

BIOLOGICAL REPRODUCTIVE OF ESTUARINE FISH COMPARING BETWEEN DEMERSAL (LONG TONGUE SOLE, *Cynoglossus lingua*) AND PELAGICAL (MUSTACHED THRYSSA, *Thryssa mystax*) ASSEMBLAGES

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Received May 6-2009; Received in revised from May 18-2009; Accepted May 28-2009

ABSTRACT

An investigation on biological reproductive of demersal (represented by the long tongue-sole, *Cynoglossus lingua*) and pelagic (represented by *Thryssa mystax*) marine fish was carried out in Ujung Pangkah Estuary during 2005-2006 representing 12 months period, so that a yearly-round reproductive pattern is known. The fish was collected by traps and gill net from the study area and analyzed for sex ratio, length at maturity, gonad maturity level, fecundity, and eggs diameter. The results showed that there is variability in reproductive pattern of both coastal waters inhabitant. The reproductive strategy of both species is discussed.

KEYWORDS: *Cynoglossus lingua*, *Thryssa mystax*, Ujung Pangkah Estuarine, reproductive pattern

INTRODUCTION

Estuarine habitats are important nursery and feeding areas for a variety of fish and invertebrates species. Ujung Pangkah Estuary is the river mouth of the downstream of the Bengawan Solo River, the longest river in Java Island, just situated at the tip of the Gresik District, East Java Province, Indonesia. The estuary is typical for nutrients rich area derives from land to supports marine life including those estuarine fish assemblages. This is likely since the area is nearby the fishing ground where fishermen depend their livelihood from collecting fish, shrimps, and mollusks (e.g. Febianto, 2007, unpublished).

Cynoglossus lingua belongs to subfamily Cynoglossinae of the family Cynoglossidae, and popularly known as *long tongue-sole*. This species is virtually found in all Indonesia's coastal waters inhabiting estuarine habitat. The mustached thryssa (*Thryssa mystax*) belongs to family Engraulididae, occurring in coastal and pelagic waters, mostly in inshore waters and estuaries, and the species is widely distributed in the Indian Ocean and West Pacific, from western coast of India to Lesser Sunda Islands (Allen, 2000; Matsuura *et al.*, 2000). Both species are considered as non-commercial species and collected as by catch, e.g. obtained from mullet (family Mugillidae) fishing (Maharani, 2006). It is, however, inappropriate to state that these two species has lesser meaning in term of the ecological processes in the estuarine ecosystem.

It is common that the reproductive behaviour of estuarine fish is initiated by off-shore migration where they spawn and release their eggs and the larvae are transported back to the coastal estuary. One important

question might be posed whether the spawning occur within equal time period or simultaneously. This is associated with the reproductive strategy of each species in the attempts to maximizing their survival and their fitness. The present study dealt with the biological reproductive encompassing various aspects of sex ratio, length at sexual maturity, gonad maturity level, fecundity, and spawning season for both species. Moreover, the study results were to compare the reproductive performance between the bottom dwellers and upper water column inhabitants in estuarine waters.

MATERIALS AND METHODS

The study site is situated in Ujung Pangkah Estuary shown in the map at the northern tip of East Java Province (Figure 1). Sampling was monthly performed during the year 2005 (August-December) and 2006 (January-July). Fish was caught by local fishermen using *jager* (traps) and drift gill net with 0.75 and 1.75 inch in mesh size, respectively. The fish was preserved in 10% of formaldehyde solution, and transported to Bogor for further analysis.

At laboratory, fish was simultaneously measured for total length (mm) and weighted for total bodyweight (g). After dissection being accomplished, visual observation on sex, gonad maturity level, and gonad staging was done at time. Twenty matured ovaries of each species were selected and enumerated for absolute fecundity by combining gravimetric and volumetric methods. From each ovary, twenty ova were selected randomly and measured by means of a micrometer eye-piece, and then mean eggs diameter was computed for all sample. The laboratory works refer mostly to Effendie (1997).



Figure 1. Sampling area in Ujung Pangkah Estuary of East Java Province.

Based on male and female proportion (M/F), accordingly, sex ratio is determined and tested whether the proportion is 1:1 by χ^2 analysis (Fowler & Cohen, 1997). The monthly gonado-somatic index was calculated as gonad weight/bodyweight timed by 100% (Effendie, 1979). In order to track on gonad development, the histological analysis was carried out referred to Banks (1986). The first maturity level was estimated by Spermman-Karber method (Udupa, 1986).

RESULTS AND DISCUSSIONS

Catch and Size Composition

The total number of specimen collected during 12 mo. periods was 400 (*C. lingua*) and 416 (*T. mystax*) individual fishes, in which the first species consisted of 172 and 228, whereas the second one was 169 and 247 individual males and females, respectively. In similar sequence, fish length varied between 65-385 mm and 69-212 mm, from which both species were grouped into 9 length classes. A relatively similar size range was found in *C. lingua* at Cimandiri Estuary in the southern part of Java (Yulianti, 2003, unpublished).

More than 80% of total catch was dominated by smaller size up to 216 and 148 mm for long tongue sole and mustached thryssa, respectively. It has long

been known that domination of smaller size in a population may indicative to overfishing condition (Chambers & Waiwood, 1996; Chambers, 1997; Trippel *et al.*, 1997). It is reported that maximum size of these two species, respectively, 40 and 20 cm (FAO, 1974). Assuming that unexploited species is characterized, among other, by the finding of the largest size within their population (King, 1997), therefore, the abovementioned statement would be misleading. Both *C. lingua* and *T. mystax* in Ujung Pangkah Estuary are considered as non-commercial species. They are caught in the traps and drift gill net is as bycatch for other fish. If it is so, the exploitation level on these species might be still below the maximum sustainability yield level. Both contrasting facts, however, needs elaboration by conducting a thorough investigation on distribution, life cycle, and population dynamics of these species. It might noteworthy to take into account that population dynamic might not be governed solely by exploitation and predator-prey in the aquatic organisms but also by the presence of birds in Ujung Pangkah Estuary. It has been reported previously (MacKinnon & Phillips, 1993; Jepson, 1997) that the biodiversity in this area is characterized by mudflat and mangrove vegetations of the study area where some 63 species of birds among which are migrating species like Australian pelican (*Pelecanus conspicillatus*) and Asian dowitcher (*Limnodromus semipalmatus*).

Sex Ratio

Figure 2 shows the changes in M/F proportion of both species, in which monthly variation was largely significantly different from 1:1 (χ^2 , $p < 0.05$). For *C. lingua*, the proportion relatively increased at the beginning of the year and reached its peak in August followed by a sharply decreased in September preceding to the rise and fall in the next months. A greater fluctuation occurred by *T. mystax*, where from March-August highly varied prior to follow increased and decreased pattern from September to March. In nature, the composition between male and female is of important meaning for reproductive success with exception for those hermaphrodite organisms. Therefore the greater variation in sex ration may be influenced by the movement or migration pattern intra and inter species.

Length at Sexual Maturity

The results showed that males were at larger size reaching its sexual maturity in both species. In *C. lingua* sexual maturity found at 94 and 85 mm in males and females, respectively. Similarly, the *T. mystax* was firstly mature at 132 and 117 mm comparing both sexes. In all living organisms, sexual maturity is sign of adulthood in which the organisms are able to reproduce their offspring. In fish, length at sexual maturity might be determined by combination of exploitation and environmental conditions (King, 1997). In heavily exploited species, maturity level is reached by smaller size, and the evidence of this phenomenon has been documented in many marine fish species, inter alia, the Indonesian flying fish (Ali, 2005; Kamal, 2007, unpublished). It was reported that a higher exploitation level of this species in the Makassar Strait resulted in smaller size of fish population compared to their compartment in Banten Bay where exploitation level is considerably lower. Although information on this matter is unavailable in both species, therefore, the study result is of preliminary results for other study in investigating the effect of fishing pressure on body size.

Gonad Maturity Level

Figure 3 shows a monthly composition of gonad maturity level of *C. lingua* and *T. mystax*. In the first species, the percentage of mature sex was coincided between males and females. In the second species, however, such pattern was not found where the number of mature males at the fourth maturity stage was virtually absent. It is suggested that such phenomenon might be influenced by migration behavior. In demersal

species like the long tongue-sole, the migration range area is presumably narrower compared to the pelagic species such as the mustached thryssa. Figure 3 has also able to show that the coastal area is, to some extent, an important habitat for males before spawning season.

All ovary developmental stages, including the spawning stage, were almost present every month, which indicated year-round spawning (not shown). Spawning period was studied by checking the temporal profile of the gonado somatic index, and by examining ovaries macroscopically and whole oocytes microscopically. The gonado somatic index values of males and females were varied from 0.16-0.99% and from 0.35-5.23%, respectively. According to average gonado somatic index, the highest values were observed in the samples caught in December for both two sexes. Most individuals spawned in December. The spawning period may occur during the whole year for *C. lingua* reaching its peak season in December-January. Based on information from female maturity level (Figure 3), the spawning season in *T. mystax* may occur earlier in November-December. The variability in spawning season is influenced by the trigger released by environmental cues including temperature and reproductive behaviour which is species-dependent. Unless, a more comprehensive research is performed, however, the premise is unsafe to be applied for both species.

Fecundity, Eggs Diameter, and Spawning Pattern

Fecundity was estimated in 107 females captured just prior to spawning. The number of eggs found in *C. lingua* ranged from 360-35,926 in females on Stage III and IV. Similarly, the fecundity in *T. mystax* ranged between 1,920-28,548 eggs. Most marine teleosts reproduce externally where the fertilization occurs in water column, and afterwards, they are planktonic during larval stage. It has long been known that adaptation pattern in reproduction for those experiences planktonic stage in their life stages, the fecundity has to be high.

Based on eggs diameter measurement, egg size varied between 0.10-0.75 μm of which the largest proportion was between 0.40-0.55 μm , whereas in the mustached thryssa was between 0.08-0.60 μm , with modus of 0.3-0.5 μm . Egg size and number are indicative of exploitation level (Chambers & Waiwood, 1996). However, no conclusion could be drawn on exploitation level of both species based on size. Therefore, a further studies need to be conducted.

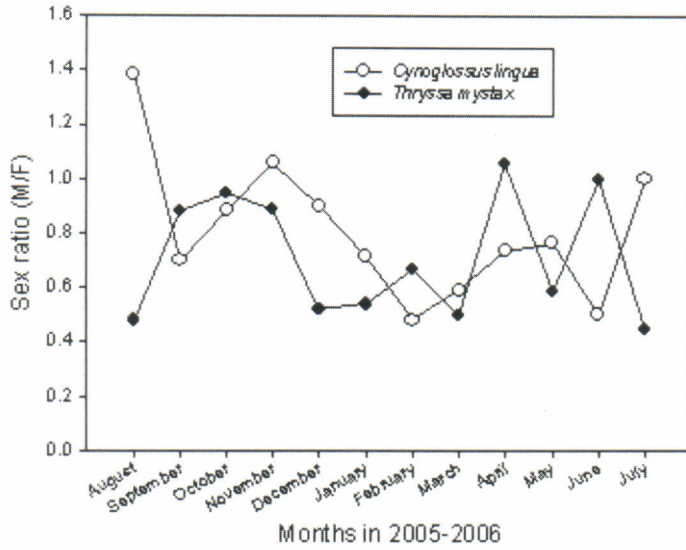


Figure 2. Changes in sex ratio of *C. lingua* and *T. mystax* in Ujung Pangkah Estuary, East Java.

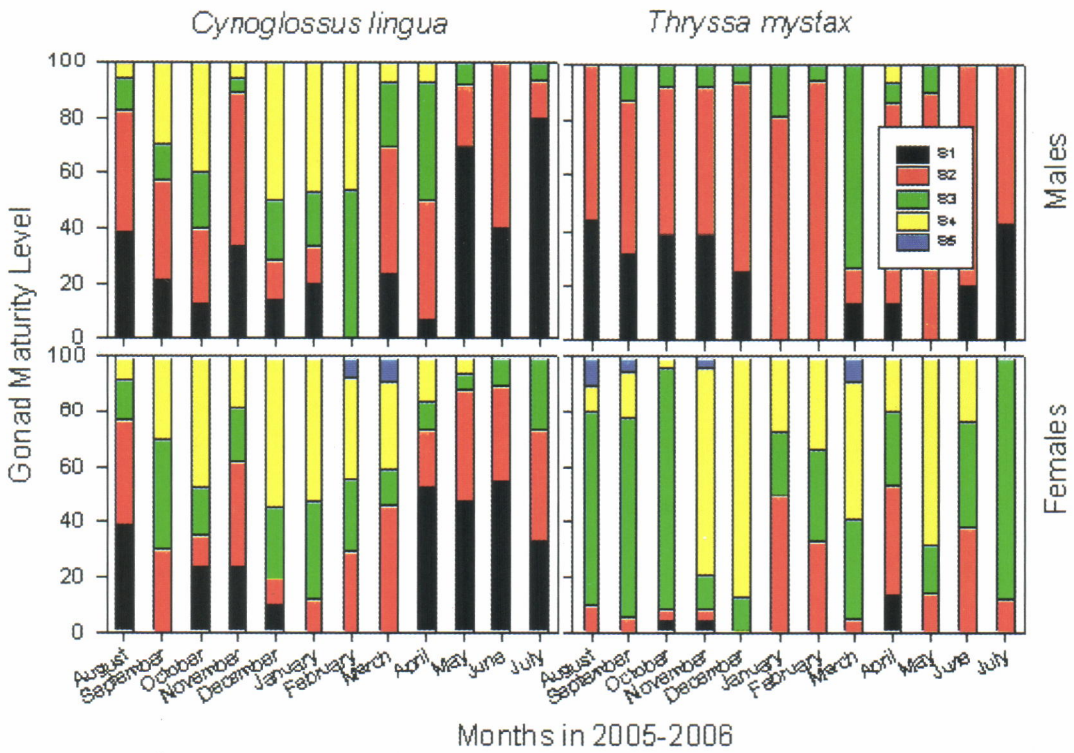


Figure 3. Gonad maturity level of *C. lingua* (left) and *T. mystax* (right) for both males (top) and females (bottom) collected from Ujung Pangkah Estuary during 2005-2006 period. The figures was recalculation and combination from various sources (Fatimah, 2006; Maharani, 2006; Soenanthi, 2006; Febianto, 2007).

Based on egg size distribution, especially obtained from the 4th maturity level, it was found that both species may be categorized as total spawner, i.e. eggs diameter is characterized by one peak within its distribution range.

CONCLUSION

1. Monthly changes in male and female proportion of both species (*Cynoglossus lingua* and *Thyryssa mystax*) was largely significantly different from 1:1.

2. First length maturity was 94 and 85 mm for males and females of *C. lingua*, respectively; and 132 and 117 mm of *T. mystax*.
3. Percentage of mature sex of *C. lingua* was coincided between males and females, but not for *T. mystax*.
4. The spawning period may occur during the whole year for *C. lingua* reaching its peak season in December-January. Based on information from female maturity level, the spawning season in *T. mystax* may occur earlier in November-December.

ACKNOWLEDGEMENT

The authors thank to DR. Sulistiono for financial support to this research. We greatly indebted to our students Lisa Fatimah, Nunik Ristiyani Maharani, Samsin Febianto, and Karlina Deka Soenanthi who collected fish and performed laboratory analysis. DR. Yunizar Ernawati, DR. Djadja S. Sjafei, and DR. Sulistiono are thanked for their supervision on this students' research project.

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