of F1 and F2 selected fish, and with breeding planned for the selected F2 generation.

With quality of fingerling production still an issue in Indonesia, it was encouraging to see an increasing focus on improving fingerling quality. Wiwie Soemarjati (BBAP Situbondo) gave an interesting presentation on good hatchery practices for mouse grouper. Good hatchery practices include: sterilisation and thorough cleaning of larval rearing tanks prior to stocking, stocking with PCR-tested eggs, washing eggs in iodine solution to reduce bacterial levels, and using nutritional supplements to improve the nutritional composition of live feeds (rotifer and brine shrimp). The implementation of these procedures has improved larval survival from 3–4% to 6.5–8%, while the rate of deformity in juvenile mouse grouper has dropped from 5–7% to 1.5–2%. Growth rate also improved, with Day 60 grouper reaching 2.8 – 3.7 cm.

The nursery stage of grouper aquaculture continues to have high mortality due to canniablism, particularly with the popular tiger grouper (*Epinephelus fuscoguttatus*). In South Sulawesi, Mohd. Syaichudin, Nana, Suarni, Naomi, Hasmawati and Maqbul (BBAP Takalar) found that increased water flow, higher feeding frequency and nursery tank design improved the survival rate of tiger grouper from the usual 25–30% up to around 70%.

Although there is considerable interest in coral trout (*Plectropomus* spp.) aquaculture in Indonesia (and elsewhere), there were only a few presentations on coral trout at the conference. Ketut Suwirya and N.A. Giri presented their experiences with coral trout spawning, hatchery and grow-out at RIM Gondol. They noted that coral trout are more susceptible to parasitic infestations than other grouper species. RIM Gondol has developed a treatment regime for coral trout (*P. leopardus*) to reduce this problem, involving the regular application of formalin and a commercial product. Coral trout broodstock spawn monthly, spawning between midnight and 0200. Hatchery survival is about 1–3%. Experimental grow-out in sea cages took 9 – 10 months to reach 500 g (starting from 15 g). *P. leopardus* is relatively sensitive to environmental perturbations.

Herno Minjoyo (BBPBL Lampung) presented some results on grow-out of coral trout on different feeds. This experiment compared feeding 'trash' fish and a commercial pellet. Overall the results were extremely poor for the commercial pellet: only 16% survival compared with 93% for fish fed 'trash' fish. It was suggested that poor quality of the pellet feed (or possibly poor storage and transportation procedures) may be to blame for this result. Such results indicate the need to improve the composition, handling and storage of pellet feeds for these to replace the widespread use of 'trash' fish as a grow-out feed for marine finfish aquaculture.

The above gives just a sample of the marine finfish presentations and posters from 'Indonesian Aquaculture 2007' intended to give members of the Asia-Pacific Marine Finfish Aquaculture Network some insight into current research and development, as well as commercial, activities in Indonesia. It also highlights the strong level of technical support that is provided to the Indonesian industry by the Directorate-General of Aquaculture and the Central Research Institute for Aquaculture of the Ministry of Marine Affairs and Fisheries. Obviously, there is still a strong focus on grouper production because of the high prices and continuing strong demand from the live fish trade. However, other species are also being developed for marine fish farming, such as the golden trevally (*Gnathanodon speciosus*) and pompano (*Trachinotus blochii*). 'Indonesian Aquaculture 2007' was a great opportunity to see how aquaculture in Indonesia is progressing. The 2007 conference was such a success that the next conference is being planned for 2008 or 2009.

Production update – marine finfish aquaculture in the Asia-Pacific region

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Introduction

The Food and Agriculture Organisation of the United Nations (FAO) has recently released the annual update of global aquaculture production and value statistics (http://www.fao.org/fi/website/FIRetrieveAction.do?dom=topic&fid=16073). This article summarises recent changes in production trends for marine finfish aquaculture in the Asia-Pacific region based on these FAO data, which now cover the period up to 2005. Although the FAO data sets go back to 1950 (production) and 1984 (value) only the last 10 years' data are presented here.

Please note: the data compiled by FAO are provided by the producer countries. In many cases the classification of aquaculture production is not reliable (see the FAO web site for comment on the accuracy of the data sets), so these data should be treated with some caution. To reduce potential inaccuracies I have confined this analysis to fairly broad search criteria, or to well-known species. Unless otherwise noted, data were sorted for: Countries: Continent = Asia & Oceania; Environments: Brackishwater & Mariculture.

Marine finfish

Production of marine finfish in the Asia-Pacific region increased by 11% between 2004 and 2005, from 1,031,800 to 1,143,719 tonnes (Table 1). Value increased by 9%, from USD 3.815 billion to 4.141 billion from 2004 to 2005 (Table 2). The largest producer remains China, with 659,000 tonnes of production in 2005 valued at USD 662

Figure 1. Value in USD millions (line) and production by country (columns) of milkfish (*Chanos chanos*) in the Asia-Pacific region, 1996 – 2005.

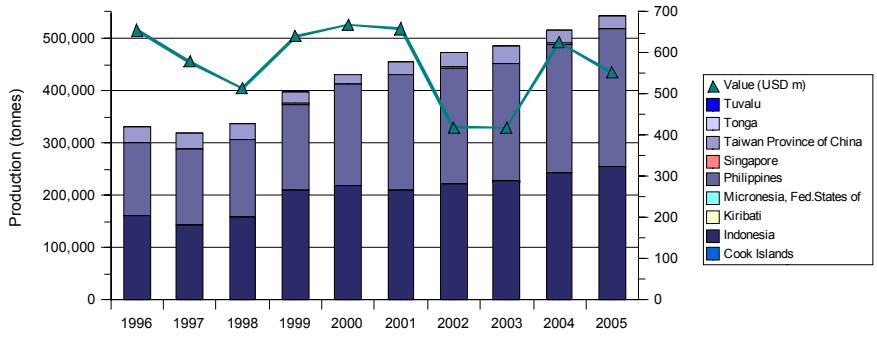


Figure 2. Value in USD millions (line) and production by country (columns) of barramundi (*Lates calcarifer*) in the Asia-Pacific region, 1996 – 2005.

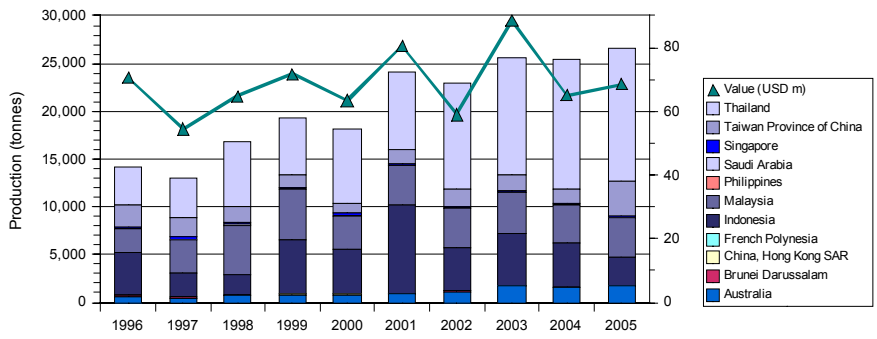
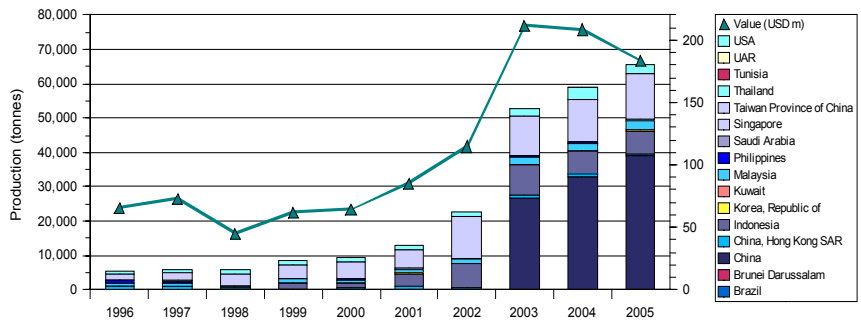


Figure 3. Global production value in USD millions (line) and production by country (columns) of groupers (Family Serranidae), 1996 – 2005.



million, followed by Japan with 256,000 tonnes, valued at more that USD 2 billion. Korea is the second-highest value producer of marine finfish, with USD 698 million from 80,522 tonnes of production.

These data suggest that production in Japan and Korea is of higher-value species than that of China. Japan produces around 22% of regional production, but the value of Japanese production is almost 50% of the regional total. The bulk of Japanese production of marine finfish (~160,000 tonnes) remains the Japanese amberjack (Seriola quinqueradiata).

Production trends in some selected species

Milkfish

Milkfish (Chanos chanos) remains a popular commodity in Indonesia and the Philippines: production of milkfish increased from 514,666 tonnes in 2004 to 542,842 tonnes in 2005 (Figure 1). However, value of production decreased from USD 627 million to USD 552 million over the same period (Figure 1), representing a decrease in price from around USD 1.20 to USD 1.00 per kilogram.

Barramundi (Asian seabass)

Barramundi production stayed relatively steady at 26,584 tonnes, up slightly from 25,399 tonnes in 2004 (Figure 2) (note that these figures exclude production listed as from freshwater, which is a relatively minor component of total production). Thailand remains the largest producer of aquacultured barramundi. Total value of production increased slightly from USD 65.08 million to USD 68.52 million (Figure 2). Average price remained steady at about USD 2.50 – 2.60 per kilogram.

Grouper

Global production of groupers increased from 59,146 to 65,362 tonnes from 2004 to 2005, an increase of 11% (Figure 3). (Note that this analysis includes countries outside the Asia-Pacific region, however the bulk of production is from Asia-Pacific countries). Despite this increase in reported production, total value of production decreased by 12%, from USD 208.5 million to USD 183.6 million over the same period (Figure 3). This may reflect increasing market saturation by farmed product, particularly by some lower-value grouper species, and consequent price decreases.

Japanese amberjack

Although there is some production of Japanese amberjack from the Republic of Korea, the bulk of production is from Japan (Figure 4). Production increased from 150,068 to 159,741 tonnes from 2004 to 2005, and value increased from USD 1.276 billion to USD 1.359 billion (Figure 4). The price of Japanese amberjack has remained steady at USD 8.50 per kilogram since 2001.

Cobia

Cobia (*Rachycentron canadum*) is an emerging species of considerable interest to farmers in the Asia-Pacific region. Presently, China and Taiwan Province of China are the only two countries in the Asia-Pacific region to report production of cobia. The apparent dramatic increase in cobia production in 2003 (Figure 5) is likely due to China

Table 1. Production of marine finfish through aquaculture (tonnes) in the Asia-Pacific region 1996 – 2005. FAO data sorted for ISSCAAP Division: Marine Finfish; Countries: Continents = Asia & Oceania; Environments: Brackishwater & Mariculture.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Australia	2,013	2,184	1,699	1,602	2,731	4,075	4,012	7,804	9,562	7,467
Bahrain	3	<0.5	1	3	12	<0.5	3	4	8	3
Brunei Darussalam	<0.5	<0.5	<0.5	36	53	30	16	18	42	42
China	182,155	254,979	306,697	338,805	426,957	494,725	560,404	519,158	582,566	658,928
China, Hong Kong SAR	3,000	2,960	1,200	1,250	1,769	2,468	1,211	1,486	1,541	1,539
Cyprus	670	842	1,053	1,313	1,735	1,725	1,705	1,654	2,319	2,245
Fiji Islands	<0.5	-	-	-	-	-	-	-	-	-
French Polynesia	.	.	2	3	1	4	1	1	.	2
Guam	5	5	5	7	7	7	7	.	.	.
India	-	1,429	1,740	.	.	.	.	2,644	8,000	8,000
Indonesia	10,512	12,264	8,386	14,879	12,623	15,020	23,007	22,810	19,884	18,783
Israel	699	1,430	1,817	2,359	2,874	3,404	3,202	3,349	3,850	3,864
Japan	247,822	245,847	255,297	253,289	245,566	252,173	260,382	264,710	252,674	256,192
Korea, Republic of	11,384	39,121	37,323	34,382	27,052	29,297	48,073	72,393	64,195	80,522
Kuwait	90	154	150	176	346	179	179	164	100	142
Malaysia	3,367	2,706	2,266	3,092	5,645	5,165	5,570	7,369	7,704	8,451
Oman	-	-	13	-	-	-	-	352	503	168
Philippines	602	726	144	188	266	376	305	732	591	724
Qatar	1	2	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5
Saudi Arabia	<0.5	<0.5	31	30	42	62	45	49	41	182
Singapore	378	205	210	295	421	259	181	226	396	579
Taiwan Province of China	10,972	13,511	15,373	14,558	15,518	17,450	26,715	29,553	26,925	25,192
Thailand	1,546	1,243	1,682	1,175	1,358	1,463	1,179	2,349	3,597	2,300
Turkey	11,530	13,800	18,810	23,000	33,337	28,485	26,020	37,717	46,732	67,824
United Arab Emirates	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2,300	570	570
TOTAL	**486,749**	**593,408**	**653,899**	**690,442**	**778,313**	**856,368**	**962,217**	**976,842**	**1,031,800**	**1,143,719**

Table 2. Value of marine finfish production (USD millions) in the Asia-Pacific region 1996 – 2005. FAO data sorted for ISSCAAP Division: Marine Finfish; Countries: Asia, Oceania; Environments: Brackishwater, Mariculture.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Australia	31.5	30.4	17.9	24.4	86.6	106.7	103.3	174.5	179.2	107.0
Bahrain	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Brunei Darussalam	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.2	0.2
China	127.5	178.5	184.0	203.3	256.2	321.6	560.4	474.0	536.5	662.1
China, Hong Kong SAR	35.7	35.0	11.3	9.4	14.6	23.0	9.5	12.8	12.6	11.3
Cyprus	6.2	7.0	7.9	8.4	8.9	7.9	8.9	9.7	17.8	16.8
Fiji Islands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
French Polynesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
India	0.0	0.7	0.8	0.0	0.0	0.0	0.0	3.4	7.1	7.3
Indonesia	17.9	20.8	14.3	28.5	26.3	33.6	58.0	98.9	61.1	23.0
Israel	9.7	19.5	21.3	27.8	21.4	21.9	17.3	17.5	20.8	21.3
Japan	2,295.0	2,141.1	1,877.8	2,082.1	2,019.6	2,058.0	2,102.5	2,103.2	2,001.3	2,044.4
Korea, Republic of	150.3	434.7	266.6	326.0	275.8	227.5	298.0	536.8	530.9	698.1
Kuwait	0.6	0.9	0.9	1.1	2.2	1.2	1.2	1.1	0.6	0.9
Malaysia	23.6	22.8	10.7	12.2	21.7	19.2	19.5	39.2	35.4	44.4
Oman	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.7	2.3	0.9
Philippines	6.8	6.7	1.1	1.3	1.3	1.8	1.2	2.3	2.7	3.1
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saudi Arabia	0.0	0.0	0.1	0.1	0.2	0.3	0.2	0.2	0.2	1.1
Singapore	2.8	1.7	1.6	1.9	2.5	1.6	1.1	1.9	2.7	3.5
Taiwan Province of China	56.5	72.7	78.8	84.1	91.5	96.9	107.5	144.1	141.7	137.0
Thailand	10.6	9.4	9.3	8.2	8.8	8.8	6.4	11.9	21.6	13.8
Turkey	97.4	114.5	153.2	169.1	130.9	85.4	78.1	176.5	236.1	340.5
United Arab Emirates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	4.3	4.3
TOTAL	**2,872.0**	**3,096.5**	**2,657.5**	**2,988.1**	**2,968.8**	**3,015.6**	**3,373.4**	**3,816.8**	**3,815.2**	**4,141.0**

Figure 4. Value in USD millions (line) and production by country (columns) of Japanese amberjack (*Seriola quinqueradiata*) in the Asia-Pacific region, 1996 – 2005.

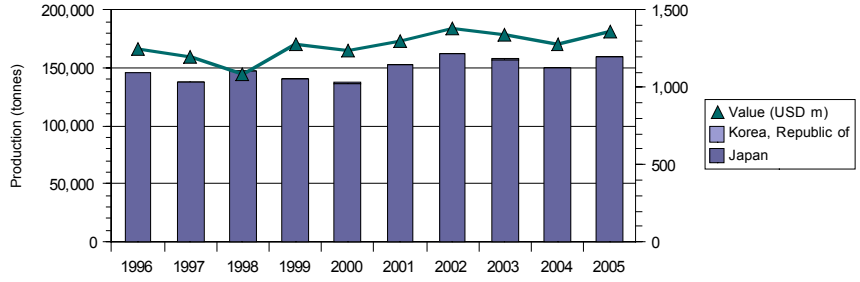
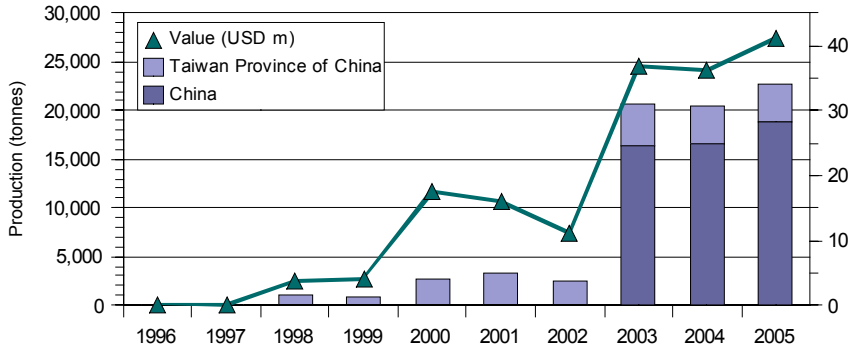


Figure 5. Value in USD millions (line) and production by country (columns) of cobia (*Rachycentron canadum*) in the Asia-Pacific region, 1996 – 2005.



beginning to report disaggregated production which had previously been reported as 'marine finfish' production. In 2004 – 2005, cobia production increased from 20,461 to 22,745 tonnes (Figure 5). Outside of the Asia-Pacific region, only Mayotte and Réunion reported small production of cobia (~ 7 tonnes in total). Total value of production increased from USD 36.2 million to USD 41.2 million (Figure 5). Price remained relatively steady at around USD 1.80 per kilogram.

Conclusion

Marine finfish aquaculture continues to expand in the Asia-Pacific region. Over the last 10 years, regional marine finfish production has grown at around 10% per annum and the 2004 – 2005 increase of 11% was in line with this general trend. The 9% increase in value in 2004 – 2005 indicates that markets generally remain relatively strong; this is substantially higher than the ten-year average value increase of 4% per annum.

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Body size of rotifers (*Brachionus rotundiformis*) from estuaries in North Sulawesi

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Introduction

Rotifer has been extensively used as a live prey for marine larvae of different taxa since the 1960s, and is still considered the main supplier of nutrition for seed production in many hatcheries. The main species of cultured rotifer for finfish larval rearing world-wide, SS-morphotype of *Brachionus rotundiformis*, has been used in the research lines of many projects. However, for larvae with very small mouths, it is intended to have a greater proportion of super small rotifers by improving culture methods. Knuckey et al. (2005) have found that smaller sized diets could increase the proportion of the small group in a rotifer population, via selection pressure on the growth and size distribution of rotifers.

Studies on *B. rotundiformis* from North Sulawesi waters have been performed since 1994 with emphasis so far on the bioecological aspects and reproductive ability, but there has been no attempt to compare body size of wild rotifers from different locations in order to select the most suitable strain in terms of size and growth performance. The change of body size after culture was clarified in this study.

Materials and methods

Rotifer collections were conducted at four estuaries in North Sulawesi, Manembo-nembo and Minanga estuaries, and Wori and Tumpaan estuaries connected to Maluku and Sulawesi Sea, respectively. A clonal culture of Minanga rotifers was then developed at 20 ppt fed on two types of diet, *N. oculata* (3-5 µm in cell diameter) and a local symbiotic microalga *Prochloron* sp (2-4 µm in cell diameter) both at 3 x 106 cells/ml. The algae were cultivated in Hirata medium of sterilized diluted sea water (20 ppt) and maintained at 25ºC. A total of about 30 egg bearing females from each location and of the culture stock of