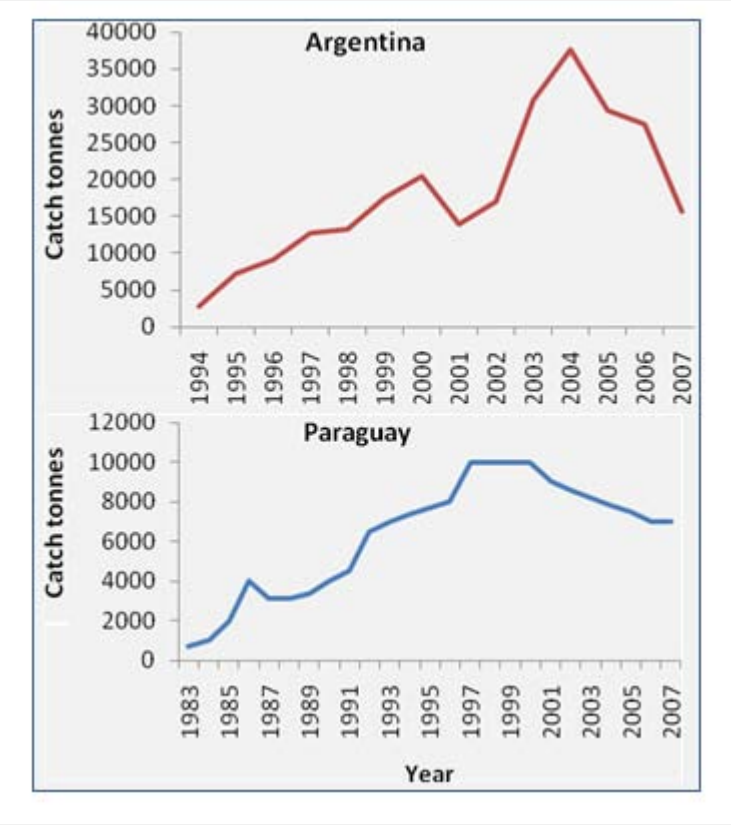
Taxonomic group	Catch (tonnes)	%
Freshwater siluroids NEI	55 620	17.75
Prochilodontids NEI	48 895	15.60
Freshwater fishes NEI	36 618	11.68
Laulao catfish	23 676	7.55
Characins NEI	21 868	6.98
Semaprochilodus insignis	15 813	5.05
Gilded catfish	13 835	4.41
Cichlids NEI	13 168	4.20
South American silver croaker	12 037	3.84
Metynnis argenteus	10 624	3.39
Hoplias aimara	9 450	3.02
Tilapias NEI	9 247	2.95
River prawns NEI	5 520	1.76
Curimata cyprinoides	5 012	1.60
Schizodon fasciatus	4 977	1.59
Cachama	4 045	1.29
Triportheus angulatus	3 239	1.03
29 other taxa	19 783	6.31
Total	313 427	100.00

BOX 8

PROCHILODUS IN THE LA PLATA RIVER SYSTEM – RESPONSE TO ENVIRONMENTAL AND FISHERIES MISMANAGEMENT

Fishes of the prochilodontid family form the mainstay of inland fisheries throughout South America. In particular, *Prochilodus lineatus* ("sábalo") and *Semaprochilodus insignis* figure largely in the catches of the Amazon, La Plata and Orinoco Rivers. Fisheries for "sábalo", aimed at export to the Brazilian and other markets, developed in Argentina and Paraguay in response to financial crises in the early 1990s. They expanded rapidly and eventually rose to levels where guidelines for reasonable levels of production were generally ignored. This, together with environmental degradation of the Paraná River owing to upstream dams, has caused a decline in the fishery in both countries (see figure below).

A similar collapse has been documented in the *Prochilodus* fisheries of the Pilcomayo River the Plurinational State of Bolivia.



Evolution of the *Prochilodus* fishery in Argentina and Paraguay

3.3.4 Islands

(Cuba, the Dominican Republic, Haiti, Jamaica)

The islands associated with the American continent include the Caribbean Islands, The Falklands (Malvinas) (UK overseas territory) and Greenland. Only 5 of the 28 islands listed in FishStatJ report any inland fisheries (Figure 37), although Cuba developed an important fishery on the numerous reservoirs through a government -sponsored stocking scheme. As a result, production rose to a relatively high level of nearly 16 000 tonnes in 1990.

The subsequent decline in this system seems to be the result of the withdrawal of government subsidies for the hatcheries that provided the fry for stocking. Other countries (the Dominican Republic and Jamaica) also adopted stocking of reservoirs as a main source of inland fish.

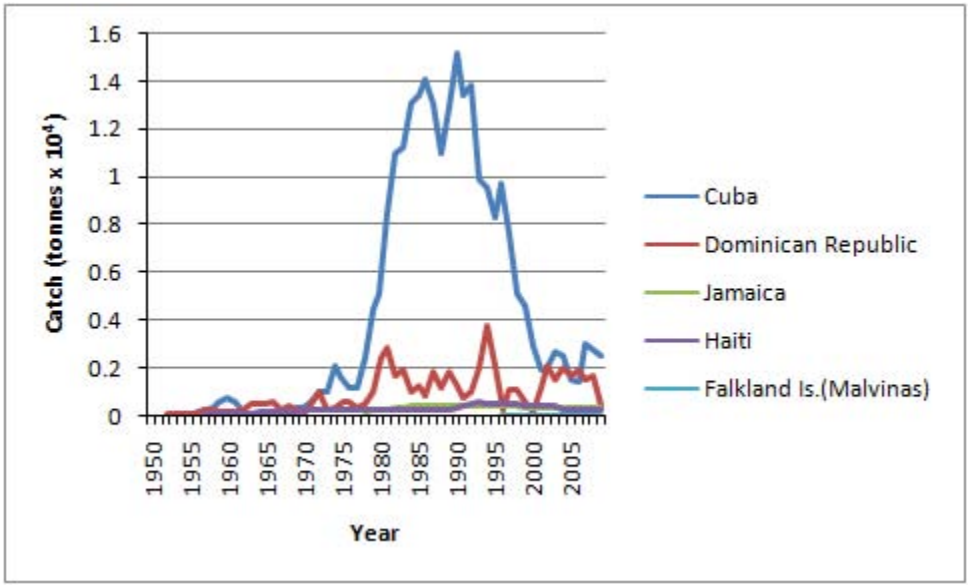


Figure 37 : Inland fish production from the islands of the Americas by country or territory, 1950–2009

The importance of this practice is shown by the fact that in 1990, at the peak of Cuban production, 99 percent of all fish captured were tilapiine cichlids (the species of choice for culture-based dam fisheries), but in 2009 only 77 percent of the catches consist of introduced tilapias (Table 29).

Table 29: Main groups of organisms caught by inland fisheries in the islands of the Americas in 2009

Taxonomic group	Catch (tonnes)	%
Blue tilapia	2 526	69.05
Freshwater fishes NEI	700	19.14
Tilapias NEI	298	8.15
Largemouth black bass	88	2.41
Common carp	28	0.77
American eel	9	0.25
Mountain mullet	9	0.25
Total	3 658	100

3.4 Europe

Europe is divided into five areas depending on their geography and political and economic history. The Russian Federation is included in Europe since the dissolution of the USSR as a statistical entity, although much of its land mass lies in Asia, and for this reason is assigned a category of its own. The Russian Federation contributes 64.8 percent of all European production (Table 30), although some of this comes from Russian Asiatic waterways. East Europe is the second most important with 12.8 percent because there are still some important food fisheries.

Table 30: Percentage contribution of the various inland European regions to the total catch in 2009

Subregion	Catch (tonnes)	%
Russian Federation	24 6137	64.78
East Europe	48 685	12.81
North Europe	36 278	9.55
West Europe	31 443	8.28
South Europe	17 415	4.58
Total	379958	100.00

Figure 38 shows that European catches rose steadily until the late 1980s after which they declined. Aps, Sharp and Kutonova (2004) trace this decline to the pressures of commercial and recreational fishing as well as to the degraded state of many of the rivers and lakes. Certainly, commercial fisheries for food in this region are now waning, partly because the fish stocks have been depleted or altered by other human interventions or because a shift has occurred in preference towards products from marine and aquaculture sources, but mainly because inland water fishers can no longer earn enough from the occupation to make it worthwhile.

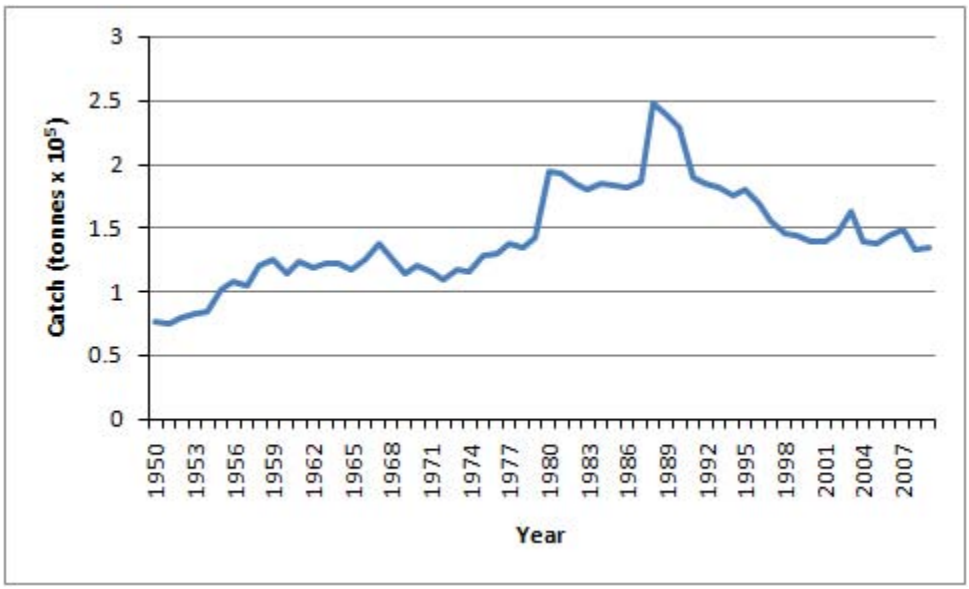


Figure 38: Trends in reported catch from the four European regions for 1950–2009, excluding the Russian Federation (the Russian Federation is treated separately in Figure 45)

Europe is heavily dependent on animal protein-based diets. Marine fish makes a very significant contribution at 18 percent of the total, but the contribution of fish from aquaculture (3.5 percent) and inland capture fisheries (0.5 percent) is very low compared with other continental areas (Table 31). Fish in total contribute only 22 percent to the animal protein budget. However, these figures are likely to be deceptive as Europe, in common with Australia and North America, imports large quantities of marine capture and aquaculture products.

Table 31: Europe – production of animal protein by source in 2009 (aquatic plants are excluded from the aquaculture figures)

Item	Catch (tonnes)	%
Pig meat	26 002 390	36.80
Chicken meat	13 389 692	18.95
Marine fish	13 007 157	18.41
Cattle meat	10 824 082	15.32
Aquaculture	2 484 585	3.52
Turkey meat	1 664 140	2.36
Sheep meat	1 138 100	1.61
Rabbit meat	505 129	0.71
Duck meat	450 627	0.64
Inland fish	379 958	0.54
10 other categories	809 887	1.15
Total	70 657 757	100.00

Source: FAOSTAT; FishStat.

Catches are heavily oriented to cyprinids and percids, although in some regions salmonids, pike and coregonids are important (Table 32).

Table 32: Main groups of organisms caught by inland fisheries in Europe in 2009 (excluding the Russian Federation)

Family	Catch (tonnes)	%
Other	49 179	38.01
Cyprinidae	33 351	25.78
Percidae	14 508	11.21
Esocidae	8 844	6.84
Coregonidae	7 806	6.03
Salmonidae	7 385	5.71
Clupeidae	4 384	3.39
Anguillidae	2 428	1.88
Cambaridae	1 500	1.16
12 other taxa	4 436	3.31
Total	129 385	100.00

The number of taxa reported in the catches increased year on year from 1950, with 13 taxa reported in 1950 to 70 taxa in 2000, and thereafter the numbers remained relatively stable. At the same time, the number of reports of “freshwater fishes NEI” decreased from over 70 percent in the 1950s to about 20 percent in the late 1980s and early 1990s, although there has been a steady increase in this category since then (Figure 39).

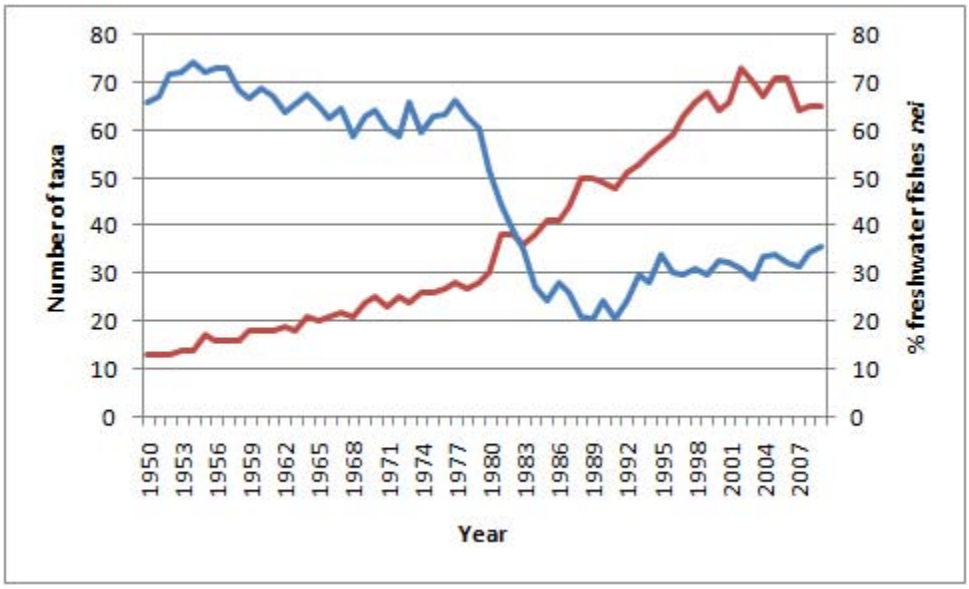


Figure 39: Trends in number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for Europe (excluding the Russian Federation) for 1950–2009

3.4.1 West Europe

(Andorra, Austria, Belgium, Channel Islands, Faroe Islands, France, Germany, Ireland, Isle of Man, Liechtenstein, Luxembourg, the Netherlands, Switzerland, United Kingdom of Great Britain and Northern Ireland)

The main freshwater resources in Western Europe are the numerous rivers, some of which are large such as the Rhine, the Rhone and the Loire Rivers. There are also some reservoirs and large lakes in some countries.

Most countries in Western Europe reserve their inland fish populations for recreational purposes. In some countries, the catch may be eaten but in others there is a catch-and-return policy. Catches are dominated by Germany at 69.27 percent of total regional catch in 2009 (Figure 40), where there are still significant commercial food fisheries. It is difficult to explain the drop in catches from 1982 to 1994, but this may be associated with changes in reporting during the period of unification, as prior to 1989 catches were reported separately for the then two German states. Catches in most other West European countries have declined steadily from peaks in the late 1980s.

Table 33 shows that a large portion of the catch (65 percent) is not identified to taxonomic group but that catches otherwise consist of a mix of salmonids, cyprinids, coregonids and other lesser groups.

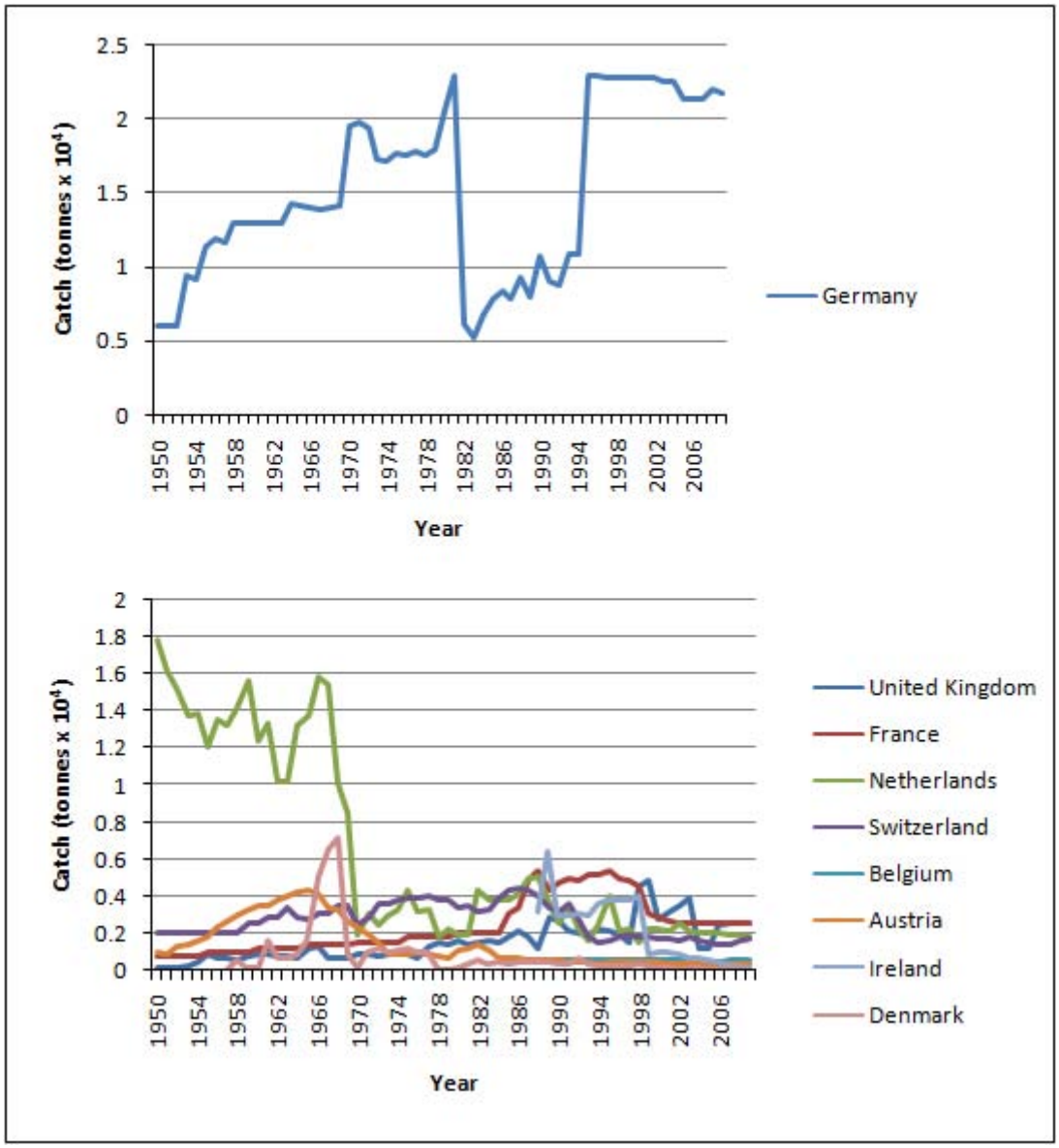


Figure 40: Inland fish production from the West European region by country, 1950–2009

Table 33: Main groups of organisms caught by inland fisheries in Western Europe in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	20 342	64.79
European eel	1 924	6.13
Whitefishes NEI	1 650	5.26
Rainbow trout	1 514	4.82
Cyprinids NEI	1 013	3.23
European smelt	790	2.52
European perch	705	2.25
Freshwater bream	477	1.52
Pike-perch	456	1.45
Roach	330	1.05
20 other taxa	2197	7.00
Total	31 398	100.00

3.4.2 North Europe

(Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, Sweden)

The main aquatic resources of Northern Europe are lacustrine with extensive networks of glacial lakes throughout much of the area. There are also many short, steep rivers suitable for migratory salmonids, although some of these have been dammed.

Northern European catches are dominated by Finland, which contributed 80.7 percent of the regional catch in 2009 (Figure 41). Finland still retains an extensive commercial lake fishery sector and the recreational fishery also catches fish for consumption. A similar situation is found in Estonia, but in most other countries of the region the fisheries are purely recreational. Note that Estonia, Latvia and Lithuania only started reporting as independent countries in 1988, as their catches were included in those of the USSR prior to that date.

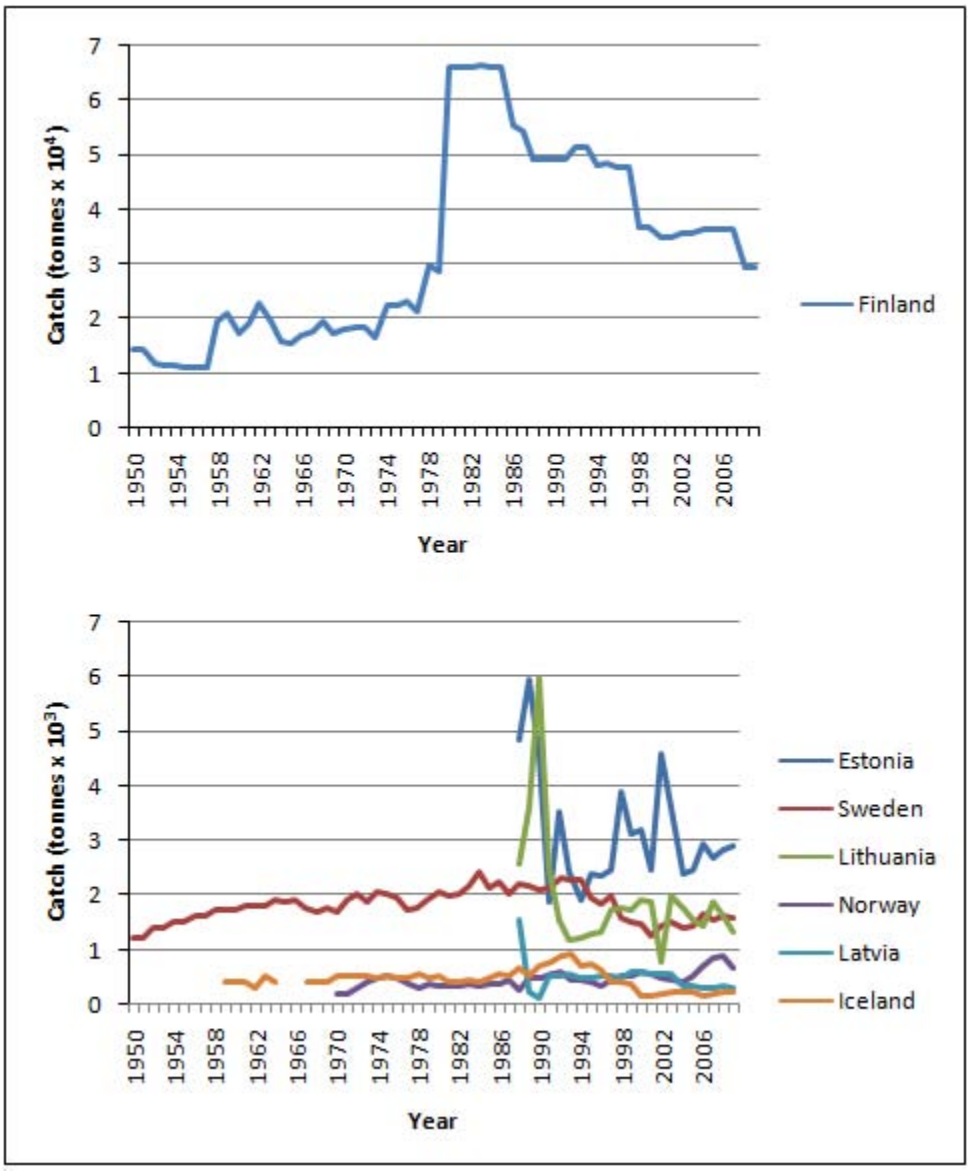


Figure 41: Inland fish production from the North European region by country, 1950–2009

Most fishes are identified to taxonomic grouping (Table 34) and catches are distributed among the percids, cyprinids, pike and coregonids. Salmonids, which contributed only 7.2 percent of the catch in 2009, have declined considerably from a high of 26 percent in 1968 (see Box 9). Similarly, coregonids have declined from 21 percent of the catch in 1968 to 16 percent in 2009.

Table 34: Main groups of organisms by family caught by inland fisheries in Northern Europe in 2009

Taxonomic group	Catch (tonnes)	%
European perch	8 374	23.92
Northern pike	7 303	20.86
Vendace	4 306	12.30
Pike-perch	3 130	8.94
Roach	2 925	8.36
Freshwater bream	2 221	6.34
European whitefish	1 257	3.59
Atlantic salmon	1 052	3.01
Rainbow trout	766	2.19
Trouts NEI	701	2.00
Burbot	622	1.78
Freshwater fishes NEI	359	1.03
Three-spined stickleback	355	1.01
16 other taxa	1 637	4.68
Total	35 008	100.00

3.4.3 South Europe

(Albania, Bosnia and Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Greece, Italy, Malta, Montenegro, Portugal, Spain)

Southern Europe has a mixture of lake and river resources. Catches from the region as a whole peaked at nearly 44 000 tonnes in 1986 and have since declined to 17 415 tonnes in 2009 (Figure 42). The major producer for many years was Spain, which still produces 34 percent of the total, followed by Italy at 28 percent, Albania at 13 percent, and Bosnia Herzegovina at 11 percent.

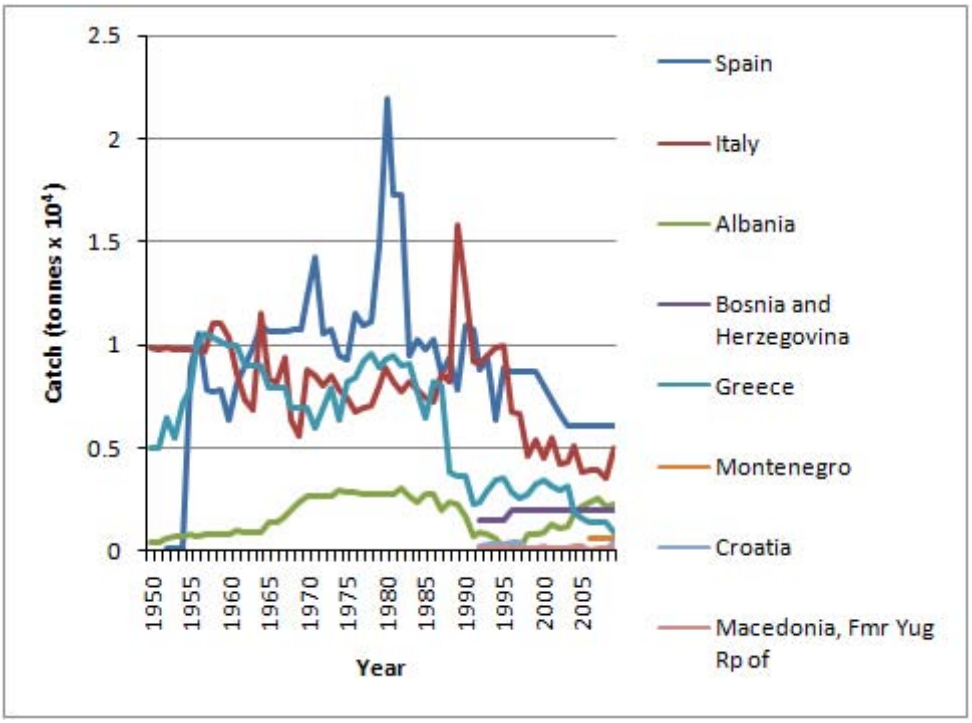


Figure 42: Inland fish production from the Southern European region by country, 1950–2009

Catches are not well defined by taxonomic group, as 57 percent were reported under the "freshwater fishes NEI" category in 2009. Cyprinids (15 percent) and salmonids (13 percent) together comprised a further 28 percent (Table 35).

Table 35: Main groups of organisms caught by inland fisheries in Southern Europe in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	9 706	56.19
Sea trout	1 806	10.46
Red swamp crawfish	1 500	8.68
Salmonoids NEI	857	4.96
Common carp	584	3.38
Bleak	535	3.10
Cyprinids NEI	369	2.14
Mullets NEI	220	1.27
Goldfish	210	1.22
Crucian carp	208	1.20
Silver carp	186	1.08
22 other taxa	1 093	6.33
Total	17 274	100.00

3.4.4 East Europe

(Belarus, Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland, , Montenegro, Romania, Serbia, Slovakia, Slovenia, Ukraine)

Eastern Europe has significant river and lake resources centred on the Danube basin, its tributaries and delta, and the Dneiper and Dneister Rivers and reservoirs of the Ukraine. To the north, Poland has an extensive lake district. Inland water fish have been an important source of food in many eastern European countries and they developed important fisheries, especially under the former centrally planned economies when they enjoyed significant government subsidies.

Analyzing the catches from eastern Europe are difficult because of the inclusion of the figures for several of the modern states (Belarus, Republic of Moldova and Ukraine) in the former USSR series before 1988. Furthermore, the former Czechoslovakia divided into the Czech Republic and Slovakia in

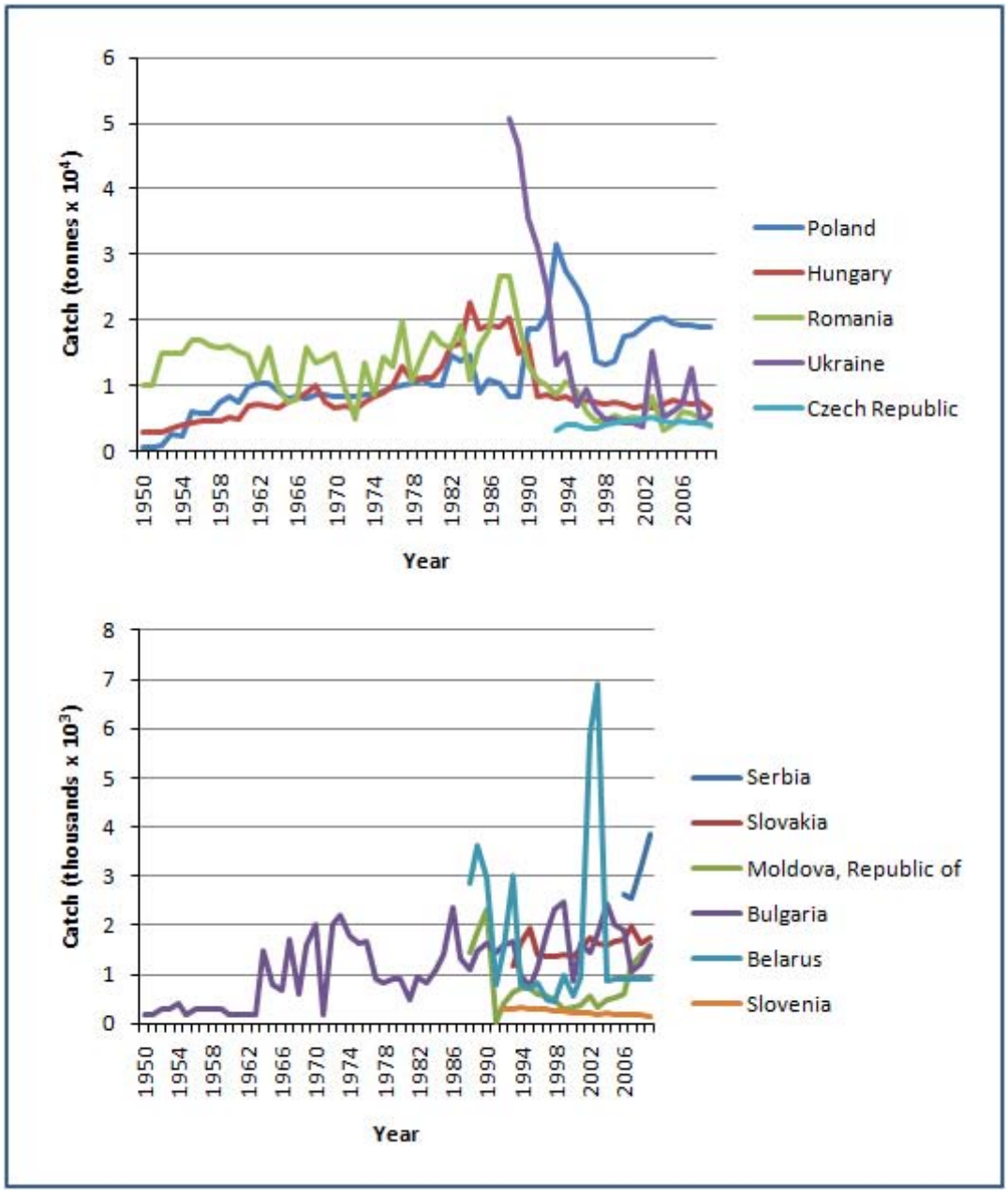


Figure 43: Inland fish production from the Eastern European region, 1950–2009
(*Top*: Major producers. *Below*: Minor producers)

1992–1993, and Yugoslavia dissolved into component states, some of which (Serbia and Slovenia) are in eastern Europe and the rest in the Southern European region. Catches from the whole region rose sharply to a peak of 132 000 tonnes in 1988, but then declined sharply as subsidies were withdrawn and market structures changed after the changes in economic regime following the collapse of the USSR. The falling trend lasted until 1998, when there was a slight recovery in the sector followed by a slow decline.

The major fish producer in the region was the Ukraine and contributed about 36 percent of the catch in 1988, when it was first recorded as an entity separate from the USSR (Figure 43). Its catches have since fallen significantly to only 12 percent of the regional total and it has been overtaken by Poland, which now contributes 38 percent, and Hungary 13 percent. Romania has suffered a similar decline from 33 percent in 1986 to only 7 percent to the 2009 total.

Catches are heavily weighted to the cyprinids (43.7 percent of total), as common carp is a favoured dish in many countries (Table 36). Otherwise a wide range of species are stocked into lakes and reservoirs to support the remaining commercial fisheries and a growing recreational sector.

Table 36: Main groups of organisms caught by inland fisheries in Eastern Europe in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	16 726	37.30
Common carp	9 598	21.41
Black and Caspian Sea sprat	3 679	8.20
Freshwater bream	2 238	4.99
Goldfish	2 001	4.46
Cyprinids NEI	1 338	2.98
Northern pike	1 123	2.50
Pike-perch	938	2.09
Silver carp	900	2.01
Crucian carp	735	1.64
Pontic shad	645	1.44
Grass carp (= white amur)	570	1.27
Roach	528	1.18
Wels (=Som) catfish	498	1.11
39 other taxa	3 322	7.41
Total	44 839	100.00

3.4.5 The Russian Federation

The Russian Federation spans both Asia and Europe, and has extensive inland water resources. In Europe, it has the Ponto-Caspian Rivers (the Volga, Don and Ural Rivers) and their numerous reservoirs. To the north, it has a series of large rivers draining into the Arctic Ocean (including the Ob, Irtysh, Lena Rivers), and to the east, there are numerous shorter rivers including the lengthy Amur, which borders China. In the centre of the country, there is Lake Baikal.

Inland fish has always been important in the Russia Federation and production stood at about 437 000 tonnes in 1988, when it first reported as a separate entity (Figure 44). Catches declined to about half that figure in 1994, but have stabilized over the last ten years. Figure 44 shows the catches from the former USSR area (includes catches from what are now the countries of Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan), which have reported independently after 1988. In 1988, the combined catch from these countries was 251 172 tonnes. This represented 36.5 percent of the 1988

total of these countries and that reported by the Russian Federation (688 160 tonnes), thereby accounting in part for the discontinuity in the catch time line in Figure 43.

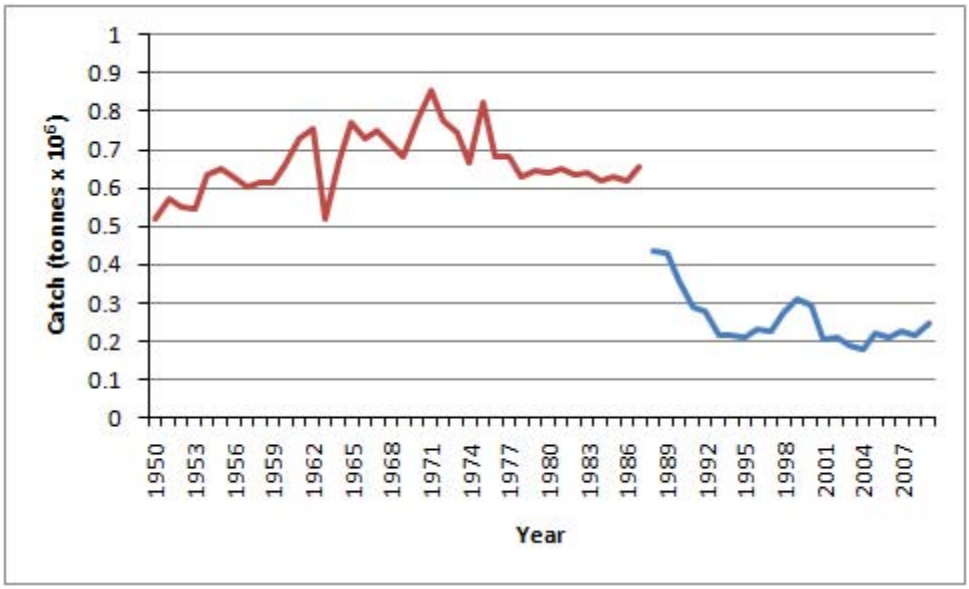


Figure 44 : Inland fish pr oduction from t he U nion of Sov iet Soc ialist R epublics, 1950–1987 (red line) and the Russian Federation, 1988–2009 (blue line)

Catches consist of 50 taxonomic groups (including a very low percentage of "freshwater fishes NEI) (Figure 45), but are centred mainly on salmonids (38 percent) and cyprinids (29 percent) (Table 37). Salmonid catches are particularly important economically and have risen considerably in recent years (see Box 9).

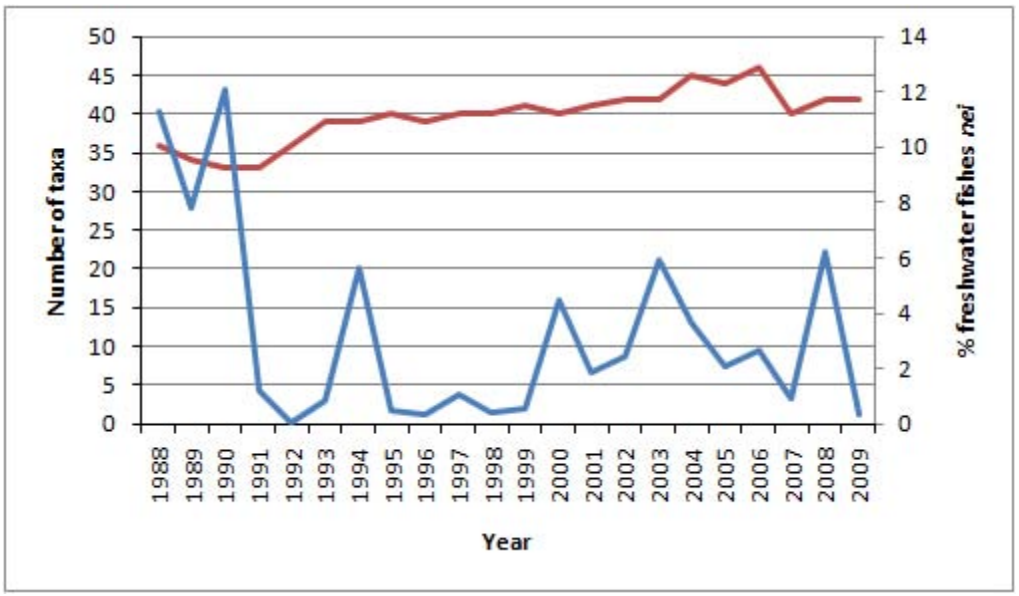


Figure 45: Trends in number of taxa (red line) and the percentage of freshwater fishes NEI (blue line) reported by year for the Russian Federation for 1988–2009

Table 37 : Main groups of organisms caught by inland fisheries in the Russian Federation in 2009

Taxonomic group	Catch (tonnes)	%
Chum (= keta = dog) salmon	41 913	17.03
Pink (= humpback) salmon	30 632	12.45
Freshwater bream	27 886	11.33
Cyprinids NEI	26 192	10.64
Northern pike	15 988	6.50
Sockeye (= red) salmon	15 403	6.26
Whitefishes NEI	13 381	5.44
Roaches NEI	12 527	5.09
Wels (= som) catfish	11 732	4.77
European perch	8 565	3.48
Smelts NEI	5 871	2.39
Orfe (= ide)	4 837	1.97
Black and Caspian Sea sprat	4 379	1.78
Freshwater crustaceans NEI	3 349	1.36
Salmonoids NEI	3 151	1.28
Tench	2 622	1.07
Pike-perch	2 515	1.02
25 other taxa	15 194	6.17
Total	246 137	100.00

3.5 Oceania

(Australia, Fiji, New Zealand, Papua New Guinea, Solomon Islands)

Oceania consists of a series of islands, many of which are small with few inland water resources. There are, however, several larger islands including Papua New Guinea with the Fly and Sepik River systems and Australia with the Murray-Darling systems and a number of smaller rivers.

The trends in inland fisheries of Oceania are shown in Figure 46. The main source of inland water fish comes from Papua New Guinea with nearly 75 percent of the combined catch (Table 38). The fishery was based mainly on the Fly River, but the introduction of species into the Sepik River has also formed the basis of a capture fishery. Catches from some island groups do not appear in FishStat: for example, the Solomon Islands record an inland subsistence fishery landing some 2 000 tonnes per year which do not appear in FishStat (FAO Fishery Country profiles[8]). Catches from Australia have always been relatively low and have declined from 1992 onwards; there was a minor fishery for the introduced common carp in the 1990s for cat food, but this later proved uneconomical. Furthermore, fish populations in the main Murray-Darling River system are severely stressed owing to river regulations and desiccation of the river channel and riparian wetlands (Gehrke *et al.*, 1995). The resource is now mainly reserved for recreational fishing (Annex 3).

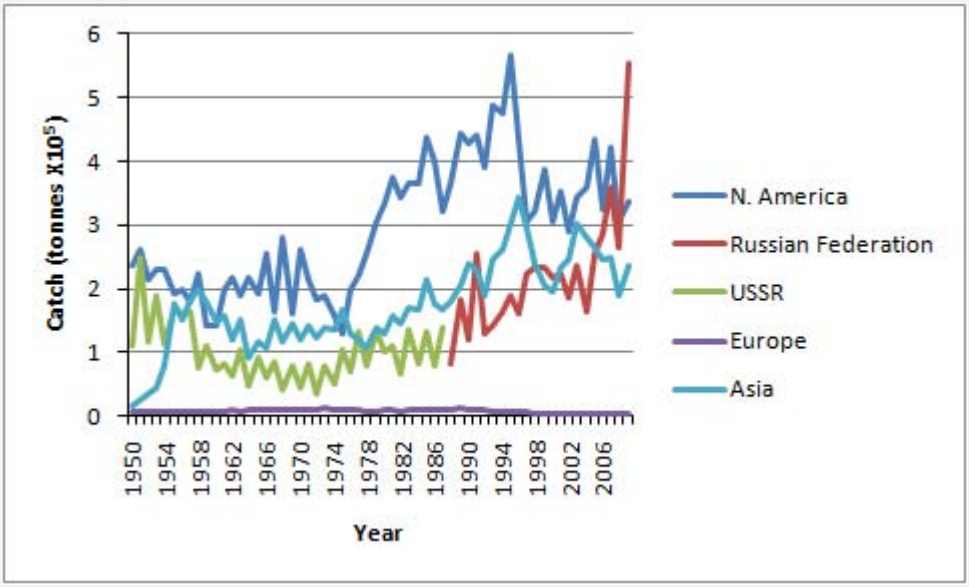
[8] www.fao.org/fishery/countrysector/FI-CP_SB/en

BOX 9

SALMON – RISE AND FALL OF A GROUP OF COMMERCIALLY IMPORTANT FISHES

Salmon are large anadromous fishes of the family Salmonidae (arbitrarily excluding trout, char, etc.) that are regularly caught both at sea and in freshwaters. The discussion here is limited to records of salmon catches from inland waters (1 130 250 tonnes as against a marine catch of 1 025 449 tonnes in 2009). Salmon have exercised the imagination of many nations, particularly in the North Temperate Zone. The various species of salmon (genera *Oncorhynchus* and *Salmo*) are also the only inland fish to appear worldwide as a canned product. Economically, they formed the mainstay of many inland (and marine) fisheries in East Asia, North America, North and West Europe and the Russian Federation (and the former USSR area before it). Catches were initially low, but rose to just over a million tonnes in 1995. Increases occurred in all continents and, in particular, in North America where they rose to 565 000 tonnes in 1995 (see figure below). Subsequently, inland salmon catches from all continents have declined with the exception of the Russian Federation, where they rose to 552 000 tonnes in 2009. At the same time, the declining trend has now been reversed, mainly because of the catches of the Russian Federation, and the world total rose to over 1.1 million tonnes in 2009.

Catches are heavily weighted to the various species of Pacific salmon (see table). Salmons are also the basis for a rapidly growing aquaculture sector, and there is concern that escapes from aquaculture have a negative impact on the fitness of wild stocks. Furthermore, aquaculture associated diseases such as *Gyrodactylus* have caused problems as in the collapse of Norwegian stocks.



Catches of salmon from inland waters of different regions, 1950–2009

Principal categories of salmon caught in inland waters in 2009

Species	Catch (tonnes)	%
Pink	590 642	52.26
Chum	358 685	31.74
Sockeye	150 485	13.31
Coho	19 758	1.75
Chinook	6 314	0.56
Atlantic	2 369	0.21
Other	1 997	0.18
Total	1 130 250	100.00

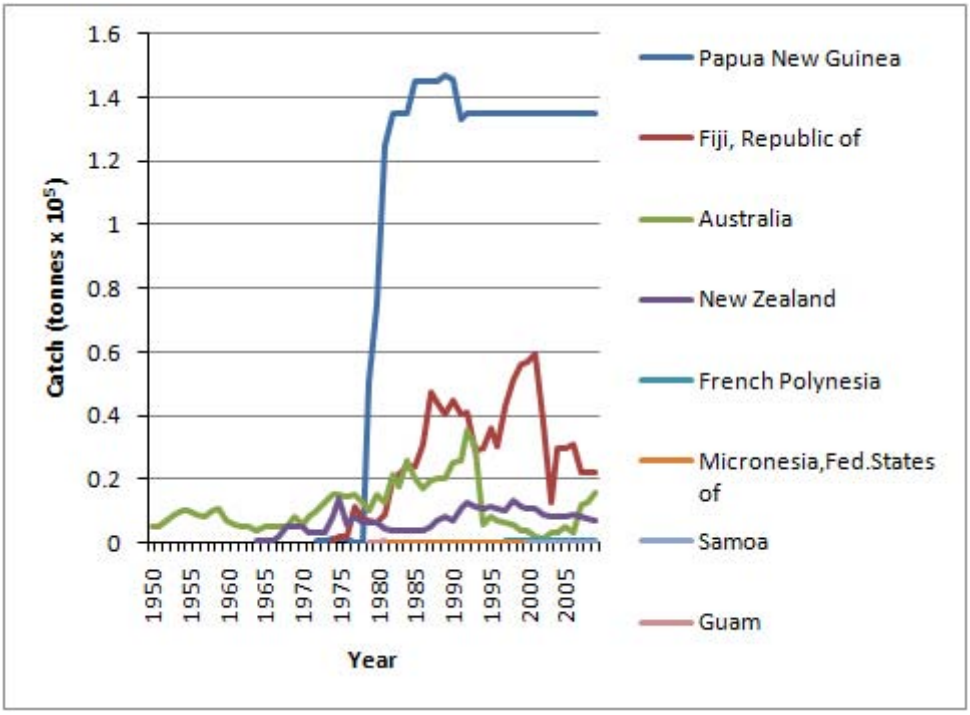


Figure 46: Inland fisheries production from Oceania by country, 1950–2009

Table 38: Percentage contribution of the various countries of Oceania to the total inland catch in 2009

Country	Catch (tonnes)	%
Papua New Guinea	13 500	74.65
Fiji	2 220	12.28
Australia	1 576	8.71
New Zealand	729	4.03
French Polynesia	53	0.29
Micronesia, Federated States of	5	0.03
Samoa	1	0.01
Guam		0.00
Total	18 084	100.00

Fish from all sources only contributes some 19 percent to the total animal protein budget in the region, with inland fisheries an insignificant 0.25 percent (Table 39). This balance is heavily influenced by Australia and New Zealand and the island states are much more dependent on marine capture fisheries (about 54 percent in 2009).

Table 39: Oceania – production of animal protein by source in 2009

Item	Catch (tonnes)	%
Cattle meat	2 804 905	38.77
Marine fish	1 199 936	16.58
Sheep meat	1 136 836	15.71
Chicken meat	989 340	13.67
Pig meat	461 335	6.38
Game meat	329 020	4.55
Aquaculture	176 370	2.44
Turkey meat	54 013	0.75
Horse meat	26 580	0.37
Goat meat	19 817	0.27
Inland fish	18 084	0.25
Duck meat	12 652	0.17
Meat NEI	4 522	0.06
Goose and guinea fowl meat	120	0.00
Total	7235539	100.00

Source: FAOSTAT; FishStat.

Forty-eight percent of the catch from the region is not identified by taxonomic group, but the remainder depend on introduced tilapia and native ariid catfishes and eleotrids (Table 40). In Fiji, the second largest producer in the region, catches are 68 percent molluscs and 21 percent crustaceans.

Table 40: Main groups of organisms caught by inland fisheries in Oceania in 2009

Taxonomic group	Catch (tonnes)	%
Freshwater fishes NEI	8 706	48.14
Mozambique tilapia	2 310	12.77
Gudgeons, sleepers NEI	1 850	10.23
Sea catfishes NEI	1 850	10.23
Freshwater molluscs NEI	1 500	8.29
Diadromous clupeoids NEI	480	2.65
River eels NEI	429	2.37
Freshwater crustaceans NEI	400	2.21
Barramundi (= giant seaperch)	350	1.94
Nile tilapia	200	1.11
River prawns NEI	5	0.03
Giant river prawn	3	0.02
Oceanian crayfishes NEI	1	0.01
Total	18 084	100.00

4. CONCLUSIONS

Records in FAO FishStat show that, globally, catches of fish and other organisms from inland waters increased at a linear rate of 2.93 percent per year from 1950 to 2009. The global rate of increase conceals substantial differences in trends between continents and subcontinental regions (Table 41).

Table 41 : Trends and mean early percentage growth for the continents and subcontinental regions, 2000–2009

Continent	Region	Catch (tonnes) 2000	Catch (tonnes) 2009	Mean annual change %	Trend
Global		8 578 430	10 323 905	2.03	Rise
Asia		5 452 674	6 962 672	2.77	Rise
	South Asia	1 801 933	2 315 499	2.85	Rise
	Southeast Asia	1 355 971	2 210 508	6.30	Rise
	China	1 953 683	2 184 018	1.18	Rise
	West Asia	180 955	137 748	–2.39	Fall
	Central Asia	73 661	57 805	–2.15	Fall
	East Asia	86 249	56 884	–3.40	Fall
Africa		2 134 034	2 423 711	1.36	Rise
	Great Lakes	774 740	898 763	1.60	Rise
	West coastal	271 943	432 821	5.92	Rise
	Sahel	337 474	333 945	–0.10	Slight fall
	Nile River	317 151	32 0547	0.11	Slight rise
	Congo basin	291 441	282 885	–0.29	Slight fall
	Southern	108 645	114 511	0.54	Slight rise
	Islands	30 000	32 828	0.94	Slight rise
	Northern	2 440	7 211	19.55	Rise
	East coastal	200	200	0.00	No change
America		539 547	539 480	0.00	No change
	North	65 953	53 861	–1.83	Fall
	Central	118 558	122 013	0.29	very slight rise
	South	351 065	359 947	0.25	very slight rise
	Islands	3 971	3 659	–0.79	Slight fall
Europe		431 461	379 958	–1.19	Fall
	Russian Federation	292 368	246 137	–1.58	Fall
	East	42 813	48 685	1.37	Rise
	North	42 709	36 278	–1.51	Fall
	West	34 393	31 443	–0.86	Slight fall
	South	19 178	17 415	–0.92	Slight fall
Oceania		20 714	18 084	–1.27	Fall
	Oceania	20 714	18 084	–1.27	Fall

Catches in Africa and Asia increased over the period for which records are available, driven largely by growth in South and Southeast Asia and in the west coastal area of Africa. Catches in Latin America remain relatively static.

The origin of the increases in catch is not clear. It is possible that actual increases in production have occurred. This is almost certain to be the case in the earlier years of the time series when inland fisheries were expanding rapidly. It is also known to be the case in individual fisheries such as that of Lake Victoria, which have been well studied (Lake Victoria Fisheries Organization). However, more recently, there are indications that the resources in Africa and Asia are heavily exploited and that real increases in production in most fisheries are unlikely at least in recent years. In these cases, the apparent increases are generally attributed to improvements in reporting, which could be achieved by incorporating catches from small-scale fisheries that have been hitherto unrecorded (see Welcomme, 1976; Coates, 2002; Lymer *et al*., 2008b for examples) or by applying better sampling and estimation techniques, as has occurred recently on the Lower Mekong (Hortle, 2007). In some cases, part of the increase could also be due to increasing human population pressures on artisanal fisheries, which are seeing increasing yields through intensified total effort even though lowered individual catches per unit effort are widespread. At the same time, the fishing down of the fish assemblages is being observed in many areas with accompanying increases in yield. Furthermore, catches for many smaller waterbodies are being enhanced by stocking. In Latin America, fisheries generally seem less heavily exploited and catches appear generally under-reported. Nevertheless, even here some fisheries have clearly declined, such as those of the Magdalena River in Colombia and the *Prochilodus* fishery of Argentina, Bolivia (Plurinational State of) and Paraguay.

Commercial freshwater fisheries in temperate regions including Australia, most of Europe (including the Russian Federation) and North America all showed decreases in catch. This may be due to environmental factors, as many of the aquatic habitats in the developed nations are highly modified to the extent that many of the anadromous species have been eliminated from certain rivers. It may also be due to social considerations, in that recreational fisheries have taken a dominant role in the use of the resource, or economical, in that fishermen can no longer make a living from inland fisheries without government subsidies. There is every indication that the eastern European fisheries and those of the Russian Federation began to decline following the change in economic system after 1988, although in the last decade there has been a tendency for the fisheries to recover in eastern Europe. Similarly, the fisheries of Central Asia, which had declined during the 1990s, have shown signs of recovery during the early 2000s.

Declines are also apparent in the stocked reservoir fisheries of centrally planned economies (such as Cuba and the countries of the former USSR), where governments have withdrawn financing of the hatcheries. De Silva and Funge-Smith (2005) have drawn attention to the fact that such operations are uneconomical in Asia without continued government support.

Records from all regions analysed indicate that reporting by taxonomic group has improved steadily. The general lowering of the proportion of fish reported under the “freshwater fishes NEI” group seems to indicate a general tightening of sampling procedures. At the same time, the number of taxonomic groups represented in the catches has increased. This may be because of the improvements in reporting, but it is highly probable that it is also a real effect attributable to the fishing-down process that occurs as exploitation intensifies. One effect that is evident is the spread of certain species around the world through introductions, either as escapes from aquaculture or to improve wild fisheries. The Nile tilapia (*Oreochromis niloticus*) is a particular example of this phenomenon. By contrast, several species are under pressure and catches of many larger species, such as the pimelodid catfishes in South America and the anadromous species such as the salmonids, have declined in recent years.

In general, the world’s inland fisheries still appear viable over all the regions examined, although environmental pressures such as damming, water abstraction and overexploitation pose a potential threat to the maintenance of present levels of catch.

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ANNEX 1

Catches, in tonnes, for all countries reporting inland fish landings, 2000–2009 (in order of magnitude of catch as of 2009)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
China	1953134	1871295	1951889	2137496	2098777	2213303	2208156	2256533	2248347	2184049
Bangladesh	670465	688920	688435	709333	732067	859269	956686	1006761	1060181	1218937
India	905700	975403	775599	757353	527290	843746	892639	823410	947208	915967
Myanmar	196060	238210	254880	290140	454260	503540	631120	717640	814740	899430
Uganda	219356	220726	221898	241810	371789	416758	367099	500000	450000	400000
Cambodia	245600	385000	360300	308750	250000	324000	422000	395000	365000	390000
Indonesia	318331	310198	304600	308526	330739	297254	293863	320802	300319	309865
Nigeria	132315	154175	187242	174968	182264	238051	223395	227107	304413	285771
Tanzania, United Republic of	271000	283354	273856	301855	312040	320566	292519	284346	281690	269402
Russian Federation	292368	206430	208522	190712	178403	219237	209376	228583	216841	246137
Thailand	201405	202500	198700	198447	203700	198730	214000	225600	228600	245500
Brazil	199159	220432	239415	227551	246101	243435	251241	243210	261280	239493
Egypt	253470	295450	292662	313428	282099	242100	256288	241743	237572	237500
Congo, Democratic Republic of	240586	227433	233800	230365	231772	230840	230588	230000	230000	230000
Philippines	151753	135845	131098	132570	140409	142181	159851	166459	179491	186444
Viet Nam	210000	243583	226958	208872	146054	138800	145800	144000	140900	144800
Kenya	210343	156763	137792	113221	119093	140199	151729	124327	127097	133286
Pakistan	176468	122468	114030	92794	93687	94644	140000	100000	108000	112355
Mexico	106817	91952	82648	99604	107203	113578	116268	116591	108853	111792
Mali	109870	100000	100000	100000	100000	100000	100000	100000	100000	100000
Ghana	74500	74500	74500	75000	75000	75000	83168	84756	85000	88700
Zambia	66671	63000	63000	66332	67725	65927	60236	73542	79403	84716
Cameroon	55000	52500	65000	55000	65000	75000	75000	74380	74000	74000

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Iran (Islamic Republic of)	123490	88335	55853	50994	55825	67066	71405	74064	65862	71781
Malawi	50000	40619	41329	53543	56463	59595	72787	66500	70019	69325
Sudan	48000	53000	52000	54000	57500	53800	52000	59810	62900	66000
Senegal	52154	50000	52000	54000	56195	55995	60305	61400	58852	58800
Sri Lanka	32340	26330	25570	26920	30780	31560	35290	38380	44500	46560
Peru	32254	35757	29968	32940	37688	40196	37466	42633	45412	45720
Japan	71252	61964	61844	60404	60499	54432	41700	39039	32626	40177
Chad	83200	75000	70000	65000	60000	55000	50000	45000	40000	40000
Turkey	42824	43323	43938	44698	45585	46115	44082	43321	41011	39187
Kazakhstan	36620	22960	24668	25195	33306	37621	34724	41366	55706	33637
Madagascar	30000	30000	30000	30000	31500	32650	32750	32630	32630	32828
Canada	40667	38140	39999	37383	36116	32269	32234	32303	31063	31379
Benin	26400	30000	29993	30000	28200	21900	29500	30200	30200	30250
Lao People's Democratic Republic	29250	31000	33440	29800	29800	26560	26925	28410	29200	30000
Niger	16250	20800	23560	55860	51466	50018	29835	29728	29960	29884
Finland	34782	34782	35563	35563	36265	36265	36513	36513	29270	29278
Congo	25438	26101	29494	31182	30338	32500	31000	30120	29362	28385
Venezuela, Bolivarian Republic of	23739	24326	40776	49090	44000	39000	42000	33500	24882	24900
Colombia	27737	26532	27738	30512	28292	19291	20000	20800	21700	22686
United States of America	25286	29527	27224	26116	29081	24809	18712	25275	24533	22482
Iraq	8378	14100	11900	13200	10581	23570	46300	45460	29986	22259
Germany	22868	22818	22798	22611	22611	21400	21442	21462	22062	21802
Nepal	16700	16700	17900	18888	19947	19983	20016	20100	21500	21500
Poland	17543	17789	18947	19994	20330	19469	19183	19059	18937	18798
Burundi	17315	8964	11000	14697	13855	14800	15750	16700	17766	17700
Ethiopia	15681	15390	12300	9213	10005	9450	9890	13253	16770	17047

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Argentina	30418	15536	18474	26596	33903	34002	33617	19695	11246	15521
Central African Republic	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
Mauritania	10000	10000	12000	12000	12000	13000	15000	15000	15000	15000
Turkmenistan	12228	12749	12812	14543	14992	15000	15000	15000	15000	15000
Sierra Leone	14000	14000	14000	14000	14000	14000	14000	14000	14000	14000
Papua New Guinea	13500	13500	13500	13500	13500	13500	13500	13500	13500	13500
Burkina Faso	8500	8500	8500	9000	9000	9000	9500	10200	11093	11800
Republic of Korea	7141	5971	5690	7539	10302	7500	6447	5803	11098	11707
Zimbabwe	13114	12300	11500	10600	10500	10420	10500	10500	10500	10500
Mozambique	19192	15076	20037	19831	27760	22991	26017	24081	28386	9546
Gabon	10417	9850	9400	9507	8293	9700	9359	9500	9500	9500
Rwanda	6726	6828	7000	7400	7826	7800	8400	9050	9050	9050
Bolivia (Plurinational State of)	6106	5940	6300	6599	6746	6660	6350	6000	6900	7568
Hungary	7101	6638	6750	6536	7242	7609	7543	7024	7394	6366
Uzbekistan	3306	2341	1564	1349	1230	1330	1431	1973	2731	6051
Morocco	1608	1660	2112	1655	850	2930	3350	4020	4440	6020
Spain	8000	7300	6600	6000	6000	6000	6000	6000	6000	6000
Ukraine	4429	4343	3823	15144	5263	6027	7171	12603	4590	5855
Angola	7000	8000	9000	10000	10000	10000	10500	9000	7500	5848
Democratic People's Republic of Korea	8000	4928	5000	5000	5000	5000	5000	5000	5000	5000
Togo	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Italy	4565	5527	4242	4379	5099	3823	3915	3944	3552	4988
Malaysia	3549	3446	3450	3828	4119	4582	4165	4280	4353	4469
Gambia	2500	2500	2500	3000	3500	4000	4500	4865	4166	4461
Czech Republic	4654	4646	4983	5127	4528	4242	4646	4276	4164	4112
Guinea	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
El Salvador	2831	1692	2663	2673	2205	2051	2034	2422	3980	3980

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Serbia	0	0	0	0	0	0	2632	2535	3153	3846
Romania	4896	5178	4858	8278	3255	4027	6049	5665	4966	3688
Syrian Arab Republic	3991	5969	6355	5851	5451	4770	4869	6075	3784	3500
Côte d'Ivoire	10502	10502	22000	22000	4856	13145	6565	3178	3200	3200
Estonia	3190	2461	4578	3593	2373	2472	2941	2665	2835	2898
Namibia	1500	2000	2000	2500	2500	2800	2800	2800	2800	2800
United Kingdom	2743	3142	3431	3875	1120	1172	2421	2517	2529	2562
Cuba	2983	1993	2023	2698	2513	1561	1449	3058	2764	2526
France	2859	2641	2600	2600	2600	2600	2600	2600	2600	2500
Guatemala	7301	6480	5665	4850	4035	3120	2360	2360	2360	2360
Albania	955	1373	1167	1265	1807	2210	2442	2598	2187	2321
Fiji	5700	5921	3800	1263	2993	3000	3078	2188	2200	2220
Bosnia and Herzegovina	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Panama	20	20	23	26	406	2950	3555	3242	3143	1913
Netherlands	2250	2200	2578	2150	2100	2100	2100	2000	2000	1900
Slovakia	1368	1531	1746	1646	1603	1693	1718	1994	1655	1761
Paraguay	28000	25000	21500	18000	14500	11000	8000	5000	1708	1700
Switzerland	1659	1715	1544	1815	1602	1475	1422	1377	1582	1687
Republic of Moldova	344	387	565	343	487	531	612	1160	1407	1607
Bulgaria	861	1640	1453	1824	2434	2025	1916	1073	1197	1588
Australia	366	185	156	303	317	501	335	1238	1275	1576
Sweden	1459	1234	1436	1491	1393	1417	1644	1546	1614	1564
Lithuania	1912	1854	758	1959	1766	1547	1437	1874	1600	1315
Azerbaijan	18797	10893	11188	6435	9258	9001	3983	2943	1517	1202
Tunisia	832	860	870	859	1049	1224	1264	1084	1096	1191
Afghanistan	1000	800	900	900	1000	1000	1000	1000	1000	1000
Costa Rica	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Equatorial Guinea	1076	1000	950	900	850	850	900	900	900	1000

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Greece	3433	3181	3000	3166	1940	1580	1413	1439	1425	940
Belarus	553	943	5877	6925	890	900	900	900	900	900
South Africa	900	900	900	900	900	900	900	900	900	900
Nicaragua	528	700	487	405	866	1042	412	853	988	868
Uruguay	2302	451	387	551	2330	2130	2137	1200	620	801
Guyana	800	800	800	800	800	800	800	800	800	800
Liberia	4000	4000	4000	3600	3200	2800	2400	1743	763	750
New Zealand	1089	1076	900	850	801	812	865	817	752	729
Norway	578	550	500	450	405	507	679	851	874	662
Armenia	1133	866	465	569	218	250	350	1065	601	619
Montenegro	0	0	0	0	0	0	600	600	600	600
Belgium	511	511	511	511	496	496	496	512	511	511
Dominican Republic	187	1158	2102	1506	1980	1694	1911	1481	1708	432
Croatia	17	34	25	19	37	33	46	60	45	425
Suriname	200	200	200	222	242	218	200	350	350	420
Israel	1852	1286	1569	1064	1137	1396	1600	840	224	401
Jamaica	400	400	400	400	400	400	400	400	400	400
Austria	439	362	350	372	400	370	360	350	350	350
Jordan	400	350	350	350	350	350	350	350	350	350
Ecuador	350	350	300	300	250	250	233	216	199	338
Latvia	612	581	581	565	360	356	328	310	349	326
Haiti	400	400	400	400	300	300	300	300	300	300
Lebanon	20	20	297	285	265	275	270	270	270	270
Iceland	176	160	210	225	222	219	173	185	231	235
Somalia	200	200	200	200	200	200	200	200	200	200
Bhutan	260	260	240	240	220	220	200	200	180	180
Slovenia	226	206	226	195	208	202	200	196	183	164
Taiwan Province of China	549	591	599	2292	245	197	149	242	198	159

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Guinea-Bissau	150	150	150	150	150	150	150	150	150	150
Tajikistan	78	137	181	158	184	146	146	146	146	146
The former Yugoslav Republic of Macedonia	208	128	148	162	213	246	89	122	122	141
Honduras	61	111	102	100	100	100	100	100	100	100
Mongolia	425	290	263	382	305	366	326	185	88	90
Botswana	166	118	139	122	161	132	81	122	86	86
Ireland	881	902	796	615	610	521	443	178	214	86
Swaziland	70	70	70	70	70	70	70	70	70	70
French Polynesia	53	53	53	52	51	50	53	53	53	53
Georgia	22	8	10	39	51	51	50	50	50	50
Denmark	183	99	77	129	123	60	54	44	40	45
Lesotho	32	24	40	42	45	45	45	48	50	45
Cyprus	78	70	60	50	40	30	20	20	20	20
Kyrgyzstan	52	57	48	14	7	14	8	34	8	10
Micronesia, Federated States of	5	5	5	5	5	5	5	5	5	5
Falkland Islands (Malvinas)	1	1	1	1	1	1	1	1	1	1
Samoa	1	1	1	1	1	1	1	1	1	1
Total (tonnes)	8578430	8535070	8408837	8626923	8598531	9370710	9758386	9960182	10189334	10323905

ANNEX 2

Identification and effect of large changes in national reports of inland capture fisheries statistics on the global trend (1950–2007)

Calculations and text by David Lymer.

Since 1950, the Food and Agriculture Organization of the United Nations (FAO) has requested its Member Countries to report inland fisheries capture statistics as part of their fisheries reporting to the organization. From this reported data, there is an apparent increasing trend in the production from global and regional inland fisheries during the period 1950–2007 (Figure 1, Section 2 of main text) that is regularly reported in global analyses (FAO, 2002, 2004).

Several predictions have been made regarding the way in which global inland fisheries are developing based on this significant and continuous trend. These contribute to an apparent general consensus that there seems to be further potential for growth in the sector. That is, the apparent increase in global inland fisheries production appears to indicate that the global threshold of production has not yet been reached. At first sight, this trend of increasing production may encourage an immediate conclusion that all is well in the fisheries of the region and that "maximum sustainable yield" (biological or economic) in these fisheries has yet to be reached. However, it has also been reported that inland fishery production has been stable in recent years if consideration is given to the improved quality of inland fisheries data and that caution should be exercised when analysing the regional catch trend, with examples from Asia and the Pacific region (Lymer and Funge-Smith, 2009) and for the African continent (Welcomme and Lymer, 2009).

FAO has highlighted its concerns regarding the quality of inland fisheries data, as reported to FAO, in recent years (FAO, 2002, 2004, 2007, 2009) and this has also been noted far earlier (Gulland, 1970). The quality of the data reported to FAO from countries and also the estimates that FAO has to make when no data has been reported[1] mean that the global and regional aggregate inland fisheries statistics are indicative rather than absolute.

The aim of this analysis was to find if there are large changes (between years) that are significant for any individual country and to investigate further whether these changes also affect the global change of that year

Identification of large changes in inland catch data

The global inland fisheries production data (1950–2007) of the FAO FishStat database were the basis for this analysis. The data included fish, crustaceans, molluscs, etc.,[2] and all FAO inland water areas. All countries were included in the analysis and the data were manipulated using Excel (Microsoft Office 2003). The analysis was done as in Lymer and Funge-Smith (2009) with minor modifications. In brief, countries with a significant increase in annual production were identified, using:

- **Criterion 1**: Any country reporting a positive change of more than 40 percent, compared with its reported production of the previous year (the 40 percent cut off was considered to be to be well above any naturally driven variability in catch and to be a result of revision of statistics rather than any actual increase in production). This identified the number of events of large increases in country production. The countries identified using criterion 1 were filtered according to criterion 2.
- **Criterion 2**: This second stage filter selected those countries which met criterion 1 and whose inland fishery production change was at least 30 percent greater than the average annual

[1] For several countries, data extracted from FishStat Plus are not official submissions by the country, but are FAO estimates in absence of submission.

[2] Exclude production figures for marine mammals, crocodiles, corals, pearls, sponges and aquatic plants.

change in global/regional inland fishery production (1951– 007).[3] This selected those events which would have a likely impact on total regional production and the trend line.

Adjustment of catch data

The data from those countries identified under criterion 2 were adjusted backwards as follows (Lymer and Funge-Smith, 2009): those countries that were selected using criterion 2 had their production data adjusted backwards using the following formula[4] (creating a new data set [*Back-adjusted*]):

Back-adjusted catch $_{\text{year x}}$ = Original catch $_{\text{year x}}$ * (1+change $_{\text{Criterion 2 year}}$): see footnote[5]

In addition, for this analysis only, occurrences of large negative change were included if their decrease (absolute value) was more than 30 percent of the average regional increase. This adjustment smoothed out the individual large increases backwards across the data series to remove the effect of a single large increase (or decrease). Further, the new data set (*Back-adjusted)* and the original data set (*Original*) was further divided by the world population (downloaded from the Department of Economic and Social Affairs of the United Nations)[6] to obtain a measure of catch/capita.

Temporal and spatial distribution of identified large changes

Globally, inland capture fisheries data for 230 countries are recorded in FishStat (FAO FishStat Plus, 2009a [now superseded by FishStatJ]). There has been a steady increasing number of reporting countries throughout the years, from a total of 173 countries in 1950, with large leaps in the numbers of countries reporting on two occasions: (a) between 1969 and 1970, from 184 countries to 202; and (b) between 1980 and 1981, from 202 to 217. The increase between 1969 and 1970 resulted in a total increase (for all 18 countries) of 200 tonnes, and for the increase between 1980 and 1981 an increase of 100 tonnes.

The increase in catch globally between 1950 and 2007 was 8 121 426 tonnes (Table A2.1), from a total catch of 1 913 101 tonnes in 1950 to 10 034 527 tonnes in 2007 (Figure A2.1). A total of 540 events were recorded, where the change in catch from the previous year had increased more than 40 percent (Table A2.1). This corresponds to an average of 9.47 countries per year^{-1} reporting large leaps in their inland water catch data. The sum of the change of these 540 changes was 4 326 831 tonnes. The sum of the changes corresponds to 53.3 percent of the total increase in the world inland capture fisheries between 1950 and 2007. The average global increase (*G. Average*) in inland fisheries catch was 142 481 tonnes (1950–2007).

Table A2.1. The number of identified changes and their percentage contribution of the change (only increases) for the countries remaining after different cut-offs (1950–2007)

	Number of changes	Sum of change/ increase (tonnes)	Change/ world increase (%)
Total increase		8 121 426	
Criterion 1	540	4 326 831	53.3
Criterion 2	26	2 682 836	33.0

[3] Many countries with total annual production may report increases of more than 40 percent between years, however, their contribution to the global/regional total may not be sufficient to warrant further treatment.

[4] Some countries with several identified changes were subject to several adjustments (i.e. the data were revised several times).

[5] Change $_{\text{Criterion 2 year}}$ = (Original Catch $_{\text{Criterion 2 year}}$ - Original Catch $_{\text{Criterion 2 year -1}}$) / Original Catch $_{\text{Criterion 2 year -1}}$

[6] *Source*: www.un.org/en/development/desa/publications/world-population-prospects-the-2010-revision.html.

Out of the 540 events, 26 were of such magnitude that they contributed to more than 30 percent of the average increase in global inland fisheries catch (0.51 countries per year). The total change of these 26 events alone was 2 682 836 tonnes (Table A2.1) and explained 33.0 percent of the total regional increase 1950–2007. These 26 events were assigned a separate code and plotted against total change (positive/negative) and total catch (Figure A2.1).

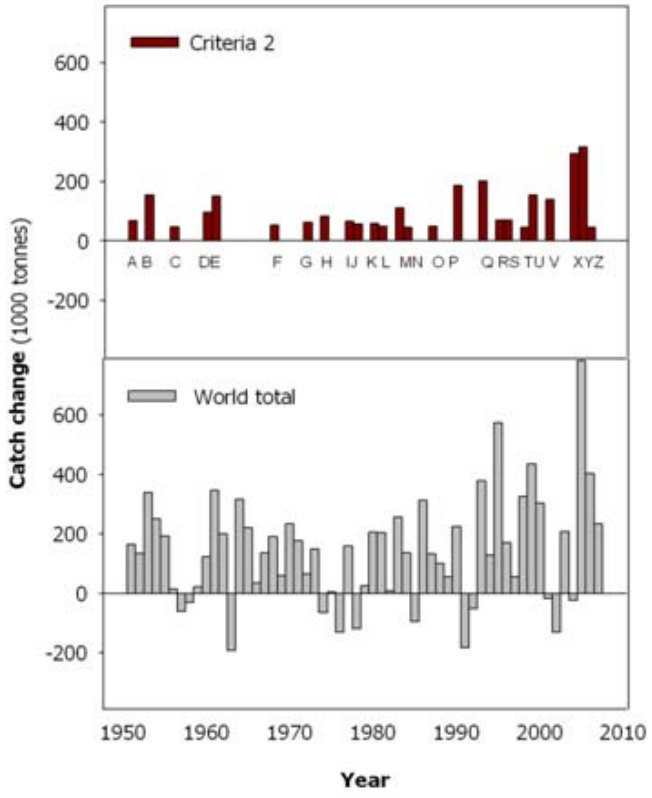

Figure A2.1: Changes (Xyear x-Xyear x-1/Xyear x-1) above 30 percent in reported production that contributed to more than 30 percent of the Asia-Pacific Fishery Commission (APFIC) regional total change in the same year (top graph); the total regional change for inland capture fishery catches 1950–2007 (bottom graph).

Note: Alphabetic code corresponds to the identified changes and countries as follows: A (1951, China); B (1953, China); C (1956, Myanmar); D (1960, China); E (1961, China); F (1968, the Philippines); G (1972, Colombia); H (1974, Brazil); I (1977, Uganda); J (1978, the Philippines); K (1980, Brazil); L (1981, Mexico and Cambodia); M (1983, the Philippines); N (1984, Democratic Republic of the Congo); O (1987, Mexico); P (1990, India); Q (1993, India); R (1995, Mali); S (1996, Viet Nam); T (1998, Nigeria); U (1999, Cambodia); V (2001, Cambodia); X (2004, Myanmar, Uganda); Y (2005, India); Z (2006, Pakistan).

The identified events (Figure A2.1) are evenly spread throughout the whole time period. The three largest individual changes are the changes: 2005 (316 456); 1993 (202 618); and 1990 (187 313); all from India.

The 26 events are due to changes in 14 countries (see note in Figure A2.1). Out of the 26 events at the global level, 16 are from 7 Asian countries, and the remaining 10 events are from 3 American countries (5 events) and 4 African countries (5 events).

Back-adjustment of catch data and catch per capita

In addition to the identified 26 events with increasing catch, 4 events of large negative change were identified, namely: China 1957 (–215 900 tonnes); Democratic Republic of the Congo 1960 (–77 500 tonnes); Cambodia 1978 (–43 800 tonnes); and Viet Nam 1994 (–67 252 tonnes). The 26 identified events (and the 4 negative events) were back calculated to estimate the historical production from inland water capture fisheries in the Asia and Pacific region. The *back-adjusted* data show that the initial production in 1950 was 3 088 488 tonnes, which suggests a 61.4 percent increase compared with the official data (Figure A2.2). In the *back-adjusted* data, the production was already above 7 400 000 tonnes in 1973, a level not reached until 1996 in the old data. For the *back-adjusted* data, there is a significant increasing trend (R^2: 0.92), as is also the case in the *original* data (R^2>0.96); however, at a much gentler increase than the old data as the initial value (1950) is higher in the *back-adjusted* data.

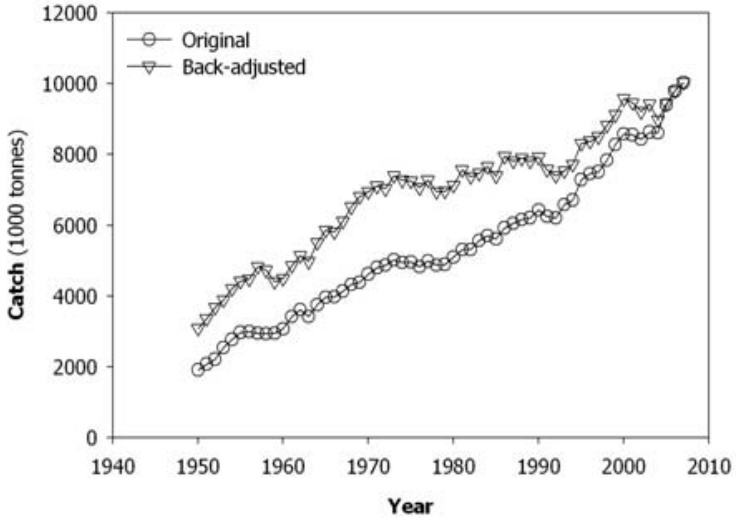

Figure A2.2: Historically modelled data of global inland water capture fisheries catch based on the changes identified using criterion 2 and the four negative changes identified (*back-adjusted*) and the original inland water capture statistics (*original*).

The catch per person differs between the *back-adjusted* and the original data set, with the highest catch/capita being recorded in 2007 for the *original* data but was already reached in 1973 for the *back-adjusted* data. Additionally, the steady increase in catch per person in the *original* data does not exist in the *back-adjusted* data, which instead decreases from 1973 onwards (Figure A2.3).

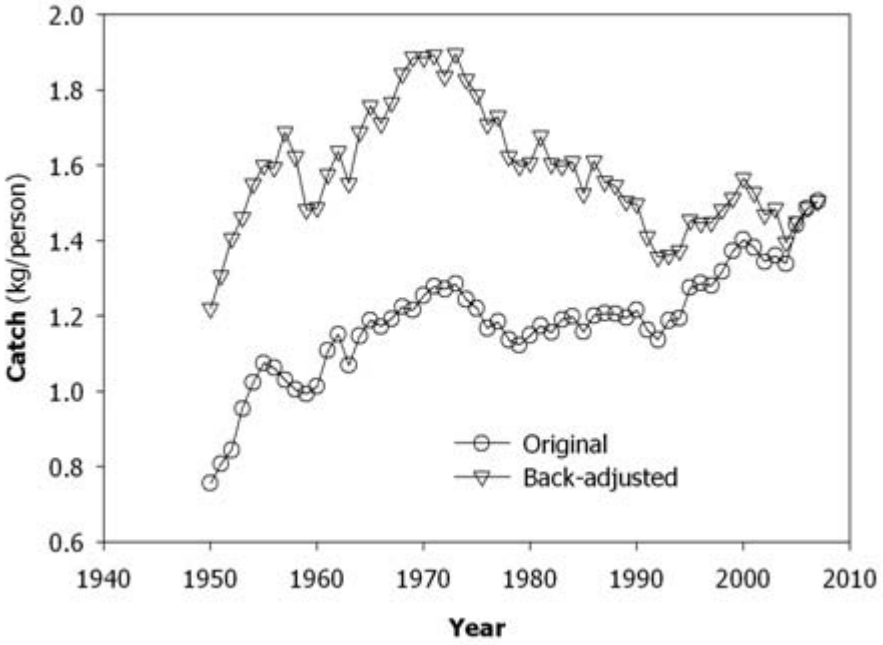

Figure A2.3 Historically modelled data of global i nland water c apture fisheries c atch/capita (person) based on the changes identified using criterion 2 and the four negative c hanges identified (*back-adjusted)* and the original inland water capture statistics (*original*).

What are the implications for interpreting the global inland fisheries trend

The analysis of the reported inland waters capture production data shows that the inclusion of new countries in the data set has a small effect on the trend in inland capture fisheries. The analysis further shows that individual countries have reported an annual increase of more than 40 percent, a total of 540 times. On average, that corresponds to more than nine countries per year reporting these very large increases in national production. Not all of these changes will significantly influence the trend of inland fisheries catch at global level (i.e. many of these countries have a relatively small contribution to total production). It is, nevertheless, noteworthy that such large increases are a common occurrence and that, overall, these identified events account for more than 53 percent of the total increase in inland water production between 1951 and 2007.

Out of the 540 events, 26 events were of a magnitude that they were greater than 30 percent of the average global change (*G. Average*) and, hence, significantly affect the global trend. These 26 events were confined to 14 countries and represent more than 33 percent of the total change between 1951 and 2007, or 2 682 836 tonnes (Table A2.1). It can be concluded, therefore, that the trend in inland catch (Figure A2.2) is significantly driven by these large changes in only 14 countries.

According to the adjusted data (historically back-adjusted), the total global production has traversed four different periods;
(1) a period of rapid growth between 1950 and the mid-1970s;
(2) a relatively stable plateau from the mid-1970's until the early 1990s;
(3) a rapid growth period until the turn of the century;[7] and
(4) a renewed period of relative stability from 2000 onwards.

In contrast, the inland fishery production data officially reported to FAO data (o*riginal*) shows a consistent increase in production throughout the period (1950–2007), and this is also reflected in a

[7] The rapid increase in total regional production and thus catch/person during the late 1990s can be largely attributed to consistent large increases in reported inland fisheries production in China and Bangladesh.

steady increase in production/capita. As a result, the rate of increased production appears slower, but catch per capita almost never declines. Again, a completely different trend emerges when using the historically back-adjusted data, with rapid increases in catch/capita until the mid-1970s and thereafter a falling catch/capita until the mid-1990s, where it again started to increase. The decrease in catch/capita is consistent with anecdotal evidence from numerous field-level sources and documented reviews of inland fisheries (e.g. Allan *et al*., 2005; Baran and Myschowoda, 2008; Hap and Bhattarai, 2009), all reporting declining catches per fisher.

While global inland fisheries production has almost certainly increased over time, possibly as a result of increasing population, it is also worth noting that there are recent reports of underestimated production in inland capture fisheries in the Asia-Pacific region (Coates, 2002; Hortle, 2007; Lymer *et al*., 2008b) and from the African continent (Welcomme, 1976; De Graaf and Ofori-Danson, 1997; van Zalinge *et al*., 1998). It can, therefore, be expected that future revisions upwards of inland fisheries production can be expected from several countries. The revised estimates for inland fisheries production from these reports alone correspond to a significant proportion of the world total inland production. It is important to note that these revised estimates do not represent a sudden increase, but almost certainly a systematic and historical underestimation of national production. The implications of this are that we must avoid falling into the trap of assuming that production is increasing when we are really only seeing a readjustment of the baseline and that from some countries, at least, there may actually be a trend of decline in the fishery being masked by the aggregation of catches and production of multiple countries.

This analysis is, in effect, a "thought experiment" using arbitrary criteria (the 40 percent increase in criterion 1 and 30 percent change in criterion 2 and simple back-adjustment of the data. As such, it represents one of several possible approaches to adjustment of irregularities in reporting. The analysis did not substantively take into account large negative revisions in criterion 1 analysis; such negative changes are fewer but could also significantly affect the data set. Another important consideration is that we have not distinguished between data reported by countries and FAO estimates. Further, the population data used for the calculation in catch/capita included the total global population, whereas the production data used did not include all of these countries (especially for the early historical data); hence, the absolute catch level is slightly lower than could be expected. However, the trend in population growth and, hence, the trend in the calculated production/capita can be considered a reliable reflection of the global situation.[8]

Inland fisheries sometimes involve international political and territorial disputes, for example in areas such as the Caspian Sea. In addition, there are disputes regarding construction of dams, irrigation schemes and pollution, which affect the fisheries in neighbouring countries, such as the Aral Sea or the Mekong basin. The multistakeholder issues surrounding freshwater use (for power, irrigation, leisure, etc.) also mean that fisheries services may not be valued highly and, as a consequence, little effort and few resource have been allocated to information gathering and management of inland fisheries. There is a growing awareness that, in certain parts of the world, inland fisheries can be a major source of protein and livelihoods, which sparked recent interest in these fisheries. Furthermore, the lack of inclusion of recreational catches and the fact that many countries still encounter great difficulties in managing and funding the collection of inland capture statistics are highlighted as major problems by FAO (FAO, 2002, 2004, 2007, 2009). In addition, the very poor breakdown into taxonomic groups reported by many countries risks biasing trend analysis by species or species groups within the inland catch data. In 2006, global inland catches classified as "freshwater fishes NEI"[9] again exceeded 50 percent (57.2 percent) of the global catch, and a most worrying trend is that these figures are actually both globally and in specific regions.

[8] This analysis could be strengthened by using the total national population data of those countries for which inland fishery production is reported.

[9] This refers to a conglomerate of many freshwater species.

In conclusion, this thought experiment highlights the need to be careful when drawing conclusions about the trend of inland water capture fisheries catches at the global level. Further, this should be taken into consideration when potential for further development is discussed.

ANNEX 3

Recreational fisheries

Prepared in collaboration with Ian Cowx and John Jorgensen.

Introduction

Recreational fisheries capture aquatic animals for leisure and sport when this does not constitute an important source of nutrition and when they are not the subject of legal or illegal trade.

Recreational fishing is pursued in both marine and inland environments, although this annex deals with inland recreational fisheries. It is usually conducted with rod and line using natural or artificial bait, although a range of other methods may be used according to local custom. Similar methods are used in subsistence fishing, so it is often extremely difficult to differentiate clearly between the two types of fisheries.

Recreational fisheries are the dominant use of inland waters fish resources in the north and south temperate zones (particularly Europe, North America, Australia, South Africa and the southern parts of South America) (see Cooke and Cowx, 2006; Hickley, 2009). The sector is also experiencing explosive development in many transition economies in Africa, Asia and Latin America. The increasing importance of recreational fishing throughout the world manifests itself in the proliferation of television programmes and in an abundance of advertisements for fishing tours and competitions available on the World Wide Web where forums for sharing photographs and exchanging experiences also can be accessed. The range of services on offer in the individual countries varies. However, there are angling associations or fishing clubs in most countries and a simple Internet search for "sport fishing" provides tens of thousands of hits and provides an overview of the variety of facilities available.

Types of recreational fishery

It is possible to distinguish three general types of recreation fisheries:

- Fishing for foreign tourists. This is widespread throughout the world, but tends to concentrate in areas known for their natural beauty or for containing fish of particular sporting value. Such areas include the Himalayas in Asia, Lake Titicaca, the Andean and Patagonian lakes and parts of the Amazon and central American lakes in Latin America, and Lake Kariba and the southern river systems in Africa. There are plenty of travel agents offering this type of service on the Internet.
- Fishing by well-off national tourists. These tourists generally reside in national urban centres, but go camping and fishing in the countryside during vacation periods. This sector flourishes throughout Europe, North America and Australia, but is developing in Latin America in places such as Santa Cruz in Bolivia (Plurinational State of), Rio Negro in Brazil, reservoirs in Venezuela (Bolivarian Republic of), throughout the lower Paraná basin and the Pantanal, and in Africa in Angola and Murchison Falls in Uganda.
- Fishing by local populations. This is closely linked to subsistence fishing in that they are generally local fisheries that also aim at providing food for the fisher and his/her family. This type of fishing can and will take place in almost any stream or waterbody, and normally does not target any particular species. Fishing by children belongs in this group, and although fishing may be a favourite pastime for them, the activity is also strongly encouraged by the parents.

Economic value of recreational fisheries

The economic potential of recreational fisheries is considerable. Direct income is generated from the sale of national fishing licences in addition to permits that may have to be paid to the owner of the fishing rights, whether this is a public or private entity. The sector also generates considerable secondary income through producers and sellers of fishing equipment, bait providers, boat renters, guides, lodge owners, travel agencies, restaurants, boat constructors, producers of books, magazines, documentaries and digital information on recreational fishing, and producers of stocking material.

The amount of money paid by people in the luxury segment is considerable. Hickley (2009) cites the standard estimate of expenditure per fisher per year in Europe as EUR 1 000. The value of a fish caught by recreational fishers is thus many times higher than that of the same fish when it is caught by a commercial food fisher. The scale of the sector is indicated in Table A3.1. Despite the considerable economic importance of this sector, it is generally unrecognized, and systematic assessment of its social and economic significance has rarely been explored in most countries.

Table A3.1: Some indicators of value of recreational fisheries

(*Note*: these values are based on the very limited information available on this generally unrecognized sector of the economy.)

Location	Recreational fishing statistics and comments
Regional statistics	
Europe	Among the 27 European Union countries, there are an estimated 25 million anglers with an estimated direct and indirect expenditure on recreational fishing in excess of USD 8 billion (Hickley, 2009).
United States of America	In 1996, 18 percent of the United States population 16 years of age and older (i.e. 35 million persons) spent 514 million angler days in freshwaters, expending USD 38.0 billion (United States Fish and Wildlife Service, 1997). In the United States, only 12 percent of the entire population have never participated in recreational angling (United States Department of Commerce, 2002).
Canada	In Canada, 3.6 million anglers spent 47.9 million angler days and caught over 232.8 million fish, while spending USD 6.7 billion, of which USD 4.7 was wholly attributed to the sport in 2000. Of these fish, some 84.6 million were retained (Department of Fisheries and Oceans, 2003).
Australia	In 2002, an estimated 3.4 million anglers in Australia contributed to 20.6 million angler days and caught in excess of 70 million finfish, while spending in excess of USD 1.3 billion (Australian Department for Agriculture Fisheries and Forestry, 2003)
Argentina	About 2 120 000 recreational fishers in a sector worth an estimated USD 100 million
Brazil	About 30 million recreational fishers in a sector worth about USD 50 million in the primary sector and USD 400 million in the secondary.
Chile	About 10 000 recreational fishers.
Cuba	About 5 600 recreational fishers.
Mexico	About 3 300 000 recreational fishers.
Paraguay	About 8 000 recreational fishers.
Global statistics	
	In 1995, it was estimated that total recreational catch worldwide is of the order of 2 million tonnes and represents an important source of animal protein in many developing countries (Coates, 1995). In 2004, it was estimated (using extrapolations from North American fisheries statistics) that total annual recreational catch worldwide may be in the order of 47 billion fish per year, of which roughly two-thirds are released (Cooke and Cowx, 2004). Kapetsky (2001) estimated that freshwater recreational fishing effort represents roughly half of the food fishing effort from a global perspective relative to all fishing effort (i.e. marine recreational and commercial fishing effort).

Environmental and social impact of recreational fishing

Globally, very little is known about how recreational fisheries affect fish stocks, and even less is known about the situation in Asian, African and Latin American countries. However, potentially the impact may be very significant; Cooke and Cowx (2004), for example, estimated that 12 percent of global fish landings comes from recreational fisheries. There is no comparable figure available for inland waters, although in waters with low productivity, such as cold mountain streams or lakes, blackwater streams and rivers and some reservoirs (see example by Regidor, 2004), recreational fisheries can be responsible for a much higher share of the catch than artisanal fisheries. Many anglers practice catch-and-release fishing in the temperate regions and now also in the tropical areas. For example, a catch-and-release fishery was described for *Cichla* spp. in the Amazon but the positive impact of this on fish survival is still being questioned and the practice remains controversial (Aas, Thailing and Ditton, 2002).

The preferred species in the fisheries varies according to the geographic area. In the mountainous areas of the tropics, the most favoured target species are the introduced species rainbow trout (*Onchorhynchus mykiss*) and brown trout (*Salmo trutta*). Recreational fishers focus on dorado (*Salminas brasiliensis*) and large catfish species in the Paraná. In the tropical lowland, a large variety of species grow big enough to be interesting as trophies, but the most favoured are *Cichla* spp., *Colossoma macropomum*, arowanas (*Osteoglossum bicirrhosum*) and big catfishes. In Asia, sporting species such as *Tor tor* are sought after in India, Nepal and Pakistan, and in Africa the preferred species are the Nile perch *Lates niloticus* and tiger fish *Hydrocynus* spp.

Several of the most popular sport fish mentioned above are also important target species for artisanal fisheries. In order to avoid conflicts, there is a tendency for recreational fisheries to centre on regions with limited artisanal fishing, for example, blackwater rivers and cold-water streams. Conflicts frequently arise between recreational and artisanal fisheries, and in developed nations this often results in buyout of the fishing rights by the recreational sector. Participation of the middle and upper classes in recreational fisheries makes the groups politically very influential and they are very well organized, which contrasts with the generally poor organization of artisanal and subsistence fishers who usually belong to the lower-income strata. The result is that current management practices (e.g. gear bans, minimum sizes, closed seasons or areas) often favour the recreational sector to the detriment of small scale fishing for consumption or for sale. An example of this is the southern part of the Pantanal in Latin America, which has effectively been reserved for recreational fishing with an estimated loss of potential food production of around 50 000 tonnes. When fishing is organized as package tours without any involvement of the local community, the benefits have almost no positive impact locally. On the other hand, recreational fishers in the first two categories frequently use local fishermen as guides, and in some places the fish caught is sold to compensate the fishers for their losses.

In developed economies where inland waters are reserved for recreation, much fishing takes place in waterbodies that have been enhanced through stocking or introductions to satisfy demands by fishers for guaranteed catches in terms of numbers or weight of specimens. There is also a general policy to the large-scale provision of leisure fishing for all classes of society where the fish are caught and returned.

Where fish resources are reserved for recreational purposes, it is common for the fish assemblages to remain reasonably pristine, despite a tendency to encourage populations of the preferred species by stocking and elimination of competitors. This means that recreational fisheries act as a stimulus for the establishment of formal or informal reserves that may restock more highly exploited areas by emigration of excess fish. In addition to stock benefits, there are benefits for aquatic ecosystems in that one of the most powerful lobbies for the conservation or rehabilitation of damaged aquatic ecosystems comes from the recreational fishing sector. Waters reserved for recreational fishing also provide a potentially exploitable stock in case of severe food need when the current financial imbalance that favours recreational fisheries may be reversed.

ANNEX 4

Crocodiles

One group excluded from the general analysis were crocodiles, as these are reported as individuals and not by weight. Furthermore, catches are mainly for skins and not for food, although the tails are eaten in many countries. Enormous numbers of crocodiles have been removed from inland waters across the world (a total of 25 180 417 since the trade was first recorded in 1972), and the yearly take is still about 1.18 million individuals (Figure A4.1), although there have been signs of a decline over the past three years. These figures can distort national fish catch estimates if due care is not taken in generating reports using FishStat Plus.

The trade in crocodile skins has been the subject of a report by Caldwell (2004), but this report deals with cultured crocodilians as well as those captured from the wild. This analysis appears to be the only one available that analyzes captures from wild sources.

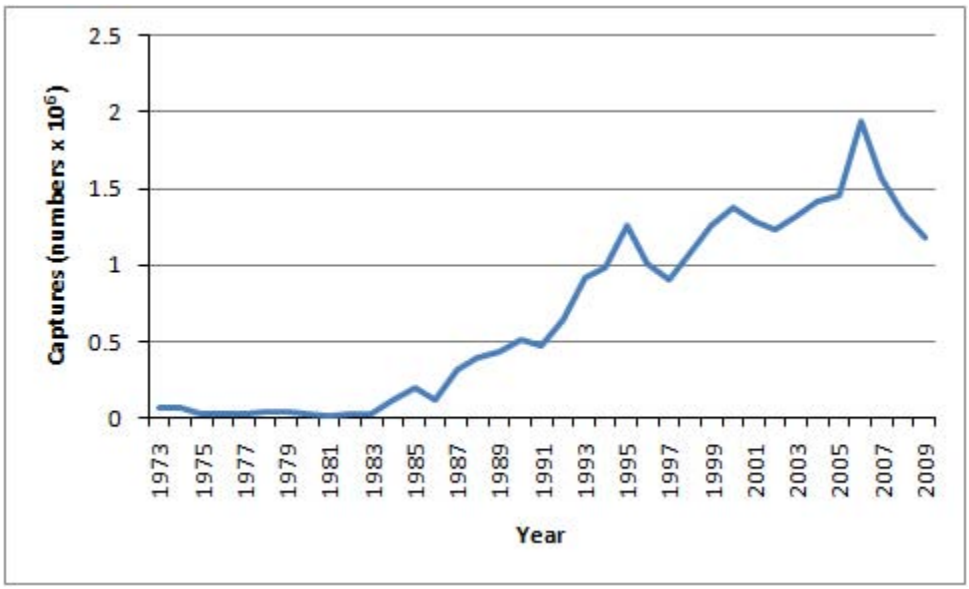

Figure A4.1: Global crocodile production (numbers) from inland waters 1972–2009

The majority of crocodilians are captured in the Americas, with South America as the principal source at about 39 percent of the yearly captures, and North America (United States of America) at over 25 percent (Table A4.1).

Table A4.1: Catch of crocodilians by continent in 2008

Country	2009	%
South and Central America	461 400	39.17
North America	297 187	25.23
Asia	234 838	19.94
Africa	126 688	10.76
Oceania	57 740	4.90
Total	1 177 853	100.00

Table A4.2 shows that the main producers in 2008 were Colombia (South America), United States of America (North America), Cambodia (Asia), and Zimbabwe and Zambia (Africa). Some notable producers, such as Uganda and the Sudan reported catches in 2006 but not in 2009. A considerable

number of individuals are produced by culture each year in some countries (Caldwell, 2004), and there may be some confusion between these and those produced by capture.

Table A4.2: Catch of crocodilians by country in 2009

Country	Quantity	%
Colombia	405 782	34.45
United States of America	297 187	25.23
Cambodia	185 000	15.71
Zimbabwe	62 101	5.27
Papua New Guinea	30 750	2.61
Guyana	28 731	2.44
Australia	26 990	2.29
Thailand	26 119	2.22
Zambia	25 575	2.17
South Africa	24 982	2.12
Indonesia	12 251	1.04
Argentina	10 831	0.92
Viet Nam	9 483	0.81
Bolivia (Plurinational State of)	7 748	0.66
Kenya	6 906	0.59
Brazil	6 569	0.56
Malawi	3 105	0.26
Botswana	1 626	0.14
Honduras	1 240	0.11
Singapore	1 086	0.09
Madagascar	1 000	0.08
Tanzania, United Republic of	790	0.07
Namibia	600	0.05
Malaysia	587	0.05
Mexico	499	0.04
Philippines	285	0.02
Taiwan Province of China	27	0.00
Ethiopia	3	0.00
Total	1 177 853	100.00

The principal species caught in 2008 were the spectacled caiman from South America, the American alligator from the United States of America, the Nile crocodile from the African countries, the estuarine crocodile from Oceania and the Siamese crocodile from Southeast Asia (Table A4.3).

Table A4.3: Numbers of principal taxonomic groupings of crocodilians caught in 2009

Species	Quantity 2009	%
Spectacled caiman	459 621	39.02
American alligator	297 214	25.23
Estuarine crocodile	232 083	19.70
Nile crocodile	126 688	10.76
Siamese crocodile	34 373	2.92
New Guinea crocodile	26 095	2.22
Morelet's crocodile	499	0.04
Cuvier's dwarf caiman	409	0.03
Broad-nosed caiman	387	0.03
Smooth-fronted caiman	322	0.03
American crocodile	160	0.01
Black caiman	2	0.00
Total	1 177 853	100.00

According to Caldwell (2004), caimans are usually harvested at about 40 kg and crocodiles at 100 kg. On this basis, the captures in 2009 were equivalent to 71 711 tonnes of crocodiles and 18 430 tonnes of caimans for a total of 90 141 tonnes. It is difficult to find any estimates for the impact of this level of abstraction of crocodilians from natural habitats, both on the populations of crocodiles themselves or on the general ecology of inland waters from which a top predator is so heavily exploited. However, some conservationist groups in South America[10] consider that the high level of exploitation, much of which is illegal and undeclared (making the present figure low relative to actual levels of capture), to be extremely damaging to some populations of the spectacled caiman.

[10] See www.endangeredspecieshandbook.org/trade_reptile_crocodiles.php

ANNEX 5

Harvest of aquatic plants

FishStat only records minimal amounts of aquatic plants as being landed throughout the world (see Figure A5.1).

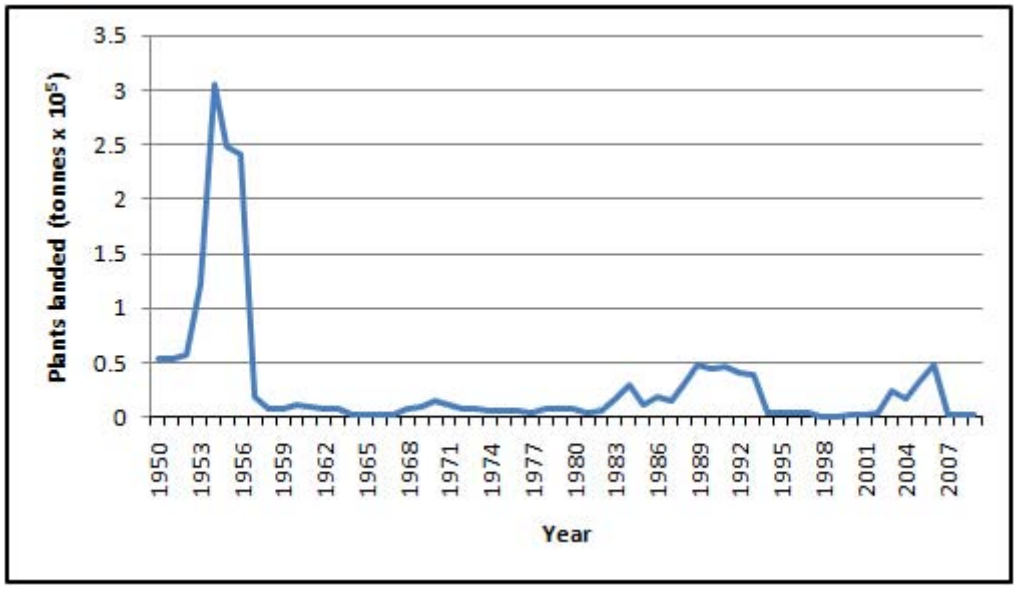

Figure A5.1: Quantities of aquatic plants recorded as landed in FAOSTAT, 1950–2009

The fact that inland plant landings are only recorded from a few countries in Asia and North America clearly does not reflect the real annual harvest of this important commodity. Aquatic plants are used throughout the world for human food, animal fodder, building materials (thatch) and fertilizers. The lack of adequate data on this group of organisms is a serious deficiency and severely distorts the value placed on inland water and wetland resources (see also FAO, 1979).

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