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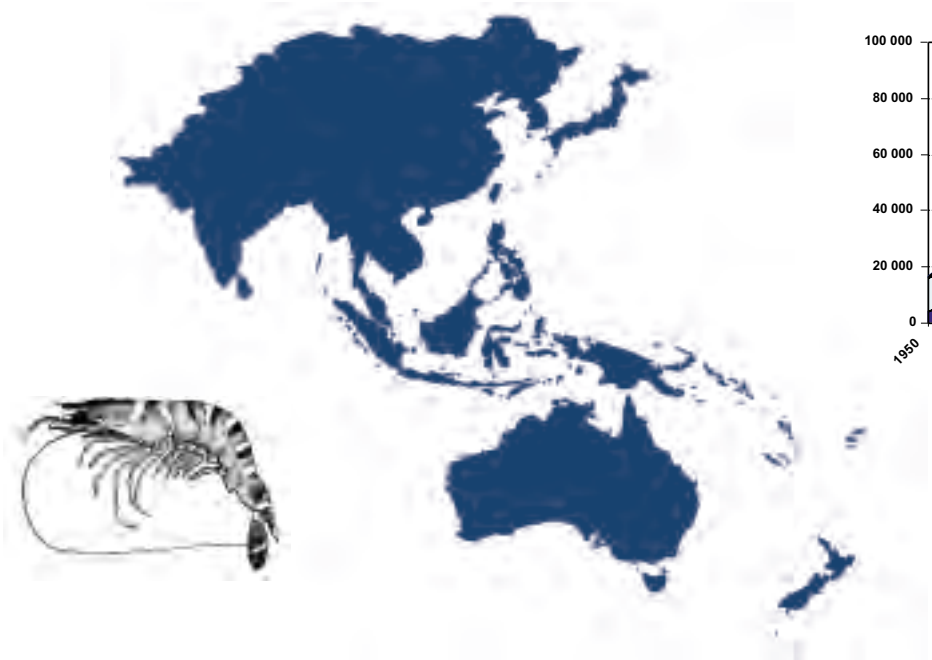
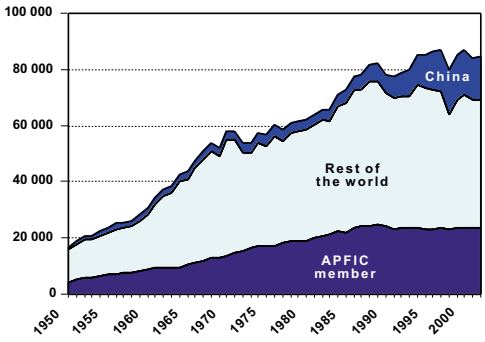
Regional overview of fisheries and aquaculture in Asia and the Pacific 2012





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Asia-Pacific Fishery Commission (APFIC)

Regional overview of fisheries and aquaculture in Asia and the Pacific 2012

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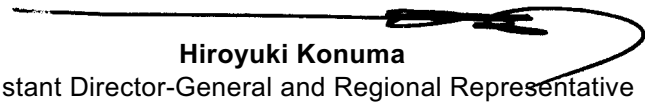
Foreword

The Asia-Pacific Fishery Commission (APFIC) is committed to acting as a regional consultative forum, providing member countries, regional organizations and fisheries professionals in the region with the opportunity to review and discuss the challenges facing the region's fisheries sector and helping them decide on the most appropriate actions to take. As part of this function, APFIC prepares a biennial status report to inform member countries and other stakeholders of trends in fisheries and aquaculture in the region and of emerging issues and other information tracking related to fisheries governance. The report is prepared for and provided to member countries and other stakeholders to assist in their deliberations during the biennial APFIC regional consultative forum meeting and the regular session of the Commission.

The present report *Regional overview of fisheries and aquaculture in Asia and the Pacific 2012* provides information on trends in fisheries and aquaculture in the region as well as short reviews of some current issues facing fisheries and aquaculture in the region that are likely to challenge the sector as it adapts to the continuously changing production and market environments.

The marine capture fisheries section of the report has been organized to reflect the three large ecosystems of interest to the region, namely the South China Sea and the Bay of Bengal and the Sulu-Sulawesi/Timor-Arafura Seas subregions. The aquaculture review is organized around different commodity groups and their respective characteristics.

As a regional sourcebook of trends in fisheries and aquaculture, the information contained in this review will support regional dialogue on the status of these marine fishery subregions and the commodity trends in aquaculture.



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Preparation of this document

This document was prepared for the Thirty-second Session of the Asia-Pacific Fishery Commission (APFIC), which was held in Da Nang, Viet Nam from 20 to 22 September 2012.

APFIC has continued to implement its new role as a regional consultative forum and is endeavouring to respond effectively to the changing requirements in the fisheries and aquaculture sector in the region. APFIC is committed to improving the quality of information on the status and trends of fisheries and aquaculture in the region and to reviewing and analyzing this information regularly. The purpose of this document is to inform APFIC member countries of the current status and potential of fisheries and aquaculture in Asia and the Pacific region and of the emerging issues facing the sector.

This review would not have been possible without access to the national statistical information of APFIC member countries, FAO colleagues, the work of regional organizations such as Southeast Asian Fisheries Development Center (SEAFDEC), Bay of Bengal Programme International Governmental Organization (BOBP-IGO) and the many others that collate and analyze information relevant to the fishery and aquaculture subsectors of the region. In particular, we would like to acknowledge the dedicated contributions by country correspondents:

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Introduction

Fish and fishery products make an enormous contribution to the nutrition and wellbeing of the peoples of Asia and the Pacific region, possibly exceeding their contribution in any other region of the world. The quantities produced and the sheer diversity of species and products from inland and marine waters that exist in the region is clear testimony to a deep-rooted tradition of fish consumption and its importance in the diet and culture of the peoples of Asia.

The APFIC biennial *Regional overview of fisheries and aquaculture in the Asia-Pacific 2012* is intended to provide a resource book comprising a summary of regional information on fisheries and aquaculture. The capture fisheries review is divided into three subregions, the South China Sea, the Bay of Bengal and the Sulu-Sulawesi and Timor-Arafura Seas subregion. The aquaculture section of the overview covers different commodity groupings across the region.

The APFIC *Regional overview of fisheries and aquaculture in the Asia-Pacific 2012* is an ongoing biennial effort by the Commission to collate national sources of data that can help to explain some of the background effects on the fisheries of the region. The ultimate goal of this is to organize fisheries-relevant information into meaningful geographical, biological and governance units so that the fisheries and their resources can be considered at a level of detail that is not possible using aggregated national catches or the FAO statistical areas.

This approach is in line with the recommendation of the Thirtieth APFIC Session to promote ecosystem approaches to management and with the Thirty-first Session, which endorsed the review of trends in subregional fishing areas.

The presentation of information in this format enables policy issues to be viewed in a broader context and can increase our understanding of how they relate to other aspects of fisheries and aquaculture management. It is expected that this review will also encourage APFIC member countries to look deeper into the information and statistics that they collect regularly or occasionally, and try to present them in a more integrated, holistic manner, thereby deepening the analysis and understanding of trends in the region's fisheries and aquaculture.

Geographical scope of this review: states, entities and areas

This review covers the states, entities and areas of Asia and the Pacific region that report fisheries and aquaculture statistics to FAO, and which are within the area of competence of the Asia-Pacific Fishery Commission.

Marine capture fisheries

For the overviews on marine capture fisheries, the subregions used marine subregions that broadly follow marine ecosystem boundaries e.g. "South China Sea and Gulf of Thailand", "Bay of Bengal and Andaman Sea",and "Sulu-Sulawesi and Timor-Arafura Seas". These are explained and indicated on maps in the relevant section. These subregional areas are part of the FAO major fishing areas (MFAs): Western/ Eastern Indian Ocean Northwest, Western/Eastern Central and Southwest Pacific Ocean (MFA 04), (MFA 06), (MFA 51 and 57), (MFA 61, 71, 77 and 81), however, catches may not reflect FAO statistics as the subregions are only part of these larger FAO statistics areas.

Where FAO national statistics have been used for marine capture fisheries, all marine catches made *outside* the subregional areas mentioned above are excluded from this review.

Inland fisheries

Statistics are principally drawn from the FAO FishStat dataset[1], the data used is for “Inland waters: Asia” and “Inland waters: Oceania”.

Aquaculture

For the aquaculture overviews the subregions are subdivided as follows:

South Asia: Bangladesh (the People’s Republic of), Bhutan (the Kingdom of), India (the Republic of), Maldives (the Republic of), Nepal (Federal Democratic Republic of), Pakistan (Islamic Republic of) and Sri Lanka (the Democratic Socialist Republic of).

Southeast Asia: Brunei Darussalam, Cambodia (the Kingdom of), Indonesia (the Republic of), Lao PDR (People’s Democratic Republic), Malaysia, Myanmar (the Union of), Philippines (the Republic of the), Singapore (the Republic of), Thailand (the Kingdom of), Timor-Leste (the Democratic Republic of) and Viet Nam (the Socialist Republic of).

China: China PR (People’s Republic of), Hong Kong SAR (Special Administrative Region of China) and Taiwan POC (Province of China).

Other Asia: Japan, Kazakhstan (the Republic of), Korea DPR (Democratic People’s Republic of), Mongolia, Korea RO (Republic of), Tajikistan (the Republic of) and Uzbekistan (the Republic of).

Oceania: American Samoa, Australia, the Cook Islands, Fiji Islands (the Republic of the), French Polynesia, Guam, Kiribati (the Republic of), the Marshall Islands, the Federated States of Micronesia (FSM), Nauru (the Republic of), New Caledonia, New Zealand, Niue (the Republic of), Norfolk Island, Northern Mariana Islands (the Commonwealth of the), Palau (the Republic of), Papua New Guinea (PNG), Pitcairn Island, Samoa (the Independent State of), Solomon Islands, Tokelau, Tonga (the Kingdom of), Tuvalu, Vanuatu (the Republic of), and Wallis and Futuna Islands.

General trends in marine capture fisheries and in the APFIC region

The Asia-Pacific region continues to be the world’s largest producer of fish. The capture production of the Asia-Pacific region has exceeded 50 percent of world production since 2006.The Asia-Pacific capture production declined slightly from 2004 to 2006, after which it started to increase, with a 3.5 percent rise between 2009 and 2010.The latest FAO figure (2010) for capture production for the Asia-Pacific region is 48.7 million tonnes. Global capture fishery production has followed a similar trend over the past decade (Table 1).

Of the top ten producers of capture fish in the world, five states are in Asia and the Pacific region. China is still by far the largest producer in the region (15.7 million tonnes) representing 32 percent of the total regional production (a slight reduction over the previous biennium), followed by Indonesia (5.4 million tonnes, 11 percent) and India (4.7 million tonnes, 10 percent).

Excluding China, capture fishery production from marine waters in the APFIC region reached 26.5 million

Table 1 The amount and relative proportion of capture fishery production in APFIC countries

Country	Production (tonnes)	% Regional production
China	15 665 587	32
Indonesia	5 384 418	11
India	4 694 970	10
Japan	4 141 312	9
Myanmar	3 063 210	6
Philippines	2 615 753	5
Viet Nam	2 420 800	5
Thailand	1 827 199	4
Korea RO	1 745 971	4
Bangladesh	1 726 586	4
Malaysia	1 437 507	3
Taiwan POC	851 505	2
Cambodia	490 094	1
Pakistan	453 264	1
Sri Lanka	437 468	1
New Zealand	436 640	1
Total	**48 691 243**	

[1] http://www.fao.org/fishery/statistics/software/fishstatj/en

tonnes in 2008 (a record at that time), but this was exceeded in 2010 with a catch of 32.0 million tonnes. Southeast Asian capture production (17.3 million tonnes) has continued to increase but there has been a slower increase in South Asia (7.4 million tonnes).

The subregion Other Asia used to be the top contributor to capture fishery production in the region, but capture production has declined since 1988 and now shows signs of levelling off (6.1 million tonnes).

The general trend in global capture fisheries is one of stable capture fishery production with background fluctuations in different fisheries. Asian capture fisheries have generally been stable or increasing over the past decade.

- Capture fishery production in China has been very stable, rising and falling by only one or two percent over the past decade with a total decadal rise of 4 percent.
- In Southeast Asia, the trend is for consistent slight annual increases of 2 to 4 percent, with a decadal increase of 29 percent.
- In South Asia the changes are more dramatic, increasing and decreasing by 5 to 8 percent, but an overall decadal increase of 28 percent.
- Other Asia is relatively stable with an overall decline of 16 percent over the decade.
- Oceania has had rather large decreases in production over the past five years, but the decadal trend is an increase of 9 percent.

The consistent increases in capture fishery production that are being achieved in the South Asian and Southeast Asian subregions of APFIC member countries can be attributed to several effects, namely the increase in fishing effort, the expansion of the geographical range of fishing activities and the increase in the overall biomass of the fishery by fishing down effects (i.e. removing larger, longer-lived species and allowing a higher biomass of shorter-lived, small, fast-recruiting species).

The expansion of new areas and the transhipment of fish between fishing areas complicates trend reporting by area and the determination of the status of stocks in specific localities. This may also lead to the false assumption that there remains significant potential for further expansion of fishing.

Issues of “nei” reporting species composition in national statistics

There remains a considerable proportion of the region’s capture production reported to FAO, that is not identified at the species level but instead is recorded as marine/freshwater fish nei, marine/freshwater molluscs nei and marine/freshwater crustaceans nei (Table 2). “Nei” means “not elsewhere included”.

In 2010 the amount of capture production that was reported in Asia and the Pacific region and not identified at species, genus, or family level reached approximately 15.8 million tonnes (32 percent of the regional total production). This is an increase over the 2008 figure of 30 percent, (14.3 million tonnes).

The quantity reported under these categories shown in Table 2 has been relatively constant (about 30 percent for the APFIC region) over the past six years, however, it is notable that China has improved its reporting on individual species.

The consistently high reporting of nei marine fish (9.6 million tonnes, 19.7 percent of total regional fishery production) may also reflect a strong trend towards the capture of smaller, lower-value species. The percentages of these are high in the assessed catch composition. These small, low-value or trash fish species may not be considered worth reporting in detail as part of catch landings. This hides the effects of overfishing on the capture of juveniles of higher-value species.

Table 2 The amount and proportion of capture fishery production reported at an aggregated ("nei") level in 2010

	Southeast Asia	South Asia	China	Other Asia	Oceania	Total
Freshwater crustaceans nei	1 612	134 300	0	316	100	**136 328**
Freshwater fishes nei	1 761 777	1 419 804	1 614 697	9 689	7 929	**4 813 896**
Freshwater molluscs nei	61 572	892	286 980	4 072	1 500	**355 016**
Marine crustaceans nei	1 535	89 727	210	57 710	2 286	**151 468**
Marine fishes nei	5 298 197	1 005 153	2 832 409	398 197	72 687	**9 606 643**
Marine molluscs nei	93 785	5 788	623 434	239	5 928	**729 174**
Total	**7 218 478**	**2 655 664**	**5 357 730**	**470 223**	**90 430**	**15 792 525**
Percent of total subregional production	41.7	35.7	32.1	7.7	7.5	

Classifications of APFIC region national fishery management areas

Table 3 describes the subnational fishery management areas and jurisdictions. There is considerable variability in the way that fisheries are subdivided within the national exclusive economic zone (EEZ). A few fisheries management areas are identified in terms of the target species (e.g. Australian fisheries), but most are geographically based. These subnational geographical areas may be based on characteristics of certain fisheries (e.g. pelagic or reef-based fisheries, 3 nautical miles (nm) nearshore fishing area), but more typically are based on administrative units (state fisheries, provincial jurisdictions, or an area that represents a convenient management scale, but which may not align with a state or provincial boundary (e.g. India).

Table 3 Fisheries, fishing areas and/or management areas by country (note that this overview does not cover all national fishing areas)

Country	Fishing area
Australia	**22 fisheries** – ten managed solely by the Australian Fishery Management Authority (AFMA) and 12 managed jointly with other Australian jurisdictions or other countries under international arrangements. **AFMA managed** Bass Strait central zone (scallop); Coral Sea (sea cucumbers, aquarium fish); northern prawn fishery; northwest slope trawl fishery; small pelagic fishery (east & west); southern & eastern scalefish and shark; east coast deepwater trawl fishery; Great Australian Bight trawl sector; southern squid jig fishery; western deepwater trawl fishery. **Jointly managed** South Tasman rise trawl fishery; Torres Strait fisheries; eastern tuna and billfish; Pacific Ocean skipjack tuna; Indian Ocean skipjack tuna; southern bluefin tuna; western tuna and billfish; Antarctic waters; Heard & Macdonald islands; Macquarrie Island.
Bangladesh	**South patches** (6 200 km^2) 60 to 80 m depth (91°10′E – 91°50′E; 21°10′N – 21°40′N, squares 302–305, 402–405, 502–505 and adjacent waters. **Middle ground** (4 600 km^2) 80–100 m depth – Southwest of south patches (90°30′E – 91°40′E; 20°45′N – 21°10′N, squares 603–609, 703–709 and adjacent waters) – East of swatch of no-ground (90°00'E – 90°40′E; 21°00′N – 21°25′N squares 509–512, 609–612) **Swatch of no-ground** (3 800 km^2) submarine canyon type, depth of 800 to 1 000 m.
Cambodia	

Table 3 (cont.) Fisheries, fishing areas and/or management areas by country (note that this overview does not cover all national fishing areas)

Country	Fishing area
China	*Northern South China Sea* **Northern shelf,** South China Sea **Beibu Gulf** (Gulf of Tonkin) **Central South China Sea**
India	**Northeast coast:** Orissa, West Bengal **Southeast coast:** Tamil Nadu & Puducherry, Andhra Pradesh **Southwest:** Goa, Karnataka, Kerala **Northwest:** Gujarat, Maharashtra **Andaman & Nicobar Islands; Lakshadweep Islands**
Indonesia	**Indonesian fishery management areas (FMAs)** (AFMR, 2005. Assessment of Fisheries Management Area) – 571 Malacca Strait (135 522 km^2) – 572 Indian Ocean (Western Sumatera) (938 944 km^2) – 573 Indian Ocean (South of Java) (779 110 km^2) – 711 Natuna Sea (577 451 km^2) – 712 Java Sea (423 290 km^2) – 713 Makassar Strait – Flores Sea (1 567 135 km^2) – 714 Banda Sea (673 602 km^2) – 715 Tomini Bay, Seram and Molucca Seas and Bintuni Bay (543 609 km^2) – 716 Sulawesi, Halmahera Seas – 717 West Pacific Ocean (including Sulawesi and Halmahera Seas 1 037 376 km^2) – 718 Arafura and Timor Seas (481 511 km^2)
Malaysia	**Coastline 4 492 km,** **EEZ 453 186.18 km^2, territorial waters 63 665.3 km^2, continental shelf 476 761.87 km^2** **South China Sea** – Peninsular Malaysia east coast (134 730.07 km^2) – West coast Sabah (Total EEZ for Sabah state 90 802.19 km^2)* – Sarawak (157 998.46 km^2) **Peninsular Malaysia west coast** – Malacca Straits/Peninsular Malaysia west coast (69 655.4 km^2) **Sulu-Celebes** – Sabah east coast (total EEZ for Sabah state 90 802.19 km^2)*
Maldives	**EEZ area 916 189 km^2, shelf area 19 231 km^2** – Reef associated areas (areas in and around different coral reefs and associated biotope – Pelagic waters (Intra-atoll and outer atoll pelagic waters within EEZ).
Myanmar	**Coastline 2 832 km, EEZ area 486 000 km^2 Fishing areas:** – Fishing Zone 1: coastal fisheries, extending from the shoreline to 5 nm in the northern area and to 10 nm in southern coastal areas – Fishing Zone 2, from the outer limit of the Fishing Zone 1 out to the EEZ limit.
Philippines	Luzon, Visayas, Mindanao
Sri Lanka	**15 districts for enumeration and landings** Puttalam, Chilaw, Colombo, Negombo, Kalutara, Galle, Matara, Tangalle, Kalmunai, Batticaloa, Trincomalee, Mullaithivu, Kilinochchi, Jaffna, Mannar
Thailand	**East coast/Gulf of Thailand fishery management area** **Fishery statistical areas:** – Fishing ground 1*:* Eastern Gulf of Thailand consisting of the seas off the provinces of Trat, Chanthaburi and Rayong. – Fishing ground 2: the Inner Gulf consisting of the seas off the provinces of Chon Buri, Chachoengsao, Samut Prakan, Bangkok Metropolitan, Samut Sakhon, Samut Songkhram, and Phetchaburi. – Fishing ground 3: Upper western Gulf of Thailand consisting of the seas off the provinces of Prachuap Khirikhan, Chumphon, and Surat Thani. – Fishing ground 4*:* Lower western Gulf of Thailand consisting of the seas off the provinces of Nakhon Si Thammarat, Songkhla, Pattani and Narathiwat.

Table 3 (cont.) Fisheries, fishing areas and/or management areas by country (note that this overview does not cover all national fishing areas)

Country	Fishing area
Thailand (cont.)	– Fishing ground 5*:* Mid-Gulf of Thailand consisting of the seas in the mid-Gulf that extend southward to the international boundary line between Thailand and Kingdom of Cambodia and Thailand and Malaysia. **Andaman Sea fishery management area** **Fishery statistical areas:** – Fishing ground 6*:* Upper Andaman Sea consisting of the seas off the provinces of Ranong, Phang-nga, and Phuket. – Fishing ground 7*:* Lower Andaman Sea consisting of the seas off the provinces of Krabi, Trang, and Satun.
Timor-Leste	**Northern area:** primarily the Wetar Basin extending through to the Savu Basin serving seven districts (Bobonaro, Liquiza, Dili, Manatuto, Baucau and Lautem) including Atauro island and the Oecusse enclave. **The southern area,** named the Timor Trough serves six districts (Covalima, Ainaro, Manufahi, southern Manatuto, Viqueque and Lautem) and includes the JPDA (joint petroleum development area).
Viet Nam	**Northern area:** comprising nine provinces from Quang Ninh to Quang Binh **Central area:** comprising nine provinces from Quang Tri to Ninh Thuan **Southeast area:** comprising eight provinces from Binh Thuan to Bac Lieu **Southwest area:** comprising Ca Mau and Kien Giang only.

Sources: Country correspondent reports, national reports and Woodhams *et al*. (2011).

Fisheries classifications

The number of vessels in the region is increasing and there has been a trend of increasing motorization and total fleet capacity in the region. This has led some countries to put in place measures to decrease either the number of vessels or limit capacity (e.g. China). A large fraction of the fleet in the region is still classified as small-scale according to regional and national definitions (Table 4).

Recommendation: Harmonized methods for classification or comparison of fleets should be established to assist regional capacity assessments. National vessel inventories remain incomplete and these should be updated.

Table 4 Classification of small-scale and commercial/industrial fisheries

Countries	Small-scale fisheries	Commercial fisheries
Brunei Darussalam	**Small-scale/artisanal fisheries:** operating in all zones but concentrating in Zone 1 (0 to 3 nm).	**Trawler, purse seiner, or long liner:** – <60 GT; <350 hp operating in Zone 2 – 60.1 to 150 GT; 351 to 600 hp operating in Zone 3 – 151 to 200 GT; 600 to 800 hp operating in Zone 4.
Cambodia	**Coastal fisheries:** small-scale fisheries with/without engine (from 5 to 50 hp) operating in Zone 1.	**Commercial fisheries:** More than 50 hp operating in Zone 2.
Indonesia	Fisheries that operate without using a boat, using a non-power boat, using outboard motor size <5 GT, or inboard motor size <5 GT.	Fisheries where outboard motor size 5 to 30 GT or inboard motor size 5 to 30 GT is used. Fisheries where outboard motor size >30 GT or inboard motor size >30 GT is used.

Table 4 (cont.) Classification of small-scale and commercial/industrial fisheries

Countries	Small-scale fisheries	Commercial fisheries
Malaysia	**Traditional fisheries:** small-scale fisheries using traditional fishing gears (i.e. other than trawls and purse seiners) with vessels less than 40 GRT operating in all zones but concentrating in Zone A.	**Commercial fisheries:** medium and large-scale fisheries using commercial fishing gears such as trawls and purse seines. – Vessels less than 40 GRT are operating in Zone B. – Vessels from 40 to 70 GRT are operating in Zone C. – Vessels above 70 GRT are operating in Zone C2.
Maldives	Maldives does not have an official classification of small-scale and commercial fisheries.	
Myanmar	**Inshore-fisheries/coastal fisheries:** – Vessels of less than 30 ft or using less than 12 hp engine are operating in Zone 1 – 5 nm from shore (Rakhine coastal region) – 10 nm from shore (Ayeyarwaddy and Taninthayi region).	**Industrial fisheries:** – Vessels more than 30 ft or using more 12 hp engines are operating in Zone 2 (outer limit of inshore fishing zone to the EEZ).
Philippines	**Municipal fisheries:** Up to 15 km from shore, or equidistant between two adjacent municipalities. Small-scale fisheries with vessels of less than 3 GT operating in Zones 1 and 2.	**Commercial fisheries:** Small-scale commercial fisheries: from 3.1 to 20 GT vessels operating in Zone 2; can also operate within 10.1 to 15 km (within Zone 1) if authority is granted by the concerned local government unit. Medium-scale commercial fisheries: from 20.1 to 150 GT operating in Zone 2; can also operate within 10.1 to 15 km (within Zone 1) if authority is granted by the concerned local government unit. Large-scale commercial fisheries; more than 150 GT operating in Zone 2.
Singapore	**Small-scale fisheries** with vessels of less than 3 GT operating in Zone 1.	**Small-scale commercial fisheries:** inboard engine less than 50 GT or 380 hp operating in Zone 2.
Thailand	**Artisanal fisheries:** vessels of less than 5 GT operating in Zone 1.	**Large-scale fisheries:** vessels of more than 5 GT operating in Zone 2.
Timor-Leste	**Subsistence artisanal fisheries:** non-commercial small canoes with sails or paddles (exempt from license), operating in Zone A. **Artisanal fishing vessels:** <10 metres; self-reliant for less than 24 hours; motorized artisanal fishing vessels may not have an installed power of more than 100 CV or 74 kW; operating in Zone A.	**Semi-industrial fishing vessels:** overall length between 8 and 20 metres; with mechanical means of propulsion; self-reliant for not less than 72 hours; power, even when loaded, may not exceed 350 CV or 259 kW of installed power in the case of trawling vessels; semi-industrial fishing vessels usually have means of refrigeration that allow for the conservation of ice and fish onboard; operating in Zone C (national) and D (foreign). **Industrial fishing vessels:** overall length >20 metres; with mechanical means of propulsion; self-reliant for more than 15 days; with a processing facility and adequate means for the conservation of fish, with separate cold storage and refrigeration compartments; power, even when loaded, may not exceed 1 500 CV or 1 100 kW of installed power in case of trawling vessels.

Table 4 (cont.) Classification of small-scale and commercial/industrial fisheries

Countries	Small-scale fisheries	Commercial fisheries
Viet Nam	**Small-scale fisheries:** vessels with no engine and with engine less than 40 hp. **"Nearshore fishery":** fishing vessels with an engine capacity of less than 90 hp that have not registered for operating offshore. Fishing vessels fishing in waters of less than 30 m depth from the shore in the Tonkin Gulf waters, eastern and south-western waters, and Gulf of Thailand or in waters of under 50 m depth from the shore onwards in the central coastal area.	**Large-scale fisheries:** vessels with engine more than 40 hp. **"Offshore fishery":** defined as fishing in the waters bordered by a 30 m deep line from the shore onwards for the Tonkin Gulf waters, eastern and southwestern waters, and Gulf of Thailand and by a 50 m deep line from the shore onwards for the central coast.

Source: Adapted from SEAFDEC (2008)

Subregional overviews of marine capture fisheries

The data and information for thethree subregional fishery areas were used from the following national areas:

South China Sea subregion

- **China:** Northern part of the South China Sea. Covering provinces/regions bordering the Beibu Gulf (Gulf of Tonkin) and the northern shelf.
- **Viet Nam:** Whole country.
- **Philippines:** Whole country (except Palawan/ Mindanao).
- **Thailand:** East coast (Gulf of Thailand).
- **Malaysia:** Peninsular Malaysia east coast, Sarawak and Sabah west coast.
- **Indonesia:** FMA 711.

Bay of Bengal subregion

- **Maldives:** Whole country.
- **Sri Lanka:** Whole country.
- **India:** East coast.

Figure 1 The South China Sea and Gulf of Thailand subregion

Figure 2 The Bay of Bengal subregion

Figure 3 Sulu-Sulawesi and Timor-Arafura Seas subregion

- **Bangladesh:** Whole country.
- **Myanmar:** Whole country.
- **Thailand:** Andaman Sea/west coast.
- **Malaysia:** Malacca Straits & Peninsular Malaysia west coast.
- **Indonesia:** FMAs 571, FMA 572.

Sulu-Sulawesi and Timor-Arafura Seas subregion

- **Australia:** Northern coast: Arafura Sea, northern prawn fishery.
- **Indonesia:** FMAs 712, 713, 714, 715, 716, 718, 573.
- **Malaysia:** Sabah east coast.
- **Philippines:** Mindanao, Palawan.
- **Timor-Leste:** Whole country.

Note: This area includes the Java Sea, Natuna Sea, Banda Sea, South Java – NusaTenggara.

Trends in marine capture fishery production in the South China Sea subregion

In the **northern part of the South China Sea,** demersal catches rose from 1950 until 1960, after which they began a long-term decline, although the total catch showed a rising trend because of increasing catches of abundant low-trophic level species. There have been no reliable catch statistics since the late 1980s but some catch index data are available (Qiu *et al*., 2010).[2] This shows that the total catch declined after 1990, indicating that even the dominating low-trophic species were also overfished.

Figure 4 The South China Sea and Gulf of Thailand subregion

The **Gulf of Thailand** fishery, prior to 2007, contributed about 44 percent of the national total catch with another 40 percent caught outside of the Thai EEZ. The estimated trawlable biomass (estimated from research trawl results) declined from 680 000 tonnes in 1961 to 560 000 tonnes in 1995. Landing data is composed of catch from nine gears (otter board trawl, pair trawl, beam trawl, purse seine, push net, anchovy purse seine, mackerel encircling gill net, king mackerel drift gill net and bamboo stake trap). Total landings have decreased from 1 919 564 tonnes in 1999 to 1 447 898 tonnes in 2007, and this is attributed principally to overcapacity in the fishery. More recently, because of the adjustments to statistical collection and analysis starting in 2008 and the requirement of joint venture arrangements for foreign vessels fishing in waters of neighbouring countries to land their catches at the designated fishing ports for domestic statistical and data collection, the total landings for the Gulf of Thailand declined to 993 148 and 1 010 657 tonnes in 2008 and 2009 respectively.

The Philippines has accepted 2.5 million tonnes as its maximum sustainable yield for the marine fishery sector. In 2008, 2 559 191 tonnes of marine fish were recorded for the marine fishery sector. Recent years have seen increasing catches of small species (up to 10 percent of landings). However, there have also been increases of larger species and for some areas the CPUE/catch per day is increasing.

Viet Nam's annual landing of marine capture fisheries has increased rapidly over recent years from about 0.73 million tonnes in 1990 (2.07 million tonnes in 2007) to 2.39 million tonnes in 2011.

Indonesia's FMA 711: This FMA's fishing activities take place mainly in the coastal water in the surrounding area with a depth of less than 70 m and mostly dominated by trawlable ground for demersal fish. The area is a rich source of *Nemipterus* (for surimi production), coral reefs and coastal neritic small pelagic fish species in the southern area at a depth of less than 40 m. Small pelagic fisheries are mostly operated in the northern part. There is no significant legal transhipment in the overall FMA (approximately <10 percent), but there are clear indications that foreign vessels are extensively operating in the area because of access to the open part of the South China Sea.

[2] Source: Qiu, Y.S., Lin, Z.J., & Wang, Y.Z., 2010. Responses of fish production to fishing and climate variability in the northern South China Sea. *Progress in Oceanography* 85: 197–212.

Table 5 MSY estimates and catch in the country and fishing areas of the South China Sea

Country	Year	Catch	Estimated MSY	Area
China *Northern part of South China Sea*	2009	3 207 968	1 900 000	Northern Shelf, Beibu Gulf (Gulf of Tonkin) and Central SCS. The MSY was estimated for the Northern Shelf and Beibu Gulf. China catch data (3 039 968 tonnes) from the South China Sea in 2009 are based on 2010 China Fishery Statistical Yearbook, which reported catch data for three mainland provinces bordering the South China Sea: Guangdong, Guangxi, and Hainan. The catch landing (~168 000 tonnes) for Hong Kong SAR was added to the total.
Viet Nam	2004 2008 2011	1 724 200 ~double MSY 2 390 862	1 500 000 to 1 600 000 582 212	National total biomass estimated at: 5 075 143 tonnes. Demersal biomass: 1 174 261 Large pelagic: 1 156 032 Small pelagic: 2 744 850 tonnes. Nearshore zone (50 m depth) (Pomeroy *et al*, 2008). Latest figure (2011).
Thailand east coast *Gulf of Thailand*	2009	1 010 657 28 870 95 665 39 559 145 215 194 022 299 628 39 884 4 701 81 122 57 717 20 513 426	2 159 049	Total all species, all gears Large demersal Small demersal Large pelagic Small pelagic Anchovies/Sardine Trash fish/low-value fish Surimi species Shark/rays Squids/cuttlefish Crustaceans Shellfish Others (jellyfish).
Philippines	2008	2 559 191	2 500 000	National figure.
Malaysia *Peninsular Malaysia east coast* *Sabah west coast* *Sarawak*	2010		55 500 366 500 86 661 38 327 852 500	Peninsular Malaysia east coast demersal potential yield Peninsular Malaysia east coast small pelagic potential yield. Sarawak demersal potential yield. West coast Sabah demersal potential yield. Sarawak and west coast Sabah small pelagic potential yield. No declared MSY. Potential yield estimated as a management tool for vessel and gear numbers. Note: 1 616 988 tonnes national potential yield; 457 354 2010 catch.
Indonesia[3] *FMA 711*	2008	110 000 126 000 212 000 29 000	66 100 621 500 334 800 11 900	FMA 711 – Large pelagic group FMA 711 – Small pelagic group FMA 711 – Demersal group FMA 711 – Penaeid shrimps group.

[3] National figure for Indonesia 2010 catch: 5 039 446 tonnes, estimated MSY 6 520 100 tones. Purwanto, S. Nurhakim & Wudianto (2010).

Malaysia (Peninsular Malaysia east coast, Sabah west coast and Sarawak): Total marine fish production in Malaysia during 2010 was 1 457 364 million tonnes with 42 percent (606 867 million tonnes) from the South China Sea off the east coast of Peninsular Malaysia, Sarawak and the west coast of Sabah. Inshore waters (an area of less than 30 nautical miles from the coastline) contributed 79 percent of the catch and fishing vessels were usually below 70 gross tonnes in Peninsular Malaysia. This is consistent with the large number of inshore fishing vessels, which comprise 97 percent of the country's fishing vessels. Trawls and purse seines are the two major gear types and contribute up to 74 percent of the landings.

Changes in species composition in the South China Sea and Gulf of Thailand subregion

Historically, there have been large and widespread changes in the fish fauna of the South China Sea. These changes include changes in species composition whereby the abundance of the more valuable fishes (groupers, snappers, sharks and rays) has decreased sharply and the abundance of smaller, less valuable species has increased (e.g. cardinal and trigger fishes). The production trends of the past ten years do not reveal the changes very clearly as the majority of the impact is presumed to have taken place during the massive expansion of fisheries effort between 1975 and 1985.

The picture that emerges is one of a subregional fishery that has been under heavy fishing pressure for more than 30 years and which has been fished down considerably. The changes were less obvious previously, but there remains a clear trend of a declining catch of large demersal and pelagic species and a rising catch of smaller fast recruiting species.

The catch from the assessed fisheries in the South China Sea subregion shows similar trends with an increasing fraction of the catch being made up of smaller sized species (Table 6). Multivariate analyses by the Trawlbase project showed differences in species composition between two survey periods (the 1970s and the 1990s). The percentage composition data from the west coast of Peninsular Malaysia generally showed that large and more valuable species declined in relative abundance whereas species of small body sizes increased, thus indicating a trend of "fishing down the food web".

Table 6 Trends in catch composition for the assessed fisheries areas in the South China Sea

Country	Time period	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ Low-value fish	Surimi species	Shark & rays	Squids/cuttlefish	Crustaceans	Shellfish
China Northern part of the South China Sea	**1950s to 2010**	–	–	o	+	o	+	nd	o	o	o	nd
Viet Nam	**2000 to 2005**	–	–	–	o	–	+	nd	nd	nd	nd	nd
Philippines	**1998 to 2008**	o	–	+	o	–	nd	nd	–	–	–	o
Thailand East coast	**1997 to 2009**	+	–	–	+	+	o	–	o	+	–	+
Malaysia Peninsular Malaysia east coast, Sarawak, Sabah west coast	**2000 to 2010**	–	+	–	–	–	+	+	+	+	–	+
Indonesia FMA 711	**1997 to 2008**	+	+	+	+	–	–	+	–	–	–	+

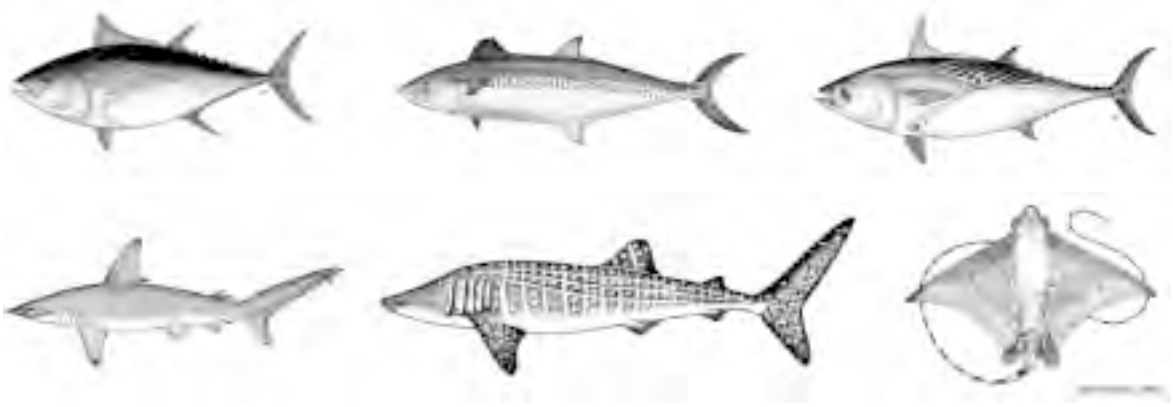
Source: Country correspondents

* abs (change (percent)/initial value (percent)) <0.05

The different groupings were assessed against their relative occurrence (percent): increased (+); – decreased (–) or were stable* (0) over a specific time period; "nd" denotes no data available.

Table 6 presents the changes in the relative composition of major species groups. The time frame for the data is the past decade, but trends from 1950 to the present are available for China. The relative trends were based on a 5 percent change over the period.

For the northern part of the South China Sea there is a trend of decreasing catches of **large demersal species** (from 37 percent of catch in the 1950s down to 17 percent in the 1970s, after which it has been stable). There is also a decline in relative catch of large demersals in Malaysia and the Gulf of Thailand, but it is stable in the Philippines and even increasing in Indonesia (FMA 711).



In the northern part of the South China Sea, **large pelagics** and **sharks and rays** have disappeared from the catch since the 1970s until the present. Conversely, there has been an increased catch of larger pelagic species in the eastern part of the South China Sea (the Philippines, including areas outside the South China Sea) and in the Gulf of Thailand and in the southern part of the South China Sea (Indonesia) in the last ten years. Catches of shark and rays have increased in Thailand and Malaysia and declined in the Philippines and Indonesia (FMA 711).

Landings of **small demersal species** have increased in the Gulf of Thailand, Malaysia and in the southern part of the South China Sea (FMA 711, Natuna Sea, Indonesia). Whereas catches have declined in the northern part of the South China Sea (China) the Philippines and Viet Nam.

Surimi species are the **small demersal species** specifically utilized for surimi production. Relative catches of these in the southern part of the South China Sea and Gulf of Thailand, (Indonesia FMA 711, Thailand and Malaysia), where they are specifically targeted, have increased (Table 7). The conversion ratio of raw material to surimi is approximately 3.5: 1 or higher, thus based on estimates of surimi production a total demand for raw material can be determined. The total production for the South China Sea area could be as high as 1 347 000 tonnes (see Table 13 later in the report).

Table 7 Composition of catch landings by major resource groupings in the South China Sea and Gulf of Thailand (%)

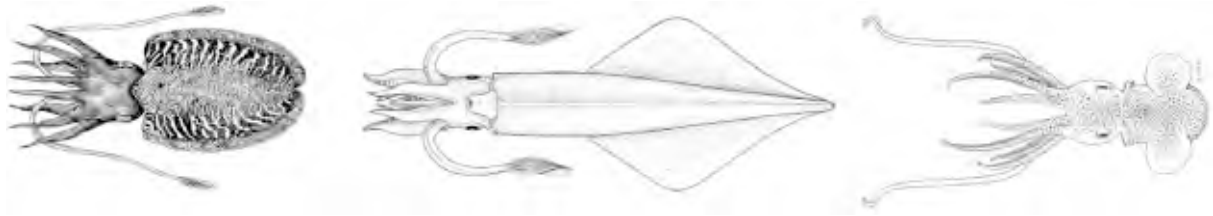
Country	Year	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans
China Northern part of the South China Sea	**2010**	2	30	3	16	4	40	nd	<1	2	2
Viet Nam Whole country											
Thailand East coast, Gulf of Thailand	**2007**	4	12	9	15	14	25	7	0	7	5
	2009	3	9	4	14	19	30	4	0	8	6
Malaysia Peninsular Malaysia east coast, Sarawak, Sabah west coast	**2008**	4	5	8	29	6	13	15	2	9	9
	2010	5	4	12	23	5	17	23	2	6	3
Philippines	**2008**	3	9	32	32	22	0	0	0	3	0
Indonesia FMA 711	**2008**	15	15	10	11	5	10	5	3	3	5
	2010	14	15	10	17	3	12	7	3	2	6

In the northern part of the South China Sea, **small pelagic species** have increased from 30 to 60 percent of the catch between 1970s and 2000 onwards and are now mostly stable (Viet Nam, Philippines). In the other parts of the South China Sea, the relative catches of small pelagics have increased (China, Thailand, Indonesia), but have declined in Malaysia. Overall they form 13 to 32 percent of the catch in the subregion.

Relative catches of **anchovy and sardines** have declined throughout the South China Sea or remain stable (China only). This group comprises only 3 to 6 percent of the catch in China, Malaysia and Indonesia, but significantly more of the catch in Thailand (14 percent) and the Philippines (22 percent).

Relative catch of **low-value/trash fish** has declined in Thailand and Indonesia, and increased in China, Viet Nam and Malaysia. This group still makes a large contribution of the total catch in the region (10 to 40 percent, Table 11). Decline in the relative catch, may be partly explained by greater classification of catch into that destined for human consumption, which has accompanied the massive rise in surimi

production in the region. There may also be an effect of the rising costs of trawling reducing overall effort over the past decade. This group is reported in detail in Table 11.



The relative catch of squids and cuttlefish is variable according the fishery, with no clear trend and they comprise a relatively small percentage of the catch landings, despite reports that they are on the rise (2 to 9 percent).

In a majority of the areas, the relative catch of **crustaceans** has declined, however they form a relatively small part of the catch (3 to 9 percent).

Fishery/stock assessments

Stock assessments based on estimations, calculation or expert opinion, were obtained for this regional overview. Some of this data were also presented in APFIC-related regional workshops (FAO, 2009a and FAO, 2009b). The assessment of fisheries/stocks has received little attention in recent years, despite its importance for decision-making in fisheries.

The continued lack of this information is a major constraint on effective communication of the changing status of various species groupings and of the extent to which overfishing (driven by overcapacity) is occurring in this region. According to the stock assessments performed for the different groups of species, a majority of the stocks or species groupings in the South China Sea subregion are overfished or fully-fished (Table 8).

In some cases the species groups are even scored as depleted. Figure 5 presents this visually using an *indicative* "traffic light" system (note that this is an illustration rather than a definitive statement regarding the status of individual species or stocks).

Overall, the heaviest fishing (indicated by depleted or fully-fished groupings) is on the western side of the South China Sea (in the shallower shelf fisheries) with stocks in better condition around Sabah, Sarawak and parts of the Philippines.

The stocks of **large demersal** species are overfished in all areas and comprise only 2 to 5 percent of the relative catch. The exception is Indonesia FMA 711 where they are fully fished and comprise 14 percent of the relative catch. **Sharks and rays**, where reported, are overfished or even depleted (China).

Small demersal species are also overfished in a majority of the areas, especially the nearshore areas. They are fully fished in the more central part of the South China Sea.

Large pelagic species generally moderately or underfished on the eastern side of the South China Sea (Philippines, Malaysia – Sabah/Sarawak and Indonesia FMA 711. They are fully fished in Viet Nam and overfished in the Gulf of Thailand.

Table 8 Status of fisheries/species groups for fisheries in the South China Sea and Gulf of Thailand areas

Country	Area	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans	Updated
China	Northern shelf	D	O	nd	O	O	F	O	D	F/O	O	2010
	Beibu Gulf	D	O	nd	O	O	F	O	D	F/O	O	2010
	Central SCS	O	F	F	M	nd	nd	nd	O	U	M	2010
Viet Nam	Whole country	O	O	F	F	nd	nd	nd	nd	nd	nd	2011
Philippines	Luzon		F	M	F	M				F		
	Visayas		M	U	U	U				M		
Thailand	East coast	O	O	O	O	O	nd	nd	nd	O	O	2010
Malaysia	Peninsular Malaysia east coast	O	O	U	U	O	nd	O	O	M	F	2009/10
	Sarawak	O/U	O/U	U	U	nd	nd	O	nd	M	F	2009/10
	Sabah west coast	O	O	U	U	nd	nd	O	nd	M	F	2009/10
Indonesia	FMA 711	F/O	F/O	U/M	M	nd	F/O	F/O	nd	nd	F/O	2010

Note: This table presents *indicative status* for species groupings. Terminologies for the level of exploitation vary between countries as do the methods of assessment and date of last assessment and the geographic scope of those assessments.

Depleted (D); overfished (O); fully fished (F); moderately fished (M); underfished (U) and "nd" denotes no data available or uncertain status. Several values indicate the range of reported values (e.g. several sub-areas).

Small pelagic species are overfished or fully fished in China, northern Viet Nam and Gulf of Thailand. They are fully fished in southern Viet Nam and the northern part of the Philippines. In the southern and southeastern parts of the South China Sea they are underfished or moderately fished. The stocks of **anchovies and sardines** are overfished on the western side of the South China Sea and moderately or underfished in the northern and central Philippines.

Low-value/trash fish species are fully fished or overfished where assessed, but there is a lack of data for this component of the catch from several countries. This is partly because of the inclusion of the species that comprise this group elsewhere in the small demersal, surimi and anchovy sardine groupings. All the assessed stocks of **surimi species** are overfished in all areas.

Squids/cuttlefish are overfished or fully fished in the northern part of the South China Sea and the Gulf of Thailand. In the southern and eastern parts they are generally moderately fished.

Crustaceans are rated as fully fished or overfished in all the assessed fisheries.

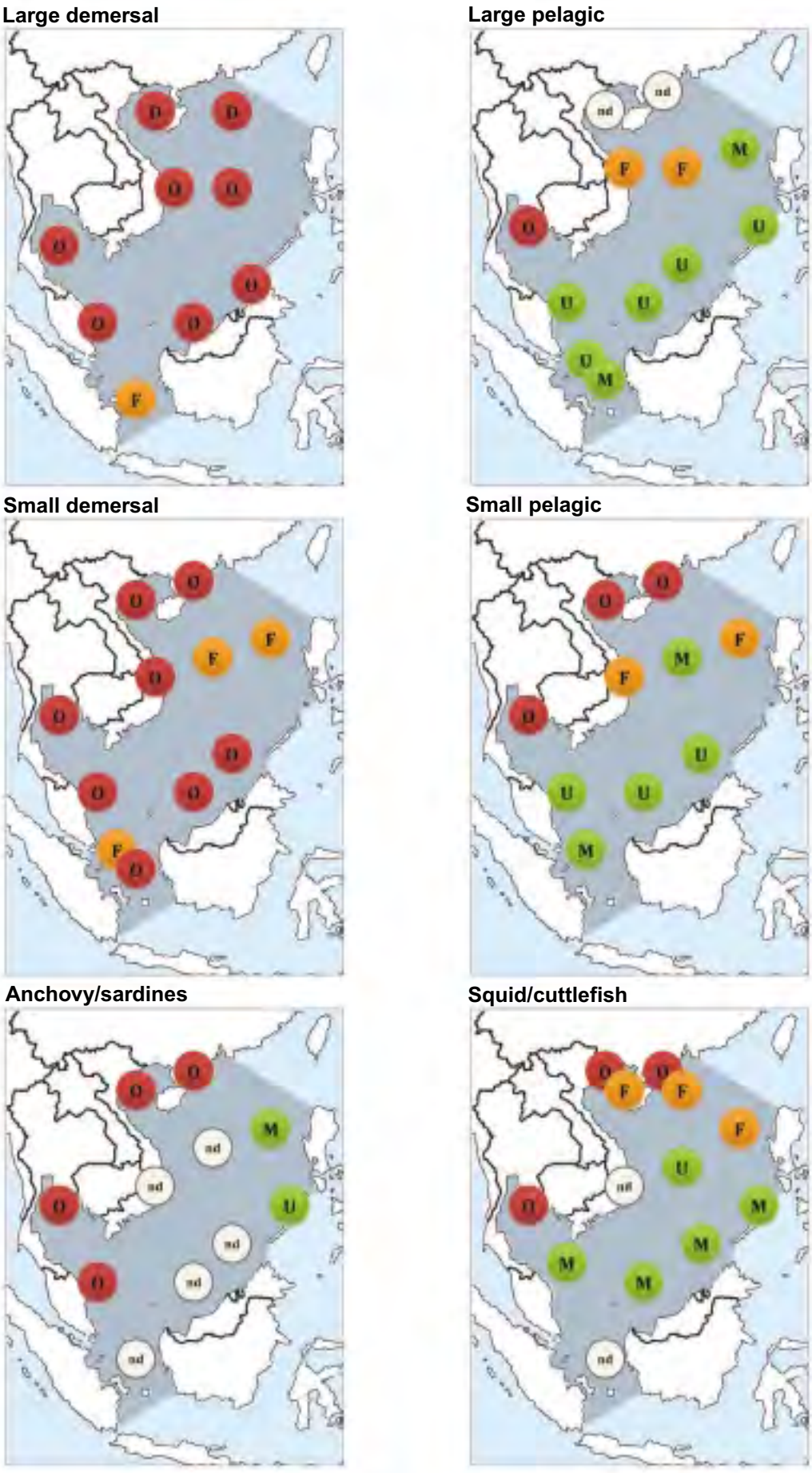
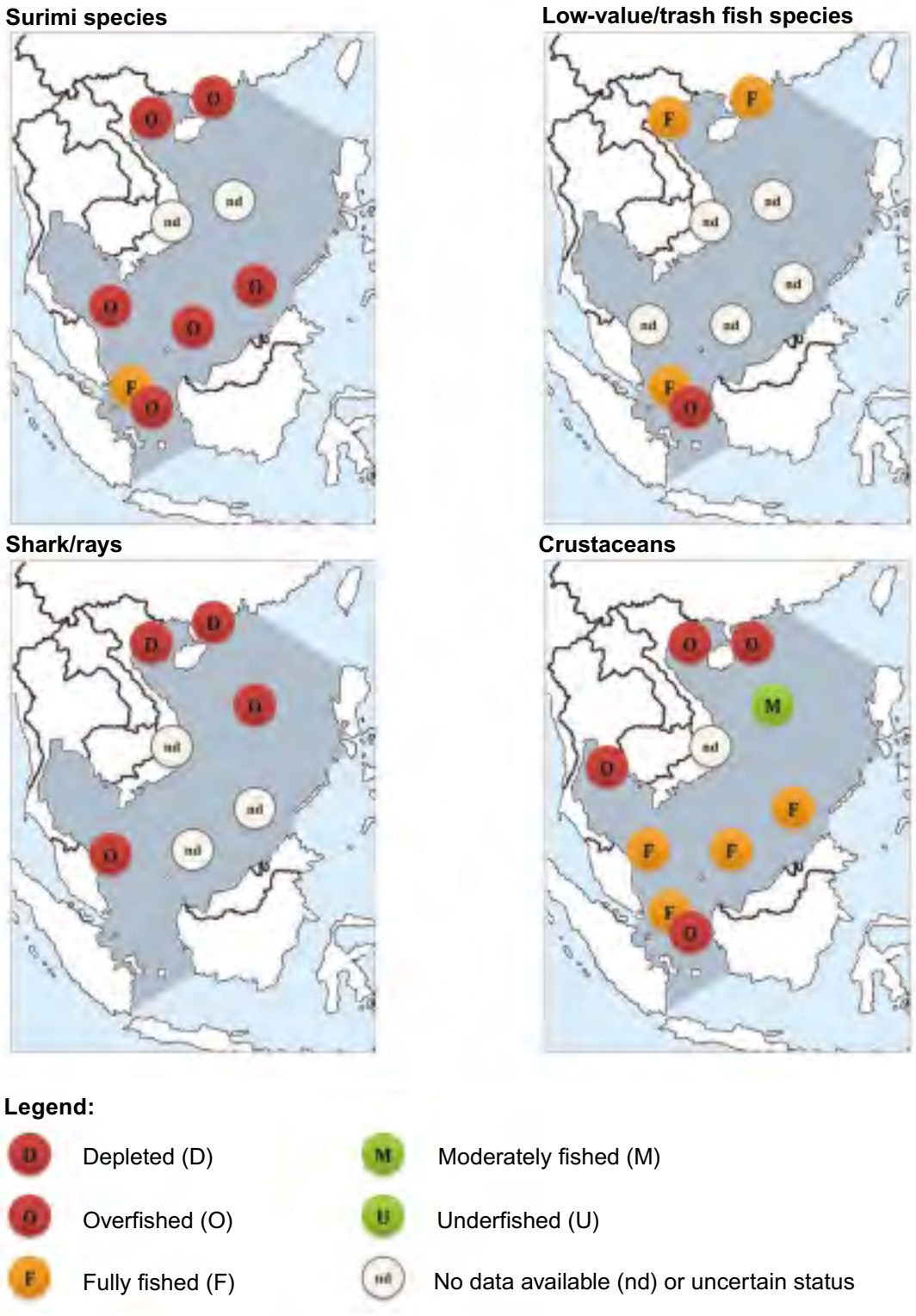


Figure 5 Indicative status of various fishery resources in the South China Sea subregion



Note: This table presents *indicative status* for species groupings. Terminologies for the level of exploitation vary between countries as do the methods of assessment and date of last assessment and the geographic scope of those assessments.

Figure 5 (cont.) Indicative status of various fishery resources in the South China Sea subregion

Trends in CPUE/catch rates

For a majority of the assessed fisheries (by gear) in the region the catch per unit effort (CPUE) and catch rates are declining (Table 9; 12 out of 15 examples). *A majority of the assessed trawl fisheries show declining CPUE* or catch trends. Also, a majority of the assessed purse seine fisheries show declining CPUE or catch rates. All net fisheries assessed show declining CPUE or catch rates. The CPUE for handline fisheries declined in one of the two assessed fisheries. Table 10 contains more detailed CPUE data for specific gears or fisheries.

Table 9 Changes in CPUE for different gears over time intervals in the South China Sea subregion

Country/area	Time period	Overall	Otter/ pair trawl	Purse seine	Other seines	Drift/gill net	Hand line	Long-line	Anchovy purse seine
China Northern part of SCS	**1970 to 2008**	↓ -43%	↓ -21 to -58%						
Viet Nam Demersal CPUE	**1985 to 2003**	↓ -68%							
Philippines Moro Gulf	**2003 to 2007**			↑ +21%		↓ -47%	↑ +48%		
Thailand East coast	**1997 to 2009**		↓ -48%	↓ -41%					
Malaysia Peninsular Malaysia east coast	**2000 to 2010**		↑ +1%	↓ -25% to -36%		↓ -21%			↑ +15%
Malaysia Sarawak	**2008 to 2010**								
Malaysia Sabah west coast	**2000 to 2008**			↑ +4-18%		↑ +7%			↑ +40%
Indonesia FMA 711	**1990 to 2007**		↓ -43%	↓ - 63%		↓ -36%			
Cambodia	No data								

Increased (↑); Decreased (↓) over the time period indicated. Where data were available, a two year average for the CPUE at the start and finish dates was used.

In China CPUE showed a decreasing trend until the 1990s. This is perhaps a similar situation to the Gulf of Thailand where heavy fishing pressure has resulted in a "fishing down" effect and the fishery has stabilized, with a shift to faster recruiting smaller species. The CPUE appears relatively stable in the **Gulf of Thailand** fishery, although overall rates are extremely low compared with rates 20 years ago. This perhaps suggests a relative stability in the fishery at a highly "fished down" level.

In **Indonesia (FMA 711)** CPUE/catch per hour is decreasing, mainly for the demersal and some small pelagics. The CPUE, expressed in mT/boat/year between 1998 and 2008 see large demersals decreasing from 600 to 20; small demersals decreasing from 300 to 20; small pelagics decreasing from 40 to 20; large pelagics stable at 5 to 6; small tuna stable at 10 to 15; crustaceans stable at 400.

For **Viet Nam,** the catch rate has declined over the last few decades, from about 1.1 tonnes/hp/year in 1985 to 0.3 tonnes/hp/year in recent years.

In the **Philippines** CPUE has been increasing in some areas, although no data are presented for nearshore coastal demersal or reef associated resources.

In Malaysia CPUE decreased over the decade (2000 to 2010) in the fisheries of Peninsular Malaysia east coast (purse seine declined 25 to 36 percent, drift/gillnet declined 21 percent). Anchovy CPUE increase in the same area (up 15 percent). In west coast Sabah, CPUE generally increased, with a significant jump in the anchovy fishery (up 40 percent), the reason for this increase is not explained although there is increased targeting of this resource, which had previously been quite underfished.

Table 10 Detailed trends in CPUE/catch rates by gear or resource for the assessed South China Sea and Gulf of Thailand fisheries areas

Country	Time period	CPUE/comment	Area
China	1980s to 2011	CPUE decreasing and seems to have levelled off since the late 1990s	**Northern part of the South China Sea**
	1983 to 1992 1986 to 1998 1986 to 1998	251–104 kg/hr 792–382 kg/kW/yr 638–149 kg/hr	**Northern shelf** Otter trawl Pair trawl Pair trawl
	1998 to 2011 1970 to 1992 1983 to 1992 1992 to 2011	149–271 kg/hr 1 870–750 kg/kW/yr 159–116 kg/hr 113–105 kg/hr	**Beibu Gulf (Gulf of Tonkin)** Pair trawl Otter trawl Otter trawl Otter trawl survey
Viet Nam	1985 to 2003	CPUE decreasing from 1 120 kg/hp/yr (1985) to 350 kg/hp/year (2003)	**National**
	2000 to 2005	87 kg/hr 60 kg/hr–40 kg/hr 40 kg/hr–70 kg/hr 71 kg/hr–88 kg/hr	Demersal, north Demersal, south west Demersal, south east Demersal, central
Philippines	2003 to 2007	45–114 kg/day 858–1 704 kg/day 3 450 – 5 820 kg/day 1 472–701 kg/day 5 989–1 777 kg/day	**Moro Gulf** Handline (Yellowfin tuna) Purse seine (Yellowfin tuna) Purse seine (Skipjack tuna) Ringnet (Yellowfin tuna) Ringnet (Skipjack tuna)
Thailand Gulf of Thailand	1976 to 1998	Decline 77.5 kg/hr to 17.9 kg/hr	Overall
	2003 to 2005	Stable 22.4–24.2 kg/hr Stable 1.01–0.94 kg/hr Stable 6.85–6.4 kg/hr Stable 4.05–5.8 kg/hr Stable 0.11–0.06 kg/hr Stable 0.27–0.23 kg/hr Stable 9.59–10.38 kg/hr Range 13 to 35 kg/hr Range 25 to 51 kg/hr Range 91 to 167 kg/hr	Overall Pelagic species Demersal species Cephalopods Shrimp Crab True trash fish Otter board trawl (<14 m) Otter board trawl (>14 m) Pair trawl
	2006 to 2011	Decline 24.7 to 25.0 kg/hr Increase 0.6 to 1.6 kg/hr Increase 7.1 to 9.9 kg/hr Increase 5.5 to 6.6 kg/hr Stable 0.1 to 0.1 kg/hr Decline 0.26 to 0.21 kg/hr Decline 10.5 to 5.9 kg/hr	Overall Pelagic species Demersal species Cephalopods Shrimp Crab True trash fish
Malaysia	2000 to 2010	Slight increase 54 to 43 kg/trip Decrease 2.2 to 1.4; 5.5 to 4.1; 21 to 16 mT/trip Increase 1.11 to 1.27 mT/trip Slight increase 0.8 to 0.97; 9.8 to 9.4; 13 to 13.7 mT/trip	***Peninsular Malaysia east coast*** Drift gillnet (Zone A) Purse seine (Zone B; Zone C; Zone C2) Anchovy purse seine (Zone A) Trawl (Zone B; Zone C; Zone)
	2008 to 2011	Decrease 47.04 to 11.82; 10.36 to 11.57 mT/trip Decrease 2.2 to 1.5; 5.5 to 4.2; 21 to 15 mT/trip (effort data not reliable – under system review) Decrease 0.66 to 0.28 mT/trip	***Sarawak*** Drift gillnet (Zone A, Zone B) Purse seine (Zone B; Zone C; Zone C2) Trawl (Zone B; Zone C; Zone C2) Other seine (Zone A)
	2009 to 2011	Slight increase 1.72 to 1.85 mT/trip 2.71 to 3.2 & 32.38 to 33.79; 22.72 to 24.55; Slight increase 6.03 to 6.79 mT/trip Slight increase 3.0 to 4.2 mT/trip (effort data not reliable – under system review) Decrease 3.89 to 3.10 mT/trip	***Sabah west coast*** Drift gillnet: (Zone A) Purse seine: (Zone B; Zone C) Purse seine (Zone C2) Anchovy purse seine (Zone A) Trawl (Zone B; Zone C; Zone C2) Other seine (Zone A)
Indonesia	1998 to 2008	Stable 40–50 tonnes/boat/yr Decrease from ~50 to ~20 tonnes/boat/yr Fluctuating between ~8 to ~5 tonnes/boat/yr	FMA 711 Trawler Seiners Drift gillnets

Low-value/trash fish production

Total production of trash/low-value fish species in the South China Sea subregion is estimated at 1.7 million tonnes (Table 11). This is a significant reduction (nearly 65 percent) over previous estimates and certainly reflects improved reporting of small demersals, anchovies, sardines and small pelagic species. It also perhaps reflects their increased utilization for human food and the increased preservation of this catch.

Table 11 Production of trash fish/low-value fish for the South China Sea fisheries areas

Country/area	Tonnes	% of total fisheries production	Comments/reference
China South China Sea	**1 280 000**	~40%	Based on the reported 3 200 000 tonnes of marine catch and 40% of trash fish/ low-value fish from sampling in year 2010.
Viet Nam	**933 183**	36% (of national catch, which was 2.6 million tonnes in 2002) 28 to 51% (Gulf of Tonkin) 47 to 68% (southeast area)	Tables in the report "Preliminary Analysis of the Enumerator Sampling Program", RIMF, Hai Phong, 2002 and survey data from Halong (408 vessels in 1996 to 1997).Otter trawl survey data 1996 to 1997, ALMRV.
Philippines	**78 000**		
Thailand East coast/ Gulf of Thailand	**367 505**	43% of overall trawl catch; 65% of otter trawl catch; 21% of pair trawl catch; 10% purse seine; 2% push net	**2007 figures** Historic levels: 561 514 tonnes (1997); 430 701 tonnes (2005) Fisheries statistics 2007 (DOF, 2009)
	299 628	60% of overall trawl catch 56% of otter trawl catch 29% of pair trawl catch 11% purse seine; 2% push net	**2009 figures** Fisheries statistics 2009 (DOF, 2011) Source: Research trawls
Indonesia FMA 711	**83 600**	Estimated as 11 to 15% of total landing	2008 figure, increased from 21 900 in 1980 National total 427 900 tonnes in 2008.
Malaysia Peninsular Malaysia east coast; Sarawak & Sabah	**106 404**	35% (as percent of total low-value/ trash fish landings) 23% Peninsular Malaysia east coast; 4.37% Sarawak; 6.7% Sabah	2010 Figures: Predominantly from trawl fisheries. Fisheries annual statistics 2000 to 2010. Decreased from 43% of total capture landings in 2000.
Cambodia	**nd**		

The percentage composition of the total production varies according to area, but reaches 60 percent or more in some areas. Overall, in the reported fisheries low-value trash fish is consistently more than 20 percent of the overall catch and will be a considerably higher percentage for the trawl fisheries (more typically 40 to 60 percent of catch), which are responsible for the majority of the catch. In some fisheries this proportion is even higher where trawl gears with small mesh sizes and depleted diversity sees anything up to 79 percent of the catch comprising the low-value trash fish component.

The composition of this catch and the fact that it is now typically used as aquaculture feed, has led to increasing interest in determining what exactly the impacts of the fishing for this component of the catch are on the wider fishery and ecosystem as a whole. All trawl fisheries will generate a proportion of this sort of low-value or trash fish, either because fish are damaged by the trawling action or the species are rather soft and easily damaged or bony and unusable as human food. The important issue to resolve is how to minimize the catch of species that have commercial value.

Recommendation: the composition (species) and locations of capture of the low-value and trash fish component should be more clearly elaborated. This is important where this is being directed into fishmeal or feeds so that the real value and/or impact of this catch can be properly assessed.

Fishmeal production

The total fishmeal production (Table 12) for the South China Sea subregion is estimated to be approximately 641 400 tonnes (assuming the 2008 IFFO estimate of only 5 000 tonnes for the Chinese provinces adjoining the SCS area). This is an 11 percent increase over the 2008 estimate of 576 000 tonnes. This fishmeal is derived largely from the low-value/trash fish catch reported in Table 11, although there are some targeted small pelagic catches that are directed into fishmeal production.

Table 12 National production, import and export of fishmeal in countries bordering the South China Sea (tonnes)

	Country					
	China	Viet Nam	Philippines	Thailand	Malaysia	Indonesia
IFFO (2010) National production	465 600	70 200	0	505 000	46 200	15 000
Fishmeal imported (2009)	1 321 033	124 430	23 780	19 034	21 862	67 785
Fishmeal exported (2009)	56 919	25 731	1 442	62 170	18 263	4 655

Notes:

Production data: IFFO estimates.

Import and export data: unless otherwise indicated, these are taken from FAO FishStat Commodities data set (2009). Note that besides various forms of fishmeal, this data also includes fish solubles, fish silage, fish waste, fish bonemeal.

China: there is very limited fishmeal production in the China mainland provinces bordering the South China Sea (~5 000 tonnes). The APFIC 2010 review suggested that the figure for the southern Chinese provinces bordering the South China Sea could be as much as 141 000 tonnes. The major fishmeal producing provinces in China are Shandong, using *Engraulis japonicus* and Zhejiang, using *Benthosema pterotum*.

Indonesia: data at national level.

Malaysia: data at national level.

Thailand: Import and Export Official figures (2009), Department of Fisheries. 2011. Fisheries Statistics of Thailand 2009. Fisheries Statistics Analysis and Research Group, Information Technology Center, Department of Fisheries, Ministry of Agriculture and Cooperatives. Technical paper no. 9/2011. 96 pp.

Production of fishmeal from processing wastes from capture fisheries and aquaculture is considered to be very significant in the region. These are trimmings and processing waste from fish processing converted to fishmeal (from fishery products destined for surimi, canning, filleting, heading and from aquaculture products e.g. shrimp heads, pangasius and tilapia processing wastes). IFFO estimates that up to ~56 percent of the fishmeal produced in the East Asian region is derived from this source. Globally this figure is only 25 percent. The fishmeal produced form fish processing is typically lower in protein content (~55 to 60 percent protein), and high in calcium (because of the use of fish frames, heads, bones etc.). However, since it is derived from fish destined for human food, the freshness is excellent and the final fishmeal product is of high quality.

There is an increasing interest in finding small pelagic fisheries that can be certified for fishmeal production in order to enable the production of certified animal feeds (e.g. pet foods and aquaculture feeds). Fishmeal derived from processing wastes as described above is relatively easy to certify. The data on fishmeal production are rather difficult to obtain and typically refer to production by industrial scale producers.

The figure above is an effort to determine the flow of fish for food and fish for feeds in the East Asian region. This means it includes all of the countries of East Asia and their aquaculture production. It is therefore not a picture of the South China Sea. The figures does demonstrate that aquaculture is providing more fish for food than fisheries in the East Asia region. It also shows that aquaculture demand for marine fish for direct feeding and fish feeds is considerable. Finally, the figure includes the use of processing wastes as fishmeal. These wastes make a considerable contribution to the overall quantity of fishmeal produced within the region.

Recommendation: The fish species composition of fishmeal should be identified according to the fishery/area of production.

Capture production of surimi species

The production of surimi in the region has increased dramatically over the past decade and reached more than 753 646 tonnes in the South China Sea subregion in 2007 (Table 13). This has increased since then, although up-to-date statistics are not available. Thailand's production increased more than 100 percent between 2005 and 2007. This has been driven by two main factors: the processing techniques for surimi have transferred well within the region and raw materials from trawl fisheries are increasingly of a type more suited for processing into surimi than direct consumption (e.g. species that have low interest to consumers).

Table 13 Production of surimi and catch of fish (raw material) from which it is derived (tonnes) in the South China Sea and Gulf of Thailand

	Surimi prodn.	Total raw material required	Thread fin bream	Lizard fish	Goat fish	Croaker	Snapper (big eye/ king)	Barra-cuda	Others
Thailand National 2007	150 000	600 000 to 700 000	189 000	190 000	119 000	Included with goat fish			32 000
China SCS provinces	111 146	nd							
Malaysia National	100 000	89 941	127 300	154 100	67 000	Included with snapper	100 500	214 400	6 700
Viet Nam National	63 250	115 035		67 620		55 860	126 420		44 100
Indonesia National	8 000	32 000	21 760		4 160	3 200	2 560		320
Total	**753 646**	**3 014 584**							

Notes: Unless specified, the 2005 figures are derived from reference http://map.seafdec.org/SurimiMile/index.php and Siriraksophon & Laong-manee (2005).

Total raw material required: 3 014 584 tonnes. This is based on the conversion of fresh fish to surimi. A crude estimate is that 100 kg of fresh fish yields approximately 20 to 25 kg of surimi. Additionally, approximately 16 kg of fishmeal is also derived from the processing wastes.

Thailand: 2007 production of surimi was 309 479 tonnes from a catch of fish suitable for surimi of 1 169 215 tonnes.

China: data based on 2010 China Fishery Statistical Yearbook, which reported surimi production in year 2009 for three mainland provinces bordering the South China Sea: Guangdong, Guangxi, and Hainan. The amount of raw material is unknown and this may include freshwater species.

Malaysia: 2010 annual landing of mixed fish category that was turned into surimi is 81 941 tonnes. This figure for raw material may be underestimated (typically 4 to 5 kg of raw material are needed for 1 kg of surimi).

Indonesia: surimi production is approximately 19 percent of total landings of surimi species. It is assumed the rest is exported as raw material for surimi production elsewhere.

This second factor is one reason why the low-value trash fish levels of trawl fisheries are not increasing despite the increasing trawl effort; increasingly species previously regarded in the trash fish category and not previously targeted, are now increasingly sought out for processing into surimi (Table 14). This is a possible reason for declining reports of low-value/trash fish production in the region.

The manufacture of surimi, which entails pulverizing fish into a puree, has implications for the identification of the species used and ultimately the source of those fish. Surimi is essentially untraceable, unless the fish used for the surimi have some form of catch documentation and the surimi is produced on a batch basis. This is unlikely in most cases, with multiple sources of fish being used for any batch of surimi. This challenges both food safety and traceability, as well as the potential for mixing IUU catches with legitimate catches.

Recommendation: The production of surimi should be reported more consistently. Surimi production is reported both in terms of final product and the raw fish equivalent. Sources of fish for surimi should be clearly identified to assist with food safety, traceability and catch documentation.

Table 14 Typical species used for surimi production

Common name	Genus/species	India	China	Thailand	Malaysia	Viet Nam	Indonesia
Threadfin bream	*Nemipterus* spp.	●		●	●		●
Lizard fish	*Saurida* spp.	●	●	●	●	●	
Goat fish	*Upeneus* spp.	●		●	●	●	●
Croakers	*Sciaenidae* spp.			●	●	●	●
Snapper (big eye/king)	*Priacanthus* spp.	●	●		●	●	●
Barracuda	*Sphyraena* spp.				●		
Conger pike	*Muraenesox cinereus*		●				
Spanish mackerel	*Scomberomorus* spp.		●			●	
Shark			●				
Cuttlefish			●				
Trevallies	*Selaroides*	●					
Bullseye	*Pempheridae*	●					
Ribbonfish	*Trichiurus* spp.	●					
Emperors	*Lethrinidae*						
Other species				●	●	●	●

Fishery zoning

Table 15 Fishing zones of the countries in Southeast Asia (South China Sea)

Countries	Fishing Zone 1	Fishing Zone 2	Fishing Zone 3	Fishing Zone 4
Brunei Darussalam	From shoreline to 3 nm	From 3 nm to 20 nm	From 20 nm to 45 nm	From 45 nm to EEZ limit
Cambodia	From shoreline to 20 m depth	From 20 m depth to EEZ limit		
China	Inshore (<40 m)	Offshore (40 to 100 m)	Shelf edge (100 to 200 m)	Central South China Sea
Indonesia	From shoreline out to 4 nm	From the outer limit of first fishing zone to 12 nm from shore	From the outer limit of second fishing zone to EEZ limit	
Malaysia	From shoreline to 5 nm	From 5 nm to 12 nm	From 12 nm to 30 nm	From 30 nm to EEZ limit
Myanmar	From shoreline to 5 nm in the northern area, 10 nm in the southern area	From outer limit to first fishing zone to EEZ limit		
Philippines	From shoreline to 15 km	From 15 km to EEZ limit		
Singapore	From shoreline to within port limits	From 12 nm to EEZ limit		
Thailand	From shoreline to 3 km artisanal fishing zone	From 3 km to 12 nm	From 12 nm to EEZ limit	
Viet Nam	From shoreline to coastal line (~6 nm from shoreline)	From shoreline to middleline (~24 nm from shoreline) depth to the EEZ limit	From middleline to the EEZ limit	

Adapted from SEAFDEC (2008), with additional data for China.

Thailand: 3 km limit expressed as nm

Management measures

Table 16 Examples of management measures used in the different fisheries in South China Sea and Gulf of Thailand (by zone)

Area	Closed areas	Closed seasons	Size limits (biological)	Gear/vessels restrictions	Licensing	Quotas
China *Northern part of the South China Sea*	Zone 1	Zone 1	No	Zones 1	All zones	No
Viet Nam	Exist	Exist		Zone 1 trawler with engine <90 hp		No
Philippines		Zone 1		All zones	All zones	
Thailand *Gulf of Thailand*	Zone 1	Zone 1		All zones		
Malaysia *Peninsular Malaysia east coast, Sarawak, Sabah*	Zone 1			All zones	All zones	
Indonesia *FMA 711*				All zones	All zones	TAC

Notes:

Indonesia: TAC quota from MF Ministerial Decree no.: Kep. 45/MEN/2011

Viet Nam: Zone 1 restriction for fish trawlers with engine <90 hp

Vessel numbers

There is a total of over 1.77 million vessels in the South China Sea (Table 17) with small-scale vessels predominating (approximately 1.5 million vessels or 86 percent of the total). This has implications for the extent to which fishing is pursued into offshore areas or remains largely confined to shallower nearshore coastal fisheries. The indication for fishing vessel numbers is that the bulk of the fishing capacity is confined to nearshore waters.

Recommendation: The extent to which effort is confined to this area should be investigated further as the proportion of catch from the nearshore coastal fleet and other vessels is not clearly reported.

Table 17 Number and type of fishing vessels in the South China Sea assessed fisheries (by area)

Vessel/gear type	Area					
	China *(SCS)*	Viet Nam	Philippines	Thailand *(east coast)*	Malaysia *(Peninsular Malaysia east coast, Sabah, Sarawak)*	Indonesia *(FMA 711)*
Year	**2004-2008**	**2010**	**2002**	**2000**	**2010**	**2010**
Trawlers	14 929	22 554				8 549
Purse seiners	5 747	6 188				1 778
Gillnet	52 704	47 312				16 187
Hook-and-line	6 979	21 896				28 232
Set net	2 685	4 240				4 553
Others	8 171	26 259				78 680
(Tuna) Longline	1 097	1 070				–
Non-powered				2 639	2 891	20 977
Outboard engine				42 217	14 697	19 486
Inboard engine				13 263	9 883	36 300
<5 GRT					16 751	28 139
>5 GRT					7 829	8 161
Small scale			1 371 676			
Commercial			16 497			
Total	**92 312**	**129 519**	**1 388 173**	**58 119**	**24 580**	**76 763**
Fleet capacity (kW)	4 777 533	6 500 000				

Notes:

China: data for three China mainland provinces were reported for 2008. The present update includes a number of Hong Kong fishing boats 4 326 (with total horsepower of 922 949 kW) reported for 2004. Also included is a number (1 097) and horsepower (255 321 kW) of Taiwan POC-based tuna longliners operating in the central part of the SCS. The data were reported for 2005.

Malaysia: the breakdown of vessel numbers does not sum to the total number of vessels because the breakdown is given for both motorization and GRT with a slight increase over the 2008 figures, mainly for outboard engine vessels.

Thailand: data from the 2000 Inter-censal Survey of Marine Fishery in Thailand: Department of Fisheries, 2009; In 2013, the National Statistic Office plans to carried out a census survey of the agricultural sector, including fisheries.

Indonesia: the gear breakdown is more than the total number of vessels, since one vessel may use more than one type of gear. The breakdown by GRT applies only to inboard powered vessels. The total for all Indonesian FMAs is 596 184 vessels.

Viet Nam: there is a 23 percent increase in vessel numbers from 2003 to 2010, but a 66 percent increase in fleet power.

Only three areas reported vessels by type of gear and of these two areas gillnetters and trawlers dominate the fleet composition. Purse seiners are relatively common, however, smaller sized gears are used to a large extent in Indonesia (e.g. hook and line). Despite some reports of fleet reductions, the overall power in the fishery seems to be increasing over that presented in previous APFIC reports. The capacity of the Vietnamese and Chinese SCS fleet is 6.5 and 4.8 million kW respectively, giving an average vessel capacity of 50 to 60 kW or 68 to 84 hp.

Recommendation: the fishing effort and production from coastal fisheries versus fishing further offshore should be clearly disaggregated.

Employment

About 3.73 million people are employed in the South China Sea area fisheries (Table 18). The breakdown of these figures into full-time and part-time is variable between countries and is rather inconsistently reported. Countries report either full- or part-time fishers, in some cases there is a breakdown between large- and small-scale fishing, and elsewhere the figures are separated between nationals and non-nationals (e.g. Malaysia) or between owners/family members and employed crew. The definitions of employment in small-scale fisheries and larger scale more commercial type fisheries are unclear and thus it is not possible to estimate with confidence employment in the two parts of the sector. However, the fact that the majority of vessels are operating within the small-scale sector indicates that this is the most significant form of employment as well.

Recommendation: Effort should be made to harmonize the recording of fishing vessel employment to reflect employment in large- and small-scale fishing.

Table 18 Employment in the South China Sea fisheries (and associated areas)

	Area					
	China *northern part of the South China Sea*	**Viet Nam**	**Philippines**	**Thailand** *Gulf of Thailand*	**Malaysia** *Peninsular Malaysia east coast,Sabah, Sarawak*	**Indonesia** *FMA 711*
Year	**2009**	**2003**	**2002**	**2000**	**2008**	**2010**
Full-time	376 716	750 000*			56 113	169 208
Part-time	272 083					150 811
Family member				80 857		75 036
Employee/crew				87 823		
National					44 364	
Foreign crew					11 749	
Small-scale			1 781 000			24 949
Commercial			7 800			
Total	**648 799**	**n/a**	**1 788 800**	**168 680**	**56 113**	**320 017**

Notes:

China (SCS): The update includes a number of Hong Kong fishermen (~8 200) reported for 2010 and an estimate of Taiwan POC tuna longline fishers in the central part of the SCS (~8 562).

Viet Nam: Estimated.

Philippines: Special Release 159 National Statistics Office, April 18, 2005.

Thailand: 2000 Inter-censal Survey of Marine Fishery in Department of Fisheries, 2009.

Indonesia: Data available at provincial level, total national employment in fisheries in Indonesia is 2 162 442 (2010).

Marine protected areas, closed areas and others

Closed areas come in many forms of which marine protected areas (MPAs) are the most common and well-known. The countries in the region have a total of at least 726 MPAs at national, district and local level (Table 19). There is a degree of mixing of marine protected areas (inferring water surface or benthic ecologies such as coral or seagrass) and more general mangrove or coastal areas (which are a combination of water and land). The contribution of these environments to fisheries varies, but they all have unique value and should not be aggregated. There are many examples of seasonally closed areas or zones in many of the countries. Additionally, there are examples of oil exploration areas that tend to be *de facto* no fishing zones (or exclusion areas).

Artificial reefs have also been constructed in several countries and these have been included the current inventory (although this data is probably incomplete).

Table 19 Marine protected areas and areas where fishing is restricted or excluded in the South China Sea and Gulf of Thailand

Area	Marine protected areas (number/area)	No fishing zones and prohibited areas	Oil exploration areas	Seasonal closed areas	Artificial reefs
China *South China Sea*	374 659 km^2	0	0	2 160 000 km^2	43 areas occupying 220 km^2 (51 893 units occupying 20 896 040 m^3)
Viet Nam	162 700 km^2				
Philippines	~600 MPA at local and district level			3	
Thailand *East coast*	71 496 km^2		21 479 km^2	(8)	Small area: 359 sites occupying 418 km^2 Large area: 33 sites occupying 1 430 km^2
Malaysia *Peninsular Malaysia east coast*	42 Islands & marine parks; 6 MPA 1 404 km^2	47 Prohibited areas are maritime waters within 3 km from any part of the coast/island 2 310 km^2			Soft bottom artificial reef: 12 sites (14 700 m^2) Tetrapod: 10 sites (12 250 m^2) Lobster artificial reef: 1 (400 m^2) Vessel: 445 vessels
Malaysia *Sabah*	6 marine parks 575 km^2				Cuboid: 13 districts along the coastline both in the South China Sea and Sulu-Sulawesi Sea.
Malaysia *Sarawak*	3 marine parks				Bebola: 2 084 units Tyre: 195 441 tyres Oil-rig: 1 unit Vessel: 84 vessels
Indonesia *FMA 711*	18 990 km^2	6	++		

Sources: http://www.southchinasea.org/?s=marine+protected+areas
http://www.southchinasea.org/docs/marine%20protected%20areas_in_South%20East%20Asia.pdf (2002)

Notes:

China: 2012 updated by including Designated Marine Parks and Marine Reserves in Hong Kong territory waters [(5)/24.3 km^2]. Artificial reefs include those in Hong Kong territory waters [637 units/166 040 m^3 or (4)/1.76 km^2]. The scale of China's artificial reefs (43)/220 km^2 may also be expressed as 51 893 units/20 896 040 m^3.

Philippines: 600 MPA at local and district level.

Indonesia: existing MPAs nationally = 15.7 million hectares (77.5% from target for 2020 of 20 million hectares. Source: REALISASIKAN TARGET KAWASAN KONSERVASI LAUT, INDONESIA GANDENG AS LUNCURKAN MPAG http://www.kkp.go.id)

Thailand: artificial reefs are for whole country.

Viet Nam: based on Prime Minister's Decision on planning to 2015

Malaysia: MPAs http://earw.icriforum.org/2010/11.Malaysia_%28Irwan_Isnain%29.pdf; http://www.dmpm.nre.gov.my/85-what_is_marine_park.html

Trends in marine capture fishery production in the Bay of Bengal

Landings from the waters of the BOBLME were estimated to be approximately 111 million tonnes between 1950 and 2006. A large number of taxa, each contributing only a relatively small amount to total catches (here grouped as "mixed group") account for 75 percent (~83 million tonnes) of the landings. **Landings have been increasing for the past decade and are now reaching 6.86 million tonnes**.

Figure 6 The Bay of Bengal subregion

India and Myanmar fleets catch over 50 percent of fish in the Bay of Bengal. The majority of landings from the BOBLME were by India's fishing fleets, which accounted for 27.1 percent of total landings (1.2 million tonnes/year since 2000). Myanmar's fleets accounted for 24 percent of total reported landings (1.1 million tonnes/year since 2000). Note, however, that there is uncertainty about Myanmar's reported landings statistics for recent years. These contributions are followed by:

- Thailand (629 000 tonnes per year since 2000)
- Bangladesh (424 000 tonnes per year since 2000)
- Indonesia (494 000 tonnes per year since 2000)
- Malaysia (361 000 tonnes per year since 2000)
- Sri Lanka (119 000 tonnes per year since 2000)
- Maldives (156 000 tonnes per year since 2000).

Other countries from outside the Bay of Bengal (primarily Japan and Taiwan Province of China) represented less than 1 percent of total landings from the Bay of Bengal LME.

The four most important individual taxa (71 000 tonnes/year since 2000) in the reported data, each accounting for about 3 percent of total catches over the entire time periodare:

- Indo-Pacific mackerels (*Rastrelliger spp*., 125 000 tonnes/year since 2000)
- Hilsa shad (168 000 tonnes/year since 2000)
- Skipjack tuna (143 000 tonnes/year since 2000)
- "Drums or croakers" (100 000 tonnes/year since 2000).

Marine resource management

The eight maritime countries in the BOBLME were assessed on their sustainable use of the resources within their EEZs, using 14 indicators of marine living resource management. The Maldives, scored highest, indicating that it could be considered a leader in marine resource management within the Bay of Bengal, but it has different dependencies on marine resources compared to the other Bay of Bengal countries. Overall, there is no single action that can be prescribed to improve marine resource sustainability; this will vary between countries, as they have different priorities, resources and values. However, the indicators presented here assist in the prioritization of goals and actions, which need to

be implemented to ensure the health of marine resources. The **total catch in the Bay of Bengal was approximately 6.86 million tonnes from data provided between 2007 and 2010** (Table 20). The FAO capture fisheries statistics for these countries and areas for 2010 were 6.87 million tonnes.

Fisheries by country

The fishery production of the **Maldives** is dominated by tuna, namely skipjack and yellowfin, (e.g. 83 percent in 2010) caught by pole and line and handline. Tuna catches increased from the beginning up until 2006 with the highest recorded catch of 166 thousand tonnes, declining since then (catch of 2010 was roughly 55 percent lower than 2006). The decrease in tuna catches have resulted in a significant decline in total marine fishery production of the country (185 000 tonnes to 93 000 tonnes between 2006 and 2010). Maldives recently placed a complete ban on shark fishing. However, there is a recent development to establish longline fishing for tuna, which may increase impacts on shark bycatch if there is a considerable increase in longline fishing. A national plan of action on shark is under development. The reef fishery, targeting various reef associated demersal species using hook and line, has seen fluctuations in catch (between 15 and 20 000 tonnes) in the period 2004 to 2010.

Table 20 Catches and MSY estimates by country and resource/fishery/gear type in the Bay of Bengal

Country	Year	Catch	Estimated MSY	Area
Indonesia	2008 Total	51 000 70 000 88 000 19 000 118 000 104 000 93 000 27 000 **570 000**	27 700 147 300 82 400 11 400 164 800 315 900 68 900 4 800	FMA 571 – Large pelagic group FMA 571 – Small pelagic group FMA 571 – Demersal group FMA 571 – Penaeid shrimps group FMA 572 – Large pelagic group FMA 572 – Small pelagic group FMA 572 – Demersal group FMA 572 – Penaeid shrimps group 2010 catch figure reported to FAO **1 289 704** tonnes
Thailand Andaman Sea	2007 2010	631 453 623 471	912 943	
Malaysia Peninsular Malaysia (west coast)	2010	733 385	62 000 155 500	Demersal potential yield Small pelagic potential yield 2010 catch figure reported to FAO Note: 1 616 988 tonnes national potential yield
Myanmar	2007 2010	1 679 000 2 060 780	1 050 000	National figure based on marine fishery stock assessment survey conducted by FAO from *1980 to 1983* 2010 catch figure reported to FAO
Bangladesh	2008 2010	514 644 607 492	MSY not established (MFO, 2009)	Estimated pelagic biomass 319 000 tonnes [1973] Estimated demersal biomass 1 560 000 tonnes [1986]. A 50% estimate for MBSY is ~939 500 tonnes
India	2010	1 079 811	3 930 000 National figure	2010 catch figure reported to FAO
Sri Lanka	2009 2010	293 170 385 058	MSY not established	Estimated potential yield 250 000 tonnes/yr (170 000 pelagic, 80 000 demersal) 2010 catch figure reported to FAO
Maldives	2010a 2010b	14 481 94 953	MSY not established	30 000 ± 13 000 tonnes/yr.[1] estimated as the maximum potential yield for commercial reef fish. 2010a estimated total nearshore/reef fishery catch 2010b total catch figure reported to FAO

In **Sri Lanka** during 2007 and 2009 the marine catch was recorded as 252 670 and 293 170 tonnes respectively. There is nearly an annual increase of 40 000 tonnes. This increase is mainly a result of the catch from the north and east and also because of the ending of fishing restrictions imposed during the civil war. It is expected to increase more as the fishery is developing in the north and east. There is increasing fishing capacity in offshore fisheries and gill net fishery is being gradually replaced by tuna longlining. This is largely driven by export demand for tuna from the European Union (EU).

Across India (east and west coasts) the annual average landings are increasing from about 0.56 million tonnes between 1950 and 1954 to 3.16, 3.30 and 3.61 million tonnes in 2009, 2010 and 2011 respectively. The Government of India has estimated the potential yield of the Indian EEZ as 3.93 million tonnes in 2001 and this now being approached. The growth in fisheries is being driven by increased export of marine products, and extension of fishing grounds offshore. Transhipment of a portion of a few high-value products such as yellowfin tuna (~10 000 tonnes), pelagic sharks (~7 500 tonnes) and lobsters (~1 000 tonnes) is not covered by catch statistics. Contribution of small pelagic species continues to increase from 39 percent of total landings (1995 to 1999) to 45 percent in 2011. Within small pelagic species, contribution of oil sardine increased from 8 percent between 1995 and 1999 to 14 percent during 2011. Generally, significant increases in low-value small pelagic species and small demersals are being noticed. Contribution of large/high-value demersals decreased from 8.2 percent (2000 to 2004) to 6.2 percent (2011). Contribution of large/high-value pelagics has fluctuated. Discards at sea are estimated at 75 000 tonnes and typically arise from multiday trawlers. These discards are not included in the reported catch figure.

In the **Indian Fisheries of the southeast coast in the Bay of Bengal** there are relatively large numbers of fishermen and fishing craft but low productivity. Declining catch rate for trawlers and fishing down the food web are evident with economic collapse of whitefish and silver bellies. Oil sardine catch, which was nil in the 1980s, has emerged as the single largest fishery in the last ten years.

In the **Indian Fisheries of the northeast coast in the Bay of Bengal** recent strengthening of the marine fishing fleet has seen marine fisheries developing fast with catches increasing. Hilsa shad (*Tenualosa ilisha*) catch from the sea is increasing, but the catch from freshwater sources is decreasing.

In **Bangladesh** during 1991/1992, the marine catch recorded was 245 474 tonnes and the catch then increased to 333 799 tonnes in 1999/2000, 474 597 tonnes in 2004/2005 and 514 644 tonnes in 2008/2009 (FYSB, 1999 to 2009). In 2009, a production figure of 0.611 million tonnes of marine fish was recorded from the marine fishery sector (MFO, 2009). Hilsa shad is the most important species in marine capture fishery and accounts for nearly half of the national marine catch and 12 to 13 percent of the total fish production of the country.

Marine fisheries have developed continuously in **Myanmar** since 1950 and gone through a phase of rapid growth since the late 1990s, increasing production from 0.6 million tonnes in 1998 to about 1.6 million tonnes. A formal stock assessment was last conducted in Myanmar 30 years ago and no current information on fish stock status is available. Some fishery indicators seem to indicate a declining trend in marine resource abundance. Size composition of the catch of some commercially important fishes such as pomfret and hilsa shad has become smaller, and the CPUE of bottom trawl fisheries is also declining annually. It may be assumed that some marine fishery resources in Myanmar are overexploited and this seems consistent with the fact that the current landings are 50 percent higher than the estimated MSY. The national MSY estimation might need to be revised if ecosystem shifts have occurred increasing the productivity of smaller species.

The Andaman Sea fishery in Thailand has seen a reduction in total landings from 805 643 tonnes in 1999 to 631 453 tonnes in 2007 and this is principally attributed to overcapacity. This fishery contributes 16 percent of the national production, of which 60 percent is caught in Thai waters (~40 percent is caught outside of Thai waters).

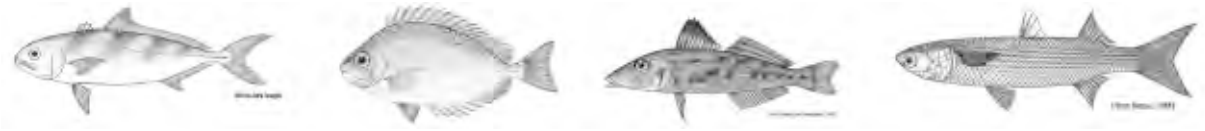
Approximately 56 percent (806 726 million tonnes) of **Malaysian** production (1.42 million tonnes) was from the Straits of Malacca. Inshore waters (an area of less than 30 nautical miles from the coastline)

contributed 83 percent of the catch and fishing vessels were usually below 70 gross tonnes (up from 81 percent). This is consistent with the large number of inshore fishing vessels, which comprise 98 percent of fishing vessels in the country. Trawls and purse seines are the two major gear types and contribute up to 71 percent of the landings (last figure 78 percent).

Catch composition trends in the Bay of Bengal and Andaman Sea subregion

The catch composition from the assessed fisheries in the Bay of Bengal subregion shows different trends depending on areas (Table 21 composition of catch landings).

Catch of **large demersal** species catches is increasing in the South Asian countries, but decreasing in the western side of the Bay of Bengal. Across the Bay of Bengal, large demersal species comprise from 3 to 16 percent of the catch.



Small demersal species have an overall stable or increasing relative catch in the region. Surimi species in the BOB area are not generally targeted for surimi production and are thus counted as small demersal species.

The catch of **sharks and rays** is decreasing in most of the fishing areas reported here, however it is increasing in Malaysia. This group comprises between 1 and 4 percent of the catch.

The relative catch trends for **large pelagic species** are stable. This group forms a relatively large proportion of the catch in Sri Lanka (53 percent) and Maldives (83 percent) as well as in the Indonesian FMA 572 waters (25 percent). Elsewhere in India, Myanmar, Thailand, Malaysia and Indonesia FMA 571 large pelagic species comprise only 4 to 12 percent of the catch.

Table 21 Trends in catch composition for the assessed Bay of Bengal fisheries areas

Country/area	Time period	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low-value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans
Maldives	2004 to 2010	+	+	–	+	nd	nd	nd	–	nd	nd
Sri Lanka	2000 to 2009	+		+		o		nd	–	nd	+
India East and west coast	1995 to 2009	+	o	+	o	+	+	+	+	–	–
Bangladesh	1999 to 2009	+	+	o	+	nd	–	o	–	+	+
Thailand West coast	1997 to 2007	–	+	–	o	–	+	+	–	–	–
Myanmar	1978 to 1994	–	–	+	–		+	+	o	nd	nd
Malaysia Peninsular Malaysia (west coast)	2000 to 2010	+	+	–	–	+	+	+	+	+	+
Indonesia FMA 571	Peak year	2003	2003	2003	2001	2001	1985	2002	2003	2003	2002
	1997 to 2008	–	–	–	–	–	–	–	–	–	–
	2010	–	–	–	–	–	–	–	–	+	–
Indonesia FMA 572	Peak year	2007		2008		1998	2005		1999	2009	
	1997 to 2008	–	–	+	+	–	–	+	–	+	+
	2010	–	+	–	+	–	–	+	–	–	+

Notes:

The different groupings were assessed in terms of their relative occurrence in the catch (percent): increased (+); – decreased (–) or were stable* (0) over a specific time period, "nd" denotes no data available.

* abs (change (percent)/initial value (percent)) <0.05.

India: data for whole country.

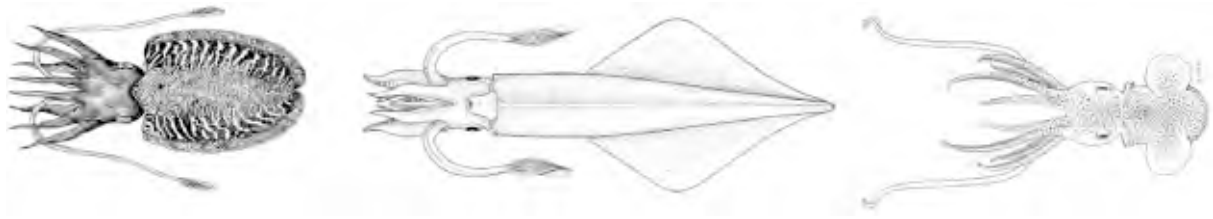
Indonesia: "peak" = the year of highest catch during 1977 to 2010.

Maldives: shark data from 2004 to 2009 used. A complete ban on shark fishery has been effective since March 2010.

The relative catch trends of **small pelagic species** (including sardines and anchovies) are increasing, comprising 10 to 45 percent of the catch in Sri Lanka, India, Thailand , Malaysia and Indonesian waters. They are a small part of the catch in the Maldives (mainly baitfish), Bangladesh and Myanmar.

Anchovy/sardine catches have decreased in Malaysia. The fisheries for oil sardine appear to be increasing in the northern parts of the Bay of Bengal, with increasing landings around Bangladesh. This has been attributed to warming of the water of the BOB, but may more immediately be related to fishing pressure on larger predatory species.

Trash/low-value fish relative catches have declined in the subregion over the course of the assessments. Together with anchovies/sardines still make up between 12 and 47 percent of the total catch in the subregion (Table 22). The total production of trash/low-value fish has risen slightly to about 941 000 tonnes (Table 26). The relative catches are stable in Malaysia over the assessment period.



Squids/cuttlefish form a relatively low proportion of the catch in the Bay of Bengal, ranging between 2 and 6 percent. **Crustaceans** comprise 6 to 15 percent of the catch and catch trends vary by country. **Shellfish** are almost unreported, but form artisanal fisheries in several countries.

Table 22 Composition of catches by major resource groupings (percent) in the Bay of Bengal

Country/area	Year	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low-value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans	Other molluscs
Maldives	2010	13	3	83	1				<1			
Sri Lanka	2009	6		53	31				4		6	
India Whole of India	2005 to 2009	9	15	12	40		12	16	4	4	15	
	2011	6	17	12	45			19	2	4	14	0.2
Bangladesh	2008/2009	11	11	41	9	0	17	0	1	0	10	
Myanmar	1994	14	21	4	4		47	9	1			
Thailand Andaman Sea	2007	6	13	5	19	7	34	5	1	6	4	
Malaysia Malacca Straits	2008	3	6	5	36	2	35	6	1	1	3	
Malaysia Peninsular Malaysia (west coast)	2010	8	6	9	24	2	25	11	1	4	12	0.2
Indonesia FMA 571	2008	12	12	10	25	5	7	8	3	2	16	
	2010	13	13	15	21	5	7	8	2	4	9	
Indonesia FMA 572	2010	8	12	25	22	8	4	4	2	3	7	

Source: APFIC 2010, 2012 correspondents' reports.

India: the percentage value for surimi is based on the species that are also included in other groups; this value is not for surimi production, but is the aggregated landings of those groups, which are surimi-type species (and which might be used for surimi). Molluscs include shell on weight.

Maldives: Maldives does not produce surimi and does not have a fishery for cephalopods.

Fishery/stock assessments

Stock assessments based on estimations, calculation or expert opinion, were obtained for this regional overview. Some of this data werealso presented in APFIC-related regional workshops (FAO, 2009a and FAO, 2009b).

The stock assessments performed for the different groups of species show that a majority of these species groups in the region are overfished or fully fished (Table 23 and Figure 7). However, there is also a large fraction of the species groups that are scored as moderately fished.

The stocks of **large demersals** are overfished or fully fished in a majority of the areas. Only in Sri Lanka and northeast India are they moderately fished or underfished. **Small demersals** are overfished or fully fished on the western side of the Bay of Bengal and in southeastern India and nearshore fisheries of Bangladesh. Elsewhere (Maldives, Sri Lanka, northeastern India and offshore in Bangladesh) they are moderately or underfished.

Large pelagic species are fully fished in southeastern India, Sri Lanka,Thailand and Malaysia, and they are moderately fished in the Maldives, northeastern India and Indonesia. **Small pelagic** species are moderately or fully fished in a majority of areas, moving to fully fished (Indonesia, Sri Lanka) or overfished (Thailand, Malaysia).

Where reported, **anchovies and sardines** are overfished (Myanmar) or fully fished (Malaysia, Sri Lanka), except in Bangladesh (moderately fished or underfished).

Where reported, low-value and trash fish species are fully fished or overfished in Indonesia, Malaysia and Thailand as well as in the nearshore areas of Bangladesh. They are moderately fished in Sri Lanka. The stocks of **surimi species** are overfished or fully fished in Indonesia, Malaysia and Thailand. They are moderately or fully fished in Bangladesh. The Maldives does not have a fishery for these species, which are predominantly derived from trawling.

Crustaceans are scored as fully fished in a majority of the assessed fisheries. **Squids/cuttlefish** are fully fished in southeastern India, but elsewhere moderately fished to underfished. No assessments were made for **shellfish** in this region.

Recommendation: Routine assessments should be carried out to enable adequate tracking of resources for management decision-making. These are particularly important to assess ecosystem level changes in relative compositions and shifting trophic levels in response to fishing pressure, and todetermine appropriate fishing effort/capacity levels in both nearshore and offshore fisheries.

Table 23 Status of fisheries/species groups for fisheries in Bay of Bengal fisheries areas

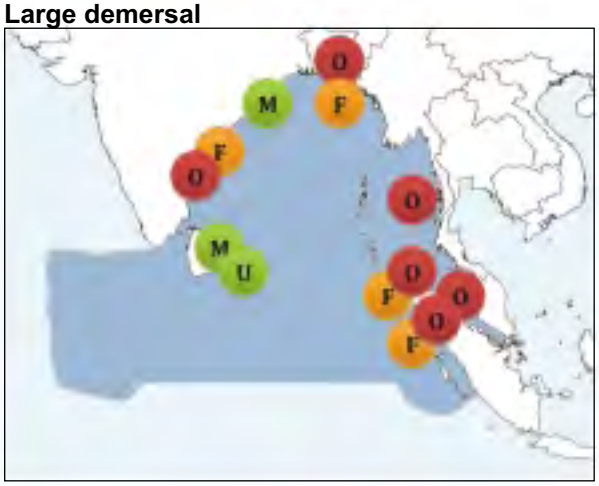
Country	Area	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low-value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans	Year
Sri Lanka	Coast 0 to 20 km	M, U	M	F	F	F	M			M	F	
	Coast 20 to 40 km	U	nd	F	M				nd			
India	SE coast	O/F	O	F	M		nd	F	F	F	F	
	NE coast	M	M	M	M		M	M	M	M	M	
Bangladesh	<40 m	O	O	F	F	M	O		M	U	F	
	>40 m	F	M	U	M	U	U		U	U	M	
Thailand	West coast	O	O	O	O							
Malaysia	Peninsular Malaysia (west coast)	O	O	F	F	F	nd	O	O	M	F	2010
Indonesia	FMA 571	F/O	F/O	M	F	nd	F/O	F/O	nd	nd	F/O	2010
	FMA 572	F/O	F/O	M	0	nd	F/O	F/O	nd	nd	F/O	2010
Maldives	National	U		F					O			2010

Note: This table presents *indicative status* for species groupings. Terminologies for level of exploitation vary between countries as do the methods of assessment and date of last assessment and the geographic scope of those assessments.

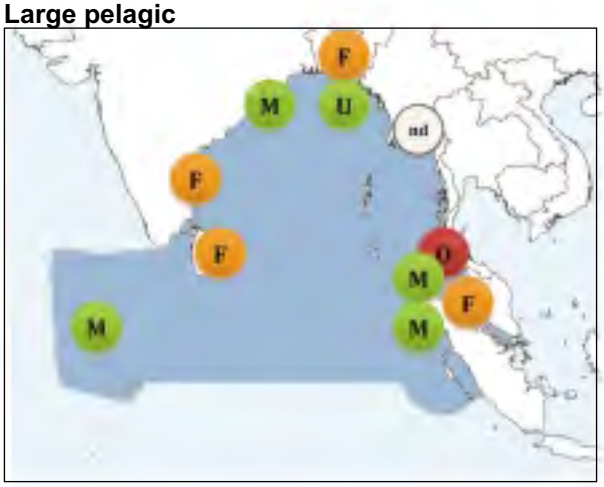
Depleted (D); overfished (O); fully fished (F); moderately fished (M); underfished (U) and empty cells or "nd" denotes no data available. Several values indicate a range of reported values (e.g. several sub-areas).

Maldives: Demersal assessments based on Anderson *et al*. (1992); shark assessments based on MRC, 2009. There has been a complete ban on shark fishing since March 2010.

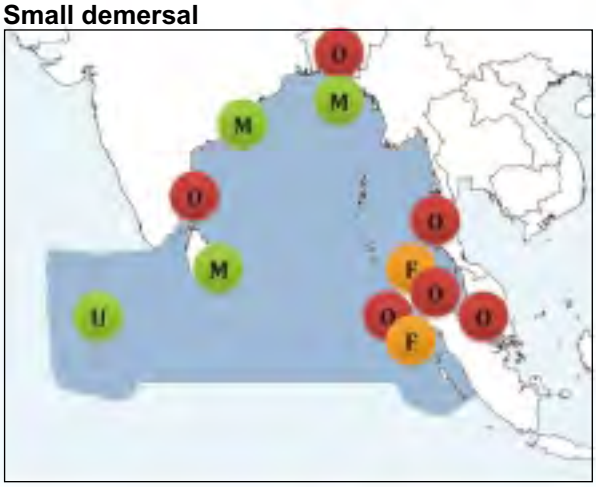
Large demersal



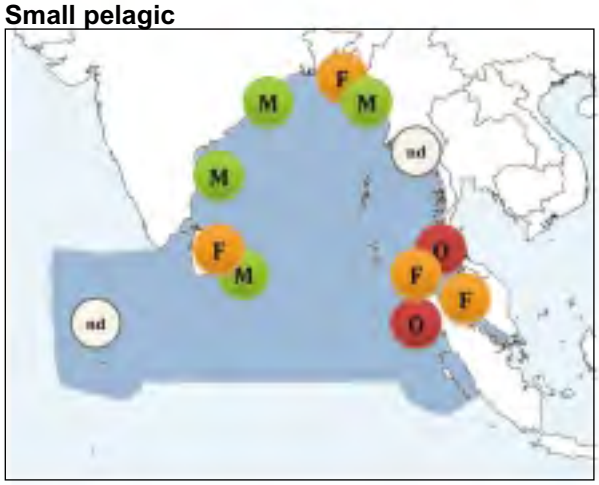
Large pelagic



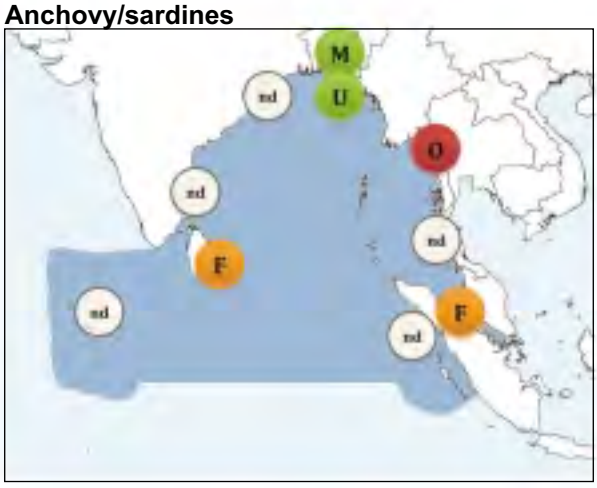
Small demersal



Small pelagic



Anchovy/sardines



Squid/cuttlefish

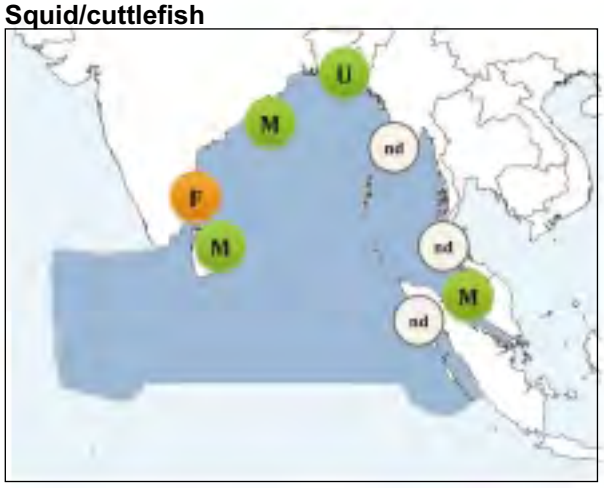
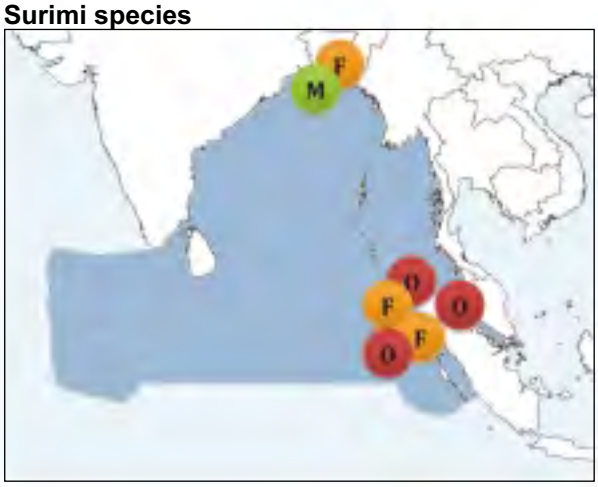
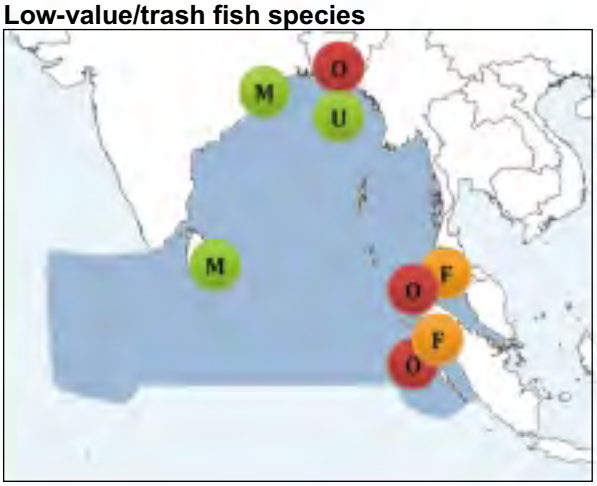


Figure 7 Indicative status of various fishery resources in the Bay of Bengal subregion

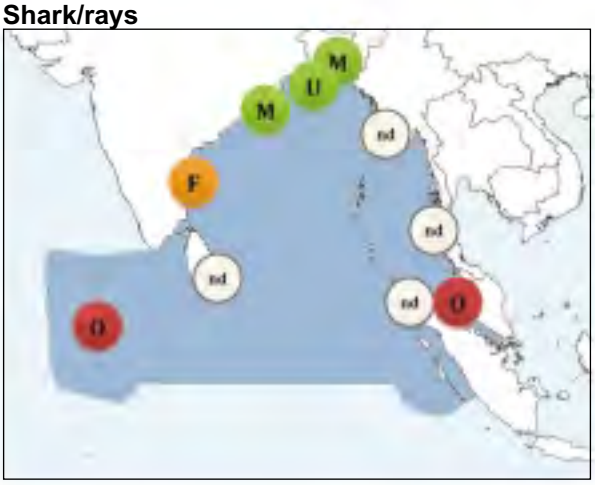
Surimi species



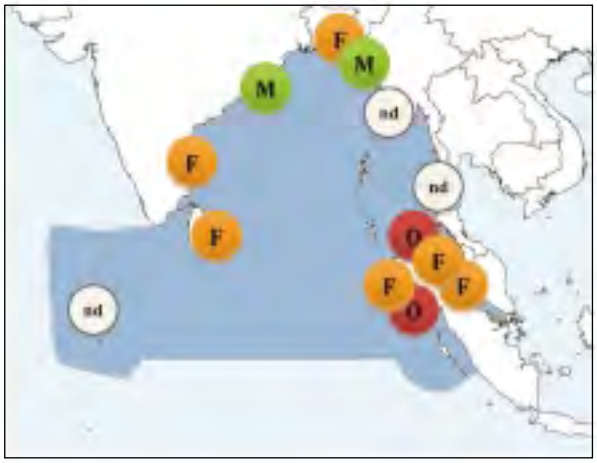
Low-value/trash fish species



Shark/rays



Crustaceans



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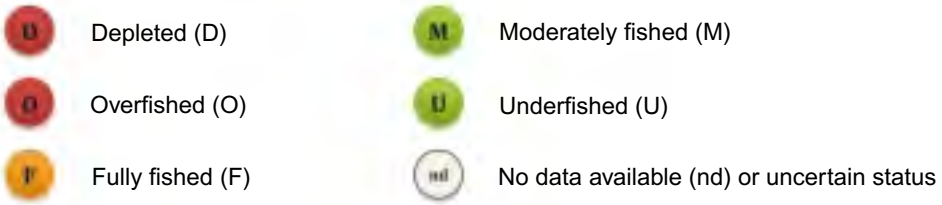


Note: This figure presents *indicative status* for species groupings. Terminologies for the level of exploitation vary between countries as do the methods of assessment and date of last assessment and the geographic scope of those assessments.

Figure 7 (cont.) Indicative status of various fishery resources in the Bay of Bengal subregion

Hilsa shad and Indian mackerel ecosystem-based fisheries in the Bay of Bengal

Box 1 presents a summary of information pertaining to hilsa shad ecosystem-based fisheries in the Bay of Bengal and Box 2 does the same for the area's Indian mackerel fisheries. A summary of the ecosystem status of each fishery is presented, followed by a brief review of socio-economic and governance issues.

Box 1 Hilsa shad ecosystem-based fisheries issues in the Bay of Bengal[4]

Ecosystem status	
Biological status of hilsa (regional stock)	According to the latest stock assessment by the BOBLME hilsa working group, the regional hilsa stock is overfished. Widespread use of small mesh gillnets is leading to a large number of juveniles being caught, especially in riverine areas and this is reducing the parent population for the next generation and contributing to the population decline.
What impact is the fishery having on the environment?	There are no major impacts on the seabed or water column.
What impact is the fishery having on endangered and threatened species?	The fishery also catches turtles, sharks and cetacean, but exact numbers are unknown. Sea turtles are considered to be a threatened species.
What impact is the fishery having on other species?	Small mesh fisheries have an adverse impact on aquatic biodiversity in rivers and floodplains.
What external factors threaten the fishery?	Habitat loss: loss of the riverine habitats through siltation and water diversion is reducing the populations of hilsa. Pollution is degrading freshwater habitat quality and consequential recruitment. Water quality in both India and Bangladesh is typically poor.
Socio-economic issues	
Contribution of the fishery to livelihoods	The hilsa fisheries play a critical role in the generation of employment and income. In Bangladesh, over 500 000 fishers are involved in catching hilsa and over 2 000 000 people are indirectly involved in the distribution and sale of hilsa, as well as in ancillary activities such as net and boat making, ice production, processing and export. The socio-economic status of most hilsa fishermen can be categorized as socio-economically disadvantaged in terms of access to services (education, health, banking, electricity, piped water), and income. However, given the relatively high value of hilsa as a result of strong local demand, the hilsa fishery may provide higher daily incomes compared to fisheries for other species.
Economic value of hilsa fisheries	Hilsa catches in Bangladesh are valued at about Tk. 90 billion/US$1.3 billion. Accurate estimates of landed values are problematic to obtain given complex relationships between money lenders and fishermen that distort prices paid to fishermen, but are thought to be about Tk. 45-60 billion/US$640 to US$850 million. Similar figures are unavailable for India or Myanmar. However, the export value for hilsa from Myanmar for 2009 was US$29.14 million for 16 744 tonnes of fish caught.

[4] The BOBLME Regional Fisheries Management Advisory Committee (RFMAC) has provided advice on the major issues facing the regional fisheries for hilsa shad and Indian mackerel. RFMAC considered a range of information including an assessment of the hilsa shad and Indian mackerel fisheries in each country in the BOBLME region using a world recognized methodology. The assessments in each country were based on performance relating to: the status of the stocks; the impacts of the fisheries on the ecosystem; and the governance and management frameworks in place. The RFMAC also considered the technical advice from the respective BOBLME working groups for hilsa and Indian mackerel.

Box 1 (cont.) Hilsa shad ecosystem-based fisheries issues in the Bay of Bengal[4]

Governance issues	
Current management	There is no coordinated regional management of the hilsa stock. Bangladesh has a hilsa fisheries action management plan.
Implementation of an ecosystem approach to fisheries management (EAFM)	AN EAFM is in place through the BOBLME Project. BOBP-IGO provides training in the Code of Conduct for Responsible Fisheries (the basis of EAFM).
Data and information	There are no integrated data management of collection activities for hilsa.
Legal tools and compliance	Legal tool exist, but few actions are directed at hilsa and enforcement of management measures is difficult.
MPAs	Bangladesh has about 1 394 km^2 of MPA (about 0.05 percent of the EEZ); India has 12 276 km^2 (about 0.5 percent of the EEZ); Myanmar has 341 km^2 (about 0.01 percent of the EEZ).Overall, the degree to which these MPAs contribute to the protection of the hilsa stock is not known.
Institutional structure	The links between the main agencies that need to be involved in hilsa management (fisheries and environment) are weak. River management decisions impact hilsa, therefore the agencies that manage these areas in each country also need to be involved.

Box 2 Indian mackerel ecosystem-based fisheries issues in the Bay of Bengal

Ecosystem status	
Biological status of hilsa (regional stock)	Stock status is unknown, but Indian mackerel is a highly productive species and this may protect it to some extent from heavy fishing pressure. The stock relationship between the fisheries for Indian mackerel is not known.
What impact is the fishery having on the environment?	There are no major impacts on the seabed or water column.
What impact is the fishery having on endangered and threatened species?	Indian mackerel fishers catch sea turtles in bottom trawls and larger-mesh gillnets, and sharks in large purse seines. Exact numbers are unknown. Sea turtles are considered to be a threatened species.
What impact is the fishery having on other species?	The stock status of other retained species landed with Indian mackerel, especially in trawl and purse seine fisheries is poorly known.
What external factors threaten the fishery?	Pollution is degrading coastal marine habitat quality.
Socio-economic issues	
Contribution to economy, employment and incomes	In Sri Lanka, Tamil Nadu, West Bengal, Thailand and Indonesia catches of Indian mackerel are low (compared to total national landings), and the socio-economic importance of Indian mackerel fisheries may be small in terms of total employment and income generation. Landings into Malaysia are significantly higher than any of the other BOBLME countries, at 140 000 tonnes in 2008.
Contribution to nutrition and food security	Small pelagics such as Indian mackerel are generally low cost to consumers, have high micronutrient content provide an important source of animal protein. They thus serve an important socio-economic role in terms of food security.

Box 2 (cont.) Indian mackerel ecosystem-based fisheries issues in the Bay of Bengal

Governance issues	
Current management	There is no coordinated regional management of the Indian mackerel stock. Bangladesh has a hilsa fisheries action management plan.
Implementation of an ecosystem approach to fisheries management (EAFM)	AN EAFM is in place through the BOBLME Project. BOBP-IGO provides training in the Code of Conduct for Responsible Fisheries (the basis of EAFM).
Data and information	There are no integrated data management of collection activities for Indian mackerel. Legal tools exist, but few actions are directed at Indian mackerel and enforcement of management measures is difficult.
Legal tools and compliance	
MPAs	Bangladesh has about 1 394 km^2 of MPA (about 0.05 percent of the EEZ); India has 12 276 km^2 (about 0.5 percent of the EEZ); Myanmar has 341 km^2 (about 0.01 percent of the EEZ). Overall, the degree to which these MPAs contribute to the protection of the Indian Mackerel stock is unknown.
Institutional structure	The links between the main agencies that need to be involved in hilsa management (fisheries and environment) are weak. River management decisions impact hilsa, therefore the agencies that manage these areas in each country also need to be involved.

Trends in CPUE/catch rates

In the **Maldives** CPUE (kg/boat/day) decreased from 691 to 593 from 2004 to 2010 (Table 24). This decline is mostly a result of the significant decreased catches of tuna. In **Sri Lanka** it is not certain whether CPUE/catch per hour is increasing or decreasing, as there is no long term data set on CPUE. Over the past 20 years, CPUE has decreased 69 percent in (non-purse) seine fisheries and 51 percent in net fisheries. The lobster fishery has seen a 60 percent reduction in CPUE (Table 24).

CPUE trends in **India** have declined in trawl fisheries nationally. In the southeast, CPUE is now 25 percent of the 1992 rate. CPUE/catch per day per trawler in **Bangladesh** is steady for shrimp trawlers but declining for fish trawlers (MFO, 2009), which saw a 38 percent decline in CPUE over ten years (1999 to 2009) (Table 24).

The CPUE of bottom trawl fisheries in **Myanmar** is declining annually (Table 24).

Table 24 Trends in CPUE/catch rates by gear for the assessed Bay of Bengal fisheries areas

Country	Year	Overall	Trawl	Purse seine	Other seines	Net (drift, gill, ring)	Anchovy purse seine	Long-line	Prawn trawl fishery	Lobster fishery
Maldives	2004 to 2010	↓ -24%								
Sri Lanka	1985 to 2005				↓ -69%	↓ -51%			↓ -6%	↓ -60%
India *Southeast coast*	1995 to 2009		↓ -73%							
Bangladesh	1999 to 2009		↓ -38%						↓ -1%	
Thailand *West coast*	1984 to 2005		↓ -38%	↓ -76%						
Malaysia Peninsular Malaysia (*west coast)*	2000 to 2008		↑	↑	↓	→				
Indonesia *FMA 571*	1977 to 2008		↑ +5-79%	↑ +15-94%	↑ +29%	↓ -18%	↓ -30%	↓ -76%		
Indonesia *FMA 572*	2001 to 2010		↓ -80%	→		↑ +250%		→		

Increased (↑); decreased (↓) or not changed (→) over a specific time period – where data available, a two-year average for the CPUE at the start and finish dates were used.

For **Thailand Andaman Sea**, CPUE trends are either stable or slightly increasing over a three-year period (Table 25). **Peninsular Malaysia (west coast)** trends in CPUE here appear to be stable or increasing (Table 25).

In **Indonesia FMA 571**, the Malacca Strait CPUE/catch per hour for trawlers has shown large decreases, and less so for sine netting. This is mainly seen in the demersal and some small pelagic species (measured as mT/boat/year between 1998 and 2008). Large demersal CPUE has decreased from 400 to 40 and small demersal decreased from 300 to 40. The small pelagic group is relatively stable at 30 to 35 and the large pelagic group fluctuating between 30 and 35. Large tunas have increased from 0.1 to 0.6 and small tuna are stable at 15 to 20. Crustaceans have decreased from 400 to 50. **Indonesia FMA 572 (Western Sumatra)** Large decreases in trawl CPUE have seen large demersal CPUE has decreased from 200 to 20; small demersal decreased from 300 to 30. Longlining, and drift gill net operations are less affected and even increasing CPUE. This is reflected in the small pelagic CPUE stable at 60 to 80 and large pelagic CPUE increasing from 2 to 8. Large tuna CPUE is decreasing from 7 to 3 and small tuna are fluctuating between 50 and70. Crustaceans have decreased from 100 to 20.

Table 25 Detailed CPUE/catch rates by gear or resource for the assessed Bay of Bengal fisheries areas

Country	Time period	CPUE/catch rate	Resource/area/source of information
Maldives	2004 to 2010	691 to 593 kg/boat/day	All fisheries (MoFA statistics)
Sri Lanka	1986 to 1995 1990 to 1995 1953 to 1986 1953 to 1986 1983 to 2005 1985 to 2005	3.3 to 1.0 kg/boat/day 9.1 to 8.6 kg/boat/day 65 to 177 kg/haul 83 to 210 kg/haul 336 to 28 kg/haul 186 to kg/haul	Lobster fishery (south coast) Prawn trawl fishery (Negombo lagoon and adjacent waters) Beach seine fishery (west coast) Beach seine fishery (northwest coast) Beach seine fishery (southwest coast) Ring net (scad) fishery (southwest coast)
India	1995 2000 2008 2010 1995 2000 2008 2010 2010	48.5 kg/hr 42.8 kg/hr 35.7 kg/hr 36.8 kg/hr 82.5 kg/hr 41 kg/hr 21.8 kg/hr 21.2 kg/hr 37.9 kg/hr	Trawl (all India average) SE coast (Chennai) SW coast India (Mangalore) not Bay of Bengal
Bangladesh	2000 to 2009 2000 to 2009 2004 to 2009	3 000 to 1 859 kg/day 490 to 483 kg/day 139 to 25 kg/day	Fish trawl (<40 m depth within EEZ) shrimp trawl (<40 m depth within EEZ) Fishing (>40 m depth Chittagong/Cox's Bazaar)
Myanmar	1979 to 1980 1983 to 1989 1996 to 1998 2006 to 2007	670 to 946 kg/hr 184 to 253 kg/hr 96 to 137 kg/hr 90 kg/hr	Fritjof Nansen survey FRV Chulaborn, FV251, commercial data Commercial fishing MV SEAFEC survey
Thailand Andaman Sea	2003 to 2005	77 to 83 kg/hr 1.8 to 2.2 kg/hr 21 to 26 kg/hr 7 to 5 kg/hr 16 kg/hr 37 kg/hr 58 kg/hr 103 kg/hr	Total Pelagic Demersal Cephalopod True trash fish Otter board trawl (<14 m) Otter board trawl (>14 m) Pair trawl
Malaysia Peninsular Malaysia (west coast)	2000 to 2010	Slight decrease 50 to 40 kg/trip Increase 1.43 to 2.28; 1.52 to 3.0; 7.77 to 9.0 mT/trip Increase 0.82 to 0.58 mT/trip Increase 0.36 to 0.64; 2.74 to 4.34; 7.75 to 8.21 mT/trip Increase 0.25 to 0.32 mT/trip	Drift/gillnet (Zone A) Purse seine (Zone B; Zone C; Zone C2) Anchovy purse seine (Zone B; Zone C; Zone C2) Trawl (Zone A) Other seine (Zone B; Zone C; Zone C2; Zone A)
Indonesia FMA 571	2000 to 2010	Decreased 1 740 to 120 tonnes/boat/yr Decreased 57 to 24 tonnes/boat/yr Fluctuating 13 to 8 tonnes/boat/yr	Trawler 90% decreased Seiners Drift gill netter
Indonesia FMA 572	2000 to 2010	Decreasing from 500 to 92 tonnes/boat/yr Slightly increase tonnes/boat/yr ~5 increase to ~25 tonnes/boat/yr Increased 300%	Trawlers Seiners Drift gill netters Longline

Low-value/trash fish production

Total production of trash/low-value fish species in the Bay of Bengal subregion (Table 26) is less than 941 000 tonnes (this figure includes the whole of India, thus the actual BOB figure will be less). The percentages of total production vary according to area, but reaches 65 percent (Peninsular Malaysia, west coast) or more in some areas. Overall in the reported fisheries, trash/low-value fish ranges between 4 and 65 percent depending upon the predominant gear used. A more typical range is 14 to 64 percent. The principal source of this information is reports from trawlers.

Table 26 Production of trash/low-value fish for the assessed Bay of Bengal fisheries areas

Country	Tonnes	% of total catch	Comments/reference
Maldives	**None**		Maldives fisheries consist of pole and line and handline gears that are highly selective hence, catch of low-value trash fish is non-existent.
Sri Lanka	**nd**	Estimated for shrimp trawlers as 92 to 93% in Mannar & Palk Bay. 56 to 64% in Negombo & Chilaw	Shrimp trawl fisheries bycatch in Sri Lanka's Palk Bay and Gulf of Mannar fisheries have ratios of trash fish: shrimp of 14:1 and 12:1, respectively. The ratios for Negombo and Chilaw shrimp trawl fisheries are much lower at 1.3:1 and 1.8:1, respectively.
Bangladesh	**85 843**	17%	Includes nei species.
India	**396 780**	12% of total national production 17% Calicut (SW coast) 15% Chennai (SE coast) 27% Visakhapatnam (SE coast) *Non Bay of Bengal:* 24% Veraval (NW coast) 39% Mumbai (NW coast) 25% Mangalore (SW coast)	Total country production recalculated from CMFRI annual report 2010/11. Detailed figures from typical trawler landings, recalculated from CMFRI Annual report 2010/11. Trawlers contribute ~ 60% of total landings in all the centres.
Thailand Andaman Sea	**215 571**	79% of otter trawl catch 28% of pair trawl 7% purse seine catch	2007 figure, decreased from 260 596 tonnes in 1997, 323 715 tonnes in 2005). Fisheries statistics 2007 (DOF, 2009).
Malaysia Peninsular Malaysia *(*west coast)	**201 035**	65% national low-value/trash fish catch	2010 figures: predominantly from trawl fisheries. Fisheries annual statistics 2000 to 2010. Increased from 57% of total capture landings in 2000.
Indonesia *FMA 571* *FMA 572*	**23 500** **18 000**	6.9% 4.2% 9% (nationally)	Decreased from 81 000 tonnes (2000) to 24 000 tonnes (2010). Decreased from 27 200 (2000) to 19 700 (2010) National total 477 900 tonnes in 2008.

Fishmeal production

The total fishmeal production for the Bay of Bengal subregion (Table 27) is estimated to be 27 000 to 30 000 tonnes (Malaysia, Indonesia and Thailand production is reported under the South China Sea subregion). This is presumed to be derived largely from the catch above. The region produces large quantities of dried fish, which are powdered/pounded to form basic animal feeds or fish feeds or directly as human food and which are not classified as fishmeal (alternative local terms are used such as “fish powders”).

The reduction in demand in Bangladesh is attributed to the decline in shrimp production.

There appears to be interest in some areas (e.g. India) in increasing the utilization of discards (75 000 tonnes) for fishmeal by establishing a collection system at sea. This is in response to increasing demands associated with aquaculture intensification in the Bay of Bengal subregion and could start to drive direct targeting and mesh size reductions if a significant onshore market was established. This has been the experience from the South China Sea subregion. In other cases (e.g. Thailand and Malaysia) the trash fish production above will be directed into fishmeal as well as fed directly to marine fish in cages. The figure reported for India is much higher than that estimated by IFFO in 2010.

Table 27 National production, import and export of fishmeal in countries bordering the Bay of Bengal (tonnes)

	Area				
	Sri Lanka (2009)	**India** (2010)	**Bangladesh** (2009)	**Maldives** (2009)	**Myanmar** (2010)
Fishmeal produced	1 000	53 800	5 618	59	31 600
Fishmeal imported	10 642	11 270	11 178	2	87
Fishmeal exported	0	9 042	323	790	13 256

Notes:

India: the figure of 53 800 tonnes was estimated by IFFO (2010). It is estimated that between 120 000 and 150 000 tonnes wet weight of catch are directed principally to artisanal dried fishmeal. Some commercial fishmeal capacity exists. Main groups used: Threadfin breams, silverbellies, goatfish, sardines, squilla, Acetes, crabs, pufferfish. Imports and exports as reported to FAO (2009).

Sri Lanka: production figure is FAO estimate (2009). Sri Lanka does not produce fishmeal commercially, but there is some home-based small-scale production. Imports and exports as reported to FAO.

Bangladesh: figures as reported to FAO. Imports and exports as estimated by FAO.

Myanmar: IFFO estimate (2010); a figure of 20 600 tonnes was reported to FAO (2009); exports as reported to FAO; imports as estimated by FAO.

Maldives: reported to FAO.

Capture production of surimi species

The relative catch of surimi species has increased in India, Malaysia and Indonesia FMA 572 (Table 28). The total production for the region is roughly estimated as 75 000 tonnes, requiring approximately 262 500 tonnes of raw material. (Table 28).

Many countries in the Bay of Bengal subregion do not produce surimi in significant quantities. This largely assumes that facilities to produce surimi are not yet established (there is a technological lag). It may also be speculated that the fisheries of this region are in a better condition, thus fish is utilized directly for consumption and there is less pressure to process fish into surimi to increase utilization for human consumption (especially products of trawl fisheries).

Note that the surimi production for Thailand, Malaysia and Indonesia (from the Bay of Bengal fisheries) is reported in the South China Sea section, as the majority of the production of these species is derived from this subregion.

Table 28 Production of surimi and catch of fish (raw material) from which it is derived (tonnes) in Bay of Bengal countries

	Total surimi production	Total raw material required	Threadfin bream	Lizard fish	Goat fish	Croaker	Snapper (big eye/ king)	Barracuda	Other
India (2010)	~70 000	245 000							
Myanmar (2005)	5 000	17 500	10 150	1 050	2 450	2 800	700	350	
Total	**75 000**	**262 500**							

Notes:

Raw material figure assumes a conversion ratio of 3.5:1, fresh fish to surimi.

India: figure for whole country. The value for raw material is an estimate.

Myanmar: 2005 figures derived from reference http://map.seafdec.org/SurimiMile/index.php and Siriraksophon & Laong-manee (2005).

Bangladesh, Sri Lanka& Maldives: do not produce surimi.

Fishery zoning

Table 29 presents some details on the fishing zones of South Asia and Southeast Asia that are considered part of the Bay of Bengal.

Table 29 Fishing zones of the countries in South Asia and Southeast Asia with waters in the East Indian Ocean (Bay of Bengal)

Countries	Fishing Zone 1	Fishing Zone 2	Fishing Zone 3	Fishing Zone 4
Maldives	From shore to 75 miles (reserved for local vessels)	From 75 miles to 200 miles (local and foreign vessels)	100 to 200 miles (longline vessels)	
Sri Lanka	Lagoon fisheries, continental shelf and slope	Offshore area is up to EEZ and high seas		
India Southeast coast	Artisanal craft within 5 km from shore	Mechanized craft beyond 5 km from shore	Mechanized craft OAL <20 m beyond 10 km	Mechanized craft OAL >20 m beyond 23 km
India Northeast coast	Artisanal craft within 5 km from shore	Mechanized craft OAL <15 m beyond 5 km	Mechanized craft OAL >15 m beyond 20 km	
Bangladesh	Coastal area and shallower part of the EEZ of Bangladesh which is shallower than 40 m	Whole EEZ of Bangladesh which is deeper than 40 m		
Myanmar	From shore line to 5 nm in the northern area (Rakhine), 10 nm in the southern area (Ayeyarwaddy and Taninthayi) Engine <12 hp; Boat OAL <30 ft	From outer limit of inshore fishing zone (1) to EEZ limit Engine >12 hp; Boat OAL >30 ft		
Thailand	From shoreline to 3 km artisanal fishing zone	From 3 km to 12 nm	From 12 nm to EEZ limit	
Malaysia Peninsular Malaysia (west coast)	From shoreline to 5 nm	From 5 nm to 12 nm	From 12 nm to 30 nm	From 30 nm to EEZ limit
Indonesia	From shoreline out to 4 nm	From the outer limit of first fishing zone to 12 nm from shore	From the outer limit of second fishing zone to EEZ limit	

Adapted from: SEAFDEC (2008), with additional data for Sri Lanka, India and Bangladesh.

Sri Lanka: no official zoning exists.

Management measures

Management measures favoured in the nearshore zones tend to be spatial measures or seasonal closures (Table 30). Gear restrictions are also applied in nearly all fishing zones. There are limited measures applied to the catch in terms of size limits or total catch limits. All countries report difficulties with non-compliance with the measures. Vessel licensing and capacity limits are not in place, thus there are no limits placed on total catch in almost all the fisheries of the region.

Table 30 Examples of management measures used in the different Bay of Bengal fisheries (by fishing zone)

Country/Area	Closed areas	Closed seasons	Size limits (Biological)	Gear restrictions	Licensing	Quotas
Maldives	Zone 1		Zone 1	All zones	All zones	All zones
Sri Lanka		Zone 1	Zone 1	Zone 1	Zone 1	
India East coast	Zones 1–3	Zones 2–4	All zones	All zones		
Bangladesh	Zone 1	Zone 1		All zones	All zones	
Myanmar	All zones	All zones		All zones	All zones	
Thailand *Andaman Sea*	Zone 1	Zone 1		All zones		
Malaysia Peninsular Malaysia (west coast)	Zone 1			All zones	All zones	
Indonesia FMA 571				All zones	All zones	TAC

Vessel numbers

There are approximately 473 000 vessels operating in the Bay of Bengal (Table 31), the majority (74 percent) of which are small-scale vessels without engines or using outboard motors (approximately 349 000 vessels). These vessels operate in nearshore coastal waters, although in the case of Sri Lanka and the Maldives they may operate in deep waters some way from shore. These figures are over-estimated because of the inclusion of vessels from the west coast of India.

Recommendations: East and west coast fleets of India should be dealt with separately; the production from the different segments of the fishery should be established.

Table 31 Number and type of fishing vessels in the assessed Bay of Bengal fisheries (by area)

	Area							
	Maldives	**Sri Lanka**	**India**	**Bangladesh**	**Myanmar**	**Thailand** West coast	**Malaysia** Peninsular Malaysia (west coast)	**Indonesia** FMA 571 FMA 572
Year	**2010**	**2007-2008**	**2005**		**2008**	**2000**	**2010**	**2008**
Trawlers			29 241					4 806
Purse seiners			983					2 385
Gill net			14 183					29 951
Dol net			8 862					
Hook-and-line								23 400
Set net								10 530
Others			5 284					26 786
Longline			1 190					6 347
Non-motorized	905	39 104	104 270		15 219	19 412	86	20 331
Motorized-outboard	160		75 591				14 306	18 697
Inboard-mechanized	1 268	4 749	59 743		16 376	1 744	7 893	32 276
<5 GRT							7 237	24 409
>5 GRT							656	7 867
Small-scale				43 026				
Large or Commercial				200				
Total	**2 333**	**43 853**	**239 604**	**43 226**	**31 595**	**21 156**	**22 285**	**71 304**

Notes:

India: whole country; note that gear categories are not strict as more than one gear type may be utilized. The previous report of fishing vessel capacity and employment was based on the Marine Fisheries Census 2005. A census was carried out in 2010 by CMFRI and the report is being prepared. Updated data for 2010 will be available in **June 2012.**

Malaysia: figures do not include 61 vessels operating on the high seas. Vessels use different gears. The total is for non-motorized, motorized outboard and inboard-mechanized vessels.

Indonesia: data based on Indonesia annual statistical report (2009). Vessels use different gears. The total is for non-motorized, motorized outboard and inboard-mechanized vessels.

Employment

The summary figures for employment are **1.92 million** in the Bay of Bengal (Table 32). The breakdown of these figures into full-time and part-time differs among countries and is inconsistently reported.

Countries report either full-time or part-time fishers. In some cases there is a breakdown between large-scale and small-scale fishing, and elsewhere the figures are separated between nationals and non-nationals (e.g. Malaysia) or between owners/family members and employed crew. A large fraction of these are part-time fishers.

Employment figures in fisheries are notoriously difficult to obtain and even more so for the "hidden" workforce (Table 32). In many cases entire households are engaged in some form of work in the fishery either directly in fishing or indirectly in the post-harvest activities. In some cases there is considerable foreign employment of fishing crews from neighbouring countries.

Recommendation: Effort should be made to harmonize the recording of fishing vessel employment to reflect employment in large-scale and small-scale fishing.

Table 32 Employment in the assessed Bay of Bengal fisheries (by area, excluding Myanmar)

	Area						
	Maldives	**Sri Lanka**	**India** East coast	**Bangladesh**	**Thailand** West coast	**Malaysia** Peninsular Malaysia (west coast)	**Indonesia** FMA 571 FMA 572
Year		**2007-2008**			**2000**	**2008**	**2008**
Full-time	11 644	132 000	430 654	519 000		51 776	245 398
Part-time		33 100	117 241	259 500			71 254
Family members					29 820		
Employees/crew					17 717		
Nationals						39 626	
Foreign crew						12 150	
Total	**11 644**	**165 100**	**547 895**	**778 500**	**47 537**	**51 776**	**316 652**

Notes:

Bangladesh: part-time fishers have been estimated.

Indonesia: data available at provincial level; total national employment in fisheries in Indonesia is 2 162 442 (2010).

Marine protected areas, closed areas and others

All countries in the region have some form of protected area, typically marine protected areas or parks. It is unclear to what extent these have fishery protection objectives, and it is assumed that most are protecting areas of natural beauty, tourism-related special sites or habitats of special interest. The extent to which fishing is allowed or tolerated inside marine protected areas and parks is of interest as this has critical implications for their effectiveness for fisheries conservation or protection.

Fishery exclusion zones around oil or gas platforms may have some effects, acting as offshore reserved areas. The Maldives has dedicated no fishing zones and India and Bangladesh have some seasonal closures in the fishery.

Artificial reef construction was not reported for these fishing areas, although some do exist.

Recommendation: The fishery impacts of closed or protected areas should be clarified to indicate their value to fisheries. For seasonal and closed fishing areas, the fishery objective should be stated clearly.

Table 33 Marine protected areas and areas where fishing is restricted or excluded in the Bay of Bengal

Country	Marine protected areas/parks	No fishing zones	Oil exploration areas	Seasonal closed areas
Maldives	38 (234 km^2)	(~234 km^2)		
Sri Lanka	2	1	0	0
India East coast	31 (6 271 km^2)		2	2
Bangladesh	4	2	1	4
Myanmar	4 (387 km^2)			
Thailand West coast	13 (4 359 km^2)			
Malaysia Peninsular Malaysia (west coast)	4 (188 km^2)	4	0	0
Indonesia FMA 571	10	3	++	
Indonesia FMA 572	9 (3 740 km^2)			

Notes:

Maldives: all MPAs are no fishing zones except for bait fishery in some areas.

Sri Lanka: two marine parks, four marine sanctuary/reserves, nature reserves, mangrove reserves.

India: not entirely a marine area as it includes some land. There are 31 MPAs and two biosphere reserves (6.16 percent of coastal biogeographic zone; there is a proposal to increase this to 7.61 percent). Oil fields in Bombay High and Godavari Basin also function as MPAs. All MPAs include some fishing exclusion zones.

Indonesia: total area for both FMA 571 & 572.

Trends in capture fishery production in the Sulu-Sulawesi and Timor-Arafura Seas subregion

The Sulu-Sulawesi waters off the east coast of Sabah provide 6 percent of the total **Malaysian** national catch (1.42 million tonnes). The total EEZ area for Sabah state is 90 802 km^2. All catch came from inshore waters from vessels usually less than 70 gross tonnes.

In **Indonesia FMA 573**, landings of catches of large tuna, mainly from tuna longliners are mixed with catch from Banda Sea (FMA 714), roughly at about 10 percent. There is also mixing with high seas fisheries catch. Deep sea fish aggregating devices (FADs) were introduced in 2000 for trolling on tuna species. There is a narrow area of trawlable ground for the demersal fish and shrimps. Deep sea demersal fish and shrimps and lobster fisheries exist in the area with limited data available. The oceanic nature mainly influences the seasonal catch of pelagic fish species. The coastal fisheries mainly catch some large pelagic non tuna, tuna and small tuna species.

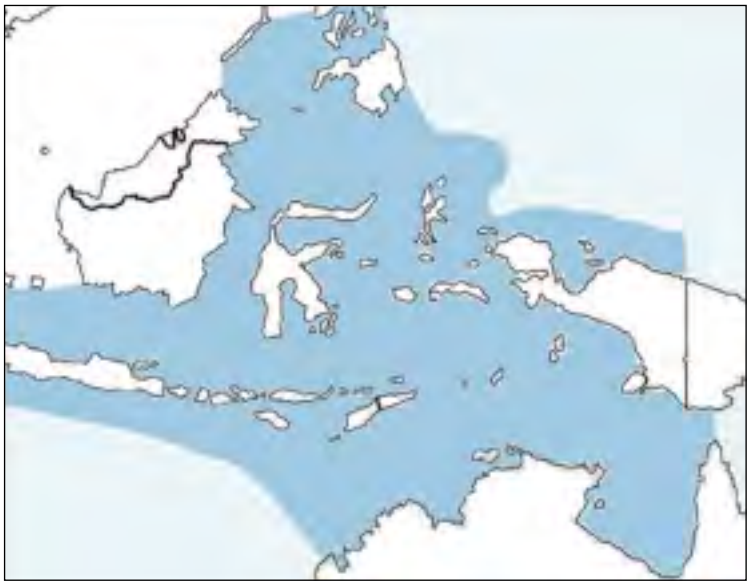


Figure 8 The Sulu-Sulawesi and Timor-Arafura Seas subregion

In **Indonesia FMA 712** fishing activities mainly operate in the coastal waters in the north coast of Java, with a depth of less than 60 m and mostly dominated by trawlable ground for demersal fish and coastal neritic small pelagic fish species. The area has one of the most crowded fleets of <10 GT in Indonesia and it is heavily exploited with respect to demersal, shrimp and small pelagic fisheries. The western area has a depth of less than 40 m and estuarine and mangrove areas play a significant role in the coastal fisheries. Small pelagic fisheries are mostly operated in the eastern part with seasonal variability from the east-westwards current pattern.

In **Indonesia FMA 713** there are shallow waters with a depth of <100 m in the western part of Kalimantan with estuarine, mangrove and coral reef areas playing a significant role in shrimp fisheries. Deep sea waters exist in the eastern part of Makassar Strait and Flores Sea, but there is limited information on deep sea fishing in Flores Sea.

Indonesia FMA 714 has deep sea waters with depths of more than 200 m is a major fishing area. Small and large pelagic species with mini purse seine (<30 GT) operate as well as small and large tuna pole and line. Vertical handliners operating with deep-sea FADs, adopting the Philippine fishing method, have tended to increase lately. There are some fishing vessels (mainly tuna long liner and squid jigger) operating in the area with home bases in FMA 712 and 573. The oceanic environment influences the fishing activities with coral reefs in the northeastern and eastern part of the area.

Indicative maximum sustainable yields (MSY) and catches for the Sulu-Sulawesi and Timor-Arafura Seas subregion are presented in Table 34.

In **FMA 716** the landing data is mixed with fish caught in FMA 715. Deep oceanic waters give a catch normally dominated by several groups consisting of small pelagic such as *Decapterus maruadsi*, *Rastrelliger kanagurta*, small tuna species such as *Euthynnus spp, Auxis spp*. and large tuna species such as *Katsowonus pelamis, Thunnus albacores*. The assumption is that the catches of FMAs 716 and 715 are equally split between the fishing fleets operating in each area.

Table 34 Indicative MSY and catches for the fishing areas in the Sulu-Sulawesi and Timor-Arafura Seas subregion

Country	Year	Catch	Estimated MSY	Area
Malaysia Sabah east coast				No data
Philippines				No data
Australia Northern prawn fishery	2010	7 699	MEY used	Tiger prawn approaching B_{mey}. No B_{mey} targets set for banana prawn stocks, current management arrangements provide for profitable and sustainable harvests. Increasing net economic return suggests a positive economic status
Timor-Leste				No data
Indonesia Timor-Arafura Sea Sulu-Sulawesi Sea Banda Sea	2011	947 500 1 020 000 122 040 930 000	1 300 500 952 900 82 100 3 182 400	FMA: 573, 712, 713, 714, 715, 716, 717 Demersal group Large pelagic group Penaeid shrimps group Small pelagic group

Notes:

Indonesia 2011 – Ministerial decree MMAF No. 45/2011

Field observations in **FMA 718** indicate that most of the demersal fish and shrimps caught here are landed and recorded as belonging to FMA 714 or the Banda Sea.

Total marine fish production and use in **Timor-Leste** was approximately 6 000 tonnes in 2011.[5] This includes those fish imported from Indonesia (mostly dried and canned) and Singapore (mostly frozen) and some from Portugal (canned, dried or frozen) as well as those fresh caught from the waters along the north and south coast. The low consumption of fish by the Timorese (~6.1 kg person/year) is primarily because of the lack of fishing capacity and means for preservation and transportation. Nearly all (99 percent) of the country's fishing vessels are small open outrigger canoes powered by small outboard or non-powered wooden boats that operate within 500 meters of shore. The exceptions to this are 11 larger boats of Makaresse construction each weighing around 10 gross tonnes that were purchased in South Sulawesi by inhabitants of Atauro island. Spear fishing, hook and line, longline and drifting gill nets are the primary types of fishing gear used. It is difficult to calculate the status of the Timorese fish stocks because of an absence of data.

Catch composition trends and production in the Sulu-Sulawesi and Timor-Arafura Seas subregion

The trends for catch composition of **large demersal** species are decreasing in Indonesia (Sulu-Sulawesi) and Malaysia (Sabah east coast) but increasing in the Timor-Arafura Sea (Table 35).

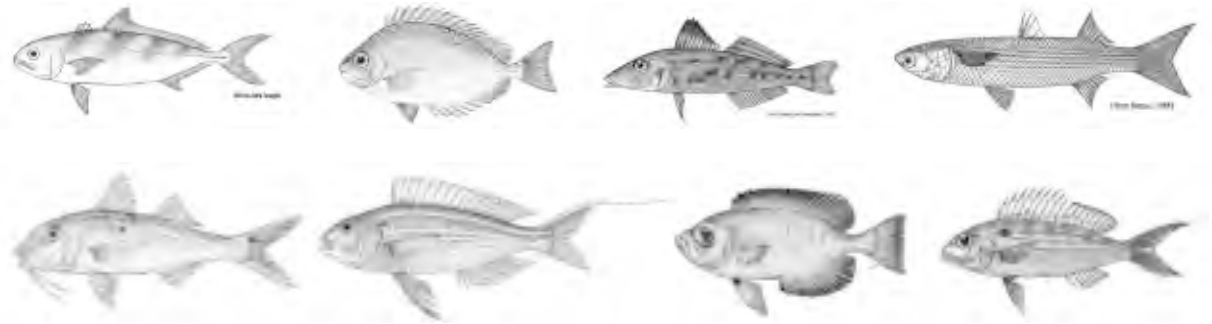
[5] Estimation not based on catch registers; calculated according with consumption data per capita (AMSAT Int, 2011) and taking into account estimates of aquaculture inputs and imports. Not comparable with further 2012 data.

The catch of **sharks and rays** are increasing Sabah east coast, but decreasing in Indonesia Sulu-Sulawesi and Timor-Arafura Seas subregion. Shark and rays comprise 1 to 3 percent of the catch.

Large pelagic species are declining in the catch forming between 6 and 15 percent of the catch.

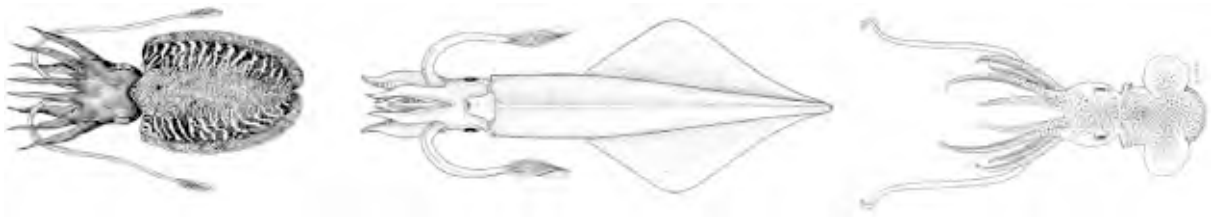
Small pelagic species relative catch trend is increasing, comprising 15 to 30 percent of the catch. Small pelagics form up to 50 percent in Timor-Leste where the fishery is targeted by the small vessel fishery so this forms a disproportionate amount of the catch.

Anchovy/sardine relative catches have increased in Malaysia east coast and the Sulu-Sulawesi Sea (Indonesia) and decreased in the Timor-Arafura Sea.



There is a trend of decreasing relative catch of **small demersal** species in Sabah east coast and Timor-Arafura Sea (Indonesia). The relative catch is increasing in the Sulu-Sulawesi Sea (Indonesia). There is no significant catch of fish for **surimi** production from this region.

The relative catches of **trash/low-value fish** are increasing in the region, except in the Timor-Arafura Sea. They comprise between 1 and 9 percent of the total catch in some areas, whereas they comprise between 26 and 35 percent of the catch in Indonesia FMAs 714, 573 and 718.



Squid/cuttlefish are increasing in catches, but form relatively little overall at 1 to 4 percent of the catch.

The trend of catches of **crustaceans** is decreasing except in Sabah east coast and overall they comprise between 2 and 12 percent of the catch (Table 35). In the Australian northern prawn fishery, which is a managed fishery, the three main species (tiger, banana and enadeavour prawns) are not overfished and not subject to overfishing. The tiger prawn fishery is approaching B_{msy} target. Banana prawns do not have a target set, but management arrangements currently promote a profitable and sustainable harvest. The bycatch has been reduced through mandatory use of turtle excluders, also particularly effective on sharks etc. Mandatory use of bycatch reduction devices (BRD) has reduced the bycatch ratio from 1:10 to 1:5.

Table 35 Trends in catch composition for the assessed fisheries areas in Sulu-Sulawesi and Timor-Arafura Seas subregion

Country/area	Time period	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low-value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans	Shellfish
Australia *Northern prawn fishery*	**2010**										–	
Malaysia *Sabah east coast*	**2009/2010**	–	–	–	+	+	+	+	+	+	+	–
Philippines												
Indonesia *Sulu-Sulawesi Sea*	**1977 to 2010**	– –	++	+/–	++	+/–	++	+++	–	++	– –	nd
Indonesia *Timor-Arafura Sea*	**1977 to 2010**	++	–	– –	+/–	– –	– –	+++	–	++	– –	– –
Timor-Leste												

The different groupings were assessed against their relative occurrence (percent): Increased (+); – Decreased (–) or were stable* (0) over a specific time period, “nd” denotes no data available.

Composition of catch landings

Table 36 presents the composition of catches by major fishery resource groupings for countries in the Sulu-Sulawesi and Timor-Arafura Seas subregion.

Table 36 Composition of catches by major resource groupings (percent) in Sulu-Sulawesi and Timor-Arafura Seas subregion

Country	Year	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/sardine	Trash fish/ low-value fish	Surimi species	Shark/rays	Squids/cuttlefish	Crustaceans
Malaysia Sabah east coast	**2010**	15	4	15	28	13	1	5	3	4	12
Indonesia Sulu-Sulawesi FMA 712	**2010**	7	12	10	19	4	29	5	2	3	6
Indonesia FMA 713	**2010**	9	10	21	28	8	5	3	1	2	8
Indonesia FMA 714	**2010**	11	1	26	30	5	26	1	2	4	
Indonesia FMA 716	**2010**	2	2	46	26	2	2		1	1	
Indonesia FMA 717	**2010**	14	3	57	5		6	2			
Indonesia FMA 718	**2010**	17	19	2	9	1	35	10			5
Timor-Leste	**2011**	71									4
Australia											
Indonesia FMA 573	**2010**	6	5	28	15	24	4	4	3	1	2
Indonesia FMA 715	**2010**	5	5	8	24	5	7	1	1	1	2

Notes:

Timor-Leste: large and small demersal species combined. Covalima, ATSEA Cruise report, 2010, S. Wirasantosa, Twagey, S. Nurhakim & D. Nugroho (eds). ATSEA Program, 209 pp.

Fishery/stock assessments

Stock assessments based on estimations, calculation or expert opinion, were obtained for this regional overview (Table 37). Some of this data were also presented in APFIC-related regional workshops (FAO, 2009a and FAO, 2009b).

The stocks of **large and small demersal species** are moderately fished or fully fished in a majority of the areas. Only in FMA 713 and 718 are they overfished. There is no information for **sharks and rays.**

Large pelagic species are moderately fished throughout the subregion. **Small pelagic** species are moderately fished in the northern areas of the Sulu-Sulawesi Sea, but fully fished further south. They are overfished in the western side of the area (Indonesia FMA 712, 713). There is no reported data for **anchovies and sardines.**

Table 37 Status of fisheries/species groups for fisheries in the Sulu-Sulawesi and Timor-Arafura Seas subregion

Country/Area	Large demersal	Small demersal	Large pelagic	Small pelagic	Anchovy/ sardine	Trash fish/low-value fish	Surimi species	Shark/ rays	Squids/ cuttlefish	Crusta-ceans
Malaysia Sabah east coast										
Philippines Mindanao		U	F	F	F				F	
Indonesia Sulu-Sulawesi FMA 712	F	F		O		F	F			O
FMA 713	O	O	M	O		O	O			O
FMA 714	F	F	M	F		F	F		M	
FMA 716	M	M	M	M		M	M			
FMA 717	M	M	M	M		M	M			O
FMA 718	O	O	nd	M	nd	O	O			F
Timor-Leste										
Australia Northern prawn fishery										F/M
Indonesia Timor-Arafura FMA 573	M	M	M	F		M	M		M	O
Indonesia FMA 715	M	M	M	F		M	M			O

Note: U = underfished; F = fully fished; O = overfished; M = moderately fished; nd = no data available.

Where reported, low-value and trash fish species are moderately fished or fully fished. There is some overfishing in FMA 718 and 713. The stocks of **surimi** species are similarly fully fished or moderately fished and overfished in FMA 713 (this is next to FMA 711 where there is a heavily targeted surimi fishery) and overfished in 718.

Crustaceans are considered overfished in a majority of the assessed fisheries and fully fished elsewhere. Only in the managed Australian northern prawn fishery are they fully fished or moderately fished. **Squids/ cuttlefish** are moderately fished in the southern part of the subregion and not reported elsewhere. No assessments were made for **shellfish** in this region.

Figure 9 presents the indicative status for various fishery resources in the Sulu-Sulawesi and Timor-Arafura Seas subregions.

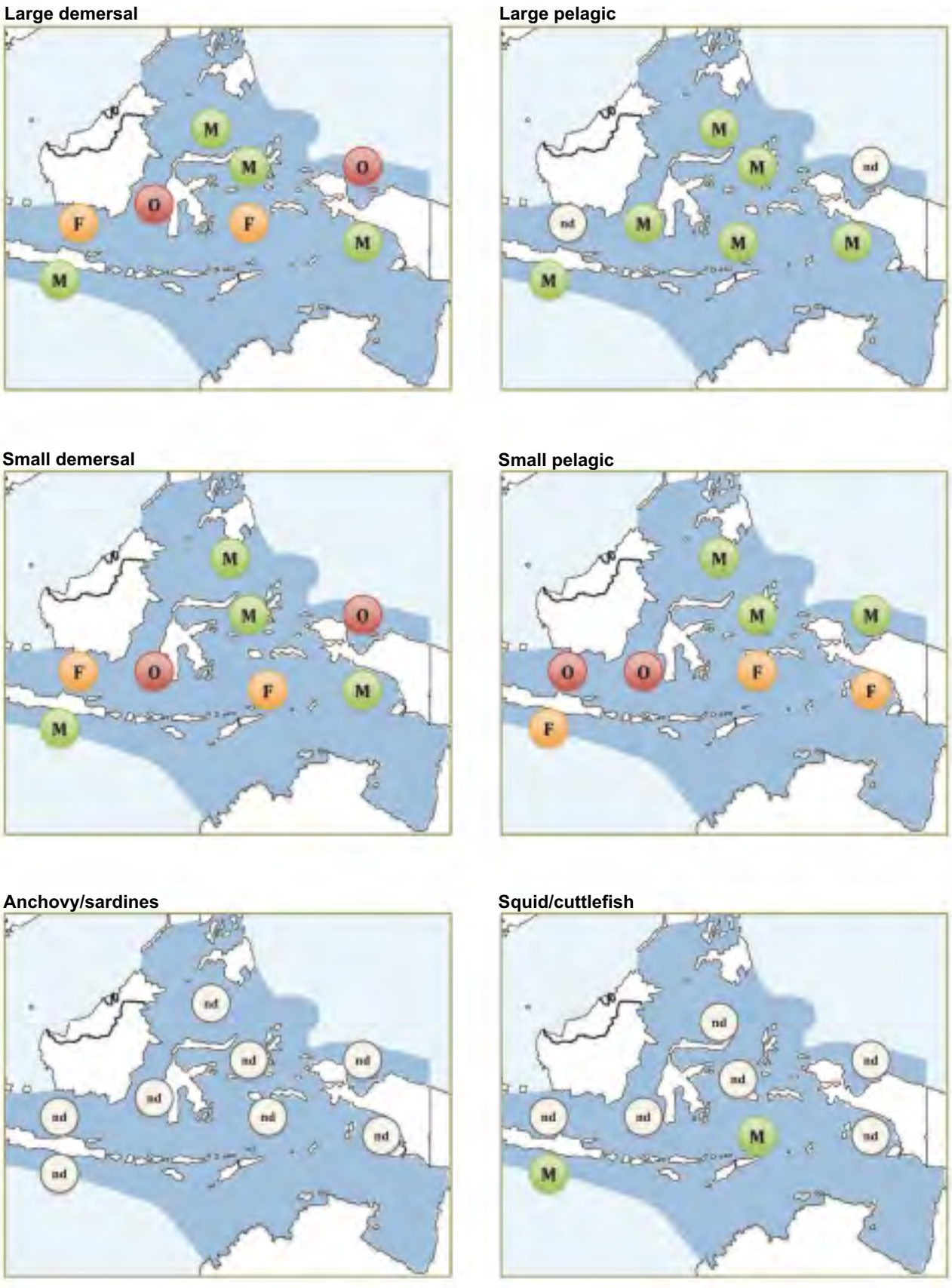
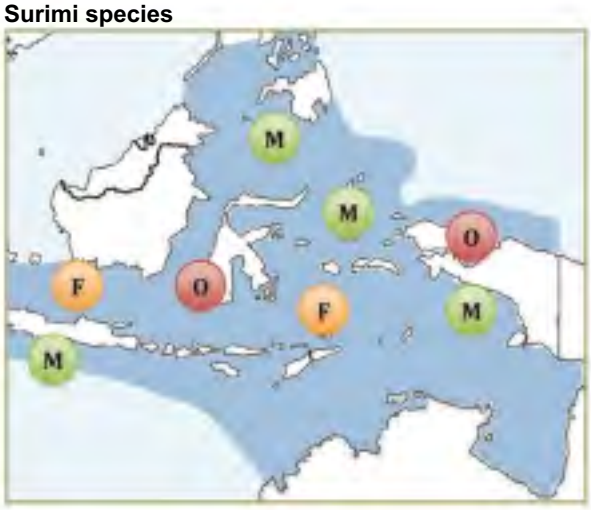
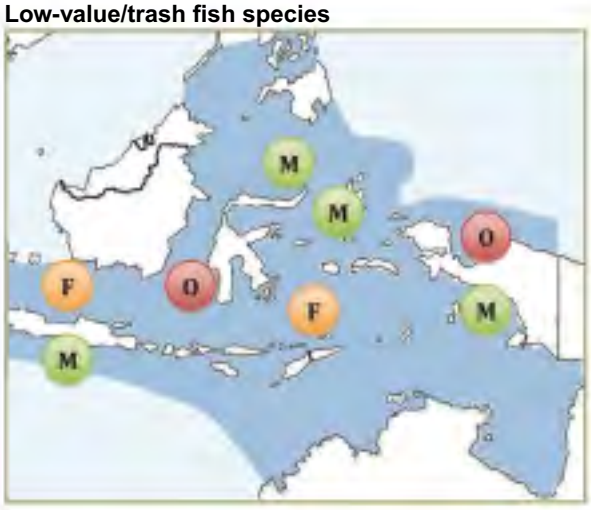


Figure 9 Indicative status of various fishery resources in the Sulu-Sulawesi and Timor-Arafura Seas subregion

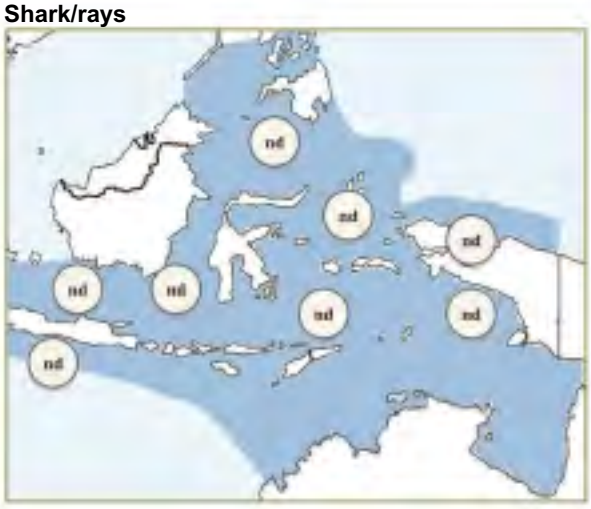
Surimi species



Low-value/trash fish species



Shark/rays



Crustaceans

Legend:

D Depleted (D)

O Overfished (O)

F Fully fished (F)

M Moderately fished (M)

U Underfished (U)

nd No data available (nd) or uncertain status

Note: this figure presents *indicative status* for species groupings. Terminologies for the level of exploitation vary between countries as do the methods of assessment and date of last assessment and the geographic scope of those assessments.

Figure 9 (cont.) Indicative status of various fishery resources in the Sulu-Sulawesi and Timor-Arafura Seas subregion

Trends in CPUE/catch rates

The trends in CPUE indicate increasing CPUE in a number of trawl fisheries (Tables 38 and 39). This is achieved in the Australian northern prawn fishery through management controls. Elsewhere the increase is less easily explained (Sabah east coast, FMA 573). Decreasing trawl CPUE is seen in FMA 712, probably as a result of overfishing.

Purse seine CPUE is generally stable in the region or increasing (FMAs 714, 716, 718, Sabah east coast). It has strongly decreased in FMA 573 (down 80 percent). Net fisheries are stable or increasing except in FMA 573. There is a strong increase in FMA 713 (up 150 percent). Pole and line CPUE is strongly down (95 percent) in FMA 716. Longline CPUE has increased in FMA 714, 716, 715, but decreased in FMA 573.

Table 38 Trends in CPUE/catch rates by gear for the assessed Sulu-Sulawesi and Timor-Arafura Seas subregion

Country/Area	Year	Overall	Trawl	Purse seine	Other seines	Net: drift/gill/ ring	Hand-line	Pole & line	Long-line
Malaysia Sabah east coast	2000 to 2010		↑ +10 to 61%	↑ +16 to 31%		↑ +10%			
Philippines									
Indonesia Sulu-Sulawesi FMA 712	2000 to 2010		↓ -55%	→		→			
Indonesia FMA 713	2000 to 2010		→	→		↑ +150%			→
Indonesia FMA 714	2000 to 2010			↑ +65%		→		↑ +12%	↑ +25%
Indonesia FMA 716	2000 to 2010			↑ +18%		Gill net →		↓ -95%	↑ +47%
Indonesia FMA 717	2000 to 2010								
Indonesia FMA 718	2000 to 2010		→	↑ +20%		↓ -40%			
Timor-Leste All fisheries			nd	nd	nd	nd		nd	nd
Australia Northern prawn fishery	1980 to 2010		↑ +500%						
Indonesia FMA 573	2000 to 2010		↑ +90%	↓ -80%		↓ -40%			↓ -50%
Indonesia FMA 715	2000 to 2010			→		→		→	↑ +60%

Table 39 Detailed trends in CPUE/catch rates by gear or resource for the assessed Sulu-Sulawesi and Timor-Arafura fisheries areas

Country/Area	Time period	CPUE/comment	Area
Malaysia Sabah east coast	2009 to 2011	Slight increase 3.61 to 3.98 tonnes/trip Increase 7.42 to 8.85 & 14.39 to 16.82; 9.10 to 11.89 tonnes/trip Increase 4.53 to 5.02; 24.85 to 39.93; 2.66 to 2.93 tonnes/trip	Drift/gillnet (Zone A) Purse seine (Zone B) Purse seine (Zone C2) Trawl (Zone B) Trawl (Zone C)
Philippines Mindanao Palawan			
Indonesia Sulu-Sulawesi FMA 712	2000 to 2010	Trawl-like decreasing 60% Large purse seiner drastically decreased since 1997 Mini purse seine tendency to slightly increase Gill nets slightly increased with fluctuations	
Indonesia FMA 713	2000 to 2010	Trawl-like decrease 90% Purse seiner stable at 50 tonnes/boat/yr Gill net slightly increased from 10 to 20 tonnes/boat/yr	
Indonesia FMA 714	2000 to 2010	No trawl-like gear available in this area Purse seine relatively stable with fluctuations in between Gill net increase from 25 to 40 tonnes/boat/yr Longline increase from 2 to 8 tonnes/boat/yr Pole and line increase from 50 to 200 tonnes/boat/yr	
Indonesia FMA 716	2000 to 2010	Purse seine decrease 30% Longline increase 70% Gill net increase 400% Pole and line decrease 85%	
Indonesia FMA 718	2000 to 2010	Trawl has decreased 60% since 2002 Purse seine relatively stable Gill net slightly decreased by 10%	
Timor-Leste	2011	Total catch 85.68 kg/hr (ATSEA cruise, Covalima) **Beacou, Bobonaro** 54 kg/boat/day sardinella 109 kg/boat/day tonggol 23 kg/boat/day flying fish 48 kg/boat/day halfbeak (*Hemiramphus*) 29 kg/boat/day needlefish (*Tylosurus crocodilus*)	
Australia Northern prawn fishery	1980 to 2010	13 000 tonnes from 40 000 vessel days (1980) = 0.325 tonnes/vessel day Banana prawn (2010) 5 642 tonnes in 3 146 vessel days = 1.79 tonnes/vessel day Tiger prawn (2010) 1 628 tonnes in 4 898 vessel days = 0.332 tonnes/vessel day	
Indonesia Timor-Arafura FMA 573	2000 to 2010	Trawl-like decrease >70% since 2008 Purse seine decreased 60% Gill net decreased 40% Longline decreased 80%	
Indonesia FMA 715	2000 to 2010	Purse seiner relatively stable Gill net increase 75% Pole and line decrease 80% Longline relatively stable	

Notes:

Indonesia: trends of CPUE by gear and by FMA were estimated based on nominal catch and effort, and refer to the change between year **2000 and 2010**.

Timor-Leste: this data is from the first three months of a recently implemented catch data project implemented by NDFA-RFLP for artisanal fishers in Timor-Leste. The total catch CPUE is from the ATSEA cruise report at Covalima, South Timor sea.

Low-value/trash fish production

There is relatively little information available for low-value and trash fish production in this region. Percentage compositions are given in Table 40 but the total production is not available for many areas.

Table 40 Production of trash fish/low-value fish for the Sulu-Sulawesi and Timor-Arafura Seas subregion

Country	Tonnes	% of total fisheries production	Comments/reference
Australia	Not reported		Discarding from the shrimp fishery (1:5 of shrimp production?)
Philippines	nd		
Timor-Leste	none	none	All national catch from 2011 from smaller scale fishery. Almost all fish caught is consumed.
Indonesia FMA 573 FMA 712 FMA 713 FMA 714 FMA 715 FMA 716 FMA 717 FMA 718	 35 152 0.2 6 38.1 – – 87.8	Estimated as 11 to 15% of total landing	2008 figure, increased from 21 900 in 1980 National total 427 900 tonnes in 2008 Source of data: National statistics on landing data; R/V. Mutiara IV.Trash – fish species mostly coming from demersal trawl, shrimp trawl and other demersal drag net. No specific trash fish data available in annual report on landing data. Trash fish data from research vessels with standard trawl between 1970 and 1980 were classified as a group of species such as *Plathycephalidae, Tetraodon, Fistularia spp.* (RIMF, 1978. Cruise report)
Malaysia *Sabah east coast*		5.7% Sabah	Predominantly from trawl fisheries

Fishing zones

Locations of fishing zones in the countries of the Sulu-Sulawesi and Timor-Arafura Seas subregion are presented in Table 41.

Table 41 Fishing zones of the countries in Sulu-Sulawesi and Timor-Arafura Seas subregion

Country	Fishing zone 1	Fishing zone 2	Fishing zone 3	Fishing zone 4
Australia				
Indonesia	From shoreline out to 4 nm	From the outer limit of first fishing zone to 12 nm from shore	From the outer limit of second fishing zone to EEZ limit	
Philippines	From shoreline to 15 km	From 15 km to EEZ limit		
Timor-Leste	**Zone A**. Located beyond 200 meters from shoreline of the national territory, for the artisanal national fisheries **Zone B**. Located within 3 nautical miles beyond the coast of the country	**Zone C**. Located within 12 nm beyond the coast of the country, for national industrial fishing (south coast)	**Zone D**. Located within 16 nm from the coast beyond the national territory, for the semi-industrial foreign fishing fleet (south coast)	**Zone E**. located within 18 nm from the coast beyond the national territory for foreign industrial fishing (south coast)

Modified from SEAFDEC (2008)

Management measures

Table 42 presents measures used to manage the different fisheries in the Sulu-Sulawesi and Timor-Arafura Seas subregion and Table 43 presents a breakdown of the number and type of fishing vessels for the same subregion.

Table 42 Examples of management measures used in the different fisheries in Sulu-Sulawesi and Timor-Arafura Seas subregion (by zone)

Area	Closed areas	Closed seasons	Size limits (biological)	Gear restrictions	Licensing	Quotas
Australia Northern prawn fishery	Spawning grounds, nursery, seagrass	Yes		BRD, TED Mesh size?	All Zones	Input controls
Indonesia	Yes	No closed seasons				National TAC
Philippines		Zone 1		All zones	All zones	
Timor-Leste	Zone 1	Zone 1		All zones		
Malaysia Sabah west coast	Zone 1			All zones	All zones	

Table 43 Number and type of fishing vessels in the Sulu-Sulawesi and Timor-Arafura Seas subregion assessed fisheries (by area)

Vessel/gear type	Area								
	Timor-Leste	Philip-pines	Malaysia	Indonesia					
			Sabah (whole state)	FMA 573	FMA 712	FMA 713	FMA 714	FMA 715	FMA 718
Year	**2011**		**2008**	**2008**					
Trawlers				63		2 691			893
Purse seiners				1 563		5 290	3 004	3 004	
D gill net				4 097	12 940	28 252	19 683	20 839	
Drag net					4 835				
Seine net					11 060				
(Tuna) longline						27 602	5 938	6 256	
Non-powered	1 541		2 886						
Outboard engine	1 087		5 234						
Inboard engine			2 858						
<5 GRT	12		8 120						
>5 GRT			2 164						
Small-scale									
Commercial	2								
Total	**2 640**		**10 978**	**5 723**	**28 835**	**63 835**	**28 625**	**30 099**	**893**

Notes:

Indonesia: the total for all Indonesian FMAs is 596 184 vessels, numbers above are only for larger scale gears.

Timor-Leste: there are two foreign vessels licensed to fish in Timorese waters, here listed under “commercial vessels”.

Aquaculture trends in Asia and the Pacific region

In 2010, the Asia and the Pacific region produced 53.1 million tonnes of aquaculture products (excluding aquatic plants). This accounts for 89 percent of the global aquaculture production of 59.9 million tonnes[6] (Table 44). The region's production has grown by 6.5 percent/year between 2000 and 2010. In terms of value, the region's share amounted to some US$95.2 billion (growing by 10.5 percent/year since 2000). This value accounted for 80 percent of the total value of global aquaculture, which was US$119.6 billion in 2010.

When aquatic plant production is included (the vast majority of global aquatic plant production also originates in Asia and the Pacific region, see Box 3 and Table 44), the region becomes even more dominant, producing 71.9 million tonnes worth US$100.8 billion out of a global total of 78.9 million tonnes worth US$125.2 billion.

Box 3 Top aquaculture producing countries in 2010

By weight: Asian states hold eight of the top ten positions.

Top ten aquaculture producer states by quantity (excluding aquatic plants) in 2010 were: China, India, Viet Nam, Norway, Indonesia, Chile, Japan, Bangladesh, Thailand and Philippines.

By value: Asian states hold eight of the top ten positions (Table 44).

This represents 91 percent of global aquaculture production by quantity and 81 percent by value in 2010.

Table 44 Top ten global aquaculture producer states in 2010 by quantity and value (excluding aquatic plant production)

By Quantity	
Country	**Tonnes (Thousand)**
China	37 052
India	4 649
Viet Nam	2 672
Indonesia	2 363
Bangladesh	1 309
Thailand	1 286
Norway	1 008
Myanmar	851
Philippines	745
Japan	718
Other	7 283
Total	**59 936**

By Value	
Country	**US$ (Million)**
China	60 295
India	9 085
Viet Nam	5 150
Norway	5 020
Indonesia	4 924
Chile	3 753
Japan	3 532
Bangladesh	2 840
Thailand	2 817
Philippines	1 563
Other	20 594
Total	**119 573**

Compared with 2000, the region's share of aquaculture production remains almost unchanged (90 percent in 2000). Similarly, the share of value remains almost unchanged (although of significantly greater value) from 80 percent in 2000. The growth rate of aquaculture production in the region has continued to be very strong (Table 45), with a yearly growth rate in terms of quantity of 6.7 percent between 2000 and 2010 (the world growth rate was similar at 6.6 percent over the same time period). Previously, the growth in aquaculture production in the APFIC region resulted mainly from the continuously increasing production from China.[7] However, the growth rate of APFIC excluding China overtook that of China during 2000 to 2010 (9.3 percent compared to 5.5 percent in terms of quantity).

[6] Note recent revisions for Chinese aquaculture data.

[7] Average annual growth rate (average) for the last ten years was 5.3 percent in terms of quantity and 10.4 percent in terms of value, including aquatic plants production.

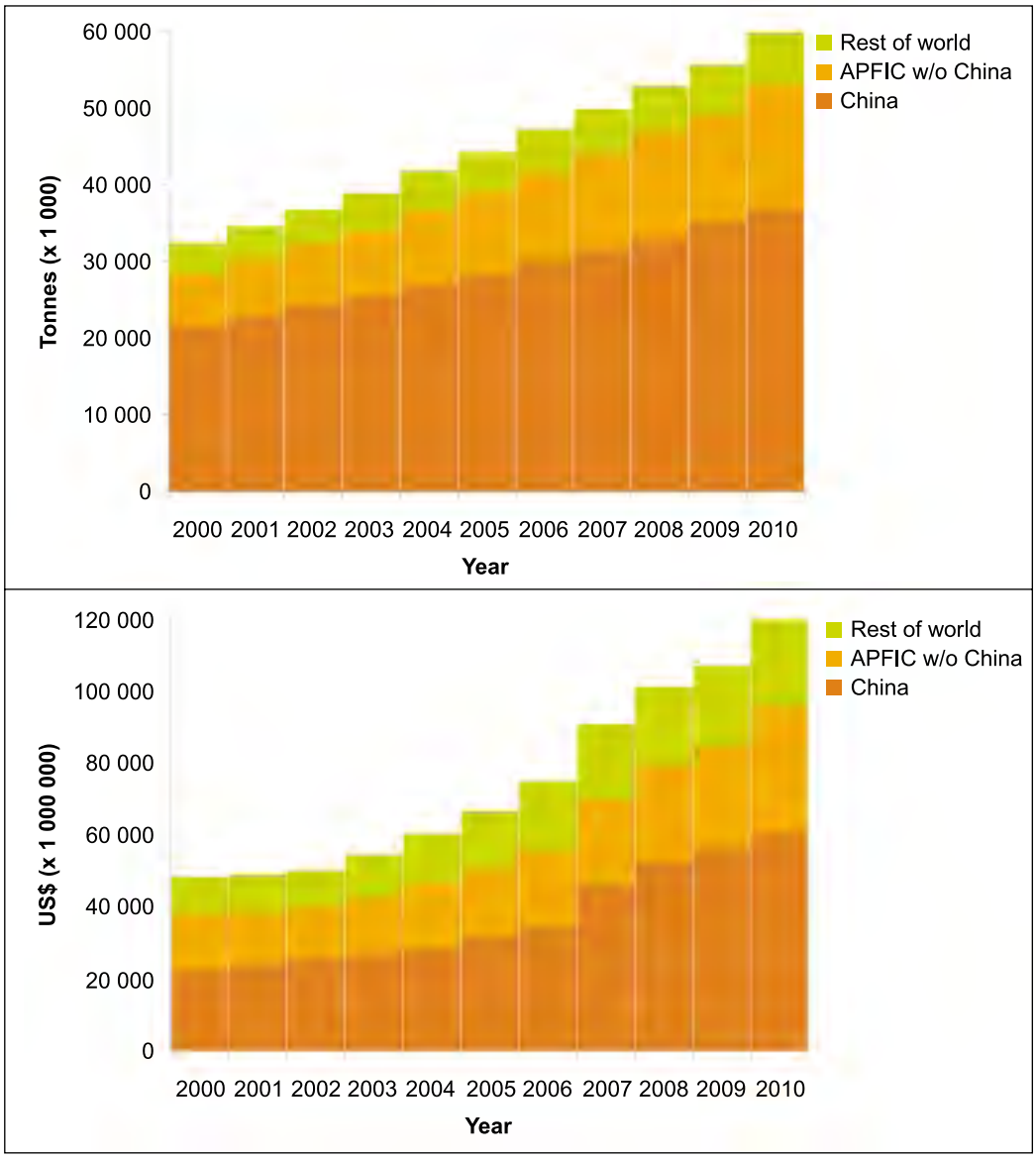
In terms of tonnage (excluding aquatic plants), other major producing countries that have shown large increases over the past decade are listed in Table 45.

Both inland culture and mariculture have shown steady growth, but the growth rate of the inland culture sector was more rapid in Asia and the Pacific region if China is excluded, at 11 percent/year for the inland sector, compared to 6 percent/year for the marine sector. For China, the yearly increase in the inland sector was 6 percent/year, compared to 5 percent/year for the marine sector (Figure 10).

Aquaculture production is not increasing throughout the region, with some countries experiencing negative or zero growth in production during 2000 to 2010. This includes

Table 45 Major producing countries that have shown large increases over the past decade

Country	Percent increase per year between 2000 and 2010 (percent/year)
Myanmar	24
Viet Nam	18
Indonesia	12
India	9
Bangladesh	7
Philippines	7
Thailand	6



Note: The data for China refer to the subregion (see page 2 this report).

Figure 10 Trends in global aquaculture production (quantity and value) 2000–2010 (excluding aquatic plants)

Japan (which has contracted by 0.6 percent/year) where there has been a decline in most of the species cultured as a result of continuing economic problems and declining population in the country.

China[8] reported a production of 48.1 million tonnes in 2010, worth US$62.8 billion (including aquatic plants), representing 61 percent of the world aquaculture production in terms of volume and 50 percent in terms of value. This continues China's consistent domination of global aquaculture production, but there has been a slight decrease of 1.2 percent/year since 2000 in terms of quantity, as the rest of the world continues to increase aquaculture production more rapidly than China.[9]

In terms of value, China's contribution has increased by 0.9 percent/year from 2000 to 2010 from 46 to 50 percent, as China begins to culture more valuable species and demand high prices for them in its local markets. Since China is such a predominant producer, the scale of reported production can mask other regional trends and China is therefore hereafter treated separately in this report.

If China's aquaculture production is excluded, Asia and the Pacific region still remains an important production area for aquaculture, exhibiting steady growth in all culture environments. In particular, inland aquaculture production has tripled from 3.8 million tonnes in 2000 to 11.0 million tonnes in 2010 and marine production (excluding aquatic plants) has almost doubled from 2.8 to 5.0 million tonnes over the same period. Such advances far exceed the growth of aquaculture in the rest of the world (Figure 11).

There has been considerable change in the top twenty cultured species (excluding aquatic plants and molluscs)[10] in the region between 2000 and 2010 (Box 4, Table 46).

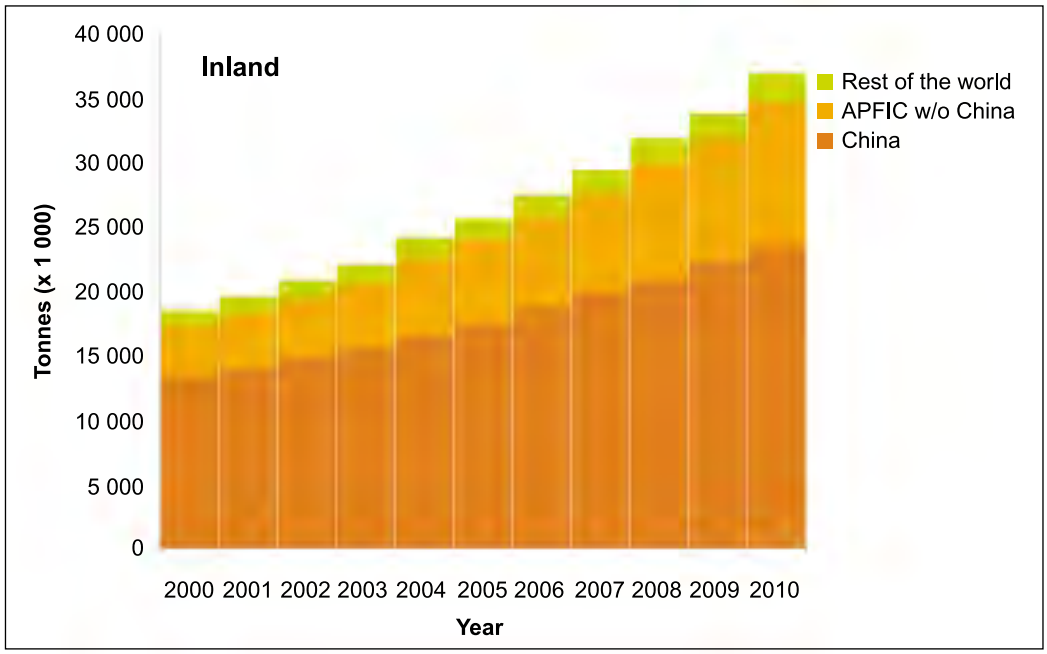
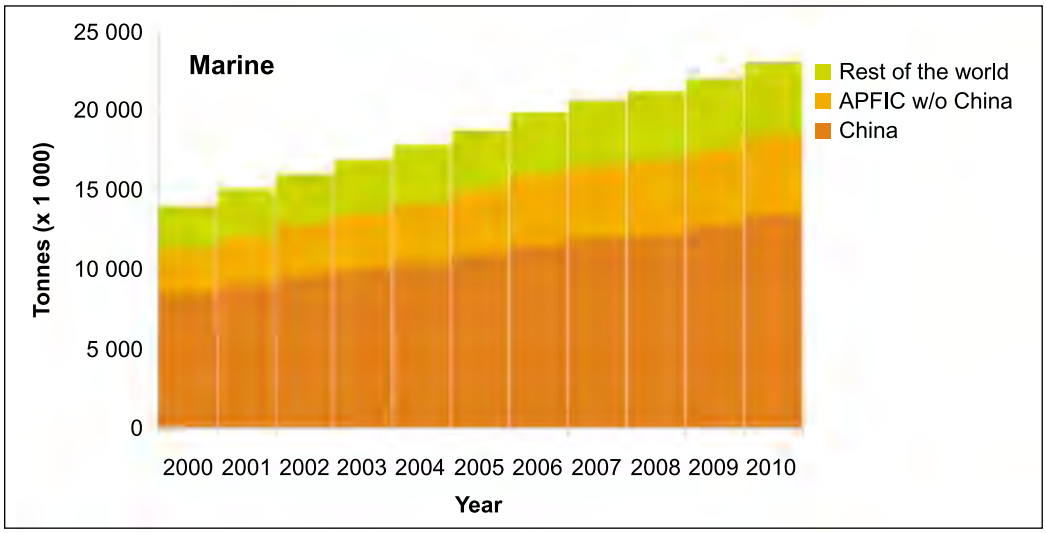


Figure 11 Trends in aquaculture production in Asia and the Pacific region by environment 2000–2010

[8] This figure is for all China (see page 2), but it must be noted that the massive scale of China's aquaculture production challenges statistical collection and there are uncertainties regarding the quantities reported.

[9] China has recently reviewed and revised aquaculture production statistics and these have been reduced from previously reported levels. This means that a comparison with production figures in earlier FAO and APFIC reports will not be possible, although the FAO FishStat data have been adjusted backwards to compensate for this and thus the latest time series in datasets of FAO are comparable.

[10] There is still significant volume of aquaculture production reported by large group of species, i.e. not identified at family, order or species level. Consequently, the species items totals could have underestimated the real production of the individual species.



Note: China refers to the subregion, see page 2.

Figure 11 (cont.) Trends in aquaculture production in Asia and the Pacific region by environment 2000–2010

Changes in the production of top species of the region

There has been considerable change in the top twenty cultured species (excluding aquatic plants and molluscs)[11] in the region between 2000 and 2010 (Box 4, Table 46). There are six new members (whiteleg shrimp, pangas catfishes nei, red swamp crawfish, cyprinids nei, snakeheads nei and Amur catfish) in the top 20 species compared with 2000, although inland waters species (mainly Chinese and Indian carps) still hold the top seven positions (Box 4).

Box 4 Top cultured species in Asia and the Pacific region 2010

The top six cultured species in 2010 were all freshwater carp (grass carp, silver carp, catla, common carp, bighead carp and crucian carp) and their aggregated production was **20 million tonnes** accounting for **38 percent of total aquaculture production of the region** (excluding aquatic plants).

The biggest mover amongst these species is the catla, which has been increasing at 20 percent/year between 2000 and 2010. In addition, there have also been significant changes in the order of the top 20. Whiteleg shrimp (increasing at 99 percent/year) and pangas catfishes nei (increasing at 29 percent/year between 2000 and 2010) are among the top ten species now.

It is worth noting that the number and quantity of high-value species that are carnivorous or dependent on high (animal) protein feed has increased during the past ten years. Freshwater species with current production exceeding 100 000 tonnes include Asian swamp eel, Japanese eel, largemouth black bass, mandarin fish and snakeheads (all increasing at 11 to 18 percent/year between 2000 and 2010), and marine and brackish water species with production levels exceeding 50 000 tonnes include: whiteleg shrimp, giant tiger prawn, Chinese mitten crab, red swamp crawfish, oriental river prawn, giant river prawn, Indo-Pacific swamp crab, Japanese amberjack, Japanese seabass, large yellow croaker, red drum, silver seabream, barramundi, groupers (nei) and turbot.

In marine waters, the production is generally dominated by high-value carnivorous/high protein feed-dependent species such as penaeid shrimp, jacks, seabass, seabream, croakers, groupers, turbot, halibut and cobia. However, some of the top species cultured in marine and brackish environments are also herbivorous/omnivorous, including milkfish, with new entrants including sea cucumbers and jellyfish. Production of crabs (especially Indo-Pacific swamp crab and swimming crabs) as well as the whiteleg shrimp have made significant advances in recent years, with whiteleg shrimp now the most produced

[11] There is still significant volume of aquaculture production reported by large group of species, i.e. not identified at family, order or species level. Consequently, the species items totals could have underestimated the real production of the individual species.

Table 46 Top twenty cultured species in Asia and the Pacific region in 2000 and 2010 by quantity (excluding aquatic plants and molluscs)

Inland waters				Marine waters			
2000		2010		2000		2010	
Species	1 000 tonnes	Species	1 000 tonnes	Species	1 000 tonnes	Species	1 000 tonnes
Silver carp	**2 957**	Grass carp (=White amur)	**4 299**	Giant tiger prawn	**626**	Whiteleg shrimp	**1 603**
Grass carp (=White amur)	**2 906**	Silver carp	**4 001**	Milkfish	**430**	Milkfish	**750**
Common carp	**2 168**	Catla	**3 870**	Fleshy prawn	**193**	Giant tiger prawn	**727**
Bighead carp	**1 417**	Common carp	**3 023**	Japanese amberjack	**137**	Aquatic invertebrates nei	**172**
Crucian carp	**1 202**	Bighead carp	**2 576**	Marine crabs nei	**111**	Indo-Pacific swamp crab	**141**
Nile tilapia	**770**	Crucian carp	**2 217**	Silver seabream	**83**	Japanese amberjack	**139**
Roho labeo	**734**	Nile tilapia	**1 789**	Penaeus shrimps nei	**60**	Japanese sea cucumber	**130**
Catla	**602**	Pangas catfishes nei	**1 343**	Aquatic invertebrates nei	**57**	Japanese seabass	**108**
Mrigal carp	**552**	Roho labeo	**1 167**	Banana prawn	**50**	Swimming crabs, etc. nei	**91**
Wuchang bream	**446**	Wuchang bream	**652**	Mozambique tilapia	**26**	Large yellow croaker	**86**
Chinese mitten crab	**203**	Whiteleg shrimp	**619**	Bastard halibut	**21**	Penaeid shrimps nei	**76**
Japanese eel	**197**	Chinese mitten crab	**593**	Metapenaeus shrimps nei	**21**	Groupers nei	**74**
Mud carp	**174**	Red swamp crawfish	**563**	Barramundi (=Giant seaperch)	**18**	Silver seabream	**74**
Black carp	**149**	Cyprinids nei	**508**	Coho (=Silver) salmon	**13**	Turbot	**60**
Giant river prawn	**130**	Black carp	**424**	Tilapias nei	**12**	Jellyfishes nei	**60**
Pangas catfishes nei	**102**	Snakeheads (=Murrels) nei	**382**	Atlantic salmon	**11**	Kuruma prawn	**57**
Oriental river prawn	**87**	Amur catfish	**380**	Mullets nei	**11**	Red drum	**52**
Mandarin fish	**86**	Mrigal carp	**379**	Indo-Pacific swamp crab	**11**	Barramundi (=Giant seaperch)	**52**
Silver barb	**85**	Blue-Nile tilapia, hybrid	**333**	Marine fishes nei	**419**	Marine fishes nei	**464**
Freshwater fishes nei	**1 658**	Freshwater fishes nei	**1 055**	Freshwater fishes nei	**17**	Freshwater fishes nei	**186**

marine species in the region at 2.2 million tonnes, with 1.6 million tonnes coming from marine/brackish environments and 0.6 million tonnes from fresh waters (Table 46).

As aquaculture has become more intensive in the region, commercial feed use has also been increasing. Feed is becoming a significant proportion of the total production costs, ranging between 50 and 70 percent in semi-intensive to intensive systems. Over the last decade, there has been a continuous increase in the price of all the major aquaculture feed ingredients, including fishmeal, soybean meal, maize etc. Although the cost of feed ingredients has pushed the aquaculture feed prices to historically high levels, there has been little corresponding increase in the market price of the major aquaculture commodities (especially whiteleg shrimp, tilapia and pangassius). This has resulted in declining profit margins and a tendency to drive the intensity of production to try to compensate for the low unit price.

It is notable that following an APFIC recommendation in 2006 to provide disaggregated reports of aquaculture production, in 2010 the quantity of freshwater fishes (nei) decreased by 24 percent, whereas total production increased, indicating improved disaggregation of statistics supplied by member countries.

Species composition

Aquaculture is an expanding sector in Asia and the Pacific region and very important for many of its economies. The current trend and current expectations are that aquaculture will play an even more important role in the future, both in terms of an important rural livelihood and an invaluable source of protein for both the poor and the rich in Asia and the Pacific region, although attention from outside tends to focus more on internationally-traded commodities.

To highlight the changes taking place within the sector, a review of the major groups of species that are currently cultured in the region is presented below. Species are grouped according to the trophic needs of the species and the environment in which they are cultured – either freshwater or marine and brackish waters (grouped together). Production and value is presented per species (family, order) from each trophic level and from each of these two types of environments. Often the lower trophic levels of aquaculture do not generate the same amount of attention as the higher-level trophic species. However, the lower trophic levels of aquaculture that require fewer inputs are often the cornerstone of the diet for both the rural poor and the urban poor.

Freshwater carnivorous finfish species

This group of species comprises mostly freshwater species, but includes some marine or brackish water species which are also cultivated in freshwater environments (i.e. pomfred and puffers) and also diadromous or anadramous species including some salmonids, eels and sturgeons.

In general, the culture of this group of higher-value freshwater fish in the Asia-Pacific region has been growing very quickly over the past decade, reaching a rate of growth of 14 percent/year between 2000 and 2010, compared to only 6 percent/year for omnivorous/herbivorous freshwater species over this same time period (Figure 12). This is in response to the growing affluence of the population in the region and their demand for higher value species. It also reflects the higher profitability of farming these higher-value species. However, the total production of these higher-value species amounted to just 1 515 994 tonnes in 2010, compared to 30 084 809 tonnes for freshwater omnivorous and herbivorous species in the APFIC region. These higher trophic level species thus made up just 5 percent of freshwater fish production in the region in 2010.

China dominated production of these higher-value freshwater species, with a total production of 1 391 039 tonnes or 92 percent of the total production of this group in 2010 from the APFIC region. Although China cultured 14 species of carnivorous freshwater fish in 2010, most of this production comprised snakeheads (376 529 tonnes), Asian swamp eels (272 939 tonnes), mandarin fish (252 622 tonnes), Japanese eel (233 128 tonnes) and largemouth black bass (185 941 tonnes). Other major producing states include Indonesia (nearly 60 000 tonnes or 4 percent, comprising mostly eastern pomfred and snakeheads), Japan (over 20 000 tonnes or 1.4 percent, comprising Japanese eels), Korea RO (nearly 11 000 tonnes or 0.7 percent, comprising mostly Japanese eel and rainbow trout), Thailand (7 000 tonnes or 0.5 percent, mostly striped snakehead) and Bangladesh (6 000 tonnes or 0.4 percent, also mostly snakeheads).

In terms of overall value, these carnivorous/high production input species were valued at US$5.7 billion in 2010 (with US$4.8 billion or 85 percent produced by China), a 13 percent annual increase between 2000 and 2010. This equates to a unit value of US$3.78/kg, which declined slightly by 1 percent/year between 2000 and 2010.

In contrast, the omnivorous and herbivorous freshwater fish production was valued at US$42.5 billion in 2010 (with US$24.9 billion or 59 percent being produced by China), an 11 percent annual increase between 2000 and 2010. This equates to a unit value of US$1.41/kg, almost one third of the value of

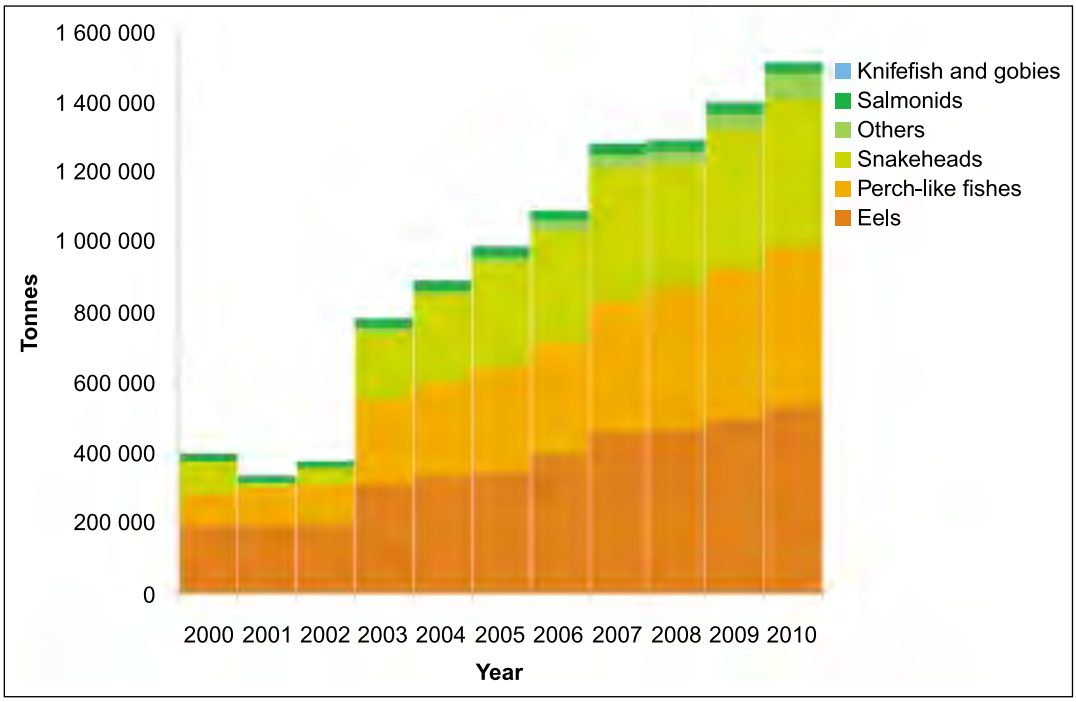


Figure 12 Changes in freshwater carnivorous fish species group production 2000–2010 in Asia and the Pacific region

the carnivorous species, but the unit value of this group increased by 4 percent/year between 2000 and 2010, indicating the growing popularity of these lower value freshwater fish species for local consumption in the Asia-Pacific region.

Eels (order Anguilliformes and Synbranchiformes)

The global production of eels in 2010 was 544 536 tonnes, almost triple the production in 2000. The vast majority, 536 449 tonnes (99 percent), of this production was produced in Asian farms, and increased by 11 percent/year between 2000 and 2010 (Figure 12). Production in China, mostly Asian swamp eel (*Monopterus albus*) and Japanese eel (*Anguilla japonica*), has risen steadily at 12 percent/year from 2000 to 2010, reaching a new high in 2010 of 506 067 tonnes worth US$1.6 billion at a unit value of US$3.07/kg. Eel production in Japan (*Anguilla japonica*) has remained stable for the past ten years at about 20 000 tonnes, worth US$435 million at a very high unit value of US$21.15/kg. Indonesia, Korea RO, Singapore, Thailand and Cambodia also produced small quantities of eels through aquaculture (including Japanese eel, river eels nei, Asian swamp eels and rice paddy eels).

China has regularly imported European glass eels (*Anguilla anguilla*) and therefore its reported Japanese eel production is likely to include the European eel too. Europe has increasingly supplied Asian eel farms with glass eels and the region has gradually become more dependent on the wild-caught eels of Europe. In 1997, for example, France exported more than 266 tonnes of European eels to destinations outside the European Union (EU), amounting to 55 percent of all EU eel exports outside Europe that year. Correspondingly, the Chinese import of eel in 2007 was 203 tonnes (Ringuet *et al.,* 2002). The listing of European eel under CITES Appendix II came into effect on March 2009 and this now means that export outside of Europe is restricted. The sourcing of elvers within Asia and the Pacific region has now become a priority, with reports of several countries looking to their own resources for possible export to China and other eel culturing countries.

It should be noted that the accurate reporting of eel production with respect to the actual species produced is now of considerable importance with regard to the CITES listing. The APFIC region should see a significant decline in *Anguilla anguilla* production (in principle to zero) from Asian countries that lie outside of its natural range and therefore cannot import elvers from Europe.

Perch-like fishes (family Percichthyidae)

China reported a production of 252 622 tonnes for mandarin fish (*Siniperca chuatsi*) worth US$2.4 billion at a high unit value of US$9.31/kg in 2010. The production has been steadily increasing since 1995 when it was first reported in China, and its production grew at an annual rate of 11 percent between 2000 and 2010. China also reported the production of 185 941 tonnes of largemouth black bass (*Micropterus salmoides*) worth US$290 million at a low unit value of US$1.56/kg. This species was introduced to China from North America and was first reported in 2003. Since that time, China's production has increased at 8 percent/year. Other reported species in this family are barramundi (giant sea perch) (*Lates calcarifer*) in Taiwan Province of China and silver perch (*Bidyanus bibyanus*) in Australia. The trend for this group has been a rapid increase in production of 18 percent/year between 2000 and 2010 (partially because of the recent adoption of culture of the mandarin fish and largemouth black bass in China).

The culture of mandarin fish in China is worth mentioning since being highly carnivorous it is considered only possible to raise it on live food. There has now developed a complete service sector of farmers who produce small bream as live feed for this fish. This is a good example of a low trophic level fish being cultured as feed for a carnivore, with little or no reliance on marine sources of feed in the system. A lesson here is that small-scale farmers can use low-risk systems to service more intensive or higher-value aquaculture operations.

Snakeheads (family Channidae)

The total production of this group for Asia and the Pacific region in 2010 was 421 275 tonnes. The top five producing nations are China, Indonesia, Thailand, Cambodia and Bangladesh. Species include mostly unclassified snakeheads (China and Indonesia), Indonesian snakeheads (Indonesia and Thailand), striped snakeheads (Thailand, Cambodia and Bangladesh) and others. China has recently started to report snakehead production separately (as with other species) and in 2010 China reported production of 376 529 tonnes, worth US$459 million at a low unit value of US$1.22/kg, but growing at 14 percent/year between 2000 and 2010. This production is now 89 percent of the total Asia-Pacific production of snakeheads.

The trend for this group is hard to describe because of the recent of inclusion of the Chinese production in 2003, but growth has been rapid at an average of 17 percent/year between 2000 and 2010. Indonesia has been producing since 2002, and has increased production rapidly since then at 47 percent/year to a total of 23 010 tonnes worth US$34 million at a unit value of US$1.49/kg in 2010. Cambodia and Bangladesh have only been producing at a low level (5 to 6 000 tonnes) over the past 2 to 5 years. Thailand has been producing for a long time, and has fluctuated between 4 and 12 000 tonnes over the past ten years. India has fluctuated in the past ten years with a high in 2000 of 80 740 tonnes and a low in 2001 of 1 300 tonnes, then it has increased rapidly back to 39 994 tonnes in 2007. Since 2008 snakeheads have been unreported up to and including 2010.

The snakehead species, although generally popular in some countries do not enjoy a large export market, even within the region (there is certainly no intraregional trade). The fish has no real fillet value and is generally sold live or whole. However, some of it is exported from mainland China to Hong Kong SAR. The rapid rise of *Pangasius spp*. and tilapia has undermined the significance of the species group in some countries where it once had greater prominence as a cultured species. Its carnivorous nature also means that profit margins are generally lower than those which can be achieved from the more omnivorous catfish species.

Salmonids – freshwater (family Salmonidae)

Freshwater production of salmonid species in the region has developed relatively slowly over the last ten years and reached 30 919 tonnes worth US$143 million at a high unit value of US$4.64 in 2010, an increase of 4 percent/year between 2000 and 2010. This is much less than reported by FAO in 2008 since there was a considerable production of rainbow trout in IR Iran, which has since been removed from the APFIC region in the FAO statistics. China is the top producer of freshwater salmonids by volume (59 percent of the volume produced in the Asia-Pacific region in 2010), producing 18 119 tonnes worth

US$29 million at a low unit value of US$1.57/kg. However, other countries in the region produce more valuable salmonids, particularly rainbow trout in Japan and Korea RO and Chinook salmon in New Zealand, so that the share of China in terms of value was only 20 percent in 2010.

This rise in the volume of production has come mainly from the increasing production of rainbow trout (*Oncorhynchus mykiss*) in China, which since its first report in 2003 has grown at 9 percent/year to reach 16 686 tonnes worth US$26 million at a low unit value of US$1.58/kg in 2010. Rainbow trout is the predominant freshwater salmonid produced in the region, amounting to 25 600 tonnes, representing 83 percent of all freshwater salmonids produced. Other countries producing rainbow trout include Japan, producing 9 363 tonnes (including trouts nei) worth US$94 million at a high unit value of US$10.00/kg in 2010 (but decreasing by 6 percent/year between 2000 and 2010), Korea RO (stagnant at 2 652 tonnes worth US$16 million at a unit value of US$6.06 in 2010) and small quantities in Nepal, Papua New Guinea and Australia. Trout is now also produced in smaller quantities in several other Asian countries (e.g. Viet Nam, Thailand, India and Afghanistan), but in some cases may not appear in the disaggregated statistics.

Other species of freshwater salmonids cultured in the region include 3 262 tonnes of trouts nei (*Salmo spp.*) from Japan (decreasing by 2 percent/year between 2000 and 2010), 1 433 tonnes of Salmonids nei from China (decreasing at 6 percent/year between 2000 and 2010) and 625 tonnes of Chinook salmon (*Oncorhynchus tshawytscha*) worth US$4 million at a unit value of US$6.17/kg from New Zealand in 2010.

Knifefish and gobies (order Osteoglosiformes and Gobiformes)

These species are not widely cultured but have a good market price in certain countries. Sand goby production in Asia continues to be almost totally based on ongrowing of wild caught fingerlings. The total production of knifefish and gobies was 2 431 tonnes worth nearly US$5 million at a unit value of US$1.95/kg in 2010. Although this is a small production, it represents a yearly increase of 25 percent between 2000 and 2010. Much of this increase can be attributed to the Indonesian production of marble goby (*Oxyeleotris marmorata*), which reached 980 tonnes worth US$4 million at a unit value of US$4.16/kg in 2010. This species is also produced in small quantities in Thailand (105 tonnes in 2010) and Malaysia (where only 9 tonnes were produced in 2010). Previously Singapore also produced a small amount, but did not report any in 2010.

The slow growth rate and carnivorous habit as well as the requirement for moving or well-aerated water make culture of this species comparatively costly. The low densities of culture also mean that returns per unit area are low and the rerun period is long. Farmers are tending to move away from this species towards more rapid turnover and intensive systems of tilapia, where margins and lower, but cash flow is more regular.

Over the past two years, two new species of knifefish, the bronze featherback (*Notopterus notopterus*) and the clown knifefish (*Chitala chitala*) have also been reported by Bangladesh with a total production of 1 334 tonnes worth US$3.6 million at a unit value of US$2.71/kg in 2010.

Others

Other high-value fish species being produced in the region in freshwater include sturgeons nei (*Acipenseridae spp.),* eastern pomfred (*Schuettea scalaripinnis*) and puffers nei (*Tetraodontidae spp.).* Sturgeon spp. are cultured mostly in China where 35 504 tonnes worth US$101 million at a unit value of US$2.86 were produced in 2010. This is a yearly increase of 21 percent since first being reported in 2003. Within the past three years there has also been some small production of this fish in Viet Nam (180 tonnes in 2010). The eastern pomfred is grown in Indonesia and has increased very rapidly (69 percent/year) since first being reported in 2005 to a total of 34 123 tonnes worth US$45 million at a unit value of US$1.31/kg in 2010. Puffer species have been reported by China since 2003 and their production has grown at 13 percent/year since then to a total of 2 842 tonnes worth over US$4 million at a unit value of US$1.56/kg in 2010.

Marine and brackish water finfish species

Total production of cultured marine/brackish water fish species in the APFIC region has increased considerably over the past ten years and reached some 2 457 805 tonnes worth US$7.9 billion at a unit value of US$3.22/kg in 2010, an increase in production and value of 7 percent per year over that in 2000 (Figure 13). In terms of the number and trophic level of species cultured, the vast majority of these species are carnivorous with a high unit value. However, the species with the highest production figure of all is milkfish, which is herbivorous/omnivorous.

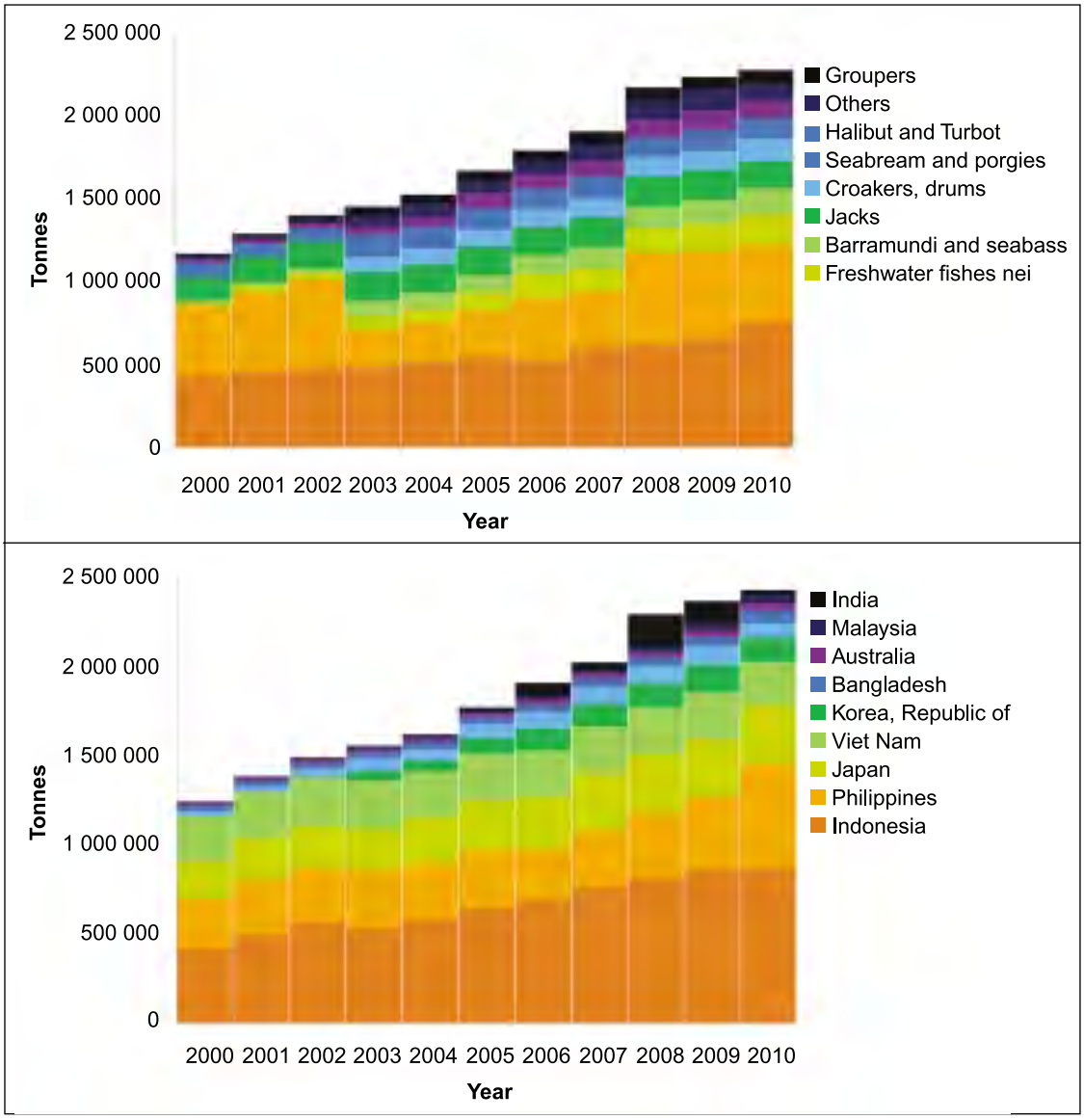


Figure 13 Marine and brackish water finfish species production by species group and by country 2000–2010 in the Asia and the Pacific region

In terms of herbivorous and omnivorous marine/brackish water fish species, the total production in the APFIC region has increased significantly to some 830 329 tonnes worth US$1.3 billion at a relatively low unit value of US$1.53/kg in 2010, an increase in production and value of 6 percent/year between 2000 and 2010. Herbivorous/omnivorous fish species make up 34 percent of the volume and 16 percent of the value of marine finfish produced.

In terms of purely carnivorous marine/brackish water fish species, the total production in the APFIC region, production has increased even more rapidly to some 1 627 476 tonnes worth US$6.7 billion at a relatively high unit value of US$4.09/kg in 2010, an increase in production and value of 8 percent/year between 2000 and 2010. Carnivorous fish species currently make up 66 percent of the volume and 84 percent of the value of marine fish produced, and the culture of this group of fish is growing rapidly.

The culture of marine carnivorous fish typically depends on direct use of low-value fish, which has created increasing concern over the pressure on capture fisheries recently. To address the issue, an FAO regional technical cooperation programme (TCP) project on substituting low-value fish with pellet feed has been implemented successfully and indicates that the substitution with formulated feeds can be profitable and can improve management.

Milkfish (family Chanos)

Milkfish (*Chanos chanos*) is the most popular marine fish cultured in the APFIC region, comprising over 30 percent of the total production of all marine fish species cultured (Figure 14). The Asia-Pacific region produced a total of 750 466 tonnes of milkfish in 2010, growing by 6 percent/year between 2000 and 2010. Milkfish production was valued at US$1.1 billion in 2010 (at a unit value of US$1.49/kg), growing by 5 percent/year between 2000 and 2010. Milkfish is one of a few omnivorous/herbivorous marine finfish species cultured in the region, with others including mullet, tilapia, spinefoot spp. and some others of minor importance.

Indonesia and the Philippines are traditionally the largest producers of milkfish in the world. Indonesia is the most important country, producing 422 068 tonnes in 2010 worth US$528 million at a unit value of US$1.25/kg in 2010, and with a growth rate of 7 percent/year between 2000 and 2010. Over 99 percent of the Indonesian production comes from brackish water ponds, with only small quantities from marine cages. Milkfish culture is a strong tradition in the Philippines and this reflects the country's preference for the species. Milkfish production in the Philippines amounted to 306 643 tonnes worth US$547 million at a unit value of US$1.78/kg in 2010 and with a growth rate of 5 percent between 2000 and 2010. Milkfish have typically been produced in brackish water ponds (219 444 tonnes or 72 percent of the total in 2010 and with a growth rate of just 2 percent/year between 2000 and 2010) but there is an increasing trend in mariculture production of milkfish reported (87 199 tonnes or 28 percent of the total in 2010 with an impressive growth rate of 26 percent/year between 2000 and 2010), indicating the more intensive use of cage systems. These systems are fed with either pellets or trash/low-value fish and are part of the general trend of intensification of mariculture in the Philippines. There are also traditions of small amounts of milkfish culture in some of the Pacific islands (e.g. Guam, Kiribati and Palau) as well as Sri Lanka and Timor-Leste. Taiwan POC produced 20 380 tonnes in 2010, all in brackish water with a growth rate of only 2 percent/year over the past ten years. Singapore has developed its mariculture of milkfish steadily and produced 1 312 tonnes in 2010 with an annual growth rate of 7 percent between 2000 and 2010.

Japanese seabass and barramundi (family Centropomidae and Percichthyidae)

This group of marine fish is one of the two (jacks is the other) most important groups of carnivorous marine/brackish water finfish cultured in the APFIC region, with a production figure of 160 087 tonnes in 2010, and a rapid growth rate of 24 percent/year between 2000 and 2010.

China started reporting the production of Japanese seabass (*Lateolabrax japonicus)* in 2003 and produced 105 951 tonnes worth US$127 million at a unit value of US$1.20/kg in 2010 with an annual growth rate of 6 percent between 2003 and 2010, although production has stagnated over the past four years. This may have been an effect of China's improved reporting on individual species (these species may have previously been reported under marine finfish nei). Korea RO is also producing increasing amounts of Japanese seabass and produced 1 952 tonnes worth US$17 million at a high unit value of US$8.88/kg in 2010 and with a growth rate of 12 percent/year between 2000 and 2010, although production has also stagnated over the past four years.

Japanese seabass is a relatively high-value species (at least in Korea RO) and total production in the region was valued at US$145 million in 2010 (growing at 7 percent/year between 2003 and 2010), with an average unit value of US$1.34/kg.

Barramundi (*Lates calcarifer*) production is increasing rapidly, with the regional total reaching 52 184 tonnes worth US$219 million at a high unit value of US$4.20/kg in 2010 and with an annual rate of increase of 11 percent between 2000 and 2010, with most production coming from brackish waters. Malaysia has recently become the top producer in the region (20 022 tonnes in 2010) with a rapid rate of growth of 19 percent between 2000 and 2010. Additionally, there are recent increases from Thailand, which produced 13 434 tonnes in 2010, with an annual growth rate of 6 percent between 2000 and 2010. This species has become popular in supermarkets as a whole tablefish.

Other major producers of barramundi in the region in 2010 were China (in Taiwan POC) (9 038 tonnes), Indonesia (5 738 tonnes), Australia (3 190 tonnes) and Korea RO (1 952 tonnes), with smaller quantities coming from Singapore, Cambodia, Myanmar, Brunei Darussalam, Papua New Guinea and Sri Lanka.

Jacks (family Carangidae)

This group of marine fish is the other of the two most important groups of cultured carnivorous marine/brackish water finfish in the APFIC region. Production of jacks was 158 960 tonnes in 2010, but showed a slow growth rate of just 1 percent/year between 2000 and 2010. These are species that are almost exclusively cultured intensively in marine cages with little production coming from brackish water areas.

Japanese culture of amberjack (*Seriola quinqueradiata*) is the leader within this family with production of 138 936 tonnes worth US$1.2 billion at a very high unit value of US$8.54/kg in 2010 (87 percent of the total from this culture group), with a growth rate of just 1 percent/year, although slightly down on the 2008 production figure. The Japanese fishery for fingerlings of this species (mojako) is an interesting example of what might be considered a sustainable fish seed fishery for aquaculture. The juveniles are caught in a fishery using seaweed as attractants and the juveniles are transported live to the farms for “on-growing”. The system is demonstrably sustainable because of the length of time it has been pursued and the fishery catch records show no discernible impact on the adult fishery.

Other species within this group of jacks include amberjacks nei with 17 021 tonnes produced in China in 2010, white trevally, with 2 795 tonnes produced in Japan in 2010, and small amounts of jacks, crevalles nei produced in the Philippines and Brunei Darussalam.

Croakers and drums (family Larimichthys and Sciaenops)

The two most important species in this group, the large yellow croaker (*Larimichthys croceus*) and the red drum (*Sciaenops ocellatus*), have both recently been reported as cultured species in China.

Chinese culture of the large yellow croaker is the leader within this family with production of 85 809 tonnes in 2010, with a growth rate of 8 percent/year since it was first reported in 2003. Production of this species was worth US$102 million at a unit value of US$1.19/kg. The other major species in this group, the red drum was imported from the USA and China reported a production figure of 52 243 tonnes in 2010, with a growth rate of 4 percent/year since it was first reported in 2003. Production of this species was worth US$62 million at a unit value of US$1.19/kg.

Seabream and porgies (family sparidae)

There are three important species in this group: the silver seabream (*Pagrus auratus*), porgies, seabreams nei (sparidae spp.) and the blackhead seabream (*Acanthopagrus schlegeli*). Total production from the Asia-Pacific region in this group amounted to 123 007 tonnes in 2010, with a growth rate decreasing by 1 percent/year between 2003 and 2010.

Seabream and porgie production is confined to Japan, China and Korea RO. Japan produced 67 607 tonnes of silver seabream in 2010 worth US$534 million at a high unit value of US$7.90/kg. Production has

been declining by 2 percent/year since 2003. Korea RO also produced 6 300 tonnes of silver seabream in 2010, with Taiwan POC producing a further 17 tonnes. Korea RO also produced 2 254 tonnes of blackhead seabream in 2010 worth US$20 million in 2010 at a high unit value of US$8.68/kg. China (Taiwan POC) also produced 364 tonnes of blackhead seabream in 2010. Culture of porgies and seabreams nei was done mostly in China, producing 45 012 tonnes worth US$54 million at a low unit value of US$1.19/kg in 2010. Production has been increasing by 3 percent/year since it was first reported in 2003. These species were also produced in small quantities in Korea RO and China (Taiwan POC).

Flatfish (Turbot and bastard halibut)

There are two important species in this group, namely the turbot (*Psetta maxima*) and the bastard halibut (*Paralichthys olivaceus*). Total production of this group from the Asia-Pacific region had a growth rate of 13 percent/year between 2003 and 2010 and amounted to 104 902 tonnes in 2010.

All of the turbot production is from China, where it was first reported in 2003. Production amounted to 60 000 tonnes worth US$443 million at a high unit value of US$7.39/kg in 2010. It has grown by 43 percent/year since 2003. Bastard halibut production is mostly from Korea RO, which produced 40 925 tonnes worth US$424 million at a very high unit value of US$10.36/kg in 2010. It had a growth rate of 11 percent/year between 2000 and 2010. There is also some production of this species from Japan (3 977 tonnes in 2010), but production declined by 6 percent/year between 2000 and 2010, which is the fate of most finfish species in Japan.

Groupers (family Serranidae)

Production of groupers (*Epinephalus spp*.) has increased rapidly from 9 507 tonnes in 2000 to 81 096 tonnes in 2010 (an average annual growth rate of 24 percent). This increase is artificially inflated largely because China started to report large quantities of groupers nei from 2003. The production of groupers nei from China amounted to 60 714 tonnes worth US$173 million at a relatively low unit value of US$2.84/kg in 2010. However, the production of groupers nei from Indonesia, Thailand and Korea RO amounted to 13 444 tonnes worth US$179 million at a very high unit value of US$13.32/kg in 2010, probably reflecting the production of higher-value grouper species in these countries.

The major producers of groupers include China, Indonesia, Malaysia, Thailand and the Philippines. In 2010, production of eight different individual grouper species was reported, however the bulk of the production (74 305 tonnes or 92 percent) was reported as groupers nei, especially from China, with contributions from Indonesia and Thailand. Other countries producing groupers include Korea RO, Myanmar, Singapore, Cambodia and Brunei Darussalam. Additionally, Viet Nam is producing grouper, but has yet to report on this species separately.

Despite the huge popularity of live fish in China and Southeast Asia, only 15 to 20 percent of the amount consumed each year comes from aquaculture, as culture is principally constrained by limited and unreliable supplies of wild seed and the difficulties of spawning in captivity (Tupper and Sheriff, 2007). The grouper trade has come under the spotlight (see APFIC's *Status and potential of fisheries and aquaculture 2004*) with respect to the live reef fish trade. This is not strictly classified as aquaculture as it involves the taking of fish and "holding them" (rather than significantly increasing size or weight through feeding/growth). However, the distinctions become difficult when juvenile fish are taken from the wild and "on-grown". The culture of fingerlings in hatcheries has been achieved for some species and there is a contribution to supply fingerlings/juveniles from hatcheries, however reporting on this contribution remains weak.

Since grouper are particularly difficult to culture in closed systems, full-cycle culture of most grouper species is not yet possible (although several important advances have been made in recent years). For this reason, about two-thirds of all grouper culture involves the capture and grow-out of wild seed (Sadovy, 2000). There needs to be greater disaggregation from grouper produced from hatchery reared fingerlings versus that dependent on wild caught fingerlings and juveniles.

This is an area that would benefit from improved labelling and traceability, possibly under a certification scheme. The starting point for this would be to target those countries that are producing significant numbers of grouper fingerlings from hatcheries to determine the relative percentage contribution of fingerlings from each source (and the species that this comprises).

Tilapia cultured in marine environments (family Oreochromis)

Tilapias will be dealt with in detail in the next section, as they are mainly a freshwater species, but they can tolerate saltwater and are cultured in brackish water and occasionally marine environments. Of these, the main species are Nile tilapia (*Oreochromis niloticus*) and Mozambique tilapia (*Oreochromis mozambicus*), as well as unidentified tilapias nei.

Within brackish water/marine environments, the total production of tilapias was 60 535 tonnes worth US$95 million in 2010, at a unit value of US$1.56/kg. The overall rate of growth of marine tilapia production was 5 percent between 2000 and 2010. Most of this production was from Indonesia with 17 103 tonnes of Mozambique tilapia (but decreasing by 4 percent/year between 2000 and 2010), and 16 686 tonnes of Nile tilapia (increasing by 60 percent/year since being first reported in 2004). Some of this production of tilapias has come from polyculture of tilapias with shrimp in an effort to reduce mortalities resulting from the IMNV virus affecting Indonesian shrimp farms since 2006. The tilapia appear to be able to change water chemistry through a probiotic action and perhaps consume infected shrimp before they can pass on the virus to their neighbours. Similar use of tilapias has been noted in other countries, including Ecuador.

In addition, China (Taiwan POC) produced 10 781 tonnes of tilapias nei, in brackish water in 2010, with the Philippines producing 14 142 tonnes of various tilapia species in brackish water in 2010. Other countries also producing small quantities of tilapias in brackish water include Myanmar, Malaysia and Singapore.

Salmonids – Brackishwater/Marine (family Salmo and Oncorhynchus)

There are three species in this group cultured in marine and brackish water – the Atlantic salmon (*Salmo salar*), the Coho (silver) salmon (*Oncorhynchus kisutch*) and the Chinook (spring or king) salmon (*Oncorhynchus tshawytscha*). Total production from the Asia-Pacific region in this group amounted to 58 811 tonnes in 2010, and had a growth rate of 11 percent/year between 2000 and 2010.

Over the past ten years the Australian Atlantic salmon industry has developed considerably using high technology marine net cages in Tasmania, with a production of 31 765 tonnes worth US$338 million at a very high unit value of US$10.63/kg in 2010. This had a yearly growth rate of 11 percent between 2000 and 2010. Coho salmon culture in Japan has grown at 7 percent/year between 2000 and 2010 and reached 14 766 tonnes worth US$77 million at a value of US$5.24/kg in 2010. Chinook salmon culture in New Zealand has grown by 14 percent/year between 2000 and 2010 and reached 12 280 tonnes worth US$76 million at a value of US$6.17/kg in 2010.

Cobia (family *Rachycentridae*)

Cobia (*Rachycentron canadum*) culture has increased rapidly to 40 508 tonnes in 2010 with a growth rate of 12 percent/year between 2003 and 2010. One main reason for the rapid increase is that China started reporting this species separately from 2003 onwards. China accounted for 30 508 tonnes or 95 percent of cobia production in 2010. The value of total cobia production was US$69 million at a unit value of US$1.71/kg in 2010. Viet Nam has been reporting the culture of cobia since 2008 and produced 2 000 tonnes worth US$4 million at a unit value of US$2.00/kg (at a growth rate of 15 percent/year) in 2010. Culture of this species is believed to take place in other states such as Thailand, largely as a result of the increasing availability of fingerlings from Taiwan POC but production is not reported widely, therefore the total production figure can be considered conservative.

The very rapid growth rate of this species and relative hardiness in ponds make it an attractive species for aquaculture. It has been dubbed the “tropical salmon” because of these characteristics, however feed conversion ratios (FCRs) are high currently, which increases production costs and reduces the profit

margin (in some cases there is a net loss). The fish does not enjoy wide acceptance in Asia partly because of it being an unusual catch item (it has a solitary habit) and hence is an unfamiliar species to many. Its firm flesh makes good sashimi and it bakes well, but in other places it is more commonly known as a dried or salted fish, hence its relatively low unit value for a fish of this quality.

Mullets (family Mugil and Liza)

The main species of mullets cultured in the region are the flathead grey mullet (*Mugil cephalus*), the squaretail mullet (*Liza vaigiensis*) and other mullets nei. Total production of mullets from marine and brackish waters in the region amounted to 16 337 tonnes worth US$42 million in 2010, at a unit value of US$2.55/kg. The production of mullets had an annual growth rate of 3 percent between 2000 and 2010. All of this production came from both brackish and marine waters in Indonesia, Korea RO, China (Taiwan POC) and Singapore. Although not reported as a separate species, mainland China is also a noteworthy producer of mullet (but it is reported as marine finfish nei).

Snappers (family Lutjanus)

Total production from this group in the region totalled 8 226 tonnes worth US$40 million in 2010, at a high unit value of US$4.84/kg. The average growth rate was 8 percent/year between 2000 and 2010. There were three main species of snappers produced from the Asia-Pacific region in 2010, including the mangrove red snapper (*Lutjanus argentimaculatus*) from Malaysia, China (Hong Kong SAR) and Singapore, John's snapper (*Lutjanus johnii*) from Malaysia and Singapore, Russell's snapper (*Lutjanus russelli*) from China (Hong Kong SAR) and other snappers nei in small quantities from Cambodia, Brunei Darussalam, China (Hong Kong SAR), Singapore and the Philippines.

The mangrove red snapper is the most cultured species of snapper in the region, mostly in brackish water cage culture in Malaysia, with a total production of 5 049 tonnes, worth US$24 million and a unit value of US$4.70/kg in 2010.

Southern bluefin tuna (family Scombridae)

Aquaculture fattening of southern bluefin tuna in Australia has emerged as a significant industry for the country over the past ten years with production fluctuating between 2 200 and 4 600 tonnes per year over this period, with the 2010 production reaching 3 324 tonnes valued at US$43 million. Although the quantity is relatively low compared with other species, the very high unit value of this product (US$12.90/kg in 2010), makes its production a significant economic activity wherever it is practiced. The total effective catch limit of the Australian southern bluefin tuna wild harvest component of the fishery was set at 4 015 tonnes.[12] Since 1 January 2009, the Commission for the Conservation of Southern Bluefin Tuna (CSSBT) has established a list of authorized farms, which are approved to operate for farming southern bluefin tuna. SBT farms not on the list are deemed not to be authorized to operate for farming of southern bluefin tuna. Currently, data regarding the weight added through fattening is not available. Japan apparently has 137 bluefin tuna fattening farms, although does not report bluefin tuna production in its aquaculture satatsitics.

Other marine finfish

Total production from this group in the region totalled 102 985 tonnes worth US$887 million in 2010, at a high unit value of US$8.62/kg. The average growth rate was 17 percent/year between 2000 and 2010. There were four main species within this category namely:

- The lefteye flounder nei (*Bothidae*) (24 978 tonnes worth US$30 million at a low unit value of only US$1.19/kg from China in 2010).
- Snubnose pompano (*Trachinotus bolchii*) (24 078 tonnes worth US$529 million at a very high unit value of US$21.95/kg from China in 2010).

[12] http://www.ccsbt.org/docs/management.html

– Korean rockfish (*Sebastes schlegeli*) (20 918 tonnes worth US$171 million at a unit value of US$8.17/kg from Korea RO in 2010).
– Puffers nei (*Tetraodontidae*) (17 111 tonnes worth US$21 million at a unit value of only US$1.20/kg from China in 2010).

Other main species within this category included righteye flounders nei, tiger pufferfish, pangas catfishes nei, Japanese jack mackerel and river eels nei from China, Japan and Indonesia.

Other marine finfish not elsewhere identified (nei)

This is a group of unidentified marine fish that were produced in large quantities (464 457 tonnes in 2010, worth US$1.1 billion at a unit value of US$2.32/kg). The average growth rate was 11 percent/year over the past seven years (since China attempted to classify this category) (Table 47). Most of the fish in this group are assumed to be carnivorous species and are fed by trash/low-value fish from capture fisheries.

This group of fish is of interest because of the large reported production from China. Even though China decreased its reporting on nei species down to 167 606 tonnes in 2003 (down from 494 528 tonnes in 2002), it has since increased again to 287 768 tonnes in 2010, an increase of 8 percent/year since 2003. Other countries also have increased reporting of marine finfish nei, especially Bangladesh, Indonesia and India (Table 47). Since the individual species are not reported, trends cannot be determined.

Table 47 Aquaculture production reported under marine fishes nei in 2003 and 2010 (tonnes) in Asia and the Pacific region

Country	2003	2010
China (all)	167 606	287 768
Bangladesh	34 101	73 825
Indonesia	3 420	43 690
India	2 644	28 420
Japan	8 049	11 751
Malaysia	3 040	8 482
Viet Nam	0	5 100
Australia	41	4 118
Korea RO	40	695
Philippines	108	350
Singapore	41	108
Thailand	0	60
Cambodia	0	60
Brunei Darussalam	5	30
Regional total	**219 095**	**464 457**

Other freshwater finfish grown in marine/brackish environments nei

This is a group of unidentified freshwater fish grown exclusively in brackish water environments. These fish were produced in large quantities (185 971 tonnes in 2010, worth US$257 million at US$1.38/kg) with a growth rate of 12 percent/year over the past seven years (since Viet Nam started reporting this group).

All of the fish in this group come from either Viet Nam (130 000 tonnes worth US$190 million at a unit value of US$1.50/kg in 2010) and are probably tilapia spp. (which have the exact same unit value from reported freshwater production of tilapias nei in Viet Nam) or Indonesia (55 971 tonnes worth US$56 million at a unit value of US$1.10/kg in 2010). It is unclear what species this is in Indonesia, but it could be tilapia spp., although tilapias produced in freshwater in Indonesia were more highly valued at US$1.49/kg for Mozambique tilapia and US$1.66/kg for Nile tilapia in 2010.

Freshwater finfish requiring lower inputs

Freshwater omnivorous and herbivorous fish have been important food fish for developing states in Asia and the Pacific region. Traditional production methods have become diversified and intensified, starting with fertilized polyculture systems and moving towards systems using more supplementary feeds and even complete feeds. Driven by the pursuit of a high economic return per unit water body and offsetting the slacked market price, further pressure on intensification and the use of feeding can be expected in many states.

Traditional pond culture still remains the dominant production system for finfish species requiring lower inputs in the region and accounts for 80 percent of the total production.

The less typical farming systems such as backyard ponds, paddy fields and floodplains are expanding in some countries in the region. Production from these farming systems is often poorly captured in national statistical data collection, mainly because of the small unit size and scattered distribution. The production from individual operation of such systems may be insignificant. However, the large number of these ponds and the aggregated production and value to the households engaging in the activity is probably very significant. The lack of reliable information about this part of the sector currently limits evaluation of the grassroots impact of rural aquaculture in the region. Member countries should improve the data collection for aquaculture statistics to fully capture the contribution of all kinds of aquaculture operations.

Although it has been suggested that the wide range of aquatic species currently cultured would reduce as greater rationalization and aggregation of production operations focus on a small number of species based on the lessons of livestock sector "industrialization". Although this may be true for some aquaculture commodities (e.g. tilapia and pangasius) this has not been a widespread trend in the region so far. Instead, significant diversification of species used in aquaculture has been observed in many countries in the region as the response to diversifying market demand domestically and internationally.

In general, the culture of this group of low-value herbivorous and omnivorous freshwater fish in the Asia-Pacific region has been growing more slowly than carnivorous freshwater finfish over the past decade, reaching a rate of growth of 6 percent/year between 2000 and 2010. However, the production of these species is very high (30 084 809 tonnes in 2010), accounting for 95 percent of the freshwater fish production in the region (Figure 14). Thus, any increase represents a huge output of fish (nearly 14 million tonnes more of these fish produced in 2010 than 2000). This is because these fish (especially carps) are the major protein source in the staple diets of most of the lower income groups in the region, and there is increasing demand as these populations grow more numerous and become richer, increasing the overall demand for fish.

- China dominated production of these lower value herbivorous/omnivorous freshwater species (dominated by carps), with a total production of 19 377 236 tonnes or 64 percent of the total production of this group in 2010 from the APFIC region.
- In second place was India, producing 4 467 315 tonnes or 15 percent of the total production (again mostly carps) in 2010.
- Viet Nam is the third ranked country (largely because of its increasing production of *Pangasius sp.* catfish), producing 1 872 400 tonnes or 6 percent of the total production in 2010.

The production of this group of fish grew at just 4 percent in terms of volume and 9 percent in terms of value in China between 2000 and 2010, whereas in India, the production of these species grew at 10 percent in terms of volume and 18 percent in terms of value between 2000 and 2010. For Viet Nam, production of these species grew at an impressive 18 percent in terms of volume and 19 percent in terms of value between 2000 and 2010. Hence it has been India and Viet Nam that have been increasing the production of these types of finfish most rapidly in recent years.

In terms of overall value, omnivorous and herbivorous freshwater fish production was valued at US$42.5 billion in 2010 (with US$24.9 billion being produced by China, US$8.2 billion by India and US$2.8 billion by Viet Nam), an 11 percent annual increase between 2000 and 2010. This equates to a unit value US$1.41/kg, almost one third of the value of the carnivorous species.

It is notable that the unit value of this group increased by 4 percent/year between 2000 and 2010, showing the growing popularity of these lower-value freshwater fish species for local consumption in the Asia-Pacific region. In China, the unit value of these fish remains quite low at US$1.28/kg increasing slowly at 5 percent/year between 2000 and 2010. In India, these fish are more highly valued at US$1.84/kg, increasing rapidly at 7 percent/year between 2000 and 2010. This is because of the rapid increase in production of the relatively high unit value (US$1.85/kg) catla recently in India. In Viet Nam, finfish production in this category is dominated by *Pangasius* catfish, which (exceptionally) is largely exported, with an overall unit value of US$1.50/kg, but increasing by only 1 percent/year between 2000 and 2010 because of the saturated export market and trade restrictions imposed by the United States for this species.

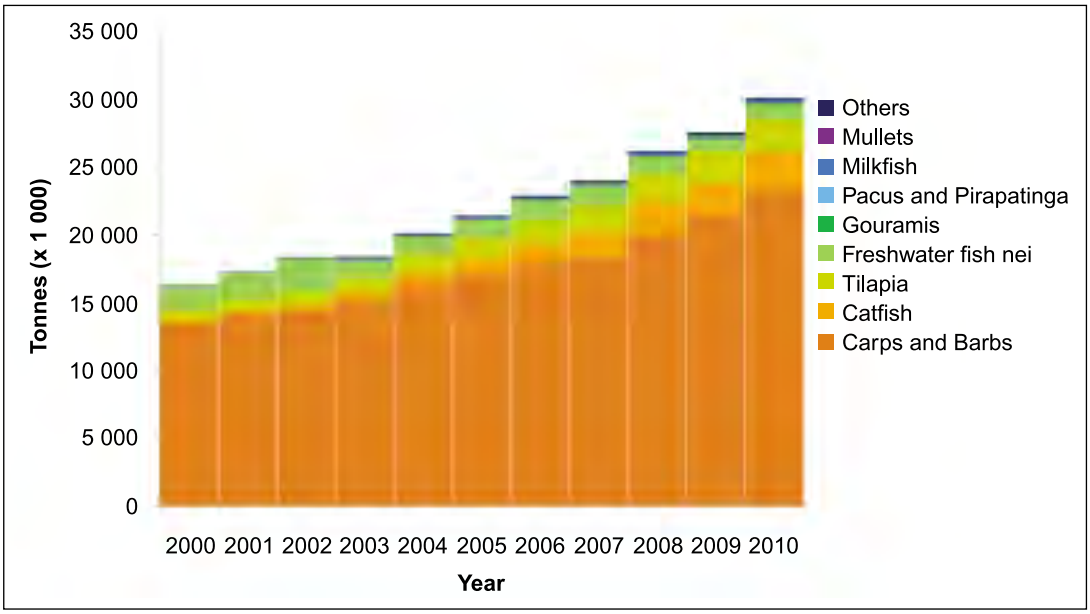


Figure 14 Changes in freshwater herbivorous/omnivorous fish species group production 2000–2010 in Asia and the Pacific region

Carps and barbs (Cyprinidae)

The production of finfish from aquaculture in the APFIC region has long been dominated by carps and barbs, a situation that is very unlikely to change in the foreseeable future. This is because of the massive volume of production, which is almost entirely consumed domestically.

Table 48 Production and value of main carp and barb species in 2010 in Asia and the Pacific region

Species	Tonnes	Value (US$1 000)	Unit value (US$/kg)
Grass carp	4 299 363	5 427 247	1.26
Silver carp	4 001 134	5 131 399	1.28
Catla carp	3 869 984	7 157 372	1.85
Common carp	3 024 610	3 686 114	1.22
Bighead carp	2 576 342	3 295 595	1.28
Crucian carp	2 216 965	2 417 511	1.09
Rohu carp	1 167 315	1 584 142	1.36
Wuchang bream	652 215	1 076 155	1.65
Cyprinids nei	508 246	745 368	1.47
Black carp	424 487	985 209	2.32
Mrigal carp	378 622	579 902	1.53
Silver barb	102 299	119 173	1.16
Regional total	**23 318 902**	**32 399 196**	**1.39**

Total production of carps and barbs from APFIC states in 2010 exceeded 23 million tonnes worth US$32.4 billion at a unit value of US$1.39/kg (Figures 14 and 15 & Tables 48 and 49). This is a steady 44 percent of the total aquaculture production of the region (excluding aquatic plants).

The top six cultured finfish species in the Asia-Pacific region are carps from freshwater production. These are, in order: grass carp or white amur (*Ctenopharyngodon idellus*), silver carp (*Hypopthalmichthys molitrix*), catla (*Catla catla*), common carp (*Cyprinus carpio*), bighead carp (*Hypopthalmichthys nobilis*) and crucian carp (*Carassius carassius*), with a further five roho labeo (*Labeo rohita*), wuchang bream (*Megalobrama amblycephala*), cyprinids nei (*Cyprinidae*), black carp (*Mylopharyngodon piceus*) and mrigal carp (*Cirrhinus mrigala*) in the top 20 (Tables 46 and 48 and Figures 14 and 15).

Their production is particularly important in terms of the vital supply of protein in the major populous states in the region such as China, India and Bangladesh.

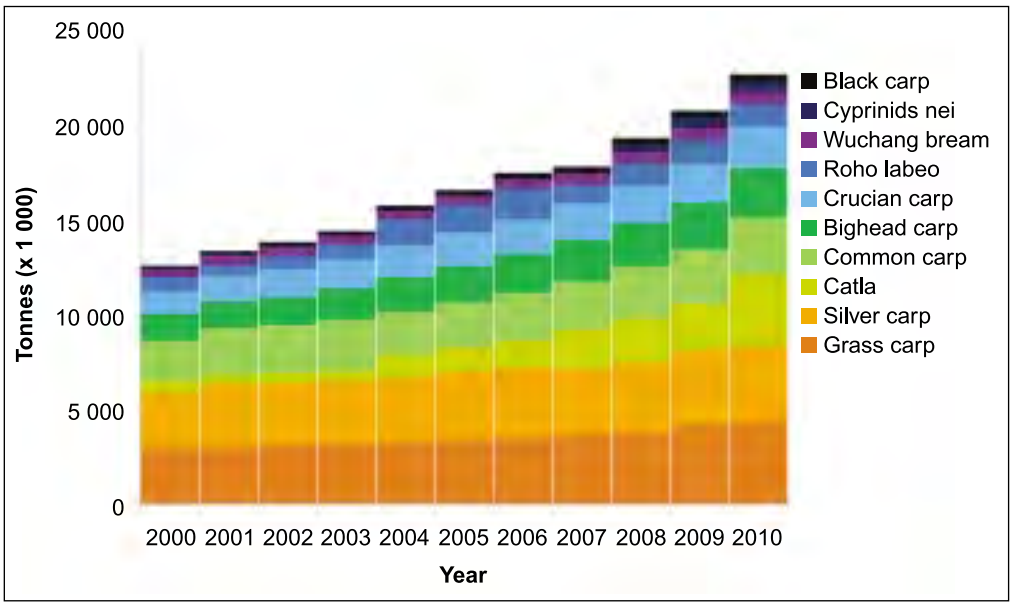


Figure 15 Changes in main carp and barb species production 2000–2010 in Asia and the Pacific region

Silver carp has had the highest production figure for decades, although grass carp, which was previously in a distant second position, has now moved to first place, putting silver carp in second place. However, the carp species with the highest rate of growth currently is the catla, the production of which has been growing at 20 percent/year in terms of volume and 28 percent/year in terms of value from 2000 to 2010.

Common carp is the most widely cultured species in the region with 19 countries having reported culturing this species. The other most widely cultured species are grass and silver carps (12 countries each), bighead carp (ten countries), roho and mrigal (nine countries each), and catla (eight countries).

Table 49 Top ten producer states of carps and barbs in 2010 in Asia and the Pacific region

Country	Tonnes
China	16 217 955
India	4 234 869
Bangladesh	938 813
Myanmar	699 275
Viet Nam	579 000
Indonesia	320 186
Pakistan	137 200
Lao PDR	61 500
Thailand	50 055
Nepal	28 080
Regional total	**23 318 902**

Although production of all of the species in this group generally exhibits an increasing trend (except for mrigal carp which has been decreasing by 4 percent/year between 2000 and 2010), the rate of growth since 2000 for all the important carp species (except catla) has started to show signs of slowing down, with growth rates of 3 to 6 percent/year in terms of volume and 1 to 11 percent/year in terms of value between 2000 and 2011.

There are reports that the profitability of production of these species in India and China is declining and farmers are starting to explore the production of alternative higher value species. Since the markets of these species are largely domestic, there is little opportunity for export, although India, for example, does export to neighbouring Nepal and Bangladesh. Moreover, Myanmar has recently strongly developed its exports of carp to neighbouring Bangladesh and also to the Near East.

Of the total production of carps and barbs in the region, the vast majority (70 percent) came from China (over 16.2 million tonnes in 2010), comprising nine species, but mostly grass carp (4.22 million tonnes) and silver carp (3.61 million tonnes), with large quantities of bighead carp (2.55 million tonnes), common carp (2.54 million tonnes) and crucian carp (2.22 million tonnes). This Chinese production was worth US$20.5 billion at an average unit value of US$1.26/kg, and production grew at an annual rate of 4 percent in terms of volume and 9 percent in terms of value between 2000 and 2010 (Table 49). As

with the APFIC region, China's production of carps and barbs comprised a steady 44 percent of total aquaculture production (excluding aquatic plants). However, regionally the production of carps and barbs in APFIC countries excluding China increased from 40 percent in 2000 to 44 percent of total aquaculture production (excluding aquatic plants) in 2010.

This increase in production of carps and barbs in other countries of the APFIC region is a result of the rapid growth rates of the production of these fish principally in India, Bangladesh, Myanmar, Viet Nam, and Pakistan (Table 49).

In India production of Indian major carps (especially catla and roho, plus mrigal and silver carps) has grown at 10 percent/year in terms of volume and 17 percent/year in terms of value between 2000 and 2010 to a production of over 4.2 million tonnes worth US$7.5 billion at an average unit value of US$1.78/kg. This has been driven mostly by the increasing popularity of catla, which has seen an increase of production of 22 percent/year by volume and 31 percent by value in India between 2000 and 2010. Catla production in India has increased from 0.5 million tonnes in 2000 to 3.5 million tonnes in 2010, and is currently worth US$6.7 billion at a unit value of US$1.86/kg. The importance of carps to the Indian aquaculture production is clear as this production equates to 77 percent by volume and 83 percent by value of India's total aquaculture production.

This fish has become so popular in India because of its high value compared with most other carp species (as it is a preferred surface feeder), its fast growth rate, advances in breeding and culture techniques, its amenability to be cultured in low input sewage-fed polyculture systems and its ease of transport, either live, fresh or sometimes iced to local markets. However, increasing intensities have increased the use of fertilizers, feeds and chemicals leading to deterioration in the culture environment and increasing disease issues. These factors must be addressed to continue the sustainable farming of this species.

Bangladesh produced nearly 1 million tonnes of carps and barbs in 2010, with a growth rate of 7 percent/year in terms of volume and 11 percent/year in terms of value between 2000 and 2010. This production was worth US$1.8 billion at a unit value of US$1.87/kg in 2010. Most of this production comprised roho, catla, silver and mrigal carps, all grown in extensive polyculture ponds. Carp production in Bangladesh is thus a fairly rapidly growing activity, with great importance to the country as it now accounts for 72 percent by volume and 62 percent by value of Bangladesh's total aquaculture production.

Myanmar produced 0.7 million tonnes of carps and barbs in 2010, with a growth rate of 22 percent/year in terms of volume and 9 percent/year in terms of value between 2000 and 2010. This was worth US$0.7 billion at a unit value of US$0.94/kg in 2010. Most (78 percent) of this comprised roho carp, with a variety of other carps grown in polyculture ponds. Carp production in Myanmar is thus a rapidly growing activity, with great importance to the country as it now accounts for 82 percent by volume and 69 percent by value of Mayanmar's total aquaculture production.

Viet Nam produced 0.6 million tonnes of carps and barbs in 2010, with a growth rate of 18 percent/year in terms of volume and value from 2008 (when these species were first reported) until 2010. This was worth US$0.9 billion at a unit value of US$1.50/kg in 2010. All of this production comprised cyprinids nei and common carp. Carp production in Viet Nam is thus a very young but rapidly growing activity, with increasing importance to the country as it already accounts for 21 percent by volume and 17 percent by value of the total Vietnamese aquaculture production.

Indonesia produced 0.3 million tonnes of carps and barbs in 2010, with a growth rate of just 4 percent/year in terms of volume and zero in terms of value between 2000 and 2010. This was worth US$0.5 billion at a unit value of US$1.70/kg in 2010. Most of this production was of common carp. Carp production in Indonesia thus remains relatively unimportant, accounting for just 5 percent by volume and 9 percent by value of the total Indonesian aquaculture production.

Pakistan produced just 0.14 million tonnes of carps and barbs in 2010, but with a very high growth rate of 27 percent/year in terms of volume and 37 percent/year in terms of value between 2000 and 2010.

This was worth US$0.2 billion at a unit value of US$1.55/kg in 2010. Most of this production comprised roho, silver, mrigal and grass carps, all grown in extensive polyculture ponds. Carp production in Pakistan is thus a rapidly growing activity, of extreme importance to the country as it now accounts for 98 percent by volume and value of Pakistan's total aquaculture production.

Other countries in the region with significant production of carps and barbs include Lao PDR (61 500 tonnes worth US$89 million in 2010, growing by 10 percent/year). Lao PDR's production of carps is important for the country making up 75 percent by volume and value of the country's total aquaculture production. Other important countries include Thailand (50 055 tonnes worth US$58 million in 2010, decreasing by 1 percent/year), and Nepal (28 080 tonnes worth US$53 million in 2010, increasing by 6 percent/year) (Table 49).

Catfish (order *Siluriformes*)

This group includes the pangas catfish (*Pangasius spp.*), *Clarias spp.*, *Mystus spp.*, *Silurid spp., Pelteobagrus spp.* and some introduced species, e.g. channel catfish (*Ictalurus punctatus*) from the United States. The total volume of catfish produced in the Asia-Pacific region exceeds the culture of tilapias making it the second most important group of freshwater fish cultured in the region. The top five producing states are Viet Nam, China, Indonesia, Bangladesh, Thailand and Malaysia (Table 50).

Table 50 Top eight producer states of catfish in 2010 in Asia and the Pacific region

Country	Tonnes	% of regional total
Viet Nam	1 150 000	42
China	794 181	29
Indonesia	373 683	14
Bangladesh	140 878	5
Thailand	136 257	5
Malaysia	102 746	4
Cambodia	23 600	>1
Myanmar	23 413	>1
Regional total	**2 750 618**	

Total production in Asia and the Pacific region in 2010 was 2.8 million tonnes, up from only 0.2 million tonnes in 2000, thus showing a rapid increase of 28 percent/year between 2000 and 2010.

This production in 2010 was worth US$3.9 billion at an average unit value US$1.42/kg.

The biggest producer of catfish is Viet Nam, which has seen a dramatic increase in the production of tra (*Pangasianodon hypothalamus*) and basa (*Pangasius bocourti*), the two main catfish species cultured in that country over the past 14 years. The production has increased from 0.1 million tonnes in 2000 to 1.14 million tonnes in 2010, valued at US$1.7 billion, at a unit value of US$1.50/kg. The production is mainly located in a few provinces in the south of Viet Nam in the Mekong river delta, with most production now originating from deep ponds and cages around the Mekong River. The United States used to be the largest market for Vietnamese produced catfish, but after a trade dispute in 2003 the Vietnamese exporters have gradually diversified away from the United States market. The export to the European Union increased and today accounts for more than 50 percent of the export. The Viet Nam Association of Seafood Exporters (VASEP) estimates that Viet Nam accounts for about 40 percent of the total European frozen freshwater fillets market comprising 27 countries. However, in the past few months, prices of Vietnamese pangasius have declined sharply as processors are currently unable to secure credit, so cannot buy the fish. This could seriously reduce production of this species in Viet Nam as producers are already operating on very thin margins.

The total production of *Pangasius sp.* in the Asia-Pacific region amounted to 1.5 million tonnes worth US$3.9 billion at a unit value of US$1.42/kg in 2010 (Figure 16). The growth rate in terms of volume and value was 29 percent/year between 2000 and 2010. Viet Nam produced the majority (77 percent) of this group, followed by Indonesia (9 percent), Bangladesh (8 percent), Malaysia (3 percent), and there were small quantities produced by Cambodia, Thailand, Myanmar and Singapore.

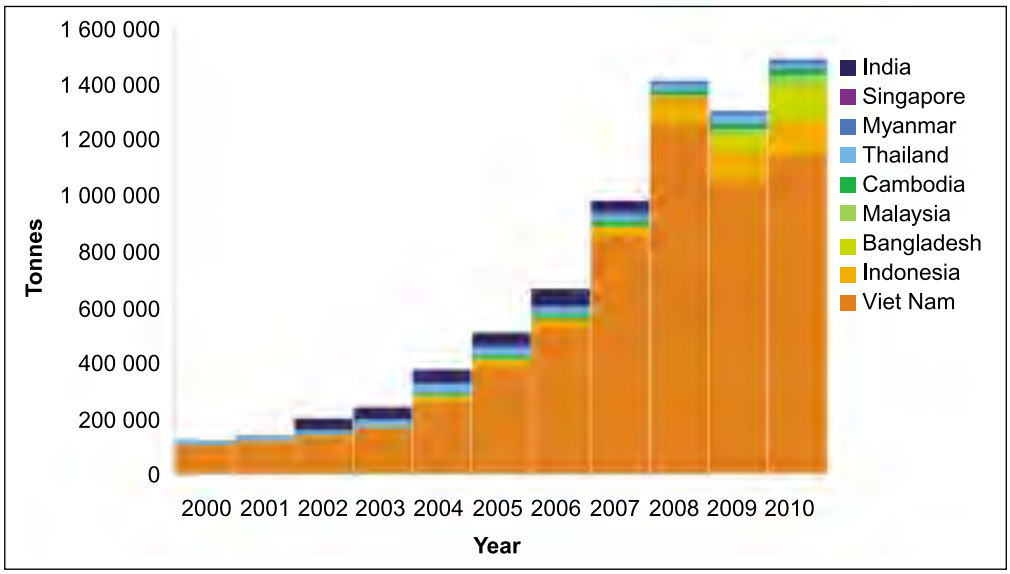


Figure 16 Production of *Pangasius sp*. catfish by country 2000–2010 in Asia and the Pacific region

Since 2008, both India and Cambodia have stopped reporting *Pangasius sp.* catfish production to FAO, but it is believed that India currently produces 180 000 to 220 000 tonnes. This substantial production should be reported as a disaggregated species.

The second largest group of catfish reported is the *Clarias spp.* group, including hybrid catfish, torpedo-shaped catfish, Hong Kong SAR and Philippine catfish. The total production of *Clarias sp.* in the region amounted to nearly 0.5 million tonnes worth US$0.6 billion at a unit value of US$1.33/kg in 2010. A growth rate of 15 percent/year in terms of volume and value has been seen for this group between 2000 and 2010. Indonesia produced the majority (54 percent), followed by Thailand (26 percent), Malaysia (14 percent), and small quantities from Viet Nam, Myanmar, Philippines, Bangladesh and Cambodia. These fish are generally consumed locally and are very popular as they can be kept alive without water for considerable lengths of time and are valued highly for that.

The American Channel catfish has also been imported into China, which now reports a production of 0.2 million tonnes worth nearly US$0.3 billion at a unit value of US$1.30/kg in 2010. Since its first importation in 2002, production has grown very rapidly by 280 percent/year in terms of volume and 230 percent/year in terms of value between 2003 and 2010. Much of this production is reportedly exported to the USA, although there is some domestic consumption now in China also.

The Asian redtail catfish (*Mystus spp.)* is grown in limited quantities in Indonesia and Malaysia, but quantities were only 5 000 tonnes worth US$17 million at a unit value of US$3.44/kg in 2010. Production of this species has increased by about 27 percent/year between 2000 and 2010. These fish are generally consumed domestically and are not exported.

The other main species of catfish produced in the region include the Amur catfish (*Silurus asotus*) produced mainly in China, with some in Korea RO. China produced nearly 0.4 million tonnes worth nearly US$0.5 billion at a unit value US$1.30/kg in 2010. The production of this species has been increasing by 11 percent/year between its first report in 2003 and 2010. In addition, China produced nearly 0.4 million tonnes of the yellow catfish (*Pelteobagrus fulvidraco*) worth US$240 million at a unit value of US$1.30/kg in 2010. The production of this species has been increasing by 21 percent/year between its first report in 2003 and 2010.

Tilapia (Cichlidae)

Tilapia production in the Asia-Pacific region has increased steadily over the past two decades and is the third most important cultured finfish species group after carps and catfish. Freshwater tilapia production reached 2 448 644 million tonnes worth US$3.7 billion at a unit value of US$1.49/kg in 2010, with an increase of 11 percent/year in terms of volume and 14 percent/year in terms of value between 2000 and 2010 (Figure 17 and Table 51).

In terms of total production of tilapias (from all environments) in the Asia-Pacific region, there was a production of 2 509 219 tonnes worth US$3.7 billion at a unit value of US$1.49/kg in 2010. Thus freshwater tilapias culture made up nearly 98 percent of total tilapia production in the region.

Table 51 Top ten producer states of freshwater tilapia in 2010 in Asia and the Pacific region

Country	Tonnes	% of regional total
China	1 396 294	57
Indonesia	424 963	17
Philippines	244 697	10
Thailand	179 355	7
Viet Nam	76 000	3
Myanmar	39 022	2
Malaysia	38 643	2
Bangladesh	24 823	1
Lao PDR	20 580	>1
Cambodia	1 700	>1
Regional total	**2 448 684**	

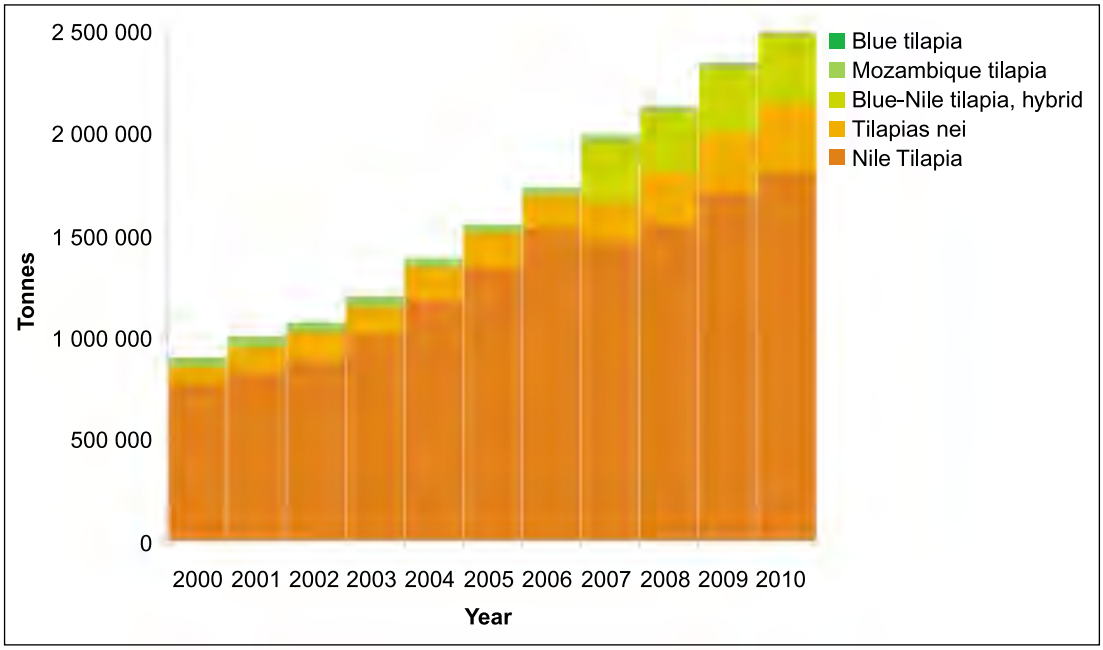


Figure 17 Production of tilapia spp. in all environments 2000–2010 in Asia and the Pacific region

In terms of world production, the Asia-Pacific region has accounted for between 70 to 87 percent of world tilapia production since 1950, but this percentage has been declining slightly over the past 13 years from 87 percent in 1997 to 72 percent in 2010.

Total world tilapia production from all environments reached 3 490 687 tonnes worth US$5.7 billion at a unit value of US$1.63/kg in 2010. The unit value of tilapia produced worldwide declined significantly from 1992 (when it was US$1.50/kg) to US$1.13 in 2005, but since then has increased again by 8 percent/year over the past five years up to its current value of US$1.63/kg in 2010. This reflects the recent surging demand for tilapia worldwide, which has occurred despite significant increases in production.

As in the Asia-Pacific region, the world production of tilapias has also been increasing by an average of 11 percent/year between 2000 and 2010. However, some major producing countries outside of the region

have been expanding very rapidly, including Egypt with a growth rate of 13 percent/year (producing 557 049 tonnes worth US$810 million at a unit value of US$1.45/kg in 2010), Brazil with a growth rate of 17 percent/year (producing 155 451 tonnes worth US$326 million at a unit value of US$2.10/kg in 2010), Ecuador with a growth rate of 18 percent/year (producing 47 733 tonnes worth US$138 million at a unit value of US$2.89/kg in 2010 – a higher value as tilapia are sold as high price fillets to USA) and Uganda with a growth rate of 55 percent/year (producing 31 500 tonnes worth US$65 million at a unit value of US$2.07/kg in 2010). It is the rapid growth of the tilapia culture industries in these countries that has caused Asia's dominance to decline in the past 13 years. Chinese tilapia farmers have seen a significant reduction of orders for tilapia from international buyers since 2010 and this has resulted in falling prices and poor returns as a result of a supply surplus. As a consequence, the tilapia culture area in China is expected to reduce by some 30 percent in 2013 in those production areas which target tilapia exports.

This development of tilapia culture has been mainly driven by the demand in the international market. In order to meet the export standard on size of fish, the culture is getting more intensive and dependent on pelleted feed. Such an "industrialization" trend is seen in some states with species such as tilapia and others including whiteleg shrimp and pangasius spp. There is a trend towards standardization of size, feeds and production systems, some quality control, avoidance of off-flavours, and marketing to supermarket chains, sometimes as fillets (as in the case of Ecuador).

In 2010, the top ten producers in the region together produced virtually all of the 2.5 million tonnes of tilapia (Table 51). Of these countries, China dominated with 57 percent of the production (mostly Nile tilapia and Blue-Nile tilapia hybrids), with Indonesia producing 17 percent (mostly Nile tilapia), Philippines producing 10 percent (mostly Nile and tilapia nei), and Thailand producing 7 percent (all Nile tilapia) (Figure 18).

In terms of species (Figure 17), the mostly commonly cultured species is the Nile tilapia (*Oreochromis niloticus*), with a production of 1.8 million tonnes worth US$2.7 billion at a unit value of US$1.51/kg in 2010. Culture of this species increased by 9 percent/year in terms of volume and 12 percent/year in terms of value between 2000 and 2010. The major producing countries for Nile tilapia are China (nearly 1 million tonnes and growing by 6 percent/year), Indonesia (0.4 million tonnes and growing by

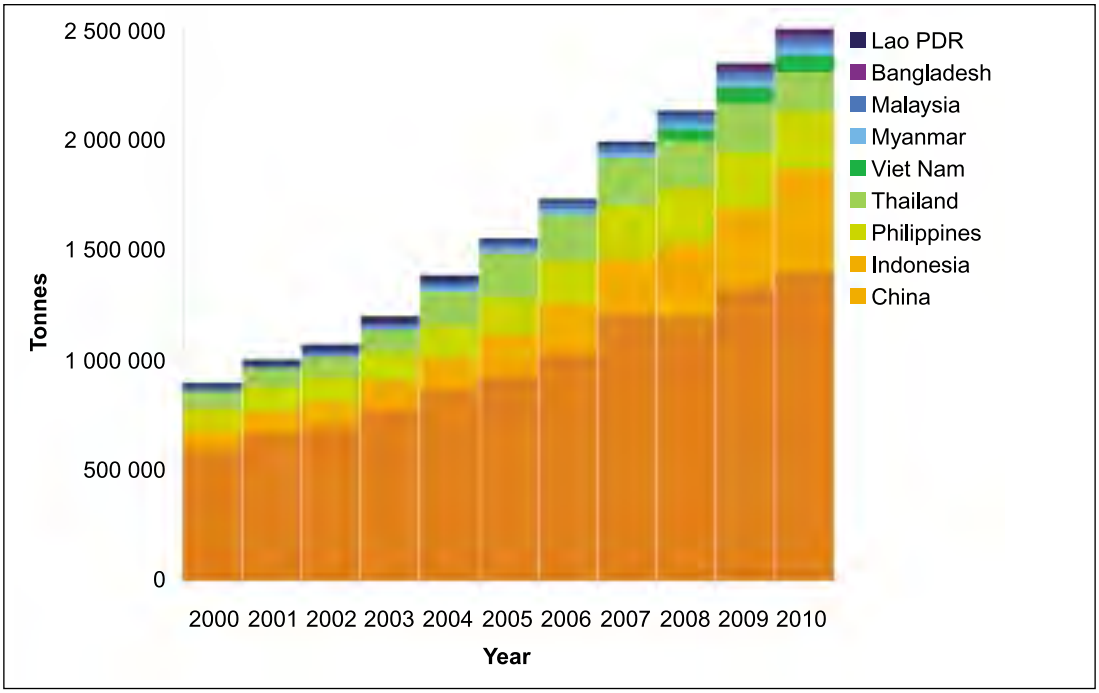


Figure 18 Production of tilapia spp. in all environments by country 2000–2010 in Asia and the Pacific region

26 percent/year) and Thailand and Philippines (each producing almost 0.2 million tonnes and growing by 8 percent/year). This species is a popular fish in polyculture and has recently been used in polyculture with shrimp species (especially the whiteleg shrimp) in Indonesia as a biological control agent to help prevent mortality caused by the IMNV virus, partially explaining the rapid increase in production in Indonesia recently.

Tilapia hybrids of the Blue (*Oreochromis aureus*) and Nile tilapia have been reported by China since 2007, and current production is already over 0.3 million tonnes, with a value of nearly US$0.5 billion at a unit value of US$1.49/kg and a growth rate of 7 percent/year between 2008 and 2010.

Unidentified tilapia species, reported as tilapia nei (*Oreochromis spp*.) have reached a production figure of over 0.3 million tonnes worth US$0.4 billion at a unit value of 1.42/kg in 2010, growing by 16 percent/year between 2000 and 2010. Most of this production originates from Philippines, Viet Nam, Taiwan POC, Myanmar and Malaysia.

Finally, there is a small production of Mozambique tilapia (*Oreochromis mossambicus*) from Indonesia, which reached 13 000 tonnes worth US$19 million at a unit value of US$1.51/kg in 2010. However, this production decreased by about 5 percent/year between 2000 and 2010, presumably being replaced by the culture of Nile tilapia.

The reported volume of exports of tilapia is equivalent to 14 percent of the regional production volume. However, tilapia is usually exported in processed form (often fillet). Considering the normal dressing out percentage of 60 percent for whole fish and 35 percent for fillet, raw tilapia used for export may account for nearly 30 percent of the total production. The production of tilapia is still largely consumed locally. The continuing domestic demand and the high quality required for export targeted fish mean that domestic marketing is still attractive in many states.

Freshwater fish nei

These unidentified fish species make up a significant proportion (over 3 percent) of reported freshwater finfish species cultured in the region. In 2010, there was a reported production of over 1 million tonnes worth US$1.7 billion at a unit value of US$1.62/kg. Despite better identification and reporting of these species by the various countries in the region recently, inconsistencies in reporting remain and trends in production are impossible to estimate.

The major contributor to the production of these freshwater fish nei is China. China first reported the category of freshwater fish nei in 1989 at nearly 0.2 million tonnes, which increased rapidly to almost 1.8 million tonnes by 2002 (where it accounted for 73 percent of this category in the region). However, in 2003 they started reporting more species and the production in this category fell to under 0.5 million tonnes in that year (42 percent of this category). However, since then it has increased again to stand at over 0.6 million tonnes in 2010 (60 percent of this category) worth US$0.8 billion at a unit value of US$1.22/kg. This improved species reporting by China in 2003 saw the start of reports of over 15 new species, with over 0.4 million tonnes of other omnivorous/herbivorous freshwater species (including 183 233 tonnes of amur catfish, 71 000 tonnes of parapatinga, 60 000 tonnes of pond loach, 47 000 tonnes of yellow catfish and 39 000 tonnes of channel catfish) and almost 0.4 million tonnes of carnivorous freshwater species (including 153 258 tonnes of snakeheads, 109 173 tonnes of largemouth black bass and 108 236 tonnes of Asian swamp eel) reported in 2003 for the first time.

India has reported increasing volumes of freshwater fish nei with 232 446 tonnes recorded in 2010 accounting for 22 percent of this category in the region and worth US$0.6 billion at a unit value of US$2.78/kg. This may well be comprised largely of *Pangasius spp.* catfish, which are otherwise unreported in India.

Indonesia has reported increasing volumes of freshwater fish nei with 87 426 tonnes recorded in 2010 accounting for 8 percent of this category in the region and worth US$96 million at a unit value of US$1.10/kg.

Viet Nam reported increasing production of freshwater fish nei up to 2007 when they reported 556 500 tonnes accounting for 38 percent of this category in the region. However, in 2008, they started reporting production of new species and the reported production of freshwater fish nei decreased to 40 000 tonnes in 2008 and 58 600 tonnes in both 2009 and 2010 (comprising 6 percent of this category) and worth US$88 million at a unit value of US$1.50/kg. Most of this new production was probably *Pangasius spp*. as the reported production jumped 400 000 tonnes between 2007 and 2008, but new species were also reported in 2008 for the first time, including 340 000 tonnes of cyprinids nei, 75 000 tonnes of common carp, 50 000 tonnes of tilapia nei, 10 000 tonnes of *Clarias spp*. catfish, 6 000 tonnes of pirapatinga and 120 tonnes of sturgeons nei.

Bangladesh reported increasing quantities of freshwater fish nei from 1995 (71 258 tonnes) to 2008, when they reported production of 174 775 tonnes (14 percent of the category). However, in 2009, production reduced to 15 165 tonnes and in 2010 to 29 052 tonnes, (just 3 percent of the category in this region) worth US$54 million at a unit value of US$1.87/kg. As with China, the reduction in reports of fish in this category was a result of better reporting at species level, with the start of reports of over 17 species in 2009. These comprised mostly herbivorous/omnivorous freshwater species (including 59 487 tonnes of striped catfish, 16 237 tonnes of tilapia nei, 11 858 tonnes of cyprinids nei, 8 149 tonnes of orange fin labeo and 7 297 tonnes of silver barb), but also included carnivorous freshwater species (such as 1 824 tonnes of bronze featherback, 1 496 tonnes of spotted snakehead, 1 309 tonnes of striped snakehead) reported for the first time in 2009.

Gouramis (*Osphronemus spp., Trichopodus spp., Anabas spp.* and *Helostoma spp*.)

The total production of gouramis in the Asia-Pacific region amounted to 106 779 tonnes worth US$249 million at a unit value of US$2.33/kg in 2010. Growth rate was 9 percent/year in terms of volume and 12 percent/year in terms of value between 2000 and 2010. The main species produced were giant gourami (*Osphronemus gourami*) at 60 836 tonnes, snakeskin gourami (*Trichopodus pectoralis*) at 31 813 tonnes, climbing perch (*Anabas testudineus*) at 8 757 tonnes, kissing gourami (*Helostoma temminckii*) at 5 281 tonnes and gouramis nei at 92 tonnes in 2010. The main producing countries were Indonesia (65 725 tonnes), Thailand (26 945 tonnes), with smaller quantities originating in Bangladesh, Cambodia and the Philippines. The main mover in the region is the giant gourami in Indonesia, the production of which has been growing at 15 percent/year between 2000 and 2010, amounting to 56 889 tonnes worth US$156 million at a unit value of US$2.74/kg in 2010. All production of gourami is consumed locally within the region.

Pacus and pirapatinga (*Collossoma spp*. and *Piaractus spp.)*

These Latin American species are not reported in detail for most countries, instead they are grouped under “freshwater species nei”. There was a total reported production of 102 019 tonnes worth US$145 million at a unit value of US$1.42/kg in 2010. Production has grown by just 5 percent/year between 2003 and 2010. China began reporting production of pirapatinga (*Piaractus brachypomus*) separately in 2003 and since then production has increased slowly (by 3 percent/year) to reach 85 415 tonnes worth US$127 million at a unit value of US$1.49/kg in 2010. Viet Nam and Myanmar started to report production of pacus and pirapatinga in 2008, with Viet Nam reaching 8 800 tonnes worth US$13 million at a unit value of US$1.50/kg in 2010 and Myanmar reaching 7 804 tonnes worth US$5 million at a unit value of just US$0.60/kg in 2010.

Milkfish (order *Chanos*)

Most of the milkfish cultured in the region was grown in brackish and marine environments and was discussed in the marine fish section. However, milkfish is also grown in freshwaters in the region, but to a lesser degree, producing just 7 percent of the total production of milkfish in all environments.

Freshwater production of milkfish has increased from 38 016 tonnes in 2000 to 58 084 tonnes worth US$98 million at a unit value of US$1.69/kg in 2010. This is a modest growth rate of just 4 percent/year between 2000 and 2010. This production originates mostly from the Philippines, with some production also from China (Taiwan POC). Some Pacific island nations including Guam and the Northern Mariana Islands have previously produced milkfish on a limited scale, but there was no reported production in freshwater from these states in 2010.

Mullet (order *Mugiliformes*)

Most mullets are produced in marine and brackish waters as reported earlier. However, some are produced in freshwaters within the region, although this makes up only 6 percent of the total production, so is relatively unimportant. Total production of mullet (*Mugil cephalus*) in the region amounted to just 1 030 tonnes worth just over US$3 million at a unit value of US$3.12/kg in 2010. However, production has been declining by 2 percent/year between 2000 and 2010. This production originates mainly from China (Hong Kong SAR and Taiwan POC), with some from Korea RO. It is all consumed locally as there is no export market for this species.

Other low-value freshwater finfish species

There are a small number of other freshwater omnivorous/herbivorous freshwater finfish species cultured in the region. The production of these species amounted to 243 317 tonnes worth US$404 million at a unit value of US$1.66/kg in 2010. Growth rate was 16 percent in terms of both volume and value between 2000 and 2010.

Of the amount produced, the majority (84 percent) is of pond loach (*Misgurnus anguillicaudatus*) and China produced 204 552 tonnes worth US$262 million at a unit value of US$1.28/kg in 2010. This species was first reported in 2003 and since then has been growing rapidly by 19 percent/year between 2003 and 2010. Another major species was clearhead icefish (*Protosalanx hyalocranius*) and China produced 18 481 tonnes worth US$23 million at a unit value of US$1.22/kg in 2010. This species was first reported in 2003 and since then has been growing by 14 percent/year between 2003 and 2010.

The remaining species included in this group was pond smelt (*Hypomesus olidus*) and China produced 12 962 tonnes worth US$16 million at a unit value of US$1.23/kg in 2010. This species was first reported in 2003 and since then has been growing by 8 percent/year between 2003 and 2010. The only other species was the Ayu sweetfish (*Plecoglossus altivelis*), produced mainly in Japan (5 676 tonnes in 2010).

Crustaceans

Crustaceans are the aquaculture species group of highest unit value in the region. Production of crustaceans has been increasing since the mid-1990s despite problems with a number of diseases. Cultured crustacean production reached 5.1 million tonnes in 2010, worth US$24.2 billion at a unit value of US$4.71/kg, an increase of 13 percent/year by volume and 11 percent/year by value between 2000 and 2010. World crustacean culture produced 5.7 million tonnes worth US$26.9 billion in 2010, and thus production from the Asia-Pacific region accounted for 90 percent by both volume and value of total global crustacean production.

Although a large number of crustacean species are cultured currently in the region, the predominant commercial species are three species of penaeid shrimp, three crab species, one crawfish species and two freshwater prawn species – together producing nearly 5 million tonnes in 2010 (Figure 19).

Of all aquaculture species produced in the region (excluding aquatic plants and molluscs), the whiteleg shrimp (*Penaeus vannamei*) was the species with the sixth highest production in terms of volume (2 221 818 tonnes), but was the most valuable single species cultured in the region, with a value of US$9.2 billion at a unit value of US$4.12/kg in 2010. Other crustacean species in the top 20 species by volume and value of culture were the giant tiger prawn (*Penaeus monodon*), the Chinese mitten crab (*Eriocheir sinensis*) and the red swamp crawfish (*Procambarus clarkii*) (Table 46 and Figure 19).

In terms of country of production, China again dominated crustacean production, producing 3.2 million tonnes or 63 percent of the total production of crustaceans in the Asia-Pacific region. Next was Thailand producing 0.6 million tonnes (12 percent), Viet Nam at 0.5 million tonnes (10 percent) and Indonesia at 0.4 million tonnes (8 percent). Other important producing states were India, Bangladesh, Malaysia, Philippines and Myanmar.

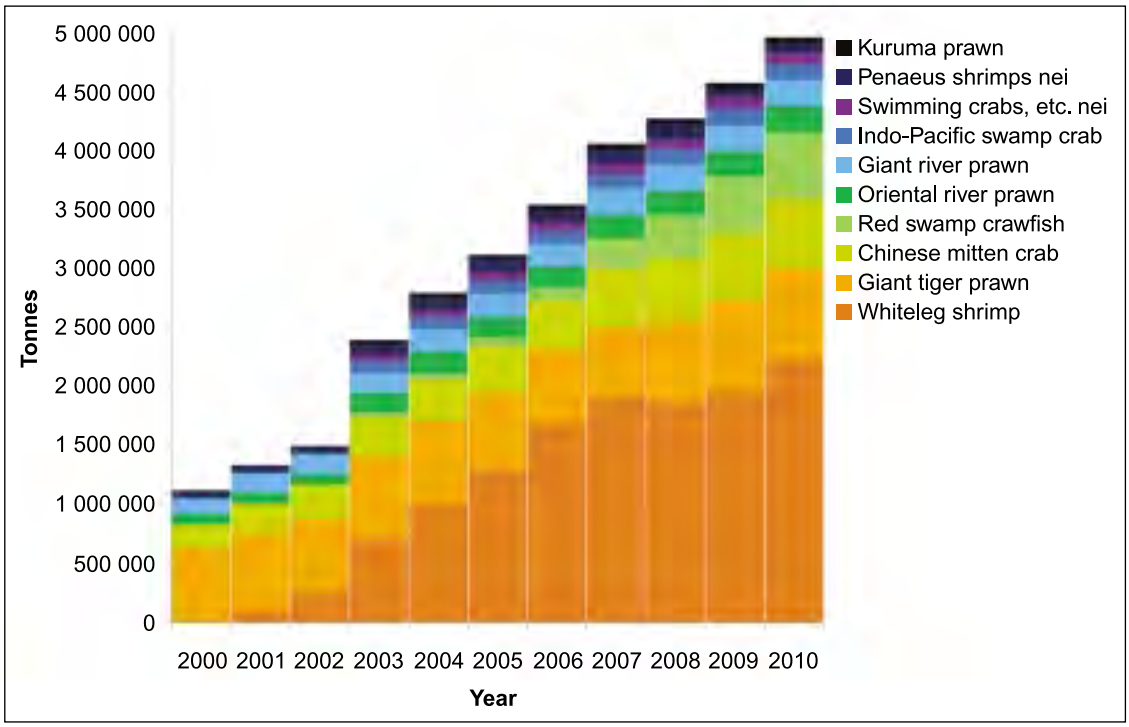


Figure 19 Production of major crustacean species 2000–2010 in Asia and the Pacific region

Penaeid shrimp culture (*Penaeidae*)

Penaeid shrimp continued to dominate crustacean aquaculture, with the Asia-Pacific region accounting for the bulk (86 percent) of production – 3.2 million tonnes out of the world total of 3.8 million tonnes in 2010. This production has been growing at a rapid rate of 13 percent/year between 2000 and 2010. This production was worth US$14.2 billion at a unit value of US$4.37/kg in 2010. Of the penaeid shrimp, there were two major species, namely the whiteleg shrimp (*Penaeus vannamei)* and the giant tiger prawn (*Penaeus monodon*) accounting for 58 percent of the total crustacean production and 92 percent of the total penaeid species production in the Asia-Pacific region in 2010. Major penaeid shrimp producing states in the region were China, Thailand, Viet Nam and Indonesia (Figures 20 and 21).

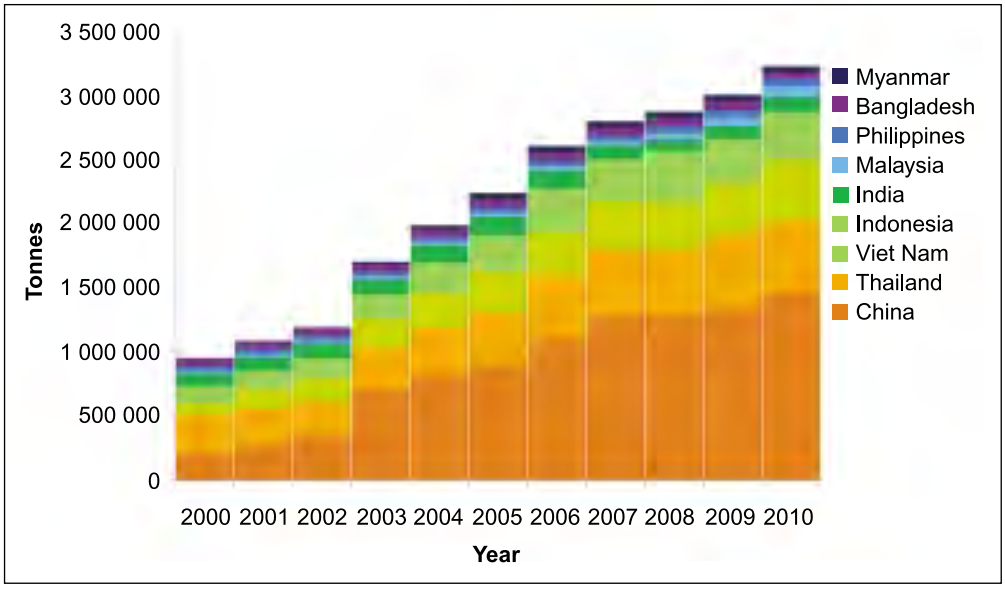


Figure 20 Production of penaeid shrimp by country 2000–2010 in Asia and the Pacific region

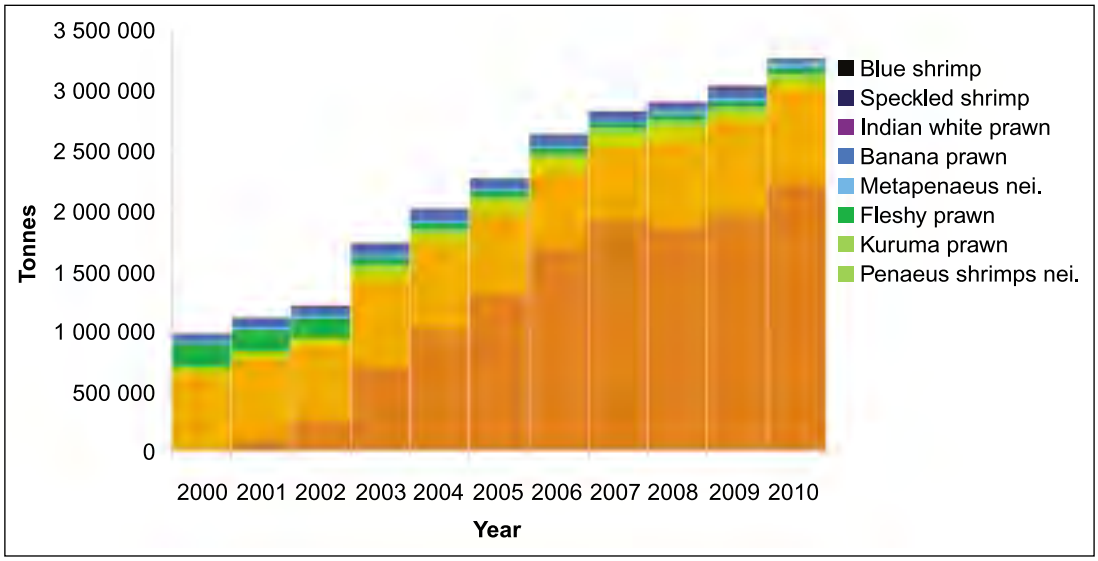


Figure 21 Production of penaeid shrimp by species 2000–2010 in Asia and the Pacific region

Whiteleg shrimp (*Penaeus vannamei*)

Whiteleg shrimp production in Asia and the Pacific region increased from 2 310 tonnes in 2000 to over 2.2 million tonnes worth US$9.2 billion at a unit value of US$4.12/kg in 2010. This is a very rapid increase of nearly 100 percent/year and is a result of the very significant importation of this South American species into Asia in the early 2000s and its subsequent dominance of the Asian shrimp culture industry (68 percent of all penaeid culture in APFIC was whiteleg shrimp in 2010). This was largely because of the beneficial characteristics of the whiteleg shrimp over the native giant tiger prawn which include: ready availability of domesticated SPF stocks (leading to fewer disease losses), the ability to intensify production (even in low salinity waters) and hence increase productivity per unit area, and their more efficient use of feed, leading to higher profitability.

The APFIC region has also dominated world culture of this species since its introduction into the region in the early 2000s, so that the percentage of this species cultured in the region has grown from 2 percent in 2000 to 82 percent of world culture (amounting to 2.7 million tonnes) in 2010.

China, Thailand, Indonesia and Viet Nam were the major producers of cultured whiteleg shrimp in the region during 2010 (Figure 22). This species was first introduced into China in 2000 and has grown from zero to 1.2 million tonnes worth US$5.4 billion at a unit value of US$4.41/kg in 2010, with a growth rate of 87 percent/year between 2000 and 2010. This has been split evenly between freshwater and marine/brackish water culture of this species. However, since 2009, there has been a new disease called acute hepatopancreatic necrosis syndrome (AHPNS) which has been affecting China, and to date there is no diagnosis or cure, so China's production is expected to drop significantly after 2010 until more is understood about this syndrome, and the data reported for 2010 may have been an overestimate as large areas of Southern China are known to have lost their first crop because of this syndrome in 2010.

Production from Thailand has continued to increase steadily from its first reported production in 2002 to 561 075 tonnes worth US$2 billion at a unit value of US$3.49 in 2010. The average growth rate was 32 percent/year between 2003 and 2010. Thailand has remained relatively disease-free to date and its production of whiteleg shrimp has been a major success for the country.

Whiteleg shrimp was first reported from Indonesia in 2004 and production increased rapidly until 2009, when a new virus, the infectious myonecrosis virus (IMNV), which was imported accidentally from Brazil in 2006 started to take full effect. Since then production has risen again as management practices developed to optimize production in the presence of this virus have been implemented. A production of 206 578 tonnes worth US$884 million at a unit value of US$4.28 was recorded in 2010. The average growth rat in production was 25 percent/year between 2005 and 2010.

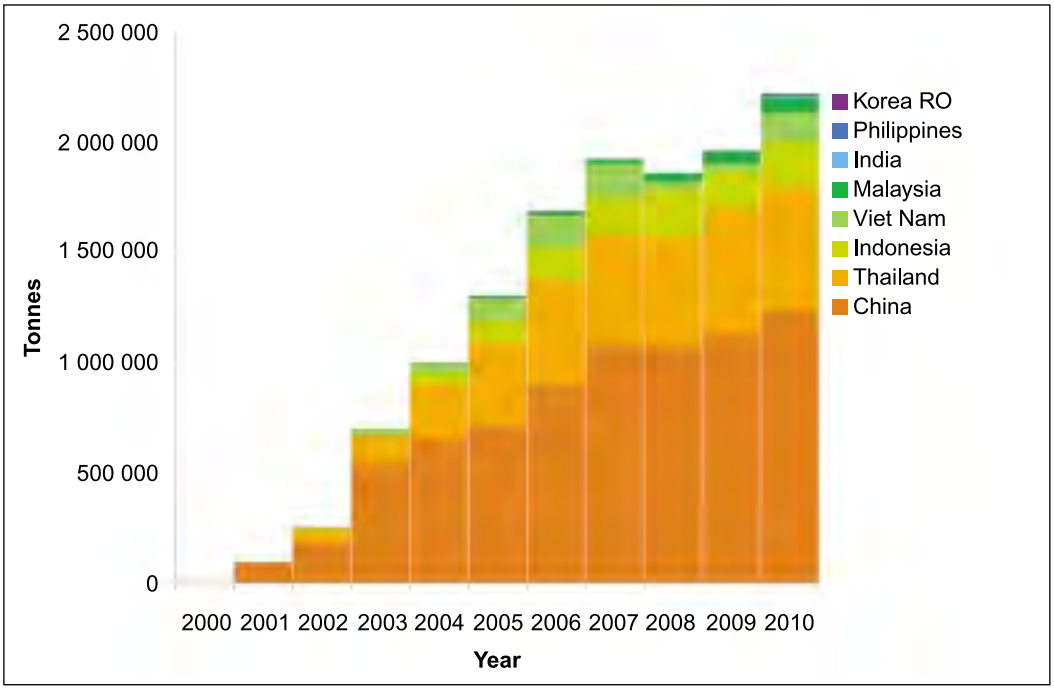


Figure 22 Production of whiteleg shrimp by country 2000–2010 in Asia and the Pacific region

Viet Nam first recorded production of this species in 2002, and it has grown at an average rate of 39 percent/year between 2003 and 2010. However, this growth has not been smooth and significant declines were seen in 2008 and are predicted again after 2010 as a result of the same AHPNS disease currently affecting China. Production in 2010 was 136 700 tonnes worth US$547 million at US$4.00/kg. However, it is known that the AHPNS syndrome was already affecting Viet Nam whiteleg shrimp producers by early 2010, and exports of Vietnamese shrimp were known to have dropped, so this may be an overestimate.

Malaysia first recorded production of this species in 2004, and it has generally grown rapidly and steadily at a rate of 60 percent/year between 2005 and 2010. However, Malaysia is also now affected by the same AHPNS disease currently affecting China and will likely reduce production after 2010. Production in 2010 was 68 084 tonnes worth US$235 million at US$3.45/kg. However, as with Viet Nam, it is known that the AHPNS syndrome was already affecting Malaysian whiteleg shrimp producers by early 2010, so this may also be an overestimate.

Other countries in the region producing smaller quantities of whiteleg shrimp include India (producing 10 400 tonnes in 2010, but increasing rapidly as a result of the rapid replacement of giant tiger prawn with whiteleg shrimp currently ongoing), Philippines (4 971 tonnes), Korea RO (2 705 tonnes) and very small quantities in Vanuatu, Northern Mariana Islands and Guam.

Giant tiger prawn (*Penaeus monodon*)

The giant tiger prawn (*Penaeus monodon*) is the second most important species of crustacean cultured in the region, having been the primary species until the importation of whiteleg shrimp in the early 2000s. Total production of this species was 776 601 tonnes worth US$3.9 billion at a unit value of US$5.07/kg in 2010 (Figure 23). This species accounted for 24 percent of all penaeid culture in APFIC region in 2010. The APFIC region also produced over 99 percent of the total global production of 0.8 million tonnes in 2010.

After a continuously declining production between 2003 and 2007, the production of giant tiger prawn increased again from 2008 to 2010 mainly because of the drastic increase in reported production from Viet Nam (from 170 000 tonnes in 2007 to 324 600 tonnes in 2008 and then up to 333 000 tonnes worth US$1.3 billion at a unit value of US$4.00/kg in 2010). In fact, Viet Nam is by far the largest producer

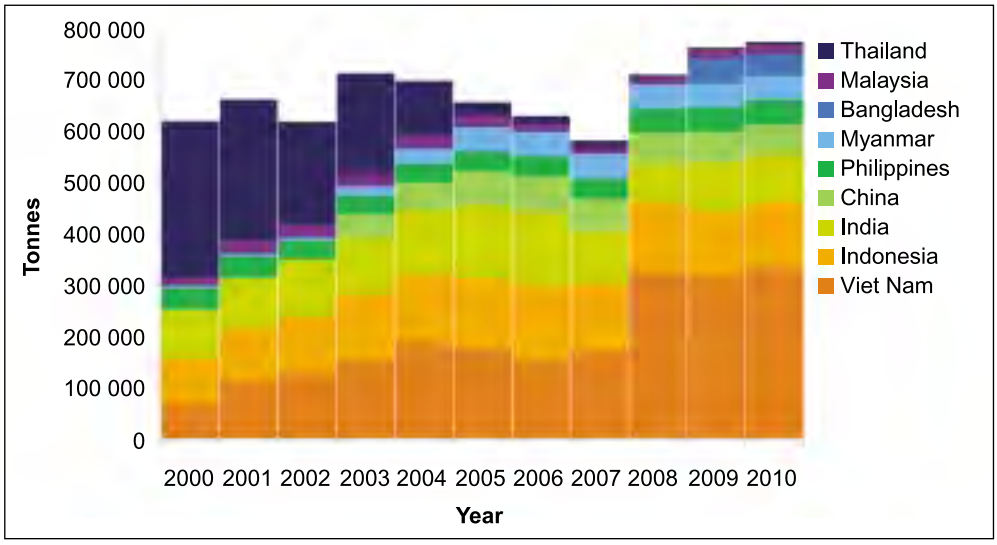


Figure 23 Production of giant tiger prawn by country 2000–2010 in Asia and the Pacific region

of this species now (with 43 percent of the region's production), with a rate of increase of 17 percent/year between 2000 and 2010. However, as with the whiteleg shrimp, the new undiagnosed disease AHPNS is also currently causing devastation to the giant tiger prawn culture industry and will likely result in severely reduced production of this species after 2010. Additionally, and as with the whiteleg shrimp, production of giant tiger prawns in the Mekong Delta region of Viet Nam is known to have suffered huge losses as a result of the AHPNS in early 2010, so data reported for 2010 may have been overestimated, as production totals do not match reported export figures from Viet Nam.

Thailand has seen the biggest change in production of giant tiger prawn in recent years. Before the introduction of whiteleg shrimp in 2002, Thailand was the biggest producer of giant tiger prawn in the world, producing over 300 000 tonnes worth US$2.2 billion in 2000, before declining rapidly to just 5 251 tonnes worth US$25 million in 2010. This reflects the very significant conversion of Thai shrimp farms to the whiteleg shrimp, spurred by viral disease problems, especially the white spot syndrome virus (WSSV) and the yellow head virus (YHV) affecting the native giant tiger prawn.

A similar trend of conversion between these species has been seen in the other major producers in the region over the past few years, so that production of giant tiger prawns in these countries has grown by only between 1 and 3 percent/year over the past ten years and any increase in shrimp production has tended to come from culture of the exotic whiteleg shrimp, as each country has allowed importation of this species. Indonesia produced 125 519 tonnes worth US$776 million at a unit value of US$6.18/kg in 2010. India produced 96 500 tonnes worth US$528 million at a unit value of US$5.47/kg in 2010. China produced 57 276 tonnes worth US$233 million at a unit value of US$4.06/kg in 2010. Philippines produced 48 162 tonnes worth US$404 million at a unit value of US$8.39/kg in 2010. Myanmar produced 46 105 tonnes worth US$184 million at a unit value of US$4.00/kg in 2010. Myanmar has shown a 25 percent/year increase in production between 2000 and 2010, but growth has stagnated since 2005. Bangladesh produced 43 154 tonnes worth US$316 million at a unit value of US$7.32/kg in 2010, and Malaysia produced 18 118 tonnes worth US$116 million at a unit value of US$6.38/kg in 2010. The only main shrimp producing countries in the region still not permitting culture of whiteleg shrimp (for reasons of biosecurity) and concentrating on culturing the giant tiger prawn are Bangladesh and Australia.

Other penaeid species (*Penaeus spp.*)

There was a production of 75 848 tonnes worth US$351 million at an average value of US$4.63/kg of penaeid shrimp nei reported from the region (90 percent from China) in 2010. Kuruma prawn (*Penaeus japonicas*) production, mostly in China and a little in Japan, has been increasing since it was first reported from China in 2003. Total production from the region was 56 598 tonnes worth US$319 million at a unit value of US$5.63/kg in 2010. Fleshy prawn (*Penaeus chinensis*) is produced in China and Korea RO.

During the 1990s this species was very popular in China, with over 200 000 tonnes being cultured per year, but production has since declined because of the importation of the whiteleg shrimp since 2001. Production in the region has been stable for the past six years and was 45 339 tonnes worth US$182 million at a unit value of US$4.01/kg in 2010. Reports of *Metapenaeus sp.* culture in the region have been rising in the past five years and production was 40 493 tonnes worth US$122 million at a relatively low unit value of US$3.02/kg in 2010. Most of this production originated from Indonesia, probably from extensive polyculture ponds cultured together with milkfish and other shrimp species. Reported production of the banana prawn (*Penaeus merguiensis*) amounted to 19 821 tonnes worth US$76 million at a unit value of US$3.84/kg in 2010. Production of this species was 50 000 to 60 000 tonnes/year since 2000, but in 2010 declined substantially as a result of Viet Nam reporting production levels of 40 000 tonnes/year over the past decade, but zero in 2010. The current production of this species originates mostly from Indonesia, also coming from their polyculture ponds. It is known that there is some production of this species from Australia also, but it is probably being reported as penaeus shrimps nei. Other penaeid species cultured in the region include the Indian white prawn (*Penaeus indicus*) produced mainly in India at over 6 000 tonnes in 2010, speckled shrimp (*Metapenaeus monoceros*) produced in Bangladesh at over 5 000 tonnes in 2010, and the blue shrimp (*Penaeus stylirostris*) produced mainly in New Caledonia at 1 500 tonnes in 2010 (Figure 21).

There are good indications that the development of more biosecure shrimp farming systems and better farm management practices have made it possible for shrimp farmers to limit the negative impact of viral diseases. The introduction of domesticated, specific pathogen free (SPF) broodstock and post-larvae of the whiteleg shrimp has also been a key factor in this development. Only in the last couple of years have domesticated SPF giant tiger prawn stocks become available, but these are still not available in large enough quantities to make a significant commercial impact. Hence signs of a comeback of giant tiger prawn in regional shrimp culture will probably be limited by the unavailability of domesticated, disease-free stocks in the near future.

Generally, the high demand from the international market has maintained interest in the culture of shrimp for export. Additionally, over the past few years, the declining trend seen in the global shrimp market value has stopped, antidumping tariffs imposed by the main USA market on shrimp from the major exporters have been reduced and prices are again increasing to levels not seen since the early 2000s, as demand outpaces supply, which has been hit by continuing disease problems.

Freshwater prawns (*Macrobrachium spp., Palaemonidae spp.* and *Caridina spp.)*

Total production of freshwater prawns in the Asia-Pacific region amounted to 471 169 tonnes worth US$2.4 billion at a unit value of US$5.00/kg in 2010. The oriental river prawn (*Macrobrachium nipponense*) and the giant river prawn (*Macrobrachium rosenbergii)* are the major freshwater prawn species cultured in the region. The oriental river prawn is currently cultured only in China and production was 225 645 tonnes worth US$1.1 billion at US$4.76/kg in 2010. Over the deacade, 2000 to 2010, production of this species increased by 10 percent/year, but growth was actually stagnant since 2007, with growers preferred to culture whiteleg shrimp in freshwater in place of oriental river prawns.

Table 52 Top eight producing states of freshwater prawns in 2010 in Asia and the Pacific region

Country	Tonnes
China	372 759
Bangladesh	36 567
Thailand	25 606
India	22 999
Viet Nam	8 190
Myanmar	2 881
Indonesia	1 327
Malaysia	619
Regional total	**471 169**

The giant river prawn is cultured in some 12 countries in the region. However, the majority of this production is from China, Bangladesh, Thailand and India (Table 52). Total production of the species in the region reached 214 505 tonnes worth US$1.2 billion at a high unit value of US$5.38/kg in 2010 with an increase of 5 percent/year between 2000 and 2010. That accounts for 99.7 percent of the total world production of this species of 215 029 tonnes in 2010. The only other countries in the world with a sizeable production are the United States, the Dominican Republic and Brazil.

The production of giant river prawn by China reached 131 521 tonnes worth US$665 million at a unit value of US$5.05/kg in 2010 and increased by 4 percent/year between 2000 and 2010. Production from Bangladesh reached 30 636 tonnes worth US$255 million at a high unit value (for export to the European Union) of US$8.33/kg in 2010 and increased by 19 percent/year between 2000 and 2010 Recent problems with antibiotic residues found on exports to the European Union have posed a serious threat to this activity. Production from Thailand (25 606 tonnes worth US$115 million in 2010) and Viet Nam (8 190 tonnes worth US$33 million in 2010) increased significantly (between 9 and 10 percent/year) between 2000 and 2010. However, production from India (13 525 tonnes worth US$56 million in 2010) declined by 21 percent/year between 2005 and 2010 because of the effects of a new virus, the macrobrachium rosenbergii nodavirus (MRNV), which has badly affected both hatchery and pond culture of this species for the past few years.

There was also some production of the giant river prawn from other countries in the region including Myanmar (2 881 tonnes), Indonesia (1 327 tonnes), Malaysia (619 tonnes) and Cambodia (120 tonnes) along with minor production from Sri Lanka, Philippines and Fiji in 2010.

There were only three other types of freshwater prawns cultured in the region in 2010, namely freshwater prawns, shrimps nei (*Palaemonidae spp.*) (21 524 tonnes worth US$97 million at a unit value of US$4.52) produced in China and Bangladesh, monsoon river prawn (*Macrobrachium malcolmsonii*) (9 474 tonnes worth US$33 million at a unit value of US$3.46/kg) produced in India, and sawtooth caridina (*Caridina denticulata*) (just 21 tonnes worth US$689 000 at a very high unit value of US$32.79/kg) produced in Korea RO.

It is not easy to intensify production of freshwater prawns because of their territorial habits and divergent growth effects. This means that the development of this sector is reasonably slow and in some states the sector has even shrunk, as attention and resources have been diverted to brackish water or freshwater shrimp production. Export markets for freshwater prawns are much smaller and less developed, mainly because consumers in general are not as familiar with these species as they are with brackish water shrimp. Freshwater prawns, however, enjoy good domestic markets especially in South Asia and Southeast Asia.

Crabs (*Eriocheir spp. Scylla spp., Brachyura spp.* and *Portunus spp.*)

Crab production in the region has been growing rapidly and reached 847 685 tonnes worth nearly US$5 billion at a high unit value of US$5.83/kg in 2010. The growth rate in crab culture in the region was 10 percent/year between 2000 and 2010. There is virtually no crab produced through culture anywhere else in the world, with the Asia-Pacific region culturing 99.9 percent of the world total.

The Chinese mitten crab (*Eriocheir sinensis*) contributed 70 percent of the total cultured crab production in the region in 2010. It is also the fourteenth most important cultured species from all environments in terms of volume in 2010, and the third most popular crustacean after the whiteleg shrimp and the giant tiger prawn. This species is currently mainly cultured in China (producing 593 296 tonnes worth US$4.1 billion at a high unit value of US$6.96/kg in 2010). There is also a very small amount produced in Korea RO, although a few other countries have also shown some interest lately. The production of this species has grown at a consistent and rapid rate of 11 percent/year between 2000 and 2010.

The Indo-Pacific swamp crab (*Scylla serrata*) is the second most cultured species in the region (11 countries reported production in 2010) with 140 937 tonnes worth US$396 million at a relatively low unit value of US$2.91/kg in 2010. Growth in production increased by just 5 percent/year between 2003 and 2010. China was the major producer (82 percent) of this species in the region, producing 116 054 tonnes worth US$276 million at a unit value of US$2.38/kg in 2010. Other major producing countries of this species included the Philippines (14 438 tonnes) and Indonesia (9 557 tonnes).

Other crab species cultured in the region include marine crabs nei (*Brachyura sp.*) from China (156 260 tonnes in 2002). However, this dropped to 9 732 tonnes in 2003, and then increased to 21 312 tonnes in 2010 worth US$87 million at a unit value of US$4.07/kg in 2010. From 2003, most of the crabs reported under this category in China were re-assigned as either Indo-Pacific swamp crab or swimming crabs nei, explaining the rapid rise in production of these species from 2002 to 2003.

The other major cultured crab species in the region was swimming crabs nei from China, which amounted 91 050 tonnes worth US$320 million at a unit value of US$3.51/kg in 2010, and grew by 9 percent/year between 2003 and 2010.

In addition, small quantities of orange mud crab (*Scylla olivacea*) from Myanmar (750 tonnes) and portunus swimming crabs nei (*Portunus spp*.) from Indonesia (335 tonnes) were reported in 2010.

Freshwater crayfish and crawfish (*Procambarus* and *cherax spp.*)

Freshwater crayfish and crawfish production has increased dramatically in recent years as a sole result of the rapid increase of production of the exotic red swamp crawfish (*Procambarus clarkii*) by China. The production reached 563 281 tonnes worth US$2.7 billion at a unit value of US$4.76/kg in 2010, an increase of 44 percent/year since its first reporting in 2003 until 2010. The other three crayfish species cultured in the region (yabby crayfish, *Cherax destructor*, red claw crayfish, *Cherax quadricarinatus* and marron crayfish, *Cherax tenuimanus*) totalled 191 tonnes worth US$3.6 million at a very high unit value of US$19.12/kg, a significant reduction from the 409 tonnes produced in 2000, with nearly all production from Australia, plus a little from Indonesia.

The only other major producer of crayfish and crawfish in the world is the United States, which produced 52 942 tonnes of the indigenous red swamp crawfish in 2010. This is less than 10 percent of the Chinese production.

Lobsters (*Panulirus spp.* and *Thenus spp*.)

Lobsters are a commodity with very little production volume but very high unit value. Their production reached 1 611 tonnes worth US$16 million at a high unit value of US$10.11/kg in 2010 and grew by 44 percent/year between 2000 and 2010. The dominant group cultured is tropical spiny lobster (*Panulirus spp.*). Viet Nam has grown very fast in the past three years to become the number one producer (1 200 tonnes worth nearly US$10 million at a unit value of US$8.00/kg in 2010. Other producing states are Indonesia and the Philippines. There are also two other species of lobsters reported from the region in 2010, which are the mud spiny lobster (*Panulirus polyphagus*) from Singapore (9 tonnes worth US$319 000 at a very high unit price of US$37.44/kg) and the flathead lobster (*Thenus orientalis*) from the Philippines (2 tonnes worth US$22 000 at US$10.86/kg).

There have been worries that the rapid increase in the culture of lobster may adversely impact the natural resources as it is entirely dependent on natural seed. But recently, there have been advances made in the long and difficult rearing of the larvae of these species, so that recently a huge new initiative has been launched by a commercial seafood company to try to close the cycle and rear large quantities of spiny lobsters in ponds in Malaysia and Viet Nam.

Molluscs

Mollusc culture is split into low-value species produced in extensive cultured systems (e.g. seeded blood cockle mudflats, mussel and oyster stake culture) and high-value species produced in intensive systems (fed systems and possibly recirculation).

Recent improved breakdown by species of aquaculture production of Chinese molluscs has given a better indication of the proportion of low-value and high-value mollusc production. China's reported production of "molluscs nei" has dropped from 1.1 million tonnes in 2002 to 753 000 tonnes in 2003. It reduced further in 2010 to 470 844 tonnes worth US$264 million at a low unit value of US$0.56/kg. These low-value molluscs were reclassified by China in 2003, leading to first reports of sea snails, swan mussels, Chinese mystery snail, pen shells nei, Asian clams and freshwater molluscs nei.

Total production of all molluscs in the Asia-Pacific region amounted to 13 059 405 tonnes worth US$11.7 billion at a unit value of US$0.90/kg in 2010. This accounted for 92 percent of the total world mollusc production of 14 222 183 tonnes worth US$14.4 billion at a unit value of US$1.01/kg in 2010.

High-value molluscs

With respect to high-value mollusc species production in the Asia-Pacific region, there was a total production of 6 069 426 tonnes worth US$6.2 billion at a unit value of US$1.01/kg in 2010. The production grew by just 3 percent/year in terms of volume and 2 percent/year in terms of value between 2000 and 2010 (Figure 24).

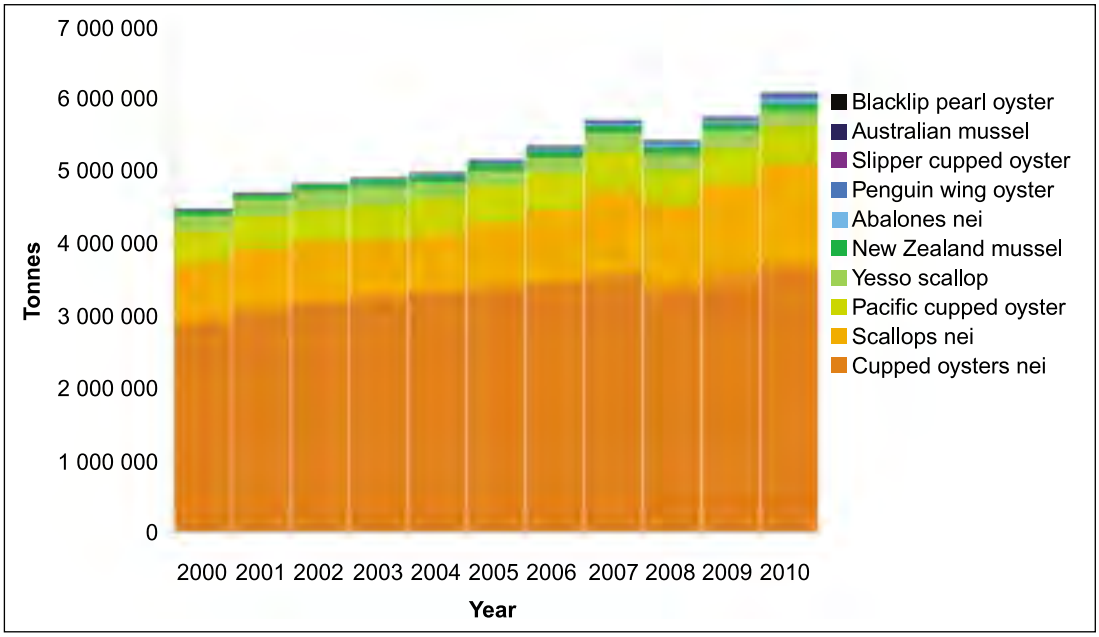


Figure 24 Production of high value molluscs 2000–2010 in Asia and the Pacific region

The most important high-value mollusc species cultured in the region was cupped oysters nei (*Crassostrea spp.*), produced mainly in China, with some also produced in Thailand. Production of this species amounted to 3 671 731 tonnes worth US$2.2 billion at a unit value of US$0.59/kg in 2010. Production grew by only 2 percent/year between 2000 and 2010. This mollusc species is the fourth most cultured species in the region, behind only the three top carp species, in terms of volume of production.

Other popular high-value mollusc species (all showing relatively slow growth rates of 0 to 6 percent/year between 2000 and 2010) include scallops nei (*Pectinidae spp.*), grown only in China (1 407 467 tonnes worth US$2 billion at US$1.42/kg), the Pacific cupped oyster (*Crassostrea gigas*), mostly from Japan, but also from China and Korea RO (517 119 tonnes worth US$740 million at US$1.43/kg), the yesso scallop (*Patinopecten yessoensis*) grown mostly in Japan (220 102 tonnes worth US$355 million at only US$1.61/kg) and the New Zealand mussel (*Perna canaliculus*) from New Zealand (95 168 tonnes worth US$241 million at US$2.53/kg) in 2010.

The species of high-value molluscs reported from the region with the fastest rate of growth is abalone nei (*Haliotis spp.*), produced mostly by China and Korea RO at 62 995 tonnes worth US$465 million at a very high US$7.39/kg in 2010, and growing by 38 percent/year between 2000 and 2010 (Figure 24).

Other important species of high-value molluscs produced in the region include the penguin wing oyster (*Pteria penguin*) with a production figure of 58 079 tonnes in 2010, the slipper cupped oyster (*Crassostrea iredalei*) (22 525 tonnes in 2010), along with the Australian mussel (*Mytilus planulatus*) (3 462 tonnes) and the black lipped pearl oyster (*Pinctada margaritifera*) (2 129 tonnes in 2010).

In terms of country of production for these high-value mollusc species: China is again the major producer by far, producing 5 143 686 tonnes worth US$4.6 billion at US$0.89/kg in 2010; Japan was second, producing 419 947 tonnes worth US$725 million at US$1.73/kg in 2010; Korea RO was third, producing 274 257 tonnes worth US$346 million at US$1.26/kg in 2010; New Zealand was fourth, producing

97 687 tonnes worth US$253 million at US$2.59/kg in 2010; Indonesia was fifth, producing 58 079 tonnes worth US$29 million at US$0.49/kg in 2010; and Thailand was sixth, producing 28 095 tonnes worth US$22 million at US$0.77/kg in 2010.

Low-value molluscs

With respect to low-value mollusc species production in the Asia-Pacific region, there was a total production of 7 million tonnes worth US$5.6 billion at a unit value of US$0.80/kg in 2010. This grew by 5 percent/year in terms of volume and 6 percent/year in terms of value between 2000 and 2010 (Figure 25).

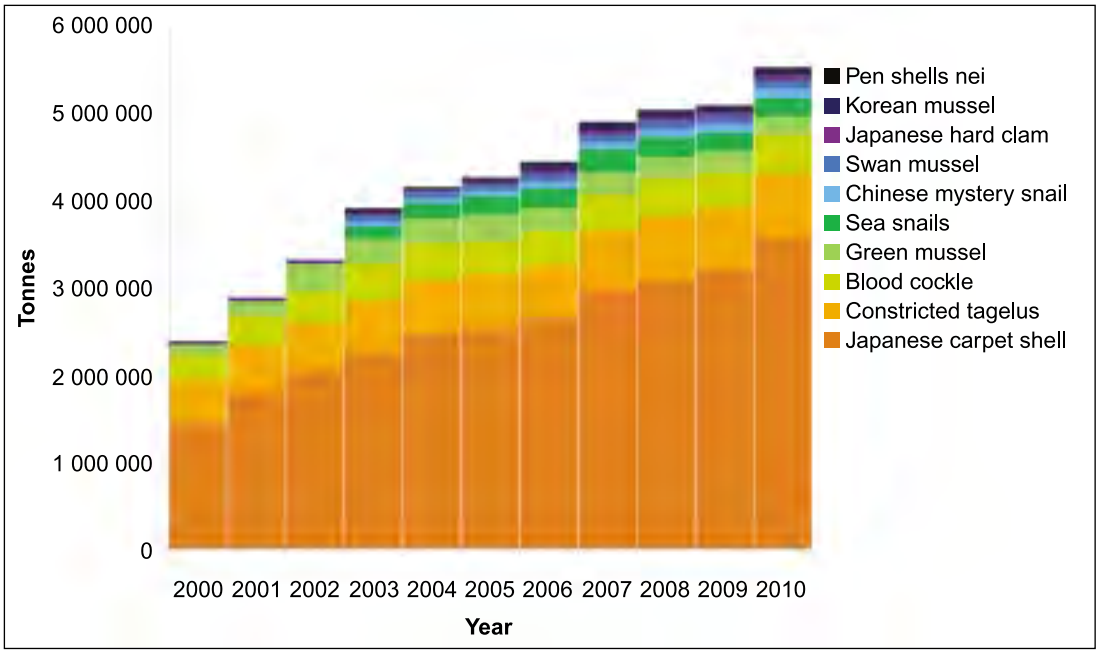


Figure 25 Production of low-value molluscs 2000–2010 in Asia and the Pacific region

The most important low-value mollusc species cultured in the region was the Japanese carpet shell (*Ruditapes philippinarum*), produced mainly in China, with some also produced in Korea RO. Production amounted to 3 563 481 tonnes worth US$3.2 billion at a unit value of US$0.90/kg in 2010. Production grew by 9 percent/year between 2000 and 2010. This mollusc species is the fifth most cultured species in the region, behind only the top three carp species and the most popular cultured mollusc, cupped oyster nei, in terms of volume of production.

Other popular low-value mollusc species (all showing growth rates of 4 to 10 percent/year between 2000 and 2010) include the constricted tagelus (*Sinovacula constricta*), grown only in China (714 434 tonnes worth US$643 million at US$0.90/kg), the blood cockle (*Anadara granosa*), mostly from China, but also from Thailand and Malaysia (465 871 tonnes worth US$511 million at US$1.10/kg), the green mussel (*Perna viridis*) grown mostly in Thailand and India (214 415 tonnes worth US$53 million at only US$0.25/kg), sea snails (*Rapana spp*.) from China (207 838 tonnes worth US$127 million at US$0.61/kg) and the Chinese mystery snail (*Cipangopaludina chinensis*) from China (110 422 tonnes worth US$88 million at US$0.80/kg) in 2010.

Other species of low-value molluscs reported from the region include swan mussel (*Anodonta cygnea*), Japanese hard clam (*Meretrix lusoria*), Korean mussel (*Mytilus coruscus*) and pen shells nei (*Atrina spp*.).

In terms of country of production for these low-value mollusc species: China was again the main producer by far, producing 6 300 914 tonnes worth US$5.1 billion at US$0.81/kg in 2010; Thailand was second, producing 242 538 tonnes worth US$76 million at US$0.32/kg in 2010; Viet Nam was third, producing 174 000 tonnes worth US$174 million at US$1.00/kg in 2010; Malaysia was fourth, producing 88 554

tonnes worth US$35 million at US$0.40/kg in 2010; and Korea RO was fifth, producing 85 527 tonnes worth US$108 million at US$1.26/kg in 2010.

Although it is possible to categorize species such as abalone or giant clam as high-value species, there are difficulties with some species such as mussels that may be cultured in low-input systems in one country (e.g. Thailand) but relatively high-input systems in another (e.g. New Zealand). Many states report their mollusc production in large groupings such as “marine molluscs nei”. The IFPRI/WFC outlook on fish supply (Delgado *et al.*, 2003) projected increasing mollusc production, although this may have been based on current production trends rather than the resource potential.

Unlike fish culture, the intensification of mollusc culture is quite difficult and probably not economically viable. The issue of site availability is likely to constrain future development of mollusc culture in several states as can be seen in the levelling off or decline in production in Japan (since the late 1980s).

The trend in mollusc culture is more likely to be a shift from lower-value species to higher-value species in those areas where sites are suitable. A further dimension is the development of intensive onshore culture operations such as those for abalone and a number of gastropod species.

Ornamental molluscs

There is a third group of molluscs that are cultured in the region and those are the ornamental molluscs that are normally cultured for use in aquaria. These are mostly giant clam species that are cultured in the clear seawater areas of the Pacific islands.

Total culture of ornamental molluscs was small, amounting to just 2 tonnes worth US$6 000 at a unit value of US$3.00/kg in 2010. This production has decreased substantially, by 18 percent/year between 2000 and 2010 as most countries have ceased production.

All of the production of these ornamental molluscs has traditionally come from Palau, Samoa and Tonga, but the only production reported in 2010 was 2 tonnes of smooth giant clam (*Tridacna derasa*) from Palau, with no reports of any other ornamental mollusc in 2010.

Aquatic plants

The total production of aquatic plants in the Asia-Pacific region reached 18 854 416 tonnes worth US$5.6 billion at a unit value of just US$0.30/kg in 2010 and accounts for over 99 percent of the total world production of 19 million tonnes in this year, indicating the importance of the region for the production of aquatic plants. Production has been growing steadily by 7 percent/year between 2000 and 2010.

Over 99 percent of aquatic plant production in the region was from brackish and marine waters, with only 101 302 tonnes of aquatic pants produced in freshwater comprising mostly of *Spirulina sp.* from China.

Aquatic plant production can be divided into two distinct groups. The first group consists of seaweeds of temperate waters that are traditionally used for food purposes and are mainly produced in East Asia. The second group consists of tropical species mainly processed as a source of commercially valuable biopolymers (carrageenan, agar) that are used for various food and non-food purposes and are produced in Southeast Asia.

Seaweeds for food purposes

The most important aquatic plant species cultured for food is the Japanese kelp (*Laminaria japonica*), produced mainly in China, plus some in Korea DPR, Korea RO and Japan, amounting to 5 146 833 tonnes worth US$301 million at a very low unit value of US$0.06/kg in 2010. The culture of this species has been growing slowly by 2 percent/year between 2000 and 2010.

Other important species include: aquatic plants nei, produced mainly in China, amounting to 3 124 076 tonnes worth US$1.5 billion at a high unit value of US$0.47/kg in 2010. The culture of this species has

been growing slowly by 1 percent/year between 2000 and 2010; wakame (*Undaria pinnatifida*) produced mostly in China, but also in Korea RO and Japan amounting to 1 537 339 tonnes worth US$667 million at a high unit value of US$0.43/kg in 2010. The culture of this species has been declining (especially in China) by 2 percent/year between 2003 and 2010; nori nei (*Porphyra spp.*) produced in China, amounting to 1 072 350 tonnes worth US$63 million at a very low unit value of US$0.06/kg in 2010.

The culture of this species has been growing by 10 percent/year between 2000 and 2010; laver (nori) (*Porphyra tenera*) produced in Japan and Korea RO, amounting to 564 234 tonnes worth US$1.1 billion at a very high unit value of US$1.94/kg in 2010. The culture of this species has been growing slowly by 1 percent/year between 2000 and 2010; and spirulina nei (*Spirulina spp.*) produced in China, amounting to 96 910 tonnes worth US$48 million at a unit value of US$0.50/kg in 2010. The culture of this species has been growing very quickly by 29 percent/year between 2000 and 2010 (Figure 26).

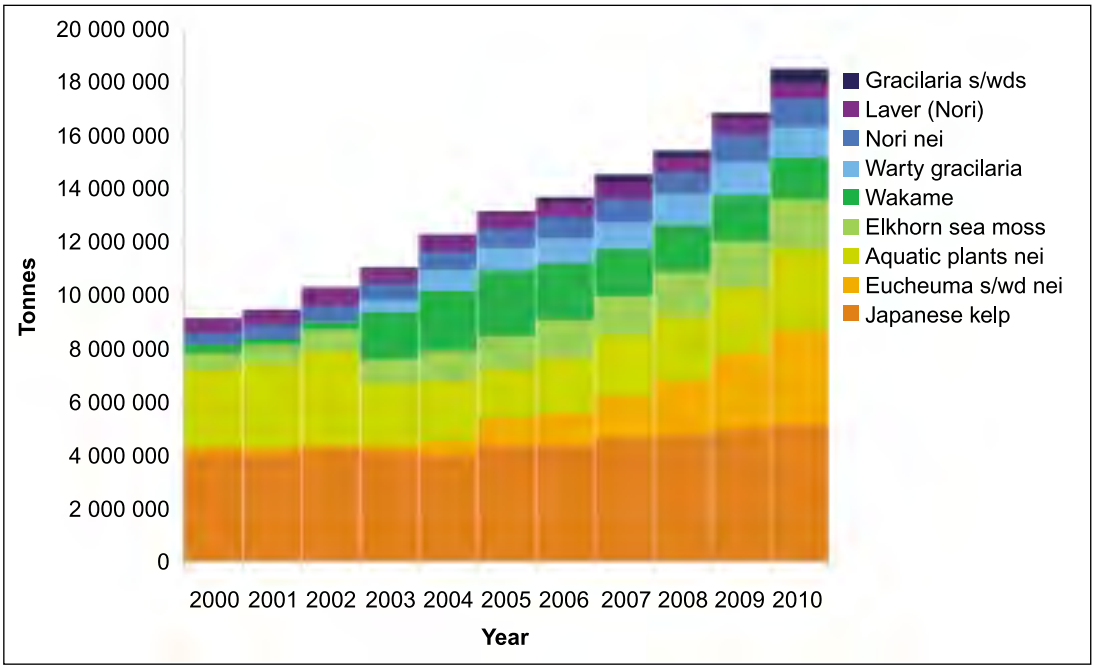


Figure 26 Production of aquatic plants by species 2000–2010 in Asia and the Pacific region

Other aquatic plants cultured for food in the region included bright green nori (*Enteromorpha clathrata*) (11 150 tonnes), green laver (*Monostroma nitidum*) (4 531 tonnes), caulerpa seaweeds (*Caulerpa spp.*) (4 309 tonnes), fragile codium (*Codium fragile*) (1 394 tonnes) and *Haematococcus pluvialis* (150 tonnes) in 2010.

Recent detailed reporting from China has given a clearer picture of aquatic plant production, so that in 2002 China reported 3.4 million tonnes of aquatic plants nei, but this was reduced to 2.2 million tonnes in 2003 as these plants were ascribed to specific species including wakame, warty gracilaria, fusiform sargassum, eucheuma nei, aquatic plants nei from freshwater, spirulina nei and Japanese isinglass, all of which were first reported separately from 2003 onwards.

In terms of country of production for these aquatic plants for food: China is again the major producer by far, producing 9 801 380 tonnes worth US$2.1 billion at US$0.22/kg in 2010; Korea RO was second, producing 880 539 tonnes worth US$310 million at US$0.35/kg in 2010; Korea DPR was third, producing 444 300 tonnes worth US$67 million at US$0.15/kg in 2010; Japan was fourth, producing 432 796 tonnes worth US$1.1 billion at a very high US$2.63/kg in 2010. This was because of the high value US$2.00 to 2.72/kg) of all of the seaweed species produced in Japan (including laver (nori), Japanese kelp, wakame and aquatic plants nei); and the Philippines was fifth, producing 4 309 tonnes worth US$3 million at US$0.51/kg in 2010 (Figure 27).

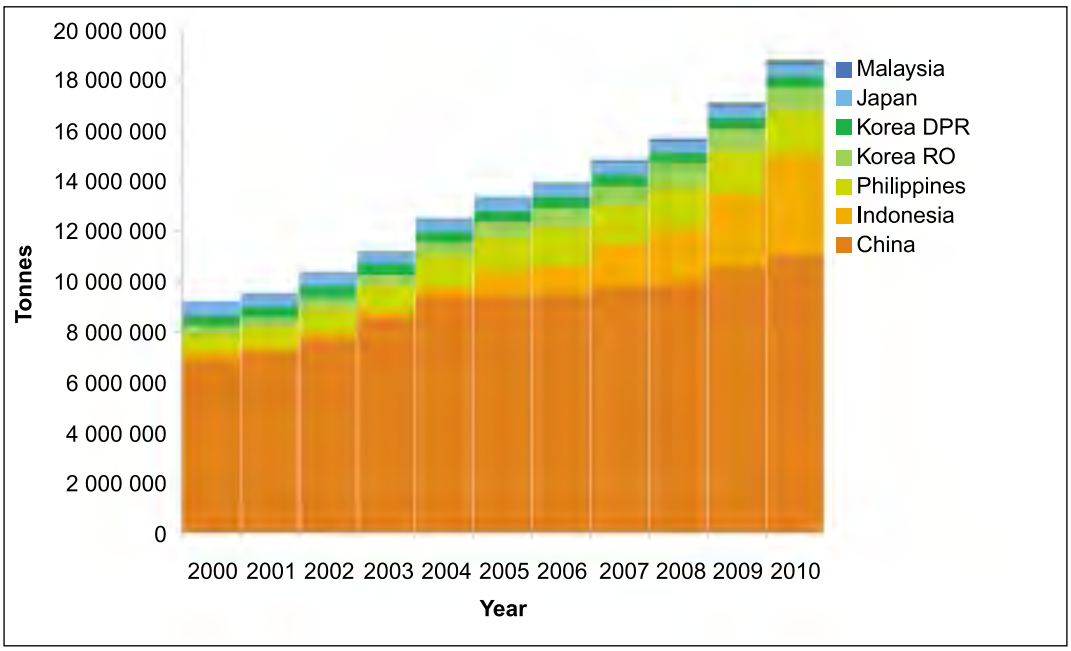


Figure 27 Production of aquatic plants by country 2000–2010 in Asia and the Pacific region

Seaweeds for biopolymers

The most important aquatic plant species cultured for use as biopolymers is *Eucheuma sp.*,[13] produced mainly in Indonesia and amounting to 3 478 501 tonnes worth US$1.1 billion at a unit value of US$0.33/kg in 2010 with a growth rate of 32 percent/year between 2000 and 2010 because of the high demand. Other important species include: elkhorn sea moss (*Kappaphycus alvarezii*), produced mainly in Philippines and Malaysia, amounting to 1 873 749 tonnes worth US$265 million at a low unit value of US$0.14/kg in 2010 and with a growth rate of 11 percent/year between 2000 and 2010; warty gracilaria (*Gracilaria verrucosa*) produced in China, amounting to 1 152 108 tonnes worth US$342 million at a unit value of US$0.30/kg in 2010 and a growth rate of 14 percent/year between 2000 and 2010; graciliaria seaweeds nei (*Gracilaria spp.*) produced mostly in Indonesia and Viet Nam, amounting to 552 606 tonnes worth US$182 million at a unit value of US$0.33/kg in 2010 and a growth rate of 37 percent/year (as a result of increased Indonesian production) between 2000 and 2010; spiny eucheuma (*Eucheuma denticulatum*) produced mostly in Philippines and Malaysia, amounting to 133 583 tonnes worth US$7 million at a very low unit value of US$0.05/kg in 2010 and a growth rate of 15 percent/year between 2000 and 2010; and fusiform sargassum (*Sargassum fusiforme*) produced in China, amounting to 78 210 tonnes worth US$36 million at a unit value of US$0.46/kg in 2010 but growth has been stagnant between 2000 and 2010 (Figure 26).

Other aquatic plants cultured for biopolymers in the region included brown seaweeds (*Phaophyceae*) (21 133 tonnes) and Japanese isinglass (*Gelidium amansii*) (1 200 tonnes) in 2010.

In terms of country of production for these aquatic plant species for biopolymer production:

- Indonesia was the major producer, producing 3 915 017 tonnes worth US$1.3 billion at US$0.32/kg in 2010.
- The Philippines was second, producing 1 796 963 tonnes worth US$254 million at US$0.14/kg in 2010.

[13] The taxonomy for *Eucheuma* is confusing. The name *cottonii* is a general word used to describe a number of *Eucheuma* species (Zuccarello *et al.*, 2006). Recent taxonomic revisions have added to the confusion. *Eucheuma striatum* var. *tambalang* and *E. alvarezii* var. *tambalang* are now *Kappaphycus alvarezii* [common name "tambalang"], *Eucheuma striatum* var. *elkhorn* is *Kappaphycus striatum* [common name "elkhorn"], *Eucheuma cottonii* is *Kappaphycus cottonii*, and *Eucheuma spinosum* is now *Eucheuma denticulatum* [common name "spinosum"] **source:** Eldredge, 1994.

– China was third, producing 1 295 778 tonnes worth US$408 million at US$0.31/kg in 2010.
– Malaysia was fourth, producing 207 892 tonnes worth US$17 million at a very low US$0.08/kg in 2010.
– Viet Nam was fifth, producing 35 000 tonnes worth US$18 million at US$0.50/kg in 2010.

Other countries producing minor quantities of aquatic plants for biopolymers in 2010 include: the Solomon islands (8 000 tonnes), Kiribati (4 745 tonnes), India (4 200 tonnes), Timor-Leste (1 500 tonnes), Fiji (560 tonnes) and Myanmar (262 tonnes).

New areas in the region are now being investigated for the expansion of seaweed production since global demand for carrageenan and other alginates is expected to continue to rise.

Reptiles and amphibians

Reported species produced in the region from this group are freshwater frogs and turtles.

Total production was 377 406 tonnes worth almost US$2 billion at a high unit value of US$5.22/kg in 2010, and growing by 9 percent/year between 2003 and 2010 (Table 53 and Figure 28).

Table 53 Production of reptiles and amphibians in 2010 in Asia and the Pacific region

Species	Tonnes	Value (US$1 000)	Unit value (US$/kg)
Turtles	295 531	1 550 510	5.25
Frogs	81 875	419 164	5.12

Production from the Asia-Pacific region amounts to 99.8 percent of the world total, again indicating the importance of this region in the culture of these species.

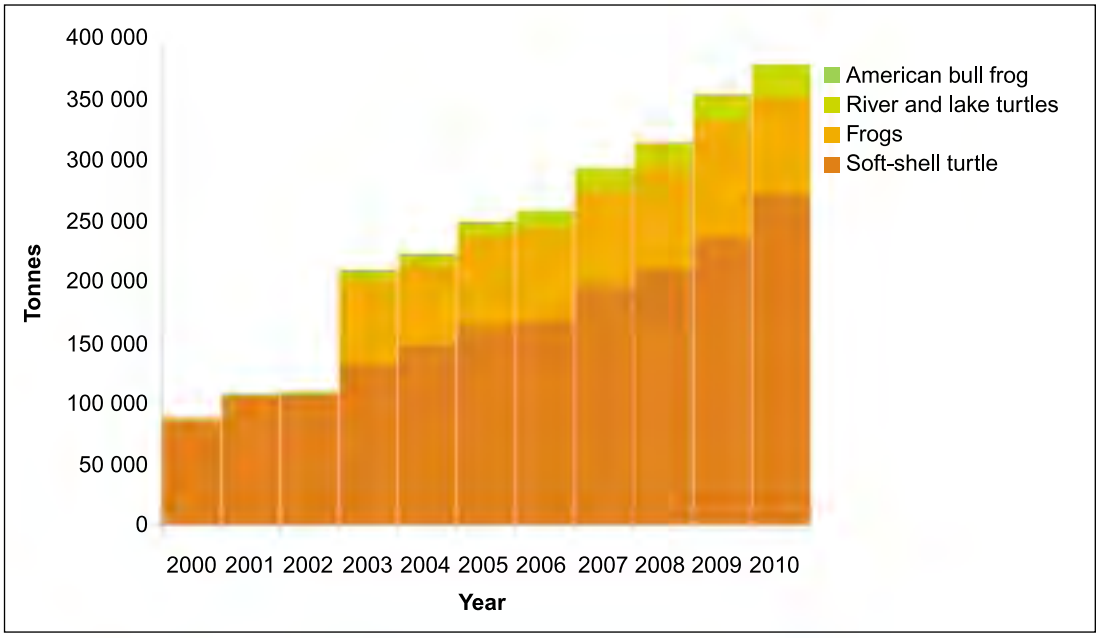


Figure 28 Production of reptiles and amphibians 2010–2010 in Asia and the Pacific region

Frogs (*Rana spp.*)

Total production of frogs in the region was 81 875 tonnes worth US$419 million at a unit value of US$5.12/kg in 2010, growing by just 2 percent/year in terms of volume and 7 percent/year in terms of value from 2003 (when China started better reporting of species) until 2010 (Table 53 and Figure 28).

Most of this frog production was reported as frogs (*Rana spp.*), with 81 326 tonnes worth US$418 million at a unit value of US$5.14 in 2010. These were produced mostly (98 percent) in China (80 607 tonnes in 2010), with some minor production in Thailand (1 186 tonnes in 2010), Cambodia (60 tonnes in 2010), Lao PDR (20 tonnes in 2010) and Indonesia (2 tonnes in 2010). The only other reported species was the American bull frog (*Rana catesbeiana*), amounting to 549 tonnes worth US$1.3 million at a unit value of US$2.38/kg in China (Taiwan POC).

There are limited data on frog production, although frogs are being increasingly cultured in many states. The small size of a typical frog farm (using small cement tanks or even pens) means that quantification of this type of operation is problematic.

Turtles

Total production of turtles in the region was 295 531 tonnes worth US$1.6 billion at a unit value of US$5.25/kg in 2010, growing by 11 percent/year in terms of volume and by 17 percent/year in terms of value from 2003 (when China started better reporting of species) until 2010 (Table 53 and Figure 28).

Most of this turtle production was reported as soft-shell turtle (*Trionyx sinensis*), with 270 436 tonnes worth US$1.4 billion at a unit value of US$5.25 in 2010. The biggest producer (90 percent) of this species was China, with 265 721 tonnes worth US$1.4 billion at US$5.19/kg in 2010. Other producing states were Thailand, Japan and Korea RO.

The other species of turtles reported from the region was river and lake turtles nei (*Testudinata spp.*), which were produced by China amounting to 25 095 tonnes worth US$130 million at a unit value of US$5.19/kg in 2010.

China dominated production of turtles (292 995 tonnes), with some minor production in Thailand (11 708 tonnes), Japan (10 080 tonnes), and Korea RO (8 321 tonnes) in 2010.

Crocodiles (family Crocodylidae)

Crocodile production is growing quickly in the region with Cambodia exporting juvenile crocodiles to both Viet Nam and China. Thailand and Papua New Guinea also have crocodile farms. The production of crocodiles is rarely reported in fishery or aquaculture statistics and is not dealt with by the FAO as crocodiles are not considered a truly aquatic species by FAO.

Niche aquaculture species

There are a number of niche aquaculture species that this review does not cover. These species are either cultured at the pilot/experimental level or simply not reported by many states.

Table 54 Niche aquaculture species in 2010 in Asia and the Pacific region

Species	Tonnes	Value (US$1 000)	Unit value (US$/kg)
Aquatic invertebrates nei	222 475	421 084	1.89
Japanese sea cucumber	130 403	453 151	3.48
Jellyfishes nei	59 616	140 694	2.36
Sea squirts nei	16 636	29 414	1.77
Sea urchins nei	6 169	21 408	3.47
Sea cucumbers nei	476	6 536	13.73
Sand fish	30	150	5.00
Regional total	**435 805**	**1 072 437**	**Ave. 2.46**

Some of the species are not food type commodities (e.g. sponge and pearls, ornamental shells, ornamental fish) and are therefore not routinely monitored by the authority reporting fisheries information. Of those that are reported, most are reported as aquatic invertebrates nei, sea cucumbers, jellyfish, sea squirts and sea urchins.

Total production of these reported niche species was 435 805 tonnes worth US$1.1 billion at a relatively high unit value of US$2.46/kg in 2010. The growth rate of this group was a rapid 22 percent/year in terms of volume and 20 percent/year in terms of value between 2003 (when China first started recording many of them individually) and 2010. This comprised 99.9 percent of the total world production of these

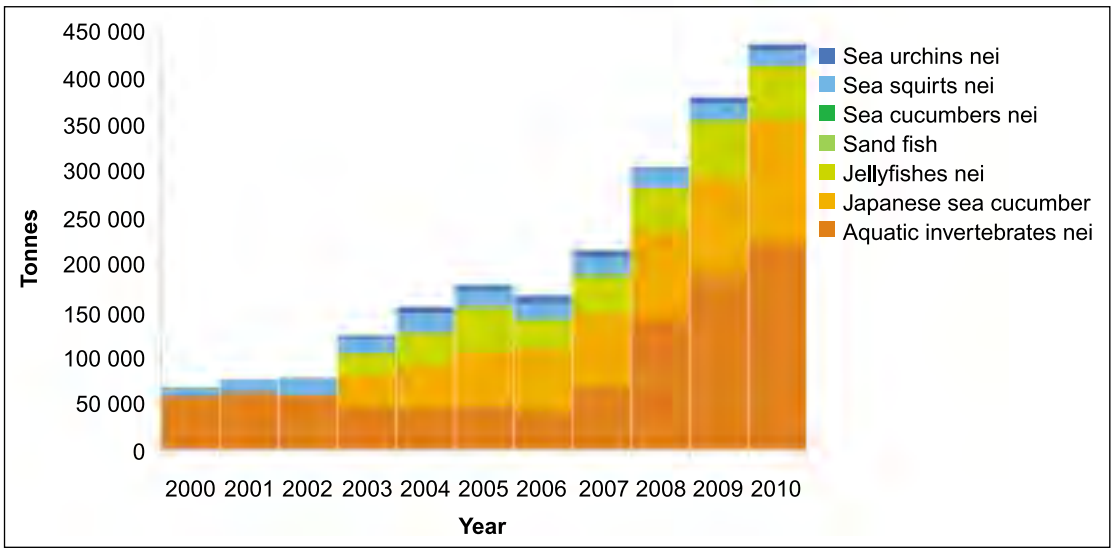


Figure 29 Production of niche species by country 2000–2010 in Asia and the Pacific region

species, with only Australia and Belgium also producing some aquatic invertebrates nei and some sea cucumbers and urchins from the Russian Federation (Table 54 and Figure 29).

The most cultured species in this group was aquatic invertebrates nei, produced mainly in marine environments, with a small quantity from freshwaters in China. Total production amounted to 222 475 tonnes worth US$421 million at a unit value of US$1.89/kg in 2010. Production of these species increased at a rapid rate of 15 percent/year between 2000 and 2010. These were mostly (83 percent) produced in China (184 871 tonnes) and Myanmar (27 349 tonnes), with some production also from Korea RO (8 424 tonnes), Australia (1 660 tonnes) and Japan (171 tonnes) in 2010.

Production of Japanese sea cucumber (*Stichopus japonicus*) amounted to 130 403 tonnes worth US$453 million at a high unit value of US$3.48/kg in 2010 and had a high growth rate of 21 percent/year between 2003 and 2010. These were nearly all (99.9 percent) produced from China (130 303 tonnes in 2010), with only 100 tonnes produced by Korea DPR.

Production of jellyfishes nei (*Rhopilema spp.*) amounted to 59 616 tonnes worth US$141 million at a unit value of US$2.36/kg in 2010 and had a high growth rate of 14 percent/year between 2003 and 2010. These were all produced in China.

Production of sea squirts nei (*Ascidiacea)* amounted 16 636 tonnes worth US$29 million at a unit value of US$1.77/kg in 2010 and had a high growth rate of 16 percent/year between 2000 and 2010. These were produced from Japan (10 272 tonnes in 2010) and Korea RO (6 364 tonnes in 2010).

Production of sea urchins nei (*Stongylocentratus spp.*) amounted to 6 169 tonnes worth US$21 million at a high unit value of US$3.47/kg in 2010 and had a growth rate of 9 percent/year between 2003 and 2010. These were all produced in China.

Production of sea cucumbers nei (*Holothuroidea)* amounted to 476 tonnes worth US$7 million at a very high unit value of US$13.73/kg in 2010 and had a very rapid growth rate of 42 percent/year in terms of volume and 64 percent/year in terms of value between 2003 and 2010. These were all produced in Indonesia and supplied as an ingredient for traditional medicines in China.

Production of sand fish, a type of sea cucumber (*Holothuria scabra)*, was just 30 tonnes worth US$0.15 million at a high unit value of US$5.00/kg in 2010. These have had a stable growth rate over last three years. These were all produced in Viet Nam.

China was again the biggest producer (87 percent) of these niche species, producing 380 959 tonnes worth nearly US$1 billion at a unit value of US$3.47/kg in 2010. Myanmar produced 27 349 tonnes, the Korea RO 14 788 tonnes and Japan 10 443 tonnes in 2010. Other minor producers were Australia, Indonesia, Korea DPR and Viet Nam.

Subregional trends in aquaculture production

Trends in South Asia

South Asia's total aquaculture production amounted to 6 138 043 tonnes worth US$12.2 billion at a unit value of US$1.99/kg in 2010, equating to just under 8 percent of the total world aquaculture production. The growth rate was 9 percent/year in terms of volume and 13 percent/year in terms of value between 2000 and 2010.

Freshwater and diadromous fish

South Asia's production has been dominated by the production of freshwater and diadromous fish throughout the past decade, such that freshwater fish account for 94 percent of total aquaculture production in this subregion, and 16 percent of total world production of freshwater fish. The South Asia subregion also produces small amounts of crustaceans, marine fish, molluscs and aquatic plants, with each accounting for just 0.7 to 3.6 percent of total production from the region (Figures 30, 31 and 32).

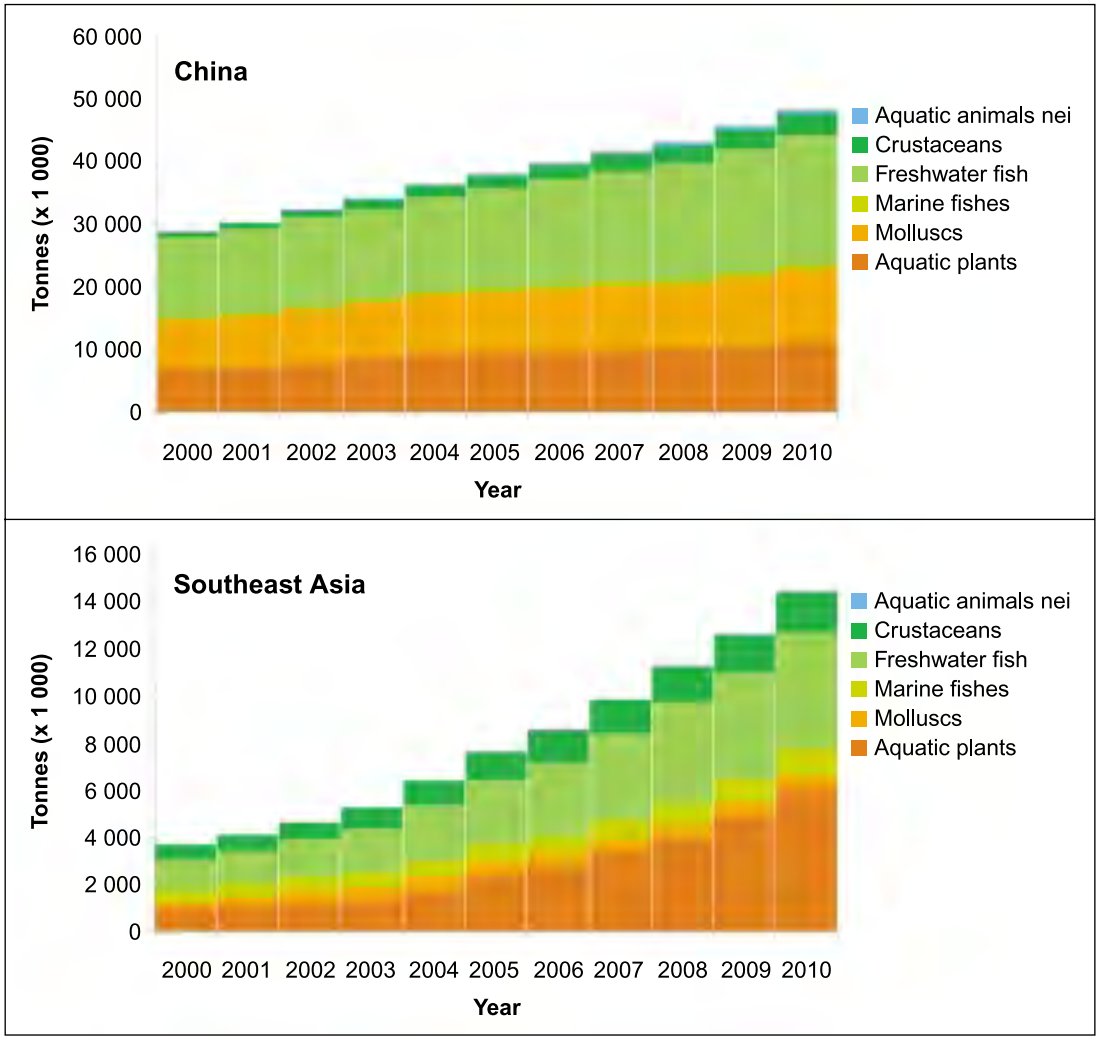


Figure 30 Trends in aquaculture production in Asia by major species groups

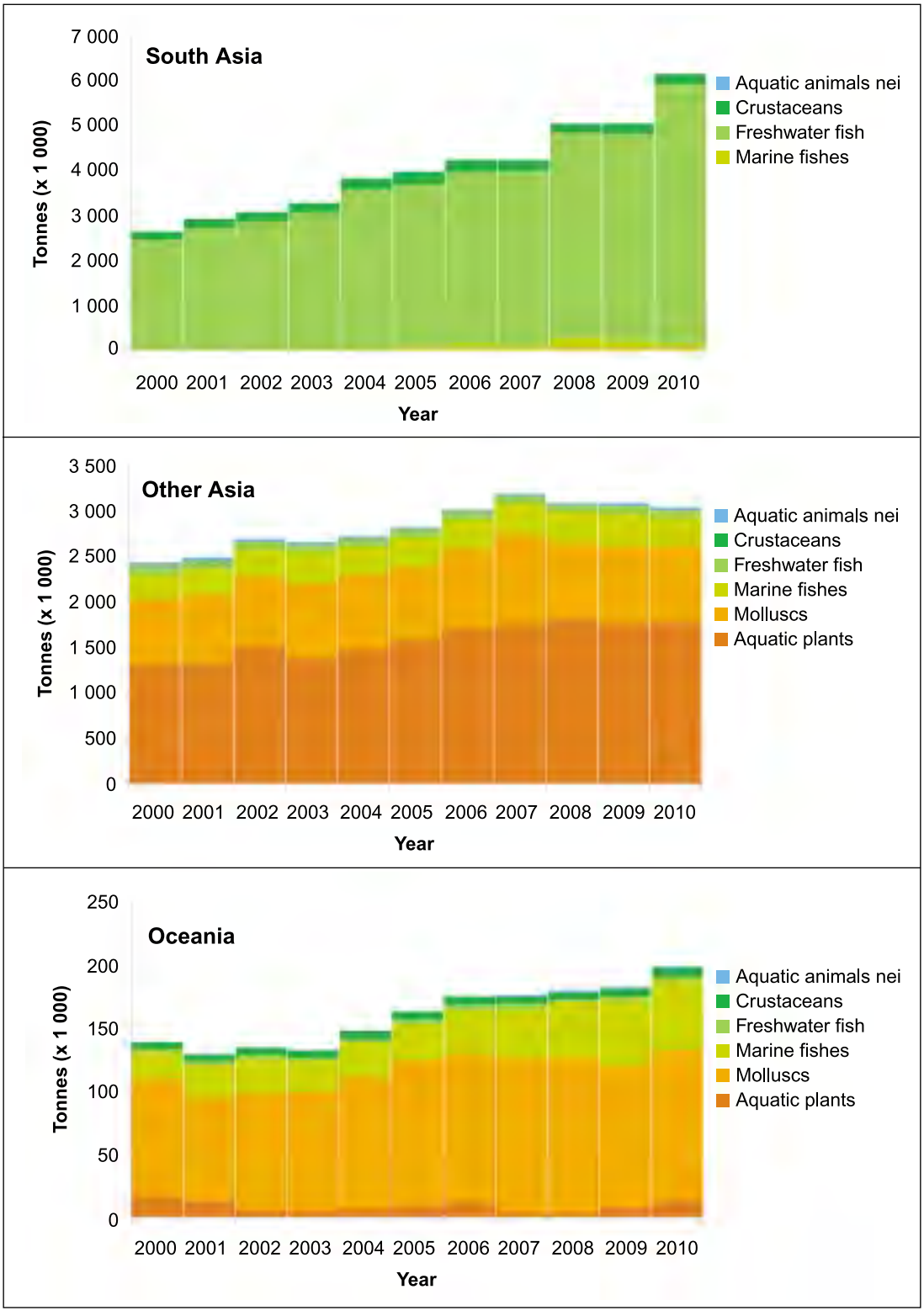


Figure 30 (cont.) Trends in aquaculture production in Asia by major species groups

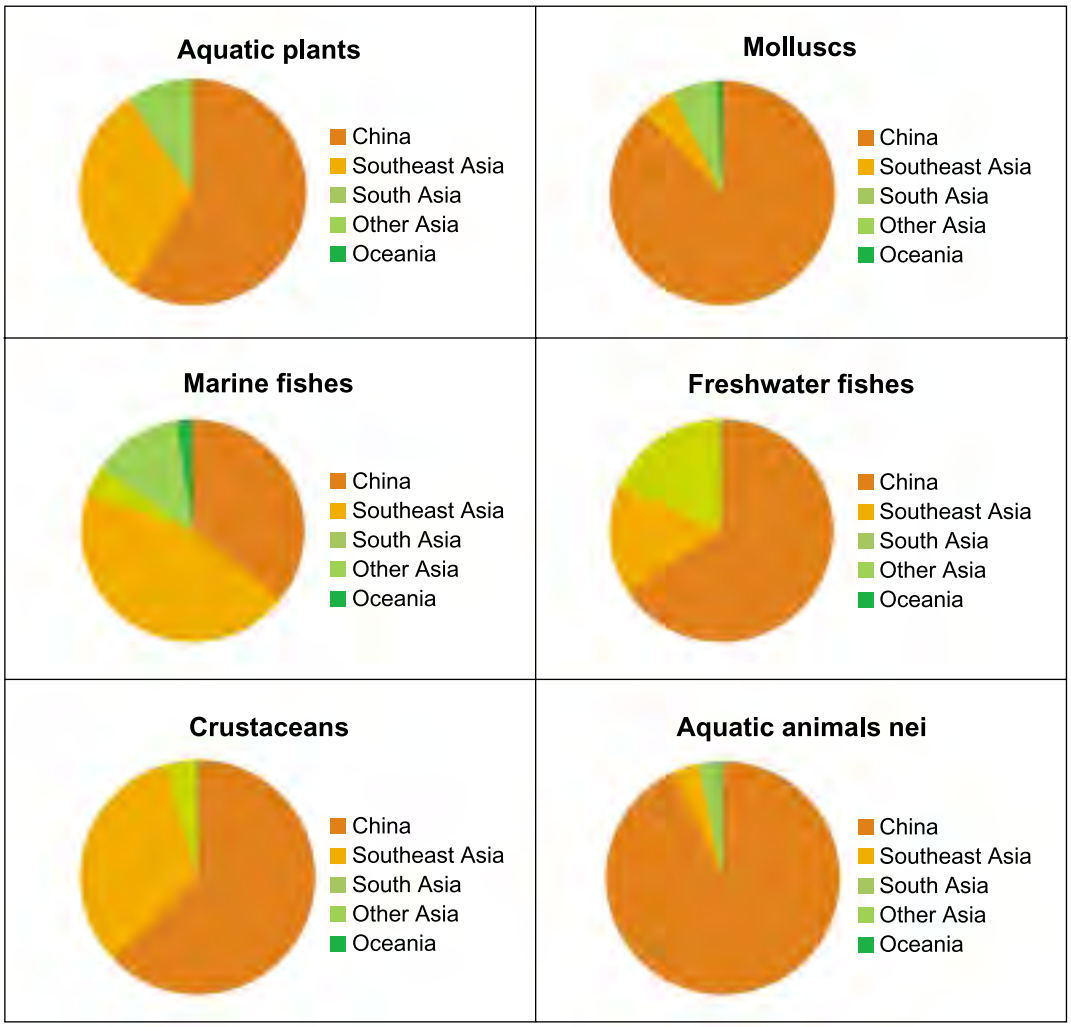


Figure 31 Contribution of Asia-Pacific subregions to major species groups in 2010

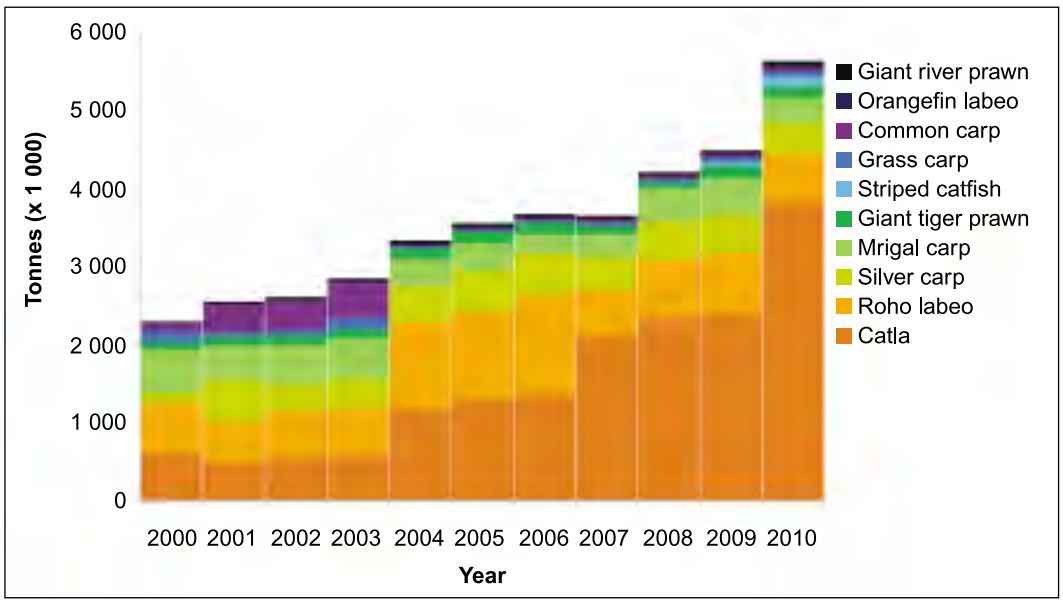


Figure 32 Main cultured species in South Asia subregion 2000–2010

The mainstay of the South Asia subregion has been production of freshwater fish, especially the omnivorous and herbivorous Indian carps. Although growth has not been as rapid as other groups in the region, it has still grown by 9 percent/year in terms of volume and by 16 percent/year in terms of value between 2000 and 2010. Production of freshwater/diadromous finfish in the subregion amounted to 5 786 811 tonnes worth US$10.6 billion at a unit value of US$1.83/kg in 2010.

This increase is probably not heavily dependent on marine sources of feed and therefore a real contribution in terms of food security.

The highest production increase has been seen with the culture of catla (*Catla catla*), which has grown from a production of 0.6 million tonnes in 2000 to 3.8 million tonnes worth US$7.1 billion at a unit value of US$1.86/kg (the highest value of all the carp species) in 2010 (a growth rate of 20 percent/year). All countries in the region now culture this species, but India dominated with 94 percent of the production in 2010.

Rohu carp (*Labeo rohita*) production grew rapidly in the subregion until 2006 (when there was a production of 1.3 million tonnes), but then production declined to 613 436 tonnes worth US$1.1 billion at a unit value of US$1.76/kg in 2010, by which time it was still the second most popular species cultured in the subregion. It was also cultured by all countries, but especially by India and Bangladesh.

Silver carp (*Hypopthalmichthys molitrix*) (an exotic Chinese carp species) production also increased rapidly, by 15 percent/year between 2000 and 2009, and production reached nearly 0.5 million tonnes in 2009. However, this production declined to just 387 259 tonnes worth US$567 million at a unit value of US$1.46/kg in 2010. This decrease was a result of a halving in production of this species in India (the major producer) from 285 602 tonnes in 2009 to 145 931 tonnes in 2010. However, production of this species in the other five states of the subregion continued to increase up to 2010.

There is also substantial production of other carps and barbs in the region, including mrigal carp (*cirrhinus mrigala*) (341 777 tonnes) mostly from India and Bangladesh, grass carp (52 745 tonnes) mostly from Bangladesh and Pakistan, common carp (*Cyprinus carpio*) (51 353 tonnes) mostly from Bangladesh, and orange fin labeo (*Labeo calbasu*) (46 521 tonnes), mostly from Bangladesh in 2010.

The subregion has also started producing *Pangasius spp*. catfish. Bangladesh began reporting the production of striped catfish (*Pangasius hypopthalmus*) in 2009 and by 2010 production reached 125 724 tonnes worth US$135 million at a low unit value of just US$1.08/kg. Although not reported to FAO, there are more recent unverified reports of significant increases in pangasius production in India, perhaps reaching 200 000 tonnes in 2010.

Production of tilapia nei (*Oreochromis spp*.) has also been reported in the region, with a small amount produced in Sri Lanka for sometime. There are also reports of a rapidly rising production since 2009 in Bangladesh with 24 823 tonnes worth US$41 million at a unit value of US$1.65/kg reported in 2010.

Aquatic plants

Although the culture of Aquatic plants has increased very rapidly by 43 percent/year between 2001 and 2010 in the subregion, production remained low at just 18 018 tonnes, worth US$0.2 million at a unit value of just US$0.04/kg in 2010. This accounts for just 0.02 percent of the world production of aquatic plants. The main species produced are the low-value elkhorn seamoss (*Kappaphycus alvarezii*) for biopolymer production and a small quantity of aquatic plants nei, both produced in India.

Molluscs

The culture of molluscs has also increased rapidly by 28 percent/year between 2000 and 2010 in the subregion. However, production remained small at just 4 242 tonnes, worth US$23 million at a unit value of US$1.26/kg in 2010. This accounts for 5 percent of the world production of molluscs. Most mollusc production in the region is of green mussel (*Perna viridis*) and Indian backwater oyster (*Crassostrea madrasensis*). Both are produced mainly in India, and both are relatively low-value species.

Marine finfish

The culture of marine finfish has increased at a relatively high rate of 14 percent/year between 2000 and 2010 in the subregion. However again, production remained small at just 102 245 tonnes, worth US$300 million at a good unit value of US$2.94/kg in 2010. This accounts for just 0.13 percent of the world production of marine fish. The species of marine fish cultured in the subregion are not defined and are classed as marine fish nei. They are produced in both India and Bangladesh at a fairly high unit value in India of US$5.53/kg) and a relatively low unit value of US$1.94/kg) in Bangladesh.

Crustaceans

The culture of crustaceans was larger, but has increased by a slow growth rate of just 2 percent/year between 2000 and 2010 in the subregion. Crustacean production was 226 727 tonnes, worth US$1.3 billion at a high unit value of US$5.87/kg in 2010. This accounts for nearly 4 percent of the world production of crustaceans. Crustacean culture in the region is dominated by production of the giant tiger prawn (*Penaeus monodon*) (mostly from India and Bangladesh), which has a very high value of US$7.32/kg in Bangladesh and US$5.47/kg in India in 2010. There is also some production of giant river prawn (*Macrobrachium rosenbergii*), mostly in Bangladesh and India where this species also fetches a very high unit value of US$8.32/kg in Bangladesh and US$4.11/kg in India in 2010 (all for the export market). India also produced 10 400 tonnes whiteleg shrimp (*Penaeus vannamei*) in 2010, but production is expected to increase very rapidly as India converts more of its shrimp farms from culturing giant tiger prawns to whiteleg shrimp because of their more cost-efficient culture technology. Bangladesh has yet to import whiteleg shrimp, but may do so in the near future because of disease and other problems with culture of other crustacean species. India also produces small quantities of monsoon river prawn (*Macrobrachium malcolmsonii*) and Indian white prawn (*Penaeus indicus*), also at high unit value. Sri Lanka and Pakistan still produce negligible quantities of crustaceans and have yet to import the whiteleg shrimp as so many other Asian countries have done.

In general, and in comparison with the remainder of the Asia-Pacific region, the level of diversification of cultured species is relatively low in this subregion, with little significant change anticipated in the near future.

Trends in Southeast Asia

Aquaculture production in Southeast Asia is highly diversified and in 2010 production of 101 different species (the majority of which were freshwater/diadromous finfish species) was reported, with the production of 17 species exceeding 100 000 tonnes each. The number of cultured species and the details of reporting have increased rapidly in recent years, increasing from 70 in 1996 to 80 in 2003. In terms of 2010 production volume from Southeast Asia, aquatic plants had a 41 percent share, however, the unit value of aquatic plants was low, so they had only an 8 percent share by value. Freshwater/diadromous fish had a 41 percent share by volume, but because of their higher unit value, a 42 percent share by value. Crustaceans had a 12 percent share by volume, but because of their high unit value, a 37 percent share by value. Marine finfish species had a high unit value, accounting for 8 percent by value, and 11 percent by volume. Molluscs again with a low unit value, had a 4 percent share by volume, and only 2 percent by value. Finally, there was minimal production of miscellaneous aquatic animals, accounting for 0.2 percent of the total production by both volume and value (Figures 30, 31 and 33).

Total production from the Southeast Asia subregion was 14 396 466 tonnes worth US$18.1 billion at a unit value of US$1.25/kg, accounting for just over 18 percent of the total world aquaculture production. The overall growth rate was a rapid 15 percent/year in terms of volume and 9 percent/year in terms of value (because of a trend for declining unit price at 5 percent/year) between 2000 and 2010 (Figures 30, 31 and 33). Production from freshwaters (principally freshwater/diadromous finfish) has been a constant 35 percent (and growing by 14 percent/year) of total production from Southeast Asia since records began in 1950, whereas 65 percent (and growing by 15 percent/year) of production (mostly aquatic plants and crustaceans) has been from marine and brackish waters.

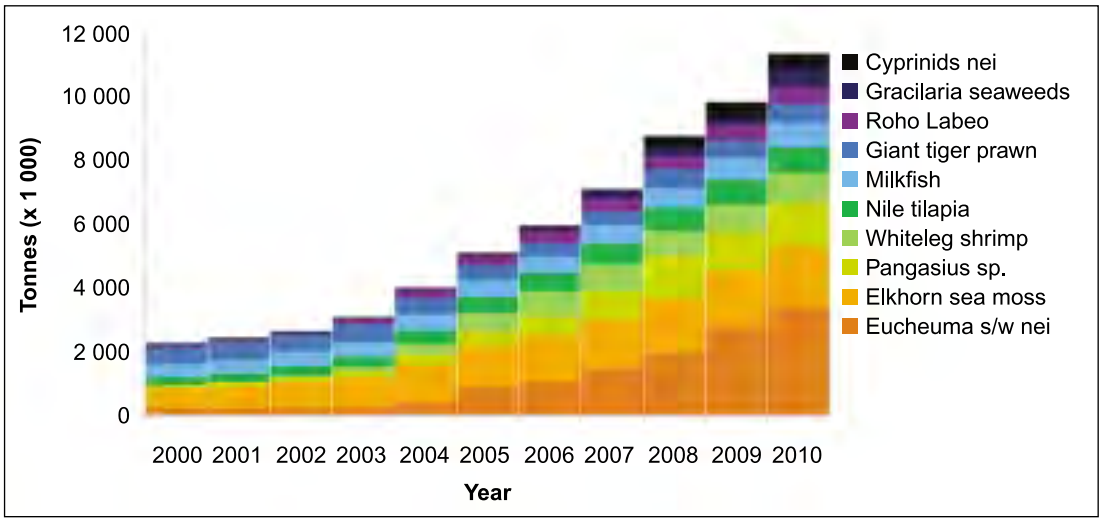


Figure 33 Main cultured species in Southeast Asia subregion 2000–2010

Aquatic plants

Aquatic plant production has the highest volume of any group in Southeast Asia. Total production was 5 960 943 tonnes worth US$1.6 billion at a unit value of US$0.26/kg in 2010. This equates to 31 percent of the total world production of aquatic plants. The growth rate was a very rapid 20 percent/year in terms of volume and 34 percent/year in terms of value because of an increase in unit value of 11 percent/year between 2000 and 2010. The massive growth of aquatic plants in this region reflects the strong promotion and good conditions in the islands of Indonesia (culturing 3.9 million tonnes or 66 percent of the total) and the Philippines (culturing 1.8 million tonnes or 30 percent of the total) in 2010. But it is also partly because of improvement and development of market chains.

In total, five species of aquatic plants are cultured (the top four being low-value species for biopolymer production), but two dominate. The most cultured aquatic plant (with 57 percent of production) and number one species of any group in Southeast Asia is eucheuma seaweeds nei (*Eucheuma cottonii*), with a production of 3 400 936 tonnes worth US$1.1 billion at a unit value of US$0.32/kg. This species in produced mainly in Indonesia, with a small quantity from Timor-Leste. The growth rate has been a very rapid 33 percent/year in terms of volume and an even higher 48 percent/year in terms of value, because of an 11 percent/year increase in unit value (from US$0.11 to 0.32/kg) between 2000 (when it was first reported) and 2010 because of the high demand for this product.

The second most widely cultured aquatic plant (with 31 percent of production) and second species overall in the subregion is the elkhorn sea moss or Zanzibar seaweed (*Kappaphycus alvarezii*), with a production of 1 869 509 tonnes worth US$265 million at a unit value of just US$0.14/kg. Growth has been 11 percent/year between 2000 and 2010.

The third main species is gracilaria seaweeds, amounting to 252 606 tonnes worth US$183 million at a unit value of US$0.33/kg. This species in produced mainly in Indonesia, with some production in Viet Nam and the Philippines. Growth of this species has also been rapid (37 percent/year) between 2000 and 2010.

The fourth main aquatic plant species in the subregion, which is cultured for use in biopolymers, is spiny eucheuma (*Eucheuma denticulatus*), amounting to 133 583 tonnes worth US$7 million at a low unit value of US$0.07/kg. This species is produced in the Philippines and Malaysia. The growth rate of this species has been 15 percent/year between 2000 and 2010.

The final species cultured for food in low quantities is caulerpa seaweeds (*Caulerpa spp.*), produced at 4 309 tonnes worth US$3 million at a unit value of US$0.59/kg in 2010. This species is cultured only in the Philippines, but production has declined by 17 percent/year between 2000 and 2010.

Freshwater/diadromous finfish

Freshwater/diadromous finfish production has the second highest volume of production in the Southeast Asia subregion, but the highest value because of their high unit value. Total production was 4 980 903 tonnes worth US$7.1 billion at a unit value of US$1.42/kg in 2010, accounting for 13 percent of the total world production of freshwater/diadromous finfish, emphasizing the importance of this subregion. The growth rate was a high 14 percent/year in terms of volume but only 10 percent/year in terms of value because of a decrease in unit value of 3 percent/year between 2000 and 2010.

The highest producing countries of freshwater fish in Southeast Asia were Viet Nam with 1 872 000 tonnes or 38 percent, Indonesia (1 332 000 tonnes or 27 percent), Myanmar 770 000 tonnes or 15 percent), Thailand (404 000 tonnes or 8 percent) and Philippines (265 000 tonnes or 5 percent) in 2010.

In total, a highly diverse 42 species of freshwater/diadromous freshwater finfish species are cultured in Southeast Asia, but eight species dominate culture production, with all eight being low-value species, with rapidly increasing production.

Pangasius sp. catfish mostly from Viet Nam are the most produced species, with production amounting to 1 361 224 tonnes worth US$2.1 billion at a unit value of US$1.52/kg in 2010, increasing by 28 percent/year between 2000 and 2010; Nile tilapia (*Oreochromis niloticus*) are produced mainly in Indonesia, Thailand and Philippines with 788 306 tonnes worth US$1.2 billion at a unit value of US$1.52/kg in 2010, increasing by 14 percent/year between 2000 and 2010; the production of rohu (*Labio rohita*) cultured mostly in Myanmar amounted to 553 879 tonnes worth US$502 million at a unit value of US$0.91/kg in 2010, increasing by 19 percent/year between 2000 and 2010; production of cyprinids nei mostly from Viet Nam amounted to 491 314 tonnes worth US$720 million at a unit value of US$1.47/kg in 2010, increasing by 47 percent/year between 2000 and 2010; the production of common carp (*Cyprinus carpio*) amounted to 427 542 tonnes worth US$684 million at a unit value of US$1.60/kg in 2010, increasing by 8 percent/year between 2000 and 2010; the production of torpedo shaped catfish (*Clarias spp.*) amounted to 328 398 tonnes worth US$410 million at a unit value of US$1.25/kg in 2010, increasing by 23 percent/year between 2000 and 2010; and the production of tilapias nei (*Oreochromis spp.)* amounted to 223 992 tonnes worth US$308 million at a unit value of US$1.37/kg in 2010, increasing by 25 percent/year between 2000 and 2010.

Additionally, there were a number of other important freshwater finfish species produced in the subregion such as freshwater fish nei (156 723 tonnes), hybrid catfish (116 875 tonnes), silver barb (90 462 tonnes), giant gourami (60 836 tonnes), catla (52 126 tonnes), milkfish (42 789 tonnes), mrigal carp (36 845 tonnes), eastern pomfred (34 123 tonnes), snakeskin gourami (31 813 tonnes) and nilem carp (21 266 tonnes) in 2010.

Crustaceans

Crustacean production is the third highest by volume in the Southeast Asia subregion (12 percent in 2010), but the second highest by value because of their very high unit value. Total production was 1 680 777 tonnes worth US$7.0 billion at a unit value of US$4.72/kg in 2010. This was 29 percent of the total world production of crustaceans, again emphasizing the importance of this subregion for this group. The growth rate was 10 percent/year in terms of volume but only 6 percent/year in terms of value because of a decrease in unit value of 4 percent/year between 2000 and 2010.

The highest producing countries of crustaceans in Southeast Asia were Thailand with productions of 592 000 tonnes (35 percent), Viet Nam with 488 000 tonnes (29 percent) and Indonesia with 391 000 tonnes (23 percent) in 2010. Malaysia, Philippines and Myanmar also produce significant amounts of crustaceans.

In total, 14 species of crustaceans are cultured in Southeast Asia, but just two high-value species dominate production in the subregion.

The whiteleg shrimp (*Penaeus vannamei*) accounted for 58 percent of the total crustacean production from Southeast Asia in 2010. Production, mainly from Thailand, Indonesia, Viet Nam and Philippines

amounted to 977 408 tonnes worth US$3.6 billion at a unit value of US$3.73/kg in 2010. Growth rate was a very high 39 percent/year between 2002 (when it was first reported in the subregion) and 2010. Production from Thailand has been especially significant, increasing from 60 000 tonnes in 2002 to 561 075 tonnes in 2010 (a growth rate of 32 percent/year). Production in Viet Nam has also grown rapidly by 39 percent/year over the same period. Malaysia and Indonesia started reporting production in 2004 and since then Malaysia has grown by 60 percent/year and Indonesia by 25 percent/year until 2010. This high growth rate and the predominance of this penaeid shrimp species in Southeast Asia has been a result of the replacement of the indigenous giant tiger prawn with this exotic species because of advantages of availability of SPF stocks, improved productivity and hence cost efficiency.

The other major crustacean species cultured in the subregion (34 percent of production) is the giant tiger prawn (*Penaeus monodon*) of which 977 408 tonnes were produced worth US$2.8 billion at a unit value of US$4.92/kg in 2010. As mentioned, culture of this species has been replaced by whiteleg shrimp, hence production has remained fairly static over the past decade, with a 1 percent/year growth rate between 2000 and 2010. However, some countries in the region have dramatically increased production, whereas others have almost totally replaced this species. Examples of the former are Viet Nam, producing 67 486 tonnes in 2000, growing by 17 percent/year to reach a reported (but possibly exaggerated) 333 000 tonnes in 2010. Other countries expanding production include Myanmar (by 25 percent/year), Indonesia (by 3 percent/year) and the Philippines (by 2 percent/year) between 2000 and 2010. In contrast, Thailand has reduced production from a dominant 304 988 tonnes in 2000 by 33 percent/year to just 5 251 tonnes in 2010.

Other important crustacean species cultured in Southeast Asia include giant river prawn (*Macrobrachium rosenbergii*) at 2 percent of production or 38 761 tonnes worth US$178 million at a unit value of US$4.59/kg in 2010. Production was mainly from Thailand, Viet Nam, Myanmar and Malaysia and growth was a high 10 percent/year between 2000 and 2010. *Metapenaeus sp.* shrimp nei were produced amounting to 40 493 tonnes worth US$122 million at a unit value of US$3.02/kg in 2010. Production was mainly from Indonesia, Viet Nam, and Philippines and growth was 7 percent/year between 2000 and 2010. The production of Indo-Pacific swamp crab (*Scylla serratus*) amounted to 24 847 tonnes worth US$120 million at a unit value of US$4.83/kg in 2010. Production was mainly from Philippines and Indonesia and growth was 9 percent/year between 2000 and 2010. The production of banana prawn (*Penaeus merguiensis*) amounted to 19 821 tonnes worth US$76 million at a unit value of US$3.84/kg in 2010. Production was mainly from Indonesia and production contracted by -9 percent/year between 2000 and 2010. In addition, 1 600 tonnes of the very high-value tropical spiny lobster (*Panulirus spp.*), were produced with a value of US$16 million at US$9.97/kg in 2010. Production was mainly from Viet Nam in offshore cages, relying on wild-caught juveniles and growth was a very high 50 percent/year between 2000 and 2010.

Marine finfish

Marine finfish production accounted for 8 percent of the aquaculture production from Southeast Asia in 2010. Total production was 1 105 194 tonnes worth US$2.0 billion at a unit value of US$1.80/kg in 2010. This was 60 percent of the total world production of marine finfish, again emphasizing the importance of this subregion for this group. The growth rate was 8 percent/year in terms of volume and 9 percent/year in terms of value between 2000 and 2010.

The highest producing countries of marine finfish in Southeast Asia were Indonesia with 586 000 tonnes (53 percent), Philippines with 323 000 tonnes (29 percent) and Viet Nam with 137 000 tonnes (12 percent) in 2010. Malaysia and Thailand also have significant production of marine fish species.

In total, 26 species of crustaceans are cultured in Southeast Asia, but six species (both low-value and high-value) dominate production in the subregion.

Milkfish (*Chanos chanos*) were by far the most cultured species in Southeast Asia, accounting for 66 percent of the total. These are grown mostly in Indonesia and the Philippines, but with some production also from Singapore and Timor-Leste. Production was 730 028 tonnes worth US$1.1 billion at a unit value of US$1.47/kg in 2010, growing by 6 percent/year between 2000 and 2010.

There was considerable production of freshwater fish nei grown in brackish waters (probably tilapia species), accounting for 17 percent of the total, mostly from Indonesia, Malaysia and Viet Nam. The production of these fish amounted to 185 971 tonnes worth US$257 million at a unit value of US$1.38/kg in 2010. The growth rate was a rapid 27 percent/year between 2000 and 2010.

Marine fish nei was the third most important group (5 percent of total), produced mainly from Indonesia, with some also grown in Malaysia and Viet Nam. Production was 57 880 tonnes worth US$97 million at a unit value of US$1.67/kg in 2010. The growth rate was an impressive 39 percent/year between 2000 and 2010, but this resulted almost entirely from a sudden (perhaps exaggerated) increase in the reported production of these fish in Indonesia in 2010.

Barramundi (*Lates calcarifer*) were produced in brackish waters mostly in Thailand, but also in Malaysia and Indonesia and smaller amounts in most countries in the region. Production was 39 936 tonnes worth US$166 million at a high unit value of US$4.16/kg in 2010. The growth rate was 9 percent/year between 2000 and 2010.

Groupers of various species (*Epinephelus spp*.) were produced from many countries including from both marine and brackish waters. Production was 32 420 tonnes worth US$254 million at a very high unit value of US$7.83/kg in 2010. The growth rate was a rapid 17 percent/year between 2000 and 2010 to satisfy the growing demand and increasing value of these species in the high-value regional markets of Hong Kong SAR, Singapore and China.

Tilapia spp. including Nile, Mozambique and tilapias nei were grown in brackish water throughout Southeast Asia, but mostly in Indonesia and the Philippines. Total production amounted to 49 754 tonnes worth US$79 million at a unit value of US$1.58/kg in 2010. The growth rate was 4 percent/year between 2000 and 2010.

Molluscs

Mollusc production in Southeast Asia amounted to 637 451 tonnes worth US$347 million at a low unit value of US$0.54/kg in 2010. This was just 4 percent of the total aquaculture production for the subregion and accounted for 4 percent of the total world production of molluscs.

Thailand was the most important country (271 000 tonnes or 42 percent of the total) for the production of molluscs in the subregion, followed by Viet Nam (174 000 tonnes or 27 percent), Malaysia (89 000 tonnes or 14 percent), India (58 000 tonnes or 9 percent) and the Philippines (43 000 tonnes or 7 percent) in 2010.

Just nine species of molluscs were produced in the region, with nearly all being marine and only one being freshwater species. There were three main species, all low-value, which included green mussel (*Perna viridis*) mostly produced in Thailand, plus some in Philippines and Malaysia at 31 percent of the total molluscs. Production was 199 598 tonnes worth US$19 million at a low unit value of US$0.09/kg in 2010. The growth rate was 5 percent/year between 2000 and 2010. Marine molluscs nei were produced in Viet Nam amounting to 26 percent of the total. Production was 165 000 tonnes worth US$19 million at a low unit value of US$0.11/kg in 2010. Growth was 15 percent/year between 2000 and 2010. Blood cockle (*Anadara granosa*) were produced in Malaysia and Thailand amounting to 24 percent of the total. Production was 154 336 tonnes worth US$19 million at a low unit value of US$0.12/kg in 2010. The growth rate was 15 percent/year between 2000 and 2010.

In addition there were three other higher value species cultured at lower levels in the subregion, including penguin wing oyster (*Pteria penguin*) from Indonesia (58 079 tonnes at a unit value of US$0.32/kg), cupped oysters nei (*Crassostrea spp.*) from Thailand (28 902 tonnes at US$0.65/kg) and slipper cupped oyster (*Crassostrea iredalei*) from Philippines (22 525 tonnes at US$0.85/kg).

Niche (aquatic animals nei) **species**

There was some limited production of niche (aquatic animals nei) species in the Southeast Asia subregion. Total production was 31 073 tonnes worth US$48 million at a unit value of US$1.55/kg in

2010. This made up just 0.22 percent of the subregion's total aquaculture production and only 4 percent of the world production of these niche species. The growth rate however, was a high 36 percent/year in terms of volume, and 21 percent/year in terms of value because of a decrease in unit value of 11 percent/year between 2000 and 2010.

Altogether, there were five niche species produced in the subregion, but three species dominated production: first was aquatic animals nei (88 percent of the total) from marine waters in Myanmar, with production amounting to 27 349 tonnes worth US$27 million at a unit value of US$1.00/kg in 2010, with a very high growth rate over the three years that they have been reported; second was soft-shell turtle (*Trionyx sinensis*) from freshwaters in Thailand, with a production amounting to 1 950 tonnes worth US$12 million at a high unit value of US$16.00/kg in 2010, with a very high growth rate of 18 percent/year between 2000 and 2010; and third frogs (*Rana spp.*) produced in freshwaters in the Philippines, plus Cambodia, Lao PDR and Indonesia at 1 268 tonnes worth US$2 million at a unit value of US$1.86/kg in 2010, growing at just 2 percent/year between 2000 and 2010.

Additional minor culture of sea cucumbers nei (476 tonnes from Indonesia) and sand fish (30 tonnes from Viet Nam) was reported in 2010.

China

Chinese aquaculture has dominated world aquaculture production since records began in 1950 and for many years before that, as China has to be considered as one of the originators of aquaculture. Production is not only higher than any other country in the world, it is also more diverse, with China reporting the culture of 112 species in 2010. The species diversification has been oriented towards high-value species and both indigenous and exotic species newly developed for aquaculture.

Aquaculture production growth from China has been maintained at a steady 5 percent/year in terms of volume between 2000 and 2010. China's aquaculture in 2000 was 29 million tonnes worth US$24 billion at a unit value of just US$0.81/kg. However, by 2010, this had increased by nearly 20 million tonnes to 48 million tonnes worth US$63 billion at a higher unit value of US$1.30/kg in 2010 (Figure 34).

This production comprised 61 percent by volume and 50 percent by value of the total world aquaculture production of 79 million tonnes worth US$125 billion in 2010 (including aquatic plants).

Production by volume in China was split almost evenly between marine and brackish water (51 percent) and freshwater (49 percent) in 2010. However, largely as a result of the high production of low-value aquatic plants in the marine environment, total value was higher for freshwater culture US$44 billion at a unit value of US$1.84 in 2010), compared to marine and brackish water culture (US$19 billion at a unit value of US$0.78/kg in 2010). Furthermore, the unit value of freshwater species produced in China increased by 6 percent/year, compared to an increase of just 2 percent/year for marine and brackish water species between 2000 and 2010. This rapid growth in the value of inland culture has occurred mainly because of the increased production of high-value finfish and crustacean species. These increases are being achieved through the intensification of existing systems rather than any significant increase in production area.

Freshwater and diadromous finfish

The group of species most important to China is freshwater and diadromous finfish species. These species, particularly Chinese carps, have long formed the backbone of Chinese aquaculture and serve as a cheap protein source for China's expanding population.

Total production within this group amounted to 20.1 million tonnes worth US$29.7 billion at a unit value of US$1.43/kg in 2010, up from 12.9 million tonnes worth US$11.6 billion in 2000. Growth rates in production were 5 percent/year by volume, but 10 percent/year by value, because of unit value increasing by 5 percent/year between 2000 and 2010. This production makes up 43 percent of China's aquaculture production by volume and comprises 56 percent of the worlds' production of freshwater and diadromous finfish.

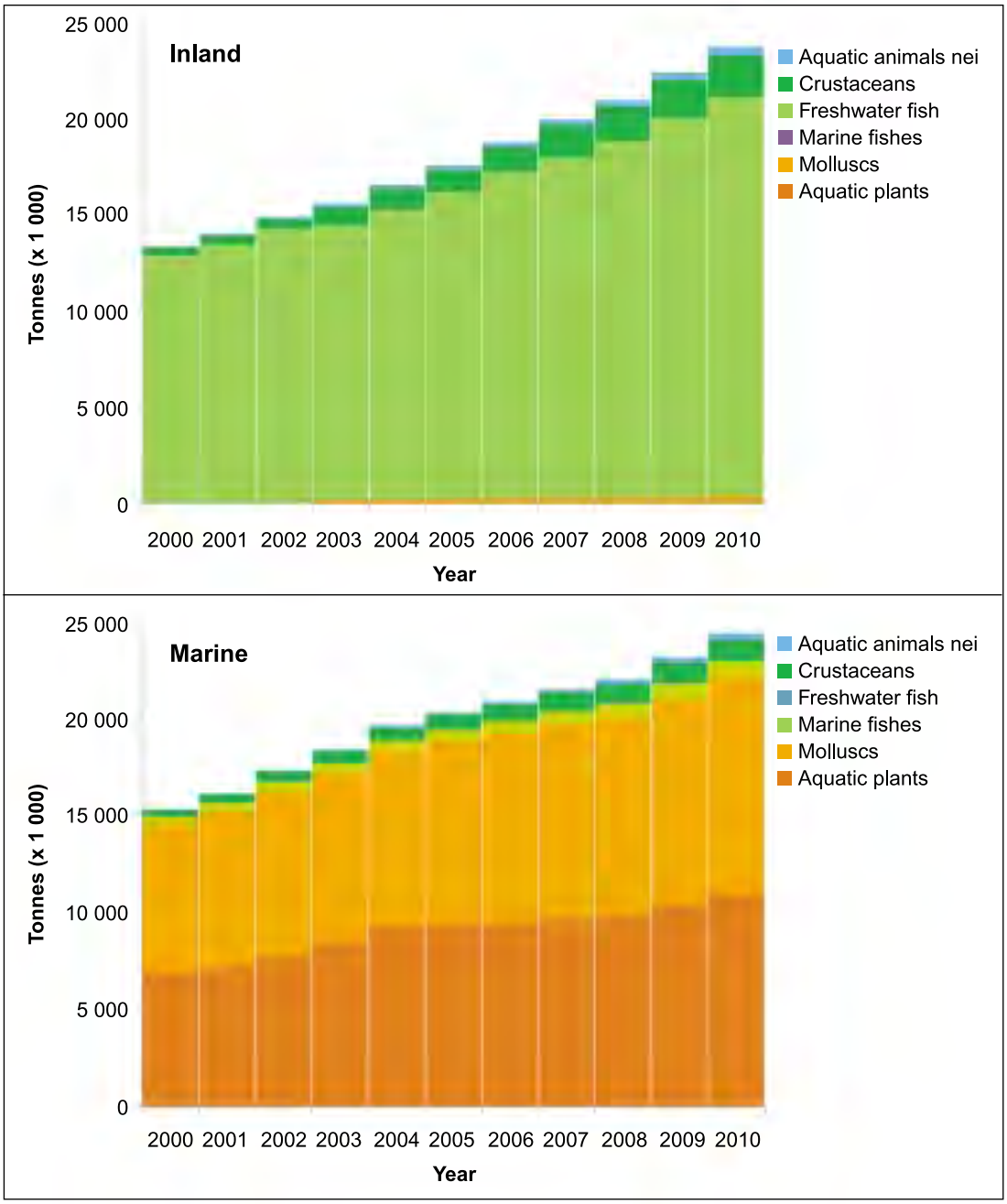


Figure 34 Trends in aquaculture production in China subregion by environment 2000–2010

China reported culture of 35 different species of freshwater/diadromous finfish in 2010. Of these, 19 species have a production of over 100 000 tonnes/year. Lower-value herbivorous and omnivorous species dominate production (19.4 million tonnes or 93 percent in 2010, growing at 4 percent/year between 2000 and 2010), of which carps and barbs are the most important group, but other groups having large productions include tilapia and catfish. However, there are some important groups of carnivorous species including eels, perch-like fish and snakeheads, with total production of carnivorous species amounting to 1.4 million tonnes (just 7 percent of total freshwater fish production) in 2010, but growing by 18 percent/year between 2000 and 2010. This is a result of the increasing demand within China for these higher-value fish species.

Chinese production of carps and barbs has increased from 10.8 million tonnes in 2000 to 16.2 million tonnes in 2010 at a modest growth rate of 4 percent/year. This still accounts for 79 percent of all freshwater fish species grown in China and 34 percent of China's total aquaculture production. Carp

will remain a major source of fish products for consumers of different income classes in China in the foreseeable future. However, these percentages have slipped by 1 percent/year from those of 2000 (84 percent and 38 percent respectively), as market diversification has resulted in rapid increases in production of new species in the country.

The top five species of freshwater fish (and five of the top ten of all species) grown in China are carps (Figure 35). Each of these species had productions in excess of 2 million tonnes in 2010.

- Grass carp or white amur (*Ctenopharyngodon idellus*) was the top species (with 20 percent of freshwater fish production), amounting 4.2 million tonnes worth US$5.3 billion at a unit value of US$1.26/kg in 2010. The growth rate was a modest 4 percent/year between 2000 and 2010.
- Silver carp (*Hypopthalmichthys molitirx*) was second (with 17 percent), with a production of 4.2 million tonnes worth US$5.3 billion at a unit value of US$1.26/kg in 2010. The growth rate was a modest 4 percent/year between 2000 and 2010.
- Bighead carp (*Hypopthalmichthys nobilis*) was third (with 12 percent), with a production of 2.6 million tonnes worth US$3.3 billion at a unit value of US$1.28/kg in 2010. The growth rate was 6 percent/year between 2000 and 2010.
- Common carp (*Cyprinus carpio*) was fourth (with 12 percent), with a production of 2.5 million tonnes worth US$2.9 billion at a unit value of US$1.14/kg in 2010. The growth rate was a modest 3 percent/year between 2000 and 2010.
- Fifth (with 11 percent) was the crucian carp (*Carassius carassius*), with a production of 2.2 million tonnes worth US$2.4 billion at a unit value of US$1.09/kg in 2010. The growth rate was 6 percent/year between 2000 and 2010.

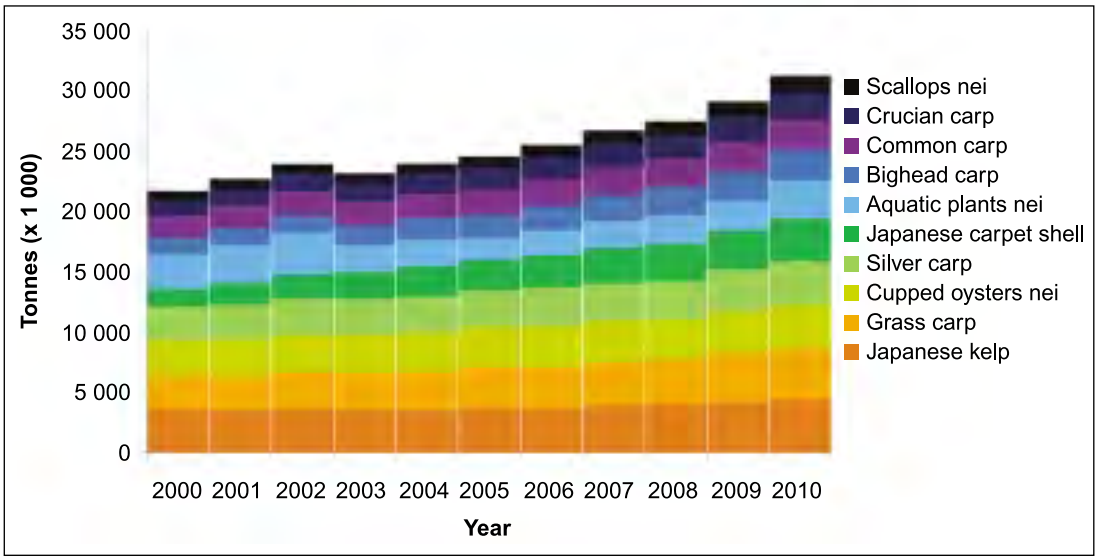


Figure 35 Trends in main cultured species in China subregion 2000–2010 (aquatic plants and molluscs included)

Other important species of freshwater fish cultured in China included the Nile tilapia (*Oreochromis nilioticus*), with a production of 1.0 million tonnes worth US$1.5 billion at a unit value of US$1.49/kg in 2010. The growth rate was a modest 5 percent/year between 2000 and 2010. Wuchang bream (*Megalobrama amblycephala*) had a production of 0.6 million tonnes worth US$1.1 billion at a unit value of US$1.65/kg in 2010 with the growth rate a modest 4 percent/year between 2000 and 2010. Freshwater fish nei had a production of 0.6 million tonnes worth US$772 million at a unit value of US$1.22/kg in 2010 and the growth rate was 7 percent/year between 2003 and 2010. Black carp (*Mylopharyngodon piceus*) had a production of 0.4 million tonnes worth US$985 million at a unit value of US$2.32/kg in 2010 and a growth rate of 11 percent/year for this higher-value carp species between 2000 and 2010.

Snakehead (*Channa argus*) had a production of 0.4 million tonnes worth US$459 million at a unit value of US$1.22/kg in 2010 and a growth rate of 14 percent/year between 2003 and 2010. Amur catfish (*Silurus asotus*) had a production of 0.4 million tonnes worth US$488 million at a unit value of US$1.30/kg in 2010 and a growthrate of 11 percent/year between 2000 and 2010. Blue-Nile tilapia hybrid (*Oreochromis aureus x O. niloticus*) had a production of 0.3 million tonnes worth US$496 million at a unit value of US$1.49/kg in 2010 and a growth rate of 6 percent/year between 2003 and 2010.

Other freshwater fish species whose culture is expanding rapidly (by 8 to 28 percent/year between 2003 and 2010) and whose production exceeded 100 000 tonnes/year in 2010 included: the Asian swamp eel (*Monopterus albus*) (272 939 tonnes), mandarin fish (*Siniperca chuatsi*) (252 622 tonnes), Japanese eel (*Anguilla japonica*) (233 128 tonnes), channel catfish (*Ictalurus punctatus*) (217 303 tonnes), pond loach (*Misgurnus anguillicaudatus*) (204 690 tonnes), yellow catfish (*Pelteobagrus fulvidracvo*) (184 281 tonnes), and largemouth black bass (*Micopterus salmoides*) (174 471 tonnes).

Of these popular freshwater and diadromous species, only three are high-value carnivorous species, namely the mandarin fish (at US$9.31/kg in 2010), the Asian swamp eel (at US$2.61/kg in 2010) and the Japanese eel (at US$2.51/kg in 2010). All of the rest, including all of the major cultured freshwater fish species were low-value omnivorous/herbivorous species at a unit value of US$1.09 to 1.65/kg (except the black carp which was valued at US$2.32/kg) in 2010 (Figure 36).

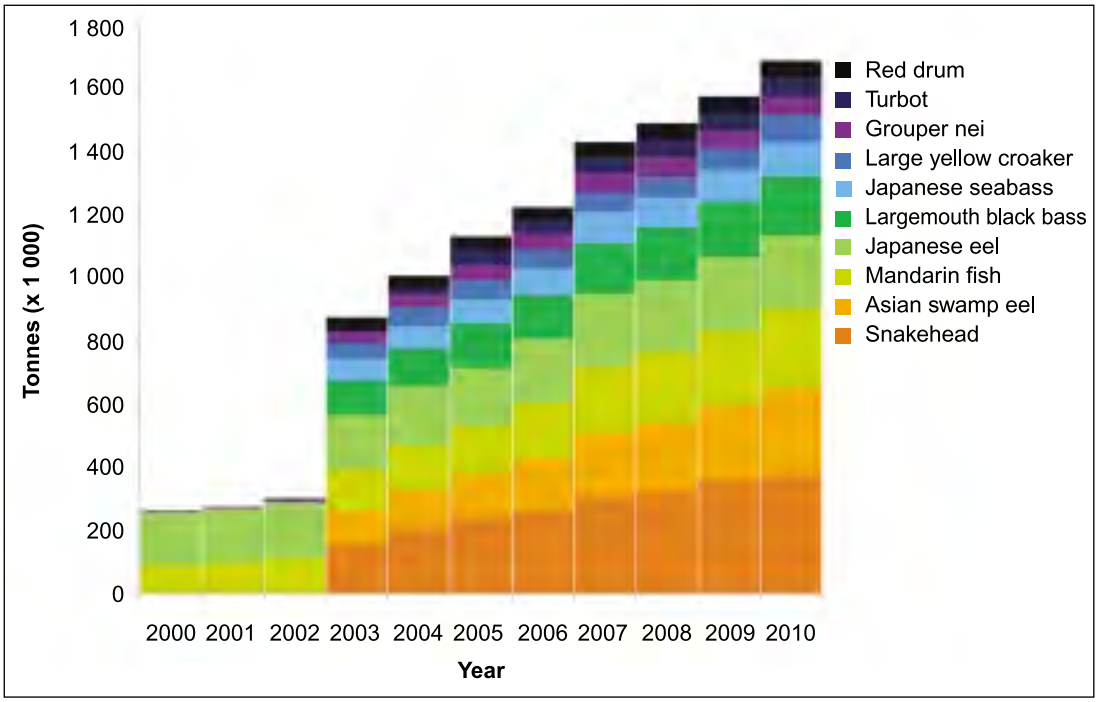


Figure 36 Main carnivorous finfish species cultured in China subregion 2000–2010

Molluscs

Molluscs were the next most cultured group in China, with a total production of 11.4 million tonnes worth US$9.7 billion at a unit value of US$0.85/kg in 2010. The growth rates were 4 percent/year in terms of volume and 5 percent/year in terms of value as unit value increased by 2 percent/year between 2003 and 2010. Mollusc production made up 24 percent of China's total aquaculture production in 2010, and amounted to 80 percent of total world mollusc production, underlining the importance of China in global mollusc production (Figures 30, 31, 34 and 35).

Most mollusc production in China (98 percent in 2010) is carried out in brackish and marine environments, where 14 out of a total of 19 species are cultured. A total production of 11.2 million tonnes worth US$9.5 billion at a unit value of US$0.85/kg was recorded in 2010. The growth rates for marine mollusc

production have been 4 percent/year in terms of volume and 5 percent/year in terms of value as a result of an increase in unit value of 2 percent/year between 2003 and 2010. There is a growing production of molluscs in the freshwater environment also, where five species are cultured with a total production of 264 770 tonnes worth US$223 million at a unit value of US$0.84/kg in 2010. The growth rates for freshwater mollusc production have been 7 percent/year in terms of volume and 14 percent/year in terms of value because of an increase in unit value of 7 percent/year between 2003 and 2010.

The two top species (each with 32 percent of Chinese mollusc production and at positions three and five of the most cultured species in China) were cupped oysters nei (*Crassostrea spp.*), with a production of 3.6 million tonnes worth US$2.1 billion at a unit value of US$0.59/kg in 2010. The growth rate was a modest 2 percent/year between 2000 and 2010. The Japanese carpet shell (*Ruditapes philippinarum*) had a production of 3.5 million tonnes worth US$3.1 billion at a unit value of US$0.89/kg in 2010. The growth rate was a rapid 10 percent/year between 2000 and 2010 (Figure 35). Mollusc production is also difficult to intensify and this increased production suggests the development of new production areas.

Other important mollusc species included scallops nei (*Pectinidae*), with a production of 1.4 million tonnes worth US$2.0 billion at a high unit value of US$1.42/kg in 2010 and a growth rate of 6 percent/year between 2000 and 2010. The production of constricted tagulus (*Sinonovacula constricta*), amounted to 0.7 million tonnes worth US$643 million at a unit value of US$0.90/kg in 2010. The growth rate was a modest 4 percent/year between 2000 and 2010. Sea mussels nei (*Mytilidae*) production amounted to 0.7 million tonnes worth US$183 million at a unit value of US$0.26/kg in 2010 and a growth rate of only 4 percent/year between 2000 and 2010. Marine molluscs nei (*Mollusca*) production was 0.5 million tonnes worth US$264 million at a unit value of US$0.56/kg in 2010. The growth rate was -6 percent/year between 2003 and 2010 as these were reclassified as other species from 2003 onwards. Blood cockle (*Anadara granosa*) production was 0.3 million tonnes worth US$310 million at a high unit value of US$1.36/kg in 2010. The growth rate was 6 percent/year between 2000 and 2010. Sea snails (*Rapana spp.*) production amounted to 0.2 million tonnes worth US$127 million at a unit value of US$0.61/kg in 2010 and the growth rate was 6 percent/year between 2003 and 2010.

Aquatic plants

Aquatic plants were the next most cultured group in China, with a total production of 11 million tonnes worth US$2.5 billion at a low unit value of US$0.23/kg in 2010. The growth rates were 5 percent/year in terms of volume and 7 percent/year in terms of value as unit value increased by 2 percent/year between 2000 and 2010. Aquatic plant production made up 23 percent of China's total aquaculture production in 2010, and amounted to 58 percent of total world aquatic plant production, underlining the importance of China in global aquatic plant production (Figures 30, 31, 34 and 35).

Most aquatic plant production in China (99 percent in 2010) is carried out in brackish and marine environments, where 9 out of a total of 11 species are cultured. A total production of 11 million tonnes worth US$2.5 billion at a unit value of US$0.23/kg was recorded in 2010. Growth rates for marine aquatic plant production have been 4 percent/year in terms of volume and 5 percent/year in terms of value because of an increase in unit value of 1 percent/year between 2003 and 2010. There is a growing production of aquatic plants in the freshwater environment also, where two species are cultured amounting to a total production of 97 060 tonnes worth US$49 million at a relatively high unit value of US$0.50/kg in 2010. The growth rates for freshwater aquatic plant production have been 10 percent/year in terms of volume and 14 percent/year in terms of value because of an increase in unit value of 3 percent/year between 2003 and 2010. Most aquatic plants cultured in China are destined for human food use, with limited production of plants for biopolymers.

By far the most important species (with 40 percent of Chinese aquatic plant production and the single species with the highest volume of production in China) was Japanese kelp (*Laminaria japonica*) for food use, with a production of 4.4 million tonnes but worth only US$78 000 at an extremely low unit value of US$0.02/kg in 2010. The growth rate was a modest 2 percent/year between 2000 and 2010 (Figure 35).

Other important aquatic plant species included aquatic plants nei, with a production figure of 3.1 million tonnes worth US$1.4 billion at a unit value of US$0.46/kg in 2010 and a growth rate of 5 percent/year between 2003 and 2010. However, these plants were reported at far greater levels prior to 2003 when most of this production was re-ascribed to other aquatic plant species (Figure 34). Warty gracilaria (*Gracilaria verrucosa*) production (for biopolymer use) was 1.2 million tonnes worth US$342 million at a unit value of US$0.30/kg in 2010 and a growth rate of 14 percent/year between 2003 and 2010. Wakame (*Undaria pinnatifida*) production amounted to 1.1 million tonnes worth US$502 million at a unit value of US$0.46/kg in 2010 with a negative growth rate of -5 percent/year between 2003 and 2010. Nori nei (*Porphyra spp.*) production was 1.1 million tonnes worth only US$63 million at a very low unit value of US$0.06/kg in 2010. The growth rate was a rapid 10 percent/year between 2003 and 2010. *Spirulina spp.* from freshwaters had a production figure of 96 910 tonnes worth US$48 million at a unit value of US$0.50/kg in 2010. The growth rate was a very high 29 percent/year between 2003 and 2010. Fusiform sargassum (*Sargassum fusiforme*) production (for biopolymer use) amounted to 78 210 tonnes worth US$36 million at a unit value of US$0.46/kg in 2010. There was no growth between 2003 and 2010 Lastly, eucheuma seaweeds nei (*Eucheuma spp.*) production (for biopolymer use) was 64 260 tonnes worth US$30 million at a unit value of US$0.46/kg in 2010. There was no growth between 2003 and 2010.

Crustaceans

Crustaceans were the next most cultured group in China, with a total production of 3.2 million tonnes worth US$15.6 billion at a high unit value of US$4.87/kg in 2010. The growth rates were the highest of all main groups in China at 17 percent/year in terms of volume and value and unit value increased by 1 percent/year between 2000 and 2010. Crustacean production made up 7 percent of China's total aquaculture production in 2010, and amounted to 56 percent of total world crustacean production, again emphasizing the importance of China in global crustacean production (Figures 30, 31 and 34).

Most crustacean production in China (67 percent in 2010) is carried out in the freshwater environment, where 9 out of a total of 16 species are cultured. A total production figure of 2.1 million tonnes worth US$11.7 billion at a high unit value of US$5.45/kg was recorded in 2010. The growth rates for freshwater crustacean production have been very high with 19 percent/year in terms of volume and 22 percent/year in terms of value as a result of an increase in unit value of 3 percent/year between 2000 and 2010. There is also significant production of crustaceans in the marine environment, where 11 species are cultured giving a total production figure of 1.1 million tonnes worth US$3.9 billion at a lower unit value of US$3.70/kg in 2010. The growth rates for marine crustacean production were 13 percent/year in terms of volume and just 9 percent/year in terms of value because of a decrease in the unit value of -4 percent/year between 2000 and 2010.

The most important crustacean species (accounting for 38 percent of Chinese crustacean production) was the whiteleg shrimp (*Penaeus vannamei*), which is an exotic species that was first recorded in 2000 in Taiwan POC and in 2001 in mainland China. From zero in 2000, production reached 1.2 million tonnes worth a substantial US$5.4 billion at a high unit value of US$4.41/kg in 2010. The growth rate was a staggering 87 percent/year between 2000 and 2003, but slowed to a relatively lower, but still substantial 13 percent/year between 2003 and 2010. However, as mentioned in the section on crustaceans, a new disease, AHPNS, has been negatively affecting production of this species in China since 2010, so recent production is likely to be reduced from the levels recorded in 2010.

Interestingly, the culture of this species is carried out almost equally in fresh and marine/brackish waters in China, unlike in the other major producing subregion, Southeast Asia, where it is nearly all conducted in marine and brackish waters. In China, production from freshwater reached 619 017 tonnes worth 3.1 billion at a high unit value of US$4.97/kg in 2010, whereas production from marine waters reached 612 232 tonnes worth US$2.4 billion at a relatively low US$3.84/kg in 2010. Hence the whiteleg shrimp produced in freshwater had a substantially higher value than those cultured in marine waters.

Other important crustacean species included Chinese mitten crab (*Eriochir sinensis*) grown in freshwaters, with a production of 593 296 tonnes worth US$4.1 billion at a very high unit value of US$6.96/kg in 2010. The growth rate was 11 percent/year between 2000 and 2010. The exotic freshwater red swamp

crawfish (*Procambarus clarkii*) production amounted to 563 281 tonnes worth US$2.7 billion at a high unit value of US$4.76/kg in 2010. The growth rate was 44 percent/year between 2003 and 2010. The freshwater oriental river prawn (*Macrobrachium nipponense*) production amounted to 225 645 tonnes worth US$1.1 billion at a high unit value of US$4.76/kg in 2010 and a growth rate of 4 percent/year between 2003 and 2010. The freshwater giant river prawn (*Macrobrachium rosenbergii*) production was 131 521 tonnes worth US$664 million at a high unit value of US$5.05/kg in 2010 and a growth rate of 4 percent/year between 2003 and 2010. The Indo-Pacific swamp crab (*Scylla serrata*), cultured in marine waters, had a production amounting to 116 054 tonnes worth US$276 million at a low unit value of US$2.38/kg in 2010. The growth rate was a modest 4 percent/year between 2000 and 2010. Swimming crabs nei (*Portunidae*) grown in marine waters had a production figure of 91 050 tonnes worth US$320 million at a unit value of US$3.51/kg in 2010. The growth rate was 7 percent/year between 2003 and 2010. The production of penaeid shrimp nei (*Penaeidae*) grown in marine waters amounted to 68 003 tonnes worth US$272 million at a unit value of US$4.00/kg in 2010 and a growth rate of 15 percent/year between 2003 and 2010. The production of giant tiger prawn (*Penaeus monodon*), cultured in marine waters, had a of was 57 276 tonnes worth US$233 million at a unit value of US$4.06/kg in 2010. The growth rate was a modest 3 percent/year between 2003 and 2010. Kuruma prawn (*Penaeus japonicus*) grown in marine waters, had a production figure of 54 964 tonnes worth US$222 million at a unit value of US$4.04/kg in 2010. The growth rate was a low 2 percent/year between 2003 and 2010.

Marine finfish

Marine finfish production in China totalled 869 663 tonnes worth US$2.3 billion at a unit value of US$2.68/kg in 2010. The growth rates were good at 8 percent/year in terms of volume, but a very high 20 percent/year in terms of value as unit value increased rapidly by 11 percent/year between 2000 and 2010. This was largely because of increased culture of the higher value marine finfish species over recent years. Carnivorous marine fish production accounted for 63 percent of total marine fish production in China in 2010 with 547 651 tonnes, growing at 8 percent/year between 2003 and 2010. In comparison, herbivorous and omnivorous marine fish production amounted to 322 012 tonnes, growing at just 6 percent/year between 2003 and 2010. Marine finfish production made up less than 2 percent of China's total aquaculture production in 2010, but still amounted to 47 percent of total world marine fish production, again indicating the importance of China in global finfish production (Figures 30, 31, 34 and 36).

The most important marine finfish species (with 33 percent of Chinese production) was actually a group called marine fish nei. These were reported as amounting to 494 518 tonnes in 2002, but then reduced to 167 606 tonnes in 2003 as Chinese authorities reclassified many to species level. However, since then the reported production has increased by 8 percent/year to 287 768 tonnes worth US$583 million at a unit value of US$2.03/kg in 2010.

Other important marine finfish species were often higher value carnivorous species and included the carnivorous Japanese seabass (*Lateolabrax japonicus*) with a production figure of 105 951 tonnes worth US$127 million at a low unit value of US$1.20/kg in 2010. The growth rate was 6 percent/year between 2003 and 2010. The large yellow croaker (*Larimichthys croceus*) an omnivorous species, had a production of 85 809 tonnes worth US$102 million at a low unit value of US$1.19/kg in 2010. Its growth rate was 8 percent/year between 2003 and 2010. The production of carnivorous groupers nei (*Epinephelus spp.*) amounted to 60 714 tonnes worth US$173 million at a high unit value of US$2.84/kg in 2010. The growth rate was 8 percent/year between 2003 and 2010. The production of carnivorous turbot (*Psetta maxima*) reached 60 000 tonnes worth US$443 million at a very high unit value of US$7.39/kg in 2010. The growth rate in this case was an extremely high 43 percent/year between 2003 and 2010. The production of exotic and carnivorous red drum (*Sciaenops ocellatus*) amounted to 52 243 tonnes worth US$62 million at a low unit value of US$1.19/kg in 2010. The growth rate was 6 percent/year between 2000 and 2010. The production of carnivorous porgies/seabass nei. (*Sparidae*) amounted to 45 550 tonnes worth US$57 million at a low unit value of US$1.25/kg in 2010. The growth rate was 5 percent/year between 2003 and 2010. The carnivorous Cobia (*Rachycentron canadum*) production was 38 508 tonnes worth US$65 million at a unit value of US$1.70/kg in 2010 and its growth rate was 11 percent/year between 2003 and 2010. The production of carnivorous lefteye flounders nei (*Bothidae*) amounted to 24 978 tonnes worth US$30 million at a low unit value of US$1.19/kg in 2010. It had a negative growth rate of -1 percent/year between 2003 and 2010. The production of carnivorous snubnose pompano (*Trachinotus blochii*

was 14 074 tonnes worth US$529 million at an extremely high unit value of US$21.96/kg in 2010. The growth rate was 17 percent/year between 2007 and 2010.

Aquatic animals nei

The final group, aquatic animals nei, had a total production of 754 561 tonnes worth US$2.9 billion at a high unit value of US$3.88/kg in 2010. The growth rates were high at 14 percent/year in terms of volume and 17 percent/year in terms of value as unit value increased by 2 percent/year between 2000 and 2010. Aquatic animal nei production made up less than 2 percent of China's total aquaculture production in 2010, but contributed 93 percent of total world aquatic animal nei production, again emphasizing the importance of China in global aquaculture production (Figures 30, 31 and 34).

The production of aquatic animals nei in China is split between culture in freshwater (56 percent in 2010) and marine (44 percent in 2010) environments. There are five out of eight species cultured in freshwater, with total production reaching 424 479 tonnes worth US$2.0 billion at a high unit value of US$4.71/kg in 2010. The growth rates for freshwater aquatic animals nei production were a high 11 percent/year in terms of volume and 15 percent/year in terms of value because of an increase in unit value of 3 percent/year between 2003 and 2010. There was also significant production of aquatic animals nei in the marine environment, where four out of eight species were cultured with a total production of 330 082 tonnes worth US$0.9 billion at a lower unit value of US$2.80/kg in 2010. The growth rates for marine aquatic animals nei production were an even higher 18 percent/year in terms of volume and 21 percent/year in terms of value as a result of an increase in the unit value of 2 percent/year between 2003 and 2010.

There were five main species of aquatic animals nei produced in China in 2010. First, the soft-shell turtle (*Trionyx sinensis*) grown in freshwaters, which had a production figure of 267 900 tonnes worth US$1.4 billion at a high unit value of US$5.19/kg in 2010. The growth rate was 12 percent/year between 2000 and 2010. Second, aquatic invertebrates nei grown in both fresh and marine waters, had a production figure of 184 871 tonnes worth US$373 million at a unit value of US$2.02/kg in 2010. The growth rate was 20 percent/year between 2003 and 2010. Third, the Japanese sea cucumber (*Stichopus japonicus*) grown in marine waters, had a production figure of 130 303 tonnes worth US$452 million at a high unit value of US$3.47/kg in 2010. The growth rate was 21 percent/year between 2003 and 2010. Fourth, jellyfishes nei (*Rhopilema spp.*) grown in marine waters, had a production figure of 59 616 tonnes worth US$141 million at a unit value of US$2.36/kg in 2010. The growth rate was 14 percent/year between 2003 and 2010. Fifth, frogs (*Rana spp.*) grown in freshwaters had a production figure of 80 058 tonnes worth US$416 million at a high unit value of US$5.19/kg in 2010. The growth rate was 2 percent/year between 2003 and 2010.

In addition, there was limited production of three other species of aquatic animals nei in China in 2010: river and lake turtles nei (*Testudinata*) (59 616 tonnes), sea urchins nei (*Strongylocentrotus spp.*) (6 169 tonnes) and the American bullfrog (*Rana catesbeiana*) (549 tonnes).

Other Asia

Other Asia's total aquaculture production (including nei reports) amounted to 3 044 058 tonnes (Figure 37) worth US$6.6 billion at a unit value of US$2.17/kg in 2010, accounting for just under 4 percent of the total world aquaculture production. The aquaculture production in this region has been quite stable. Average growth has been only 2 percent/year in terms of volume and 1 percent/year in terms of value between 2000 and 2010 (Figures 30, 31 and 37).

Korea RO had the biggest production (45 percent in 2010) in the Other Asia subregion of 1 377 233 tonnes worth US$1.8 billion at a unit value of US$1.31/kg in 2010. Production grew by 7 percent/year between 2000 and 2010.

Japan produced 1 151 080 tonnes worth US$4.7 billion at a high unit value of US$4.06/kg in 2010. Japan concentrates on production of the higher value species in each group, hence its subregional dominance in terms of value, producing 71 percent of the value in 2010. However, production in Japan contracted by 1 percent/year between 2000 and 2010, as almost all major species showed declining trends, perhaps because of national economic problems and a declining population.

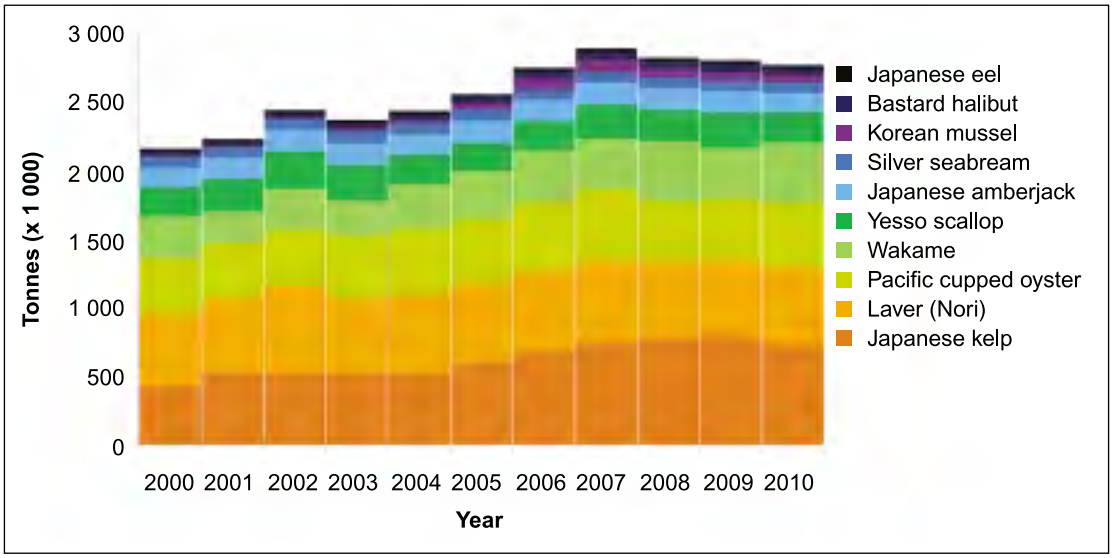


Figure 37 Main cultured species in Other Asia subregion 2000–2010

The third major player in the subregion is Korea DPR, which produced 508 350 tonnes worth US$116 million at a very low unit value of just US$0.23/kg in 2010. This was a result of the majority of production (87 percent in 2010) being low-value Japanese kelp (*Laminara japonica*). Production in Korea DPR grew by just 1 percent/year between 2000 and 2010. These three countries made up 99.8 percent of the production in the Other Asia subregion in 2010.

Aquatic plants

Aquatic plants continue to dominate aquaculture production in Other Asia, particularly in the East Asian states. They accounted for 58 percent of total production of this subregion, and 9 percent of the total world production of this group in 2010. This was followed by molluscs (28 percent) and marine finfish (10 percent). However, the high economic value of marine finfish makes this species group the largest contributor in terms of value, constituting 41 percent of total production value, whereas aquatic plants contributed only 23 percent and molluscs 18 percent of total value in 2010 (Figures 30, 31 and 37).

Total aquatic plant production reached 1 778 768 tonnes worth US$1.5 billion at a unit value of US$0.86/kg in 2010. Production increased at a modest 3 percent/year, whereas value remained stable between 2000 and 2010. Approximately 99 percent of the aquatic plants produced in the subregion are species cultured for human food use, with some high-value and some low-value species.

The most important aquatic plant species produced in Other Asia is the Japanese kelp (*Laminaria japonica*), accounting for 41 percent of all aquatic plants grown in 2010. This species is cultured in all three main countries, with production reaching 728 873 tonnes worth US$223 million at a low unit value of just US$0.31/kg in 2010. The growth rate was 5 percent/year between 2000 and 2010.

Laver (nori) (*Porphyra tenera*) is also produced in Japan and Korea RO, accounting for 32 percent of total aquatic plants in 2010. Production reached 564 234 tonnes worth US$1.1 billion at a high US$1.94/kg in 2010, with a growth rate of just 1 percent/year between 2000 and 2010.

Wakame (*Undaria pinnatifida*) also produced in Korea RO and Japan accounted for 25 percent of all seaweeds in 2010. Production was 446 009 tonnes worth US$165 million at a low US$0.37/kg in 2010 and a growth rate of 4 percent/year between 2000 and 2010.

The production of brown seaweeds (*Phaopohyceae*), the only species cultured for biopolymers in the subregion, and grown in Korea RO and Japan, amounted to 22 133 tonnes worth US$18 million at a unit value of US$0.85/kg in 2010, with a growth rate of 6 percent/year between 2000 and 2010.

There was some minor production of other aquatic plants for human food in the subregion including aquatic plants nei from Japan and Korea RO (12 594 tonnes), green laver from Korea DPR (4 531 tonnes) and fragile codium from Korea RO (1 394 tonnes) in 2010.

Molluscs

The Other Asia subregion had a large production of (mostly marine) molluscs. Production reached 840 715 tonnes worth US$1.2 billion at a unit vale of US$1.45/kg in 2010. The growth rate was a modest 2 percent/year in terms of volume but unchanged in terms of value between 2000 and 2010. Production of molluscs in the region was mostly of high-value species, especially from the richer nations in the subregion. Hence Japan produced 50 percent of the total (with >200 000 tonnes of both Pacific cupped oysters and yesso scallop), Korea RO produced 43 percent (dominated by nearly 270 000 tonnes of Pacific cupped oyster and 55 000 tonnes of Korean mussel), and Korea DPR produced 7 percent (dominated by 60 000 tonnes of unspecified marine molluscs nei) in 2010.

The major cultured species (56 percent of the total) in the subregion is the Pacific cupped oyster (*Crassostrea gigas*), cultured mainly in Korea RO and Japan. Production reached 468 074 tonnes worth US$518 million at a unit value of US$1.11/kg in 2010. Production increased only 2 percent/year between 2000 and 2010.

The yesso scallop (*Patinopecten yessoensis*) was also popular in Japan (comprising 26 percent of the total), with production of 220 102 tonnes worth US$355 million at a unit value of US$1.61/kg in 2010, with no growth.

The Korean mussel (*Mytilus coruscus*) was produced exclusively in Korea RO and amounted to 54 400 tonnes worth US$25 million at a low unit value of US$0.46/kg in 2010. However, production of this species grew by 17 percent/year between 2000 and 2010.

The Japanese carpet shell (*Ruditapes philippinarum*) was cultured in Korea RO and amounted to 23 430 tonnes worth US$43 million at a high unit value of US$1.82/kg in 2010. The growth rate was a modest 3 percent/year between 2000 and 2010.

Finally, a recent addition to mollusc culture in Korea RO is that of abalone nei (*Haliotis spp.*), which had been cultured since the early 1970s, but began a revival in the year 2000, and although still relatively small, has since grown at a rate of 78 percent/year to reach 6 228 tonnes worth an impressive US$198 million at an extremely high unit value of US$31.75/kg in 2010. This is destined for high value restaurants in Korea RO and for export markets.

Marine finfish

The culture of marine finfish in the Other Asia subregion is an important activity as it generated 71 percent of the region's value in 2010. Total production was 325 846 tonnes worth US$2.8 billion at a high unit value of US$8.56/kg in 2010 and growing by 1 percent/year between 2000 and 2010. The main production of marine finfish is by Japan (75 percent), producing 245 713 tonnes (but at a growth rate decreasing by 1 percent/year between 2000 and 2010), and the Korea RO (25 percent), producing 80 133 tonnes and growing by 11 percent/year between 2000 and 2010. It is notable that the percentage of carnivorous fish in the total marine finfish production is very high in this subregion (94 percent of total production in 2010) compared with South Asia, Southeast Asia and China, which all have much lower levels (all below 10 percent).

Although there were 21 species of marine finfish cultured in the subregion in 2010, production is dominated by the culture of high-value, carnivorous species including Japanese amberjack (*seriola quinqueradiata*), comprising 45 percent of total marine finfish cultured in the subregion and nearly all cultured in Japan. Production amounted to 139 077 tonnes worth US$1.2 billion at a high unit value of US$8.74/kg in 2010, but with zero growth rate. Silver seabream (*Pagrus auratus*) comprised 24 percent and was cultured mostly in Japan. Production amounted to 73 907 tonnes worth US$590 million at a high unit value of US$7.98/kg in 2010, but with a negative -1 percent/year growth rate between 2000 and 2010. Bastard halibut (*Paralichthys olivaceus*) comprised 14 percent and was cultured mostly in

Korea RO. Production amounted to 44 902 tonnes worth US$490 million at a high unit value of US$10.92/kg in 2010, and with an 8 percent/year growth rate between 2000 and 2010. Korean rockfish (*Sebastes schlegeli*) comprised 7 percent and was cultured only in Korea RO. Production amounted to 20 918 tonnes worth US$171 million at a unit value of US$8.17/kg in 2010, and with a 9 percent/year growth rate between 2000 and 2010. Coho (silver) salmon (*Oncorhynchus kisutch*) cultured in Japan (at 5 percent) had a production of 14 766 tonnes worth US$77 million at a unit value of US$5.24/kg in 2010 and had a growth rate of 1 percent/year between 2000 and 2010. All of these fish are for the high-value local and export markets in the subregion.

Freshwater and diadromous freshwater finfish

There was a total of 18 freshwater and diadromous freshwater finfish species cultured in the Other Asia subregion in 2010, mostly comprising high-value carnivorous species, but with some lower-value carps also. Most of the production was from Japan (65 percent) and Korea RO (21 percent) in 2010. Total production was 68 421 tonnes worth US$885 million at a high unit value of US$12.93/kg in 2010. The growth rate was -2 percent/year in terms of volume, but 5 percent/year in terms of value between 2000 and 2010.

The most important species cultured (42 percent of the total in 2010) was the Japanese eel (*Anguilla japonica*), mostly produced in Japan and Korea RO. Production amounted to 28 445 tonnes worth US$602 million at a very high unit value of US$21.16/kg in 2010. The growth rate was negligible at just 1 percent/year between 2000 and 2010.

Rainbow trout (*Oncorhynchus mykiss*), mostly produced in Japan and Korea RO (13 percent of the total) amounted to 8 797 tonnes worth US$78 million at a unit value of US$8.81/kg in 2010. The growth rate was -5 percent/year between 2000 and 2010.

Ayu sweetfish (*Plecoglossus altivelius*), mostly produced in Japan (8 percent of the total) amounted to 5 724 tonnes worth US$94 million at a very high unit value of US$16.45/kg in 2010. The growth rate was -4 percent/year between 2000 and 2010.

The other main freshwater finfish species cultured included the lower-value common carp (*Cyprinus carpio*) (4 978 tonnes), silver carp (*Hypopthalmichthys molitrix*) (4 717 tonnes), amur catfish (*Silurus asotus*) (4 194 tonnes) and trout nei (*Salmo spp.*) (3 334 tonnes) in 2010.

Crustaceans

There is a very small quantity of crustaceans cultured in the Other Asia subregion. Total production amounted to just 4 391 tonnes worth US$129 million at an exceptionally high unit value of US$29.39/kg in 2010. The production grew by just 3 percent/year in terms of volume and 8 percent/year in terms of value between 2000 and 2010. Only five high value species were cultured in the region, with just one in Japan and the others in Korea RO.

The principle crustacean species farmed is the whiteleg shrimp (*Penaeus vannamei*), which was only introduced into Korea RO in 2006, but whose culture has grown by 42 percent/year since then to 2 705 tonnes worth US$31 million at a high unit value of US$11.5/kg in 2010 for the local live and fresh market.

The only other important species cultured is the kuruma prawn (*Penaeus japonicus*), which is grown in Japan, but at a decreasing rate of -2 percent/year between 2000 and 2010. Production amounted to 1 634 tonnes worth US$97 million at an exceptionally high unit value of US$59.2/kg in 2010 for the live market in Japan.

The only other species are all cultured in Korea RO in small and decreasing quantities and include the fleshy prawn (*Penaeus chinensis*) (26 tonnes), sawtooth caridina (*Caridina denticulata*) (25 tonnes) and the Chinese mitten crab (*Eriocheir sinensis*) (5 tonnes) in 2010.

Niche species

There is limited production of niche species in the Other Asia subregion, but these species only account for less than 1 percent of the total production from the subregion and only 3 percent of world production of this group.

Total production was 25 917 tonnes worth US$56 million at a unit value of US$2.15/kg in 2010. The growth rate was -4 percent/year between 2000 and 2010. There were just four mostly low-value species produced, namely:

- Sea squirts nei (*Ascidiacea*), from Japan and Korea RO, with a production of 16 636 tonnes worth US$29 million at a unit value of US$1.77/kg in 2010. The growth rate was 5 percent/year between 2000 and 2010.
- Aquatic invertebrates nei from Korea RO and Japan, with a production of 8 595 tonnes worth US$7 million at a unit value of US$0.81/kg in 2010. The growth rate was -11 percent/year between 2000 and 2010.
- The very high value soft-shell turtle (*Trionyx sinensis*) from Japan and Korea RO, with a production of just 586 tonnes, but it was worth US$18 million at a very high unit value of US$31.40/kg in 2010. The growth rate was -1 percent/year between 2000 and 2010.
- The only other species was Japanese sea cucumber (*Stichopus japonicus*) from Korea DPR with a small production amounting to 100 tonnes in 2010.

After Japan and Korea RO, the third most important producer in the Other Asia subregion is Korea DPR. The estimated aquaculture production from this country in FISHSTATJ was about 0.5 million tonnes for 2010, but this figure has remained virtually unchanged since 2001. This production was mainly composed of Japanese kelp and marine molluscs. The government of Korea DPR is strongly promoting the culture of marine molluscs and finfish in the country. Supported by FAO technical assistance, a significant increase in marine molluscs and finfish production may be expected in the coming years because of the country's abundant natural resources, but if it has already begun, it has yet to be seen in the statistics.

Oceania

Aquaculture production in Oceania is relatively limited. Oceania's total aquaculture production amounted to 198 966 tonnes (Figure 38) worth US$1.1 billion at an overall high unit value of US$5.50/kg in 2010, accounting for just 0.25 percent of the total world aquaculture production. The growth rate in production was 4 percent/year in terms of volume and 9 percent/year in terms of value between 2000 and 2010.

Oceania's production is dominated by the production of high-value molluscs and freshwater and diadromous fish. The Oceania subregion also produces small amounts of aquatic plants, marine fish, crustaceans and aquatic animals nei, with each accounting for just 1 to 7 percent of total production from the Asia-Pacific region (Figures 30, 31 and 38).

All of this production comes almost exclusively from New Zealand (110 592 tonnes or 56 percent in 2010) and Australia (69 581 tonnes or 35 percent in 2010), with relatively little (9 percent) from the Pacific islands, the only other country in this subregion to make a contribution. Because most of the production in the subregion is in the more developed nations with higher costs of living and tastes for high-value species, this is reflected in the species chosen for culture. Hence, the relatively high unit value of the total production from the region and the dominance of higher-value species in the aquaculture practiced in this area across all groups of cultured organisms.

Molluscs

The majority of the culture in the Oceania subregion is of molluscs, especially the higher-value species. Molluscs make up 60 percent of the subregion's aquaculture production, but this production is still only 0.83 percent of the world production of this group, which is dominated by China. Additionally, growth has been slow at just 2 percent/year in terms of volume and 5 percent/year in terms of value between

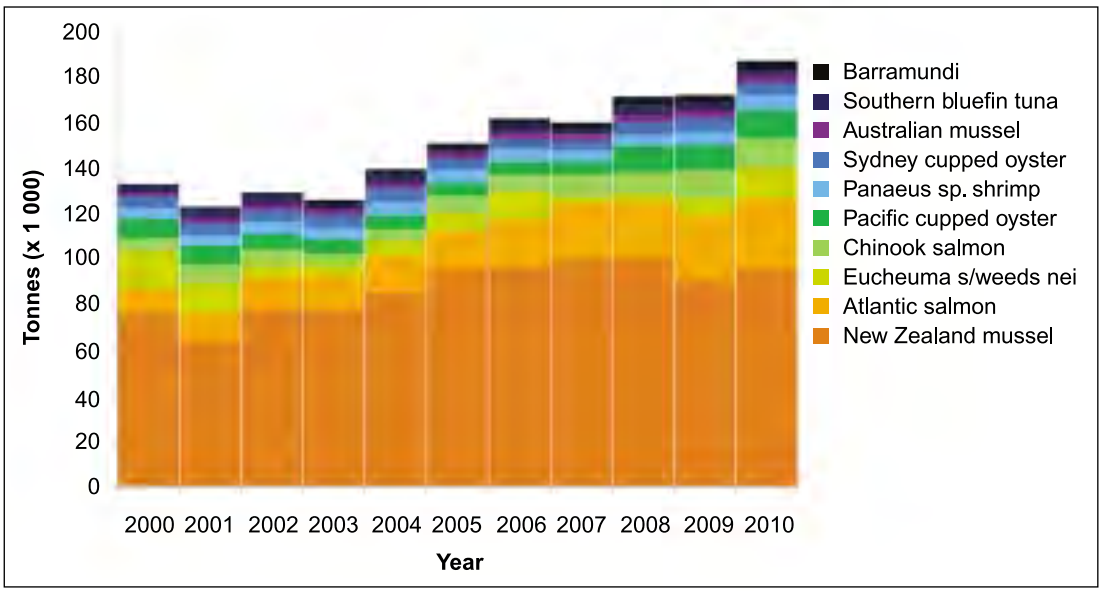


Figure 38 Main cultured species in Oceania subregion 2000–2010

2000 and 2010. Production of molluscs in the subregion amounted to 118 620 tonnes worth US$454 million at a unit value of US$3.83/kg in 2010.

The main species of mollusc cultured in Oceania (80 percent of mollusc production) is the New Zealand mussel (*Perna canaliculus*) cultured in New Zealand, the production of which amounted to 95 168 tonnes worth US$241 million at a high unit value of US$2.53/kg in 2010. Production increased slowly at just 2 percent/year between 2000 and 2010.

Among the major mollusc species cultured in the subregion is the Pacific cupped oyster (*Crassostrea gigas*), produced mostly in Australia and New Zealand with some from New Caledonia. The total production was 12 347 tonnes worth US$63 million at a high unit value of US$5.07/kg in 2010 and grew by 4 percent/year between 2000 and 2010. The Sydney cupped oyster (*Saccostrea commercialis*) is produced in Australia and had a production figure of 4 960 tonnes worth US$40 million at a very high unit value of US$7.97/kg in 2010 but with no growth between 2000 and 2010. The Australian mussel (*Mytilus planulatus*) also produced in Australia had a production figure of 3 462 tonnes worth US$9 million at a unit value of US$2.68/kg in 2010 and grew at 6 percent/year between 2000 and 2010. The blacklip pearl oyster (*Pinctada margaritifera*) is produced in French Polynesia and had a production figure of 2 129 tonnes worth nearly US$3 million at a unit value of US$1.33/kg in 2010. It grew by 11 percent/year between 2000 and 2010.

Marine finfish

After molluscs, the next most important group for the subregion is high-value marine finfish from the subregion. Production from Oceania totalled 55 368 tonnes worth US$515 million at a high unit value of US$9.30/kg in 2010 and comprised 28 percent of the total aquaculture production of the subregion, but only 3 percent of the world total of marine finfish, a category again dominated by China. The production of molluscs grew by 10 percent/year in terms of volume, and 13 percent/year in terms of value because of a 2 percent/year increase in unit value between 2000 and 2010.

There were only six species of marine finfish cultured in Oceania in 2010. The first was Atlantic salmon (*Salmo salar*), comprising 31 765 tonnes (65 percent of the total) worth US$338 million at a very high unit value of US$10.63/kg in 2010. All of this production was from Tasmania in Australia and grew by 11 percent/year between 2000 and 2010.

Second was Chinook (spring or king) salmon (*Oncorhynchus tshawytscha*), with a production amounting to 12 908 tonnes (25 percent of the total) worth US$80 million at a high unit value of US$6.17/kg in 2010. All of this production was from New Zealand.

Third was marine fish nei produced in Australia, the production of which grew by 54 percent/year and whose unit value increased by 4 percent/year between 2000 and 2010. Total production was 4 118 tonnes worth US$29 million at a high unit value of US$7.10/kg in 2010.

Fourth was southern bluefin tuna (*Thunnus maccoyii*) the production of which is conducted in offshore cages off the southern Australian coast using wild-caught juveniles and feeding with trash fish, so cannot be considered sustainable until such time as hatchery-reared fry and artificial diets have been developed. Production has fluctuated over the past decade, reaching a peak of 4 554 tonnes in 2004, but thereafter generally declining to 3 324 tonnes worth US$43 million in 2010. Production has declined by an average 7 percent/year between 2000 and 2010, largely because of a rapid and severe (9 percent/year) decline in unit price from US$32.56/kg in 2000 to just US$12.90/kg in 2010. The industry thus lost half its value over this time frame.

Fifth was barramundi (giant sea perch) (*Lates calcarifer*), with 6 percent of production amounting to 3 200 tonnes worth US$25 million at a high unit value of US$7.92/kg in 2010. This was nearly all produced in Australia, with some production also from Papua New Guinea.

Last was milkfish which was produced in very small quantities (56 tonnes total in 2010) in some Pacific islands including Guam, Kiribati and Palau.

Previously, there used to be some culture of other marine finfish in the subregion including mullet and spinefeet in Fiji, marine fish nei and six finger threadfin in French Polynesia, and mullet in Guam, but this never amounted to more than 8 tonnes of any one species and there have been no reports of production of these fish since 2006 from Oceania.

Freshwater and diadromous finfish species

There is some production of freshwater and diadromous finfish species. Freshwater fish make up less than 2 percent of the aquaculture production in Oceania and only 0.01 percent of the world total production of this group, which is dominated by China, with significant production also from Southeast Asia and South Asia. Production of freshwater and diadromous fish in the subregion amounted to 3 152 tonnes worth US$22 million at a high unit value of US$6.98/kg in 2010. Production of this group increased at 1 percent/year by volume and 7 percent/year by value because of a 6 percent/year increase in unit value between 2000 and 2010.

Although there were eight species of freshwater/diadromous fish cultured in Oceania in 2010, just four species had any substantial production: these included Nile tilapia (*Oreochromis nilioticus*) (1 275 tonnes worth US$5 million at US$3.71/kg, mostly from Papua New Guinea), freshwater fish nei (944 tonnes worth US$11 million at a very high US$12.07/kg from Australia), common carp (*cyprinus carpio*) (500 tonnes worth US$1.8 million at US$3.68/kg from Papua New Guinea) and silver perch (*Bidyanus bidyanus*) (294 tonnes worth US$3 million at a very high US$10.75/kg from Australia). There were also smaller quantities of Mozambique tilapia, milkfish, rainbow trout, Philippine catfish and tilapia nei produced from many of the Pacific islands.

All of these main species of cultured freshwater fish are high-value species destined for the high-value local and export markets. Most of the other freshwater fish species cultured in the subregion were lower-value species mostly for local consumption.

Crustaceans

There is some culture of crustaceans in Oceania, but they only make up 3.5 percent of the total aquaculture production from the subregion and only account for 0.03 percent of total world crustacean culture, which is again dominated by Southeast Asia and China. Total crustacean production in Oceania amounted to 6 861 tonnes worth US$89 million at a very high unit value of US$12.92/kg in 2010. This sector grew by 3 percent/year in terms of volume and 7 percent/year in terms of value between 2000 and 2010.

Approximately 97 percent of the crustacean production was of penaeid shrimp, which amounted to 6 631 tonnes worth US$71 million in 2010. Of these, the highest production was of penaeid shrimp nei (including the giant tiger prawn, *Penaeus monodon* and the banana prawn, *Penaeus merguiensis*) from Australia amounting to 5 381 tonnes worth US$71 million at a high unit value of US$13, for high-value local and export markets. The growth rate of the Australian penaeid shrimp culture industry was 7 percent/year between 2000 and 2010, all resulting from improved genetics and management.

The other major penaeid shrimp culture industry in the subregion is the culture of the blue shrimp (*Penaeus stylirtostris*) in New Caledonia (and a little from French Polynesia). Production amounted to 1 156 tonnes worth US$11 million at a high unit value of US$9.71/kg. Production declined by 4 percent/year between 2000 and 2010 because of competition from cheaper whiteleg shrimp production from Southeast Asia.

There is also a small production of whiteleg shrimp (*Penaeus vannamei*) amounting to 56 tonnes from Vanuatu, Northern Marianas Islands and Guam, and some giant tiger prawn (*Penaeus monodon*) amounting to 11 tonnes from Papua New Guinea and Fiji in 2010.

There was a small production of other high value crustaceans in Oceania in 2010 such as:

- marron crayfish (*Cherax tenuimanus*) amounting to 76 tonnes worth US$1.9 million at an extremely high unit value of US$25.21/kg;
- redclaw crayfish (*Cherax quadricarinatus*) at 56 tonnes worth US$0.9 million at a high unit value of US$15.32/kg;
- yabby crayfish (*Cherax destructor*) amounting to 51 tonnes worth US$0.9 million at a high unit value of US$16.88/kg;
- Indo-Pacific swamp crab (*Scylla serrata*) amounting to 18 tonnes worth US$0.2 million at a high unit value of US$11.06/kg; and
- giant river prawn (*Macrobrachium rosenbergii*) amounting to 17 tonnes worth US$0.3 million at a very high unit value of US$15.65/kg. These are almost all eaten locally in Australia.

Aquatic plants

The only aquatic plant currently cultured in Oceania is eucheuma seaweeds nei *(Eucheuma cottonii)* (Zanzibar weed) cultured for use in biopolymers mostly from the Solomon Islands, the Kiribati atolls and a little from Fiji. Total production amounted to 13 305 tonnes worth US$0.9 million at a very low value of US$0.07/kg in 2010. No growth has been seen recently in this industry. This production accounts for 7 percent of Oceania's total production and less than 0.1 percent of the world production of aquatic plants.

There was some production of niche aquaculture species in Oceania, with 1 660 tonnes worth US$14 million at a unit value of US$8.40/kg in 2010. This production grew by 14 percent/year over the past three years, since first reports in 2007. The production of niche species accounts for less than 1 percent of Oceania's total aquaculture production and just 0.1 percent of the world production of niche species. The only species reported from the subregion was aquatic invertebrates nei, all of which are produced in Australia.

Ornamentals, live reef fish, pearls

Additionally, live reef fish, aquarium fish and pearls bring significant income to some Pacific islands, although the quantity is relatively small. The target species are mostly caught from the wild, but there is an increasing desire for culture-based sources. Giant clam culture for the ornamental trade is widespread throughout the region and the total export volume is probably in the range of 30 000 to 50 000 pieces/annum. The Pacific islands is also a major supplier of "live rock" (rock encrusted with coralline algae) with approximately 50 000 pieces of live rock currently being cultured in the Fiji Islands. Interest in inland freshwater aquaculture is also growing, particularly among the larger Melanesian states such as Fiji and Papua New Guinea.

Inland capture fishery production

Inland capture fisheries production in the region continues to increase, rising by 13.7 percent over the 2008 figure and reaching 7.5 million tonnes in 2010. In descending order, China, India, Bangladesh, Myanmar, Cambodia, Indonesia, Thailand, Viet Nam, Philippines and Pakistan are the top producers and have a combined production of 97 percent of the region's inland capture of inland fish. This region now contributes 68 percent of global inland fisheries production (Table 55).

In inland waters, total production of the region excluding China was reported in 2010 at 5.3 million tonnes. This has risen 19.7 percent over the 2008 figure.

Table 55 Top producers of freshwater fish from capture fisheries in Asia

Country	Tonnes	% of regional total
China	2 289 680	30.4
India	1 468 757	19.5
Bangladesh	1 119 094	14.9
Myanmar	1 002 430	13.3
Cambodia	405 000	5.4
Indonesia	344 972	4.6
Thailand	209 800	2.8
Viet Nam	194 200	2.6
Philippines	185 406	2.5
Pakistan	115 348	1.5

South Asia contributes 37 percent of the region's production and Southeast Asia 30 percent. For the Chinese subregion, inland production in 2010 was 2.3 million tonnes or 30.2 percent of the total regional catch (Table 56).

This overall rapid increase in inland fisheries is unlikely to be a result of massive increases in fisher productivity, although there is undoubtedly increasing interest and effort being applied to enhance inland waters in the region to increase productivity. Increasing populations in developing countries of Southeast Asia and South Asia also means that there are increasing numbers of inland fishers and thus effort is also increasing.

Table 56 Contribution to freshwater fish capture fishery production by subregion

Country	Tonnes	% of APFIC regional total
China	2 289 680	30
South Asia	2 777 109	37
Southeast Asia	2 372 708	31

Part of the increase is also considered to be a result of a significant re-evaluation of the contribution of inland fisheries that led to upward revisions of previous underestimates of inland production. This is a cause for concern since actual production in some countries' inland fisheries may be declining.

Employment in inland fisheries in Asia (selected countries)

The estimation of employment or participation in inland fisheries is extremely challenging. This is because of the highly variable nature of inland fishing, which can be a full-time livelihood activity, a highly seasonal or occasional activity. Fishing may be specialized using a single gear, but more typically involves several types of gear. Inland fishing gears may be mobile (nets, hooks, lines, small traps) or larger, fixed structures (lift nets, fences, traps, pump drained trap ponds etc.). In some cases, no direct gear is used (e.g. in the case of foraging aquatic products from rice fields, frog capture by torchlight).

There are few dedicated assessments of participation/employment in inland fishing, and typically information is collected from secondary sources, census information or sample surveys of rural livelihoods. Often national statistics only focus on full-time inland fishers, despite the fact that inland fishing is rarely a dedicated full-time activity and this sort of statistic grossly underestimates the contribution to food security, household nutrition and income.

The table below gives some indications of the scale and extent of participation in inland fisheries in a number of APFIC countries (Table 57). This table will be expanded in future editions of the APFIC Regional Overview.

Table 57 Employment in selected inland fisheries

	Area					
	Cambodia	Viet Nam *Mekong Delta*	Lao PDR	Thailand	Malaysia	Indonesia
Year	**2005**	**2008**	**2005**	**2009**		
INDIVIDUALS						
Full-time		280 955				
Part-time		3 447 933				
Women		78 114				
Skilled	91 680					
Small-scale	383 910					
Commercial	5 730					
Employed/processing	63 030					
Total	**544 350**	**3 728 888**				
HOUSEHOLD						
No. of households		1 776 850	55 749	2 639 582		
% of households			77%			
Small-scale				1 979 687		
Commercial				659 896		
Employed/processing						
Total		**1 776 850**	**55 749**	**2 639 582**		

Viet Nam: There are 78 114 full-time women employed in inland fishing. The part-time figure extrapolated gives an estimated 1 776 850 households and an additional 583 863 are employed in associated services. It should be noted, that as a delta area, there may be some overlap with coastal fishing.[14]

Thailand:[15] Figures from national census.

Lao PDR: The LECS4 data (2007/8) shows that the population in Lao PDR overwhelmingly is engaged in capture fisheries with 74 percent of all households in the country having fished in the previous last 12 months. Of these, 78 percent catch fish in rivers whereas 19 percent of all households catch fish in rice fields.[16]

Cambodia: Based on an analysis of the census data, approximately one million people in Cambodia are assessed to be dependent on river fisheries in large-scale, community and subsistence fishing and in fisheries-related occupations.[17] Approximately 75 percent of the poorest quintile of the Cambodian population catch fish (and other aquatic animals) as part of their livelihood compared to only 17 percent of the richest segment. On average, 51 percent of households in Cambodia has fishing as part of their livelihood.[18]

[14] VHLSS (2008) cited in MRC; Mekong River Commission, Basin Development Plan Programme, Phase 2, Assessment of basin-wide development scenarios, Technical Note 12, Social assessment (For discussion, July 2010); Viet Nam Households Living Standards Survey (VHLSS), 2008, Viet Nam General Statistical Office. http://www.socialsecurityextension.org/gimi/gess/RessShowRessource.do?ressourceId=19860

[15] Lymer, D., Funge-smith, S., Khemakorn, P., Naruepon, S. & Ubolratana, S. 2008. *A review and synthesis of capture fisheries data in Thailand – Large-scale versus small-scale fisheries*. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2008/17, 51 pp.

[16] MRC based on LECS 2005.

[17] Cambodia Census 2008 (obtained from NIS in December 2009); Commune Database 2007 from NCDD Program (obtained in September 2009); Commune Poverty Rate 2007 (obtained from WFP in September 2009); and Statistical Yearbook of Cambodia 2008 (obtained from Economic Planning Department in 2009).

[18] Employment in fisheries sector, MAFF, 2005.

Examples of fish consumption

Viet Nam – Mekong Delta

The VHLSS 2008 data on consumption shows that average fish consumption in the 130 districts differs substantially – from a mean of 40 kg/capita/year in the marine fishing parts of the Mekong Delta to 24 kg/capita/year in the mainly inland fishing districts, down to 8 kg/capita/year in the Central Highlands. However, the data also shows that compared to pork and chicken, fish is by far the most important source of protein.

"It is beyond question that fish and aquatic animals are the mainstay of food security, and the most important source of protein for people in the Mekong Delta. Accessibility to food sources is a key factor for food security, and because of the extremely water resource rich environment, wild fish and aquatic animals are accessible to most people with reasonable time and effort."[19]

Lao PDR – freshwater fish

Over the seven-day recall period, wild fish was eaten by 81 percent of households, other aquatic animals by 55 percent, fish from ponds by 20 percent, poultry and pork each by 41 percent, and buffalo/cow meat by 42 percent of the households. Out of all reported animal protein consumption days, wild fish alone made up 35 percent of the total. These findings are supported by other studies highlighting the importance of freshwater biodiversity resources for the Lao diet.

"Overall, it is estimated that about 157 000 (±20 000) households, or 24 percent of the people in rural Lao PDR, would become food insecure if fishing, hunting and gathering were less productive or reduced (taking into account how much the household diet depends on natural resources and their capacity to cope with the loss of these resources)".[20]

Cambodia – freshwater fish

Fish and aquatic animals and plants are an extremely important and large part of the diet in Cambodia's water resource rich areas. Yearly per capita consumption of freshwater fish and aquatic animals across the different districts and provinces of Cambodia ranges from 17 kg to 84 kg. A survey in six districts of Cambodia carried out in 2003 found that ~92 percent of the animal protein consumed at home is sourced from aquatic animals (79 percent being fish protein). Fifty-three percent of vegetables consumed by the communities are sourced from aquatic plants during the wet season.

"Cambodian freshwater capture fisheries probably contribute more to national food security and the economy than such fisheries does in any other country in the world".[21]

Indonesia

Indonesia's 240 million population currently consumes about 30 kg/capita/year of fishery products. Consumption has risen more than 10 percent since 2006 from 27 kg/capita/year. Fish consumption is highest in Indonesia's eastern Mollucas region where consumption is about 48 kg/capita/year. The lowest average consumption is ~12 kg/capita/year in Yogjakarta in eastern Java. The Ministry of Maritime and Fisheries aims to increase the consumption of fish among Indonesians to 35 kilograms per capita (FAO, 2007). The national figure for consumption is an estimated 24.3 kg/capita/year.[22]

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[19] **Viet Nam:** Mekong River Commission, Basin Development Plan Programme, Phase 2, Assessment of basin-wide development scenarios, Technical Note 12, Social assessment. (For discussion, July 2010); VHLSS (2008).

[20] **Lao PDR:** MRC, citing Comprehensive Food Security & Vulnerability Analysis (CFSVA, 2005).

[21] **Cambodia:** Consumption and yield of fish and other aquatic animals from the Lower Mekong Basin. MRC Technical Paper No. 16. (October 2007); Aquatic resources valuation and policies for poverty elimination in the Lower Mekong Basin. Volume 2. Project technical report. Final (April 2005).

[22] **Indonesia:** FAO 2007 data on apparent consumption; internet news articles.

Maldives – marine fish

"The Maldivian people have been estimated to have among the highest levels of per-capita fish consumption of any nation, at 125 kg/capita/year. The majority of this consumption is of tuna and other pelagic species, whereas the majority of export fisheries are also centered on tuna."[23]

Philippines

Filipinos obtain 22 percent of their total protein requirements from fish, which is actually 56 percent of their animal protein intake.[24]

> "*The pattern of fish consumption, both in terms of quantity and quality of fish consumed, varies widely among Filipino consumers according to income strata. In 2000, the average value of per capita consumption of fish in the richest quintile is 3.4 times that consumed in the poorest quintile ... Often, consumers in the lowest income sector purchase cheaper fish types (including processed fish), while the more affluent consumers purchase the bigger and more expensive fresh fish."*[25]

[23] **Maldives:** Spalding M.D., Ravilious C. & Green E.P. 2001. *World Atlas of Coral Reefs*. Prepared at the UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, USA.

[24] **Philippines:** Espejo-Hermes, J. 2004. Trends and status of fish processing technology. In DA-BFAR: In turbulent seas: The status of Philippine marine fisheries. Coastal Resource Management Project of the DENR, Cebu City, Philippines. 378 pp.

[25] **Philippines:** Garcia, Y.T., M.M. Dey, & S.M.M. Navarez. (2004) Demand for fish in the Philippines: responses to price and income changes. In: Garcia, Y.T., M.M. Dey, & R.L. Tan (eds.) Sustaining fisheries and aquaculture production to benefit poor households in the Philippines.

International and regional agreements

There are a variety of agreements that relate to different fishery issues in the region. The agreements come in different forms: binding and voluntary; global and regional. The agreements may cover fisheries specifically or be related indirectly through environment, biodiversity, labour or other international norms that relate to the fishery sector and its activities. More information on these can be found on the APFIC Web site (www.apfic.org).

To ensure that the participation of countries in these agreements is monitored, APFIC continues to confirm their participation with the help of its members as recommended in previous APFIC reports.

Binding agreements

The binding agreements are usually adopted at global level; hence most of them are deposited in a UN organization. Among these, a few are of special importance (for country status in APFIC region see Table 58):

1982 United Nations Convention on the Law of the Sea (UNCLOS)[26]

For fisheries, this mainly deals with conservation, utilization and management of living resources, and the responsibility to deal with shared stocks and stocks of the high seas through regional mechanisms (e.g. regional fisheries organizations). UNCLOS covers broader areas such as the EEZ of coastal states and the access and rights relating to this. There are still some countries in the region that have not signed and/or ratified UNCLOS (Table 58) and none have done so since the APFIC review in 2008. The agreement entered into force on 16 November 1994 and is today the globally recognized regime dealing with all matters relating to the law of the sea.

2001 United Nations Fish Stocks Agreement (UNFSA)[27]

The main purpose is to implement the UNCLOS. It further elaborates general principles concerning conservation and management of straddling fish stocks and highly migratory fish stocks and emphasizes the special role of regional fisheries management organizations in conservation and management. It also highlights the obligations of states with respect to vessels flying their flags on the high seas and regional fisheries management organizations (RFMO) or arrangements, e.g. the Indian Ocean Tuna Commission (IOTC) and the Western and Central Pacific Fisheries Commission (WCPFC). The United Nations Fish Stocks Agreement entered into force on 11 December 2001, but there are still many countries in the region that have not signed or ratified the convention. Bangladesh ratified the UNFSA in 2012.

1995 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (FAO Compliance Agreement)[28]

The FAO Compliance Agreement places a general obligation on flag states to take such measures as may be necessary to ensure that vessels flying their flags do not engage in any activity that undermines the effectiveness of international conservation and management measures. In addition, it seeks to limit the freedom of vessels that have a bad compliance record to “shop around” for new flags. The Agreement applies to all fishing vessels over 24 metres in length used or intended for use for the commercial exploitation of living marine resources, including mother ships and any other vessels directly engaged in such fishing operations. The FAO Compliance Agreement entered into force on 24 April 2003, but has still to see acceptance instruments from many of the countries in the region (Table 58) and since 2008 there have been no new accessions to the agreement in the region.

[26] http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

[27] http://www.un.org/Depts/los/convention_agreements/convention_overview_fish_stocks.htm

[28] http://www.fao.org/docrep/meeting/003/x3130m/X3130E00.HTM

1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[29]

This international agreement between governments aims to ensure that the international trade in specimens of wild animals and plants does not threaten their survival. Species are categorized according to the degree of threat to their survival and this classification determines the extent to which the species can be traded and/or moved. Many countries in the region have acceded to CITES.

1992 Convention on Biological Diversity (CBD)[30]

This convention is dedicated to promoting sustainable development and was developed as a practical tool for translating the principles of Agenda 21 into reality. CBD deals with fisheries issues separately for inland, marine and coastal systems. In addition, CBD also covers issues relating to alien species introductions and movements. All countries in the region have ratified or acceded to the CBD.

2009 Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated fishing[31]

The main purpose of the Agreement is to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing through the implementation of robust port state measures.[32] The Agreement lays out in greater detail the commitments and obligations that port states have relating to the use of their ports by fishing vessels and the vessels which service the fishery. The Agreement envisages that parties, in their capacities as port states, will apply the Agreement in an effective manner to foreign vessels when seeking entry to ports or while they are in port. The application of the measures set out in the Agreement will, inter alia, contribute to harmonized port state measures, enhanced regional and international cooperation and block the flow of IUU-caught fish into national and international markets. This has not yet entered into force but has been open for signing since 2009 and five countries in the region have already signed or acceded to the agreement (Table 58). Once port state measures become a binding agreement it will have an effect on fisheries trade between regions and particularly for those highly traded species from the high seas and from within the jurisdiction of the regional fishery management organizations.

1973 International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 and specifically Annex V)[33]

The International Convention for the Prevention of Pollution from Ships is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The Convention includes regulations aimed at preventing and minimizing pollution from ships – both accidental pollution and that from routine operations – and currently includes six technical Annexes. Annex V Prevention of Pollution by Garbage from Ships (which entered into force on 31 December 1988) deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The most important feature of Annex V is the complete ban imposed on the disposal into the sea of all forms of plastics. This annex also covers lost or discarded fishing gears and refuse from fishing operations.

2007 ILO Work in Fishing Convention (188)[34]

The Work in Fishing Convention has yet to come into effect, but it sets new standards and contains provisions designed to ensure that fishers have decent conditions of work on board fishing vessels with regard to minimum requirements for work on board; conditions of service; accommodation and food; occupational safety and health protection; medical care and social security. It applies to all fishers and fishing vessels engaged in commercial fishing operations.

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[29] http://www.cites.org/eng/disc/text.php

[30] http://www.cbd.int/convention/text/

[31] http://www.fao.org/fileadmin/user_upload/legal/docs/1_037s-e.pdf

[32] "Port state measures" generally refer to actions taken to detect illegal fishing when ships come to port. This can include undertaking inspections of documentation, catches and equipment when boats land to take on fuel and supplies or offload fish, or requiring vessels to make activity reports before entering port. Vessels found to be involved in IUU fishing can be denied docking rights, causing considerable financial losses to their owners. Such measures are among the most effective means of preventing the import, transshipment or laundering of illegally caught fish.

[33] http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-%28marpol%29.aspx

[34] www.ilo.org/dyn/normlex/en/f?p=1000:12100:0::NO::P12100_INSTRUMENT_ID:312333

Voluntary agreements

There are a number of voluntary (non-binding) international agreements that are of importance to fisheries in the region (see Lymer and Funge-Smith, 2008):

1995 FAO Code of Conduct for Responsible Fisheries (CCRF)[35]

The CCRF defines norms for responsible fisheries and sets out principles and international standards of behaviour for responsible practices to ensure the effective conservation, management and development of living aquatic resources as well as respect for the ecosystem and biodiversity. The CCRF recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery sector. The CCRF takes into account the biological characteristics of the resources and their environments and the interests of consumers and other users. States and all those involved in fisheries are encouraged to apply the CCRF and give effect to it. The FAO Compliance Agreement (see binding agreements) is an integral component of the Code.

FAO international plan of action for the management of fishing capacity (IPOA-Capacity)[36]

The international plans of action (IPOA) are voluntary instruments elaborated within the framework of the CCRF. They apply to all states and entities and to all fishers. The FAO international plans of action (IPOA) for the management of fishing capacity have the following objective "… to achieve worldwide, preferably by 2003 but no later than 2005, an efficient, equitable and transparent management of fishing capacity". It also highlights assessment and monitoring of fishing capacity and preparation and implementation of national plans.

FAO international plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing (IPOA-IUU)[37]

The objective of the FAO international plans of action to prevent, deter and eliminate illegal, unreported and unregulated fishing is to prevent, deter and eliminate IUU fishing by providing all states with comprehensive, effective and transparent measures by which to act, including through appropriate regional fisheries management organizations established in accordance with international law. The IPOA in particular encourages states to develop national plans of action to implement the IPOA-IUU

SEAFDEC Regional Code of Conduct for Responsible Fisheries[38]

The SEAFDEC regional guidelines relating to the Code of Conduct for Responsible Fisheries defines norms for responsible fisheries within the SEAFDEC region. They are derived from the FAO Code of Conduct for Responsible Fisheries.

2007 The Regional Plan of Action for Responsible Fishing (RPOA)[39]

The Regional Plan of Action for Responsible Fishing which was signed by several countries in the region and also covers a large area of the seas in the region and complements the IPOA and NPOA on IUU fishing. This voluntary instrument that takes its core principles from the above-mentioned and already established international fisheries instruments for promoting responsible fishing practices. It is a commitment to implement those aspects of fisheries management that relate to combating IUU fishing. The coverage of the RPOA is the areas of the South China Sea, Sulu-Sulawesi Seas (Celebes Sea) and the Timor-Arafura Seas. The ministerial meeting to sign the RPOA was convened from 2 to 4 May 2007 in Denpasar, Bali, Indonesia and was attended by representatives of 11 countries: Australia, Brunei Darussalam, Cambodia, Indonesia, Malaysia, Papua New Guinea, Philippines, Singapore, Thailand, Timor-Leste and Viet Nam. The countries signing the RPOA agreed to work together on key areas of fishery management.

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[35] http://www.fao.org/docrep/005/v9878e/v9878e00.htm

[36] http://www.fao.org/DOCREP/006/X3170E/X3170E00.HTM

[37] http://www.fao.org/docrep/005/Y3536E/Y3536E00.HTM

[38] http://www.seafdec.org/index.php/publications/viewcategory/48-regional-guidelines

[39] http://www.rpoa.sec.kkp.go.id

As part of its overall monitoring and reporting role, APFIC is attempting to monitor the state of planning and implementation of the member country national plans of action that implement the relevant IPOAs. Several countries have developed NPOA, however, it is still unclear how many additional countries have initiated the NPOA planning and implementation process in the region (draft or national equivalent to NPOA), although there are increasing reports of countries starting the process (Table 59). For the international plan of action for the management of fishing capacity (IPOA-Capacity), the implementation into NPOA has seen a variety of national equivalents to the NPOA and only a few countries have developed NPOA building on the IPOA. For the international plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing **(**IPOA-IUU) the implementation into NPOA has been started (and completed by several countries in the region).

2005 APEC Bali Plan of Action[40]

The APEC Bali Plan of Action is directed towards promoting healthy oceans and coasts for sustainable growth and management of the marine environment and has a strong fisheries component. The main objectives of the APEC Bali Plan of Action (2005) are to ensure the sustainable management of the marine environment and its resources and to strengthen regional fisheries management organizations. Based on the commitment made by ministers in the 2002 Seoul Ocean Declaration, the Bali Plan of Action contains practical commitments to work towards healthy oceans and coasts for the sustainable growth and prosperity of the Asia-Pacific community. The APEC Bali Plan of Action (2005) seeks to balance conservation and management of marine resources with regional economic growth. It was adopted at the close of the second APEC ocean-related ministerial meeting. This new plan is intended to guide the work of the APEC ocean and fisheries working group for the rest of the decade through domestic and regional actions in three key areas: ensuring the sustainable management of the marine environment; providing sustainable economic benefits from the oceans; and ensuring the sustainable development of coastal communities.

Coordinating Body for the Seas of East Asia (COBSEA)[41]

COBSEA is a regional environmental agreement covering a large part of the marine area within APFIC's direct area of interest. The East Asia Seas region does not have a regional convention; instead COBSEA promotes compliance with existing environmental treaties and is based on member country goodwill. The Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the East Asian Seas Region (the East Asian Seas Action Plan) was approved in 1981 stimulated by concerns about the effects and sources of marine pollution. Initially, the action plan involved five countries (Indonesia, Malaysia, Philippines, Singapore and Thailand). In 1994, it was revised to involve another five countries (Australia, Cambodia, China, Republic of Korea and Viet Nam) and to this date the action plan still has ten member countries. The main components the East Asian Seas Action Plan are assessment of the effects of human activities on the marine environment, control of coastal pollution, protection of mangroves, seagrasses and coral reefs, and waste management and is steered by COBSEA.[42]

[40] http://www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Ocean-and-Fisheries.aspx

[41] http://www.cobsea.org

[42] The East Asian Seas Regional Coordinating Unit (EAS/RCU) serves as the Secretariat for COBSEA.

Table 58 Status of accession to international agreements

	UNCLOS		UNFSA		FAO compliance agreement	FAO Port state measures agreement	CBD	CITES	MARPOL Annex V
	sign	Rat Acc	sign	Rat Acc	Acc	Sign Acc	Rat Acc	Rat Acc	Ac Acc
South Asia									
Bangladesh	1982	2001	1995	2012			1994	1981	2002
Bhutan	1982						1995	2002	
India	1982	1995		2003			1994	1976	2003
Maldives	1982	2000	1996	1998			1992		2005
Nepal	1982	1998					1993	1975	
Pakistan	1982	1997	1996				1994	1976	1994
Sri Lanka	1982	1994	1996	1996		2011	1994	1979	1997
Southeast Asia									
Brunei Darussalam	1984	1996					2008	1990	
Cambodia	1983						1995	1997	1994
Indonesia	1982	1986	1995	2009		2009	1994	1978	
Lao PDR	1982	1998					1996	2004	
Malaysia	1982	1996					1994	1977	1997
Myanmar	1982	1996			1994	2010	1994	1997	
Philippines	1982	1984	1996				1993	1981	2001
Singapore	1982	1994					1995	1986	1999
Thailand	1982	2011					2004	1983	
Timor-Leste							2007		
Viet Nam	1982	1994					1994	1994	
Other Asia									
Iran IR	1992			1998			1996	1976	2002
Japan	1983	1996	1996	2006	2000		1993	1980	1983
Kazakhstan							1994	2000	1994
Korea DPR	1982						1994		1985
Korea RO	1983	1996	1996	2008	2003		1994	1993	1996
Mongolia	1982	1996					1993	1996	2003
Tajikistan							1997		
Uzbekistan							1995	1997	
Oceania									
Australia	1982	1994	1995	1999	2004	2010	1993	1976	1990
Cook Islands	1982	1995		1999	2006		1993		
Fiji Islands	1982	1982	1995	1996			1993	1997	
Kiribati		2003		2005			1994		2007
Marshall Islands		1991	1995	2003			1992		1988
Micronesia FSO		1991	1995	1997			1994		
Nauru	1982	1996		1997			1993		
New Zealand	1982	1996	1995	2001	2005	2009	1993	1989	1998
Niue	1984	2006	1995	2006			1996		
Palau		1996		2008			1999	2004	
Papua New Guinea	1982	1997	1995	1999			1993	1975	1993
Samoa	1984	1995	1995	1996		2009	1994	2004	2002
Solomon Islands	1982	1997		1997			1995	2007	2004
Tonga		1995	1995	1996			1998		1996
Tuvalu	1982	2002		2009			2002		1985
Vanuatu	1982	1999	1996				1993	1989	1991
China									
China PR*	1982	1996	1996				1993	1981	1988
Other APFIC									
France	1982	1996	1996	2003	1996**	2010	1994	1978	1981
UK		1997	1995	2001/2003	1996**		1994	1976	1986
USA			1995	1996	1995	2009	***	1974	1987
Total region**	**33**	**35**	**19**	**23**	**6**	**6**	**43**	**31**	**26**

Note: (n = 46); (sign = signed; rat = ratified; ac = acceded; acc = accepted

* excluding Taiwan POC, Macau SAR and Hong Kong SAR

** Through European Union

*** USA signed CBD in 1993, but has not ratified/acceded to the convention

**** Out of a total of 43 countries in the region (excluding France, UK, USA and see * above)

European Union signed the Port State Measures agreement in 2009 and approved it in 2011

Table 59 Countries that have started the process of implementing the FAO IPOA (through development of an NPOA or other measures equivalent in national planning documents)

	IUU Fishing	Capacity	Sharks	Seabirds
	NPOA	NPOA	NPOA	NPOA
South Asia				
Bangladesh	N			
Bhutan				
India		N		
Maldives	N	N	N	N
Nepal				
Pakistan	N			
Sri Lanka		N		
Southeast Asia				
Brunei Darussalam	Yes (2011)			
Cambodia				
Indonesia		Yes	Yes?	
Lao PDR				
Malaysia	Draft	Yes	Yes (to be updated)	NA
Myanmar				
Philippines		N		
Singapore				
Thailand	Draft	N	Draft being updated	
Timor-Leste				
Viet Nam	Draft	Draft		
Other Asia				
Iran IR				
Japan	Yes		Yes	Yes
Kazakhstan				
Korea DPR				
Korea RO	Yes			
Mongolia				
Tajikistan				
Uzbekistan				
Oceania				
Australia	Yes	N	Yes	Yes
Cook Islands	Draft			
Fiji Islands	Draft			
Kiribati	Draft			
Marshall Islands			Draft	
Micronesia FSO	Draft			
Nauru				
New Zealand	Yes			Yes
Niue	Draft		Draft	
Palau	Draft		Draft	
Papua New Guinea	Draft		Draft	
Samoa	Draft			
Solomon Islands				
Tonga	Draft			
Tuvalu	Draft			
Vanuatu	Draft			
China				
China	N	N		
Taiwan POC			Yes	
Other APFIC				
France	Yes			
UK	Yes		Yes	
USA	Yes	Yes	Yes	Yes
Region total*				
NPOA	5	2	4	3
Draft NPOA	14	0	4	
National equivalent	4	7		

The symbols used denote the following: Yes = NPOA; (draft) = draft NPOA; (N) = measure/policy on national level addressing the specific issue (NA) = not applicable

*Excluding France, UK and USA.

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