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

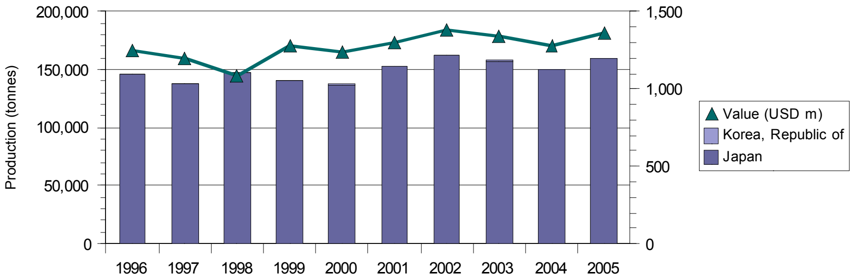
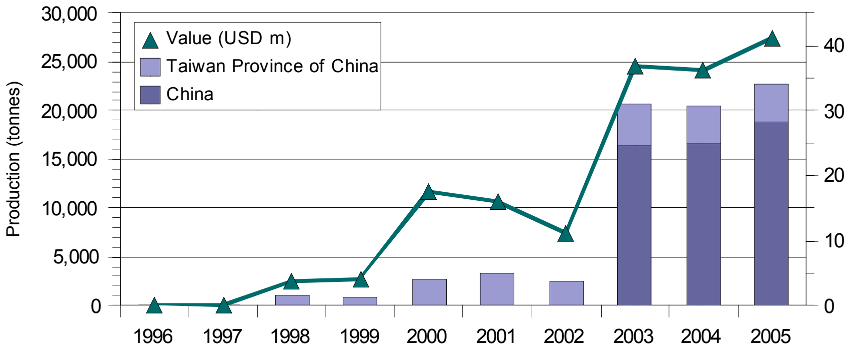


Figure 5. Value in USD millions (line) and production by country (columns) of cobia (*Rachycentron canadum*) in the Asia-Pacific region, 1996 – 2005.



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 each treatment were preserved with 4% formaldehyde solution for morphometric measurements.

Results and discussion

Table 1 lists the average body size of the wild and cultured rotifers. Lorica length of wild rotifers from all locations was not significantly different, but the lorica width and the anterior width are significantly different. The average of anterior width and lorica width taken from Minanga waters are higher than those of other locations (Manembo-naembo, Wori and Tumpaan). The size range of body size is relatively smaller than the other tropical SS-type rotifers (Thai, Fiji and Okinawa strains) as reported by Hagiwara et al., 1995).

Previous studies on rotifers from North Sulawesi (Rumengan *et al.*, 1998; and Yoshinaga *et al.*, 2004) have shown that the local rotifers belong to SS type rotifers of *B. rotundiformis*. The wild rotifers of present study are slightly bigger than the previous local strain, but much smaller for the cultured rotifers, as Rumengan *et al.* (1998) found that lorica length of egg bearing wild rotifers (150.7 ± 17.6 µm) was much smaller than that fed on Tetraselmis (199.2 ± 10.6µm), but similar to those fed on *N. oculata* (150.7 ± 12.9µm) and *Isochrysis* sp (151.5 ± 14.9µm). This is consistent with the finding of Knuckey *et al* (2004) that particle size of diet influences the degree of morphological plasticity in size. The present study shows that when fed on *Prochloron* sp the rotifers are getting smaller (Table 1). *Prochloron* sp used was isolated from the Ascidians, *Lissoclinum patella* from Manado Bay, North Sulawesi. This symbiont has previously been reported as 'uncultivable prokaryotic alga' since its discovery 40 years ago (Lewin and Cheng, 1989; Munchoff *et al.*, 2007), but it has been successfully maintained in culture away from their host in Laboratory of Marine Biotechnology, Sam Ratulangi University since 2005. However, in culture at 20 ppt their size reduced by 20% from their original size (10-30 µm) (unpublished data).

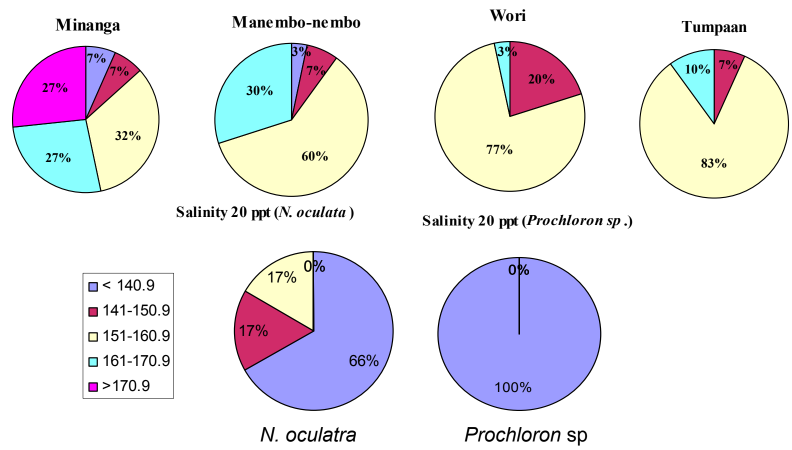
It can be seen in Fig. 1, only small portion of wild rotifer population (<20%) have body size of <141 um, but whole population of cultured rotifers are within that size range, especially those fed on *Prochloron* sp. However, it is still necessary to clarify this by long term culture and increasing the culture scale

Table 1. Body size* (µm) of wild rotifers from different locations and of cultured rotifers fed on *N.oculata* and *Prochloron* sp.

Rotifer*	Lorica Length (A)	Lorica Width (C)	Anterior Width (B)
Wild rotifers:			
Menembo-nembo	162.4 ± 8.6	119.6 ± 6.9	70.3 ± 5.2
Minanga	163.8 ± 6.9	122.6 ± 5.7	71.1± 5.3
Wori	161.8 ± 6.9	116.8 ± 6.4	69.7 ± 6.3
Tumpaan	161.3 ± 7.1	117.0 ± 6.9	69.4 ± 5.4
Cultured rotifers:			
N. oculata	127.4 ± 20.11	103.3±16.7	57.1±9.7
Prochloron sp.	108.8± 10.2	92.7±11.7	52.0±6.5

*Values are in average ± STD.

Figure 1: Lorica length of wild rotifers (upper graphs) and cultured rotifers (lower graphs) showing the proportion (%) of each size range (µm)



for mass production to meet the requirement of finfish larvae. As Knuckey *et al.*, 2004 has previously found that higher percentages of smaller rotifers suitable for first feeding larvae were obtained when rotifers were fed with ultra-small algae such as *Stichococcus* sp, but this alga is difficult to maintain in large scale culture in tropical region. Long term culture of *Prochloron* sp and their effects on rotifer growth performances in large scale remain for future studies.

References

Hagiwara, A., T. Kotani, T.W. Snell, M. Assava-Aree, and K. Hirayama: Morphology, reproduction and genetics of the tropical minute marine rotifer *Brachionus* strains. J. Exp. Mar. Biol. Ecol., 194: 25-37.

Knuckey, R.M., I. Rumengan and S. Wullur. 2004. SS-strain Rotifer Culture for Finfish Larvae with Small Mouth Gape. In: Advances in Grouper Aquaculture (M.A. Rimmer, S. McBribe and K.C. Williams, eds). ACIAR Monograph Series. p. 21-25.

Lewin, R.A dan Cheng L. 1989. *Prochloron*: A Microbial Enigma. Printed in the United States of America. pp. 115.

Munchhoff, J., E. Hirose, T. Maruyama, M. Sunairi, B.P. Burns, and B.A. Neilan, 2007. Host specificity and phylogeography of the prochlorophyte *Prochloron* sp., an obligate symbiont in didemnid acidians, Environ Microbiol. Vol 9(4): 890-9.

Rumengan, I.F.M., V. Warouw, and A.Hagiwara, 1998. Morphometry and resting egg production potential of the tropical ultra minute rotifer *Brachionus rotundiformis* (Manado strain) fed with different algae. Bull of Fac. Fisheries, Nagasaki University 79:31-36.

Yoshinaga, T., Y. Minegishi, I.F.M. Rumengan, G. Kaneko, S. Furukawa, Y. Yanagawa, K. Tsukamoto, and S. Watabe, 2004. Molecular phylogeny of the rotifers with two Indonesian *Brachionus* lineages. 2004. Coastal Marine Science, 29(1): 45-56.