DIFFERENCES IN REPRODUCTIVE TIMMING BETWEEN TWO CO - OCCURRING MULLETS (PISCES, MUGILIDAE) IN A TROPICAL BAY

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INTRODUÇÃO

Natural selection leads to the maximization of lifetime production of offspring, and more importantly, to the maximization of survivorship of offspring until adulthood. The main objective of a reproductive strategy is to maximize reproductively active offspring in relation to available energy and parental life expectancy (Roff 1992, Pianka 2000). In order to achieve this, fish follow different strategies and tactics (Potts & Wootton 1984). It is assumed that both the overall strategy and the tactical variations are adaptative (Stearns 1992). Closely related species should develop strategies to avoid interespecific competition for limited resources and to undergo environmental constraints (Wootton 1992, Amarasekare 2003). Among these strategies, timing segregation in reproduction will enable offspring to maximize the use of the available resources enhancing survival and reproductive success.

Mugil liza Valenciennes, 1836 and *Mugil curema* Valenciennes, 1836 are the most abundant species of Mugilidae in Southeastern Brazil and are very important as fishery resource. In Sepetiba Bay, an embayment in Rio de Janeiro State, *M. liza* and *M. curema* amounted to 99.7% of the total number of mullets caught in experimental samples between 1994 and 1997 (Silva & Araújo 2000). These species have similar realized niche by overlapping feeding habits, offshore reproduction, and using inner bay areas to recruit (Menezes & Figueiredo 1985, Silva & Araújo 2000, Froese & Pauly 2008). Nevertheless, owing to intra - species and inter - species variation in spawning behavior (e.g. timing and duration), there is considerable variation in life - history characteristics of mugilids, even for those that inhabit similar environments (Brusle 1981).

OBJETIVOS

We hypothesized that there are differences in reproductive traits such as reproductive timing in order to avoid offspring competition. To test this hypothesis, the gonadal cycle was compared between these two species.

MATERIAL E MÉTODOS

Sepetiba Bay is located in the southeastern region of the Rio de Janeiro State (22º54’ - 23º04’S; 43º34’ - 44º10’W) and has an area of ca. 450 km2. The rainfall period in the bay region is mainly between December and January (summer), though it can sometimes extend into March. The dry period extends from May to September (winter). South quadrant winds and marine breezes discharge their moisture against the mountain cliffs around the bay and can increase the amount of rain in the dry season (BARBIÉRI & KRONEMBERG 1994). Data on the rainfall was collected from Sepetiba Metereological Base, available at www.rio.rj.gov.br/georio.

Specimens were collected from artisanal commercial catches from July 2006 to June 2007 in the inner zone of Sepetiba Bay. The nets were 1500 m long, 3 m high and had three panels of different mesh sizes (35, 40 and 45 mm or 45, 50 and 55 mm between stretched mesh).

Individuals were randomly chosen each month. Due to the low number of males caught during the study, only females were examined. Total length (TL) to the nearest mm was measured. Total (TW) and eviscerated (EW) weight were measured to the nearest gram, and gonad weight (GW) were determined to a precision of 0.01 g. Gonadal macroscopic description followed Andrade - Talmelli *et al.*, (1996) and MARIN E. *et al.*, (2003).

The gonadosomatic index (GSI = GW x 100 x EW - 1) and frequency of gonad maturation stages were used to assess the gonadal cycle (Vazzoler 1996). Eviscerated weight was used in all indexes calculations to avoid the influence of the contents of the gonad and stomach on the weights. One - way analysis of variance (ANOVA) was used to compare GSI means among months ($p < 0.05$) and r - Spearman rank coefficient was used to assess correlation between monthly rainfall and GSI. All data are expressed as means ± standard error.

RESULTADOS

Macroscopic morphology of gonads

Ovaries are paired, elongated, covered by a fin peritoneal layer and range from filiform to piriform depending on the developmental stage. Cranial regions are larger, getting thinner up the caudal portion. Each gonad duct lies on the dorsal - medial region. These ducts have a small joint leading to a common orifice. Through the gonads, the arteries occupy a supra - visceral position and spread through lateral ramifications that become evident during gonad development. The right gonad is usually larger than the left. Macroscopic description of both *M. liza* and *M. curema* ovaries followed: Immature-Ovaries small, filiform and adhered to the swim - bladder. They are translucent with no sign of blood irrigation; Developing-Ovaries are fusiform and wider than at the previous stage, occupying almost 1/3 the abdominal cavity, and reddish in color. There is some sing of blood irrigation; Maturing-Ovaries wider and almost piriform, filling approximately 2/3 of abdominal cavity. They are reddish - yellow with a granular appearance due to the oocytes and the arteries are easily visible; Ripe (Running ripe)-Ovaries are large, piriform, yellow, smooth in appearance, turgid and round and occupy almost the entire abdominal cavity. Oocytes are easily distinguished macroscopically (as granular) and blood irrigation is evident; Spent-Ovaries are flaccid and wrinkled, occupying about $\frac{1}{2}$ of abdominal cavity. Purple in color; Recovering/ Resting-The wall is thicker and rigid, and ovaries are fusiform, occupying less than 1/3 of the abdominal cavity. Cream in color and the ovarian mass is firm and reddish in color.

Spawning Season

Mugil liza

The mean GSI from examined females showed seasonal differences during the study period ($F = 4.34$; $p < 0.01$). The lowest GSI were recorded between October and March (0.16 $\pm$ 0.02 to 0.27 $\pm$ 0.05, respectively); these values then increased in April (0.6 $\pm$ 0.04) and May (2.87 $\pm$ 1.21), peaking in June (6 $\pm$ 2.0), and then dropping sharply in July (3.89 $\pm$ 1.26), August (2.95 $\pm$ 1.5) and September (0.9 $\pm$ 0.03). Highly significant negative correlation ($p < 0.01$) was found between GSI and the rainfall (r = - 0.76).

Ripe/running ripe ovaries were observed between May and August. Spent ovaries were recorded between May and September. Immature ovaries were observed between July and February; developing and recovering/resting ovaries were found throughout the study period. Maturing ovaries were observed between April and September.

Mugil curema

The mean GSI from examined females showed seasonal differences during the study period ($F = 8.56$; $p < 0.01$). The lowest GSI were recorded between February and June (0.38 $\pm$ 0.06 to 0.52 $\pm$ 0.05, respectively); these values then increased in July (4.13 $\pm$ 0.92) and August (5.6 $\pm$ 1.26), peaking in October (8.5 $\pm$ 1.18) and then dropping sharply in November (4.59 $\pm$ 1.42), December (2.22 $\pm$ 1.09) and January (1.67 $\pm$ 0.89). No significant correlation ($p > 0.05$) was found between GSI and rainfall (r = 0.04).

Ripe/running ripe ovaries were observed between August and January. The only spent ovary was recorded in November. Immature and recovering/resting ovaries were recorded between December and January, and from November to June, respectively. Developing ovaries were found throughout the study period with the highest percentages being observed in April and May. Maturing ovaries were observed between July and January, with the highest percentages in September and October.

A temporal segregation in the spawning season was found for *M. liza* and *M. curema*, with the former showing a shorter reproductive period of four months (May to August, peaking in July) and the latter, a longer reproductive period of six months (August to January, with spawning concentrating between August and October). SILVA & Araújo (2000) reported peaks in recruitment of *M. liza* young - of - the - year in August. Araújo *et al.*, (1997) also found large numbers of *M. liza* juveniles in the inner Bay zones during the winter. These results match with our findings, which indicate that the spawning of this species occur in winter. Although no confirmatory information on reproductive period of *M. curema* is available, our observations of GSI and frequency of gonadal stages leads to a different reproductive period from *M. liza*.

Temporal separation in the spawning periods for mugilids has been reported elsewhere. Ditty & Shaw (1996) obtained *Mugil cephalus* Linnaeus, 1758 larvae from the northern Gulf of Mexico between October and March, with peak abundance in November and December, and *M. curema* larvae between April and September, with peak abundance in April and May and a decrease from August–September. Collins & Stender (1989) collected mullet larvae of both species (*M. cephalus* and *M. curema*) in only 7.4% of neuston samples from February–May. Differences in reproductive period between co - generic and co - occurring mullets was also reported by Ibañez Aguirre & Gallardo - Cabello (2004) for *M. chephalus* and *M. curema* Reproduction in Venezuelan waters, and by Kendall & Gray (2008), for *Liza argentea* (Quoy & Gaimard, 1825) and *Myxus elongatus* Günther, 1861 in Southeastern Australia.

Different species may be limited by the same resources availability but differs in terms of when they exploit the resource (Armstrong & Mcgehee 1980, Chesson 2000). Segregation in reproductive period is attributed to reduce competition between offspring for space and available food resources. According to several authors (e.g. Menezes & Figueiredo 1985, Yánez - Aracibia 1976, Blaber 2000, Silva & Araújo 2000, Froese & Pauly 2008) mugilids have similar feeding habits, diets and recruitment habitats. Therefore, offspring competitive pressure could lead selection to different spawning period of these two closed related species, a tactic used to enable coexistence, since they use the same area to recruit.

CONCLUSÃO

Mugil liza and *M. curema* from Sepetiba Bay are co generic species with similar environment use and exhibits different reproductive timming, maximizing the offspring survival. The reproduction period of these two species seems to be influence by each other and rainfall. *Mugil liza* spawns between May and August while *M. curema* spawns occur between August and January and it represent a 3 - mo difference in the spawning peak and diferences in recruitment timing of each species.

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