NOTE
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ANNUAL FECUNDITY ASSESSMENT FOR THE RIO SKATE *Rioraja agassizi* (CHONDRICHTHYES: ARHYNCHOBATIDAE) ENDEMIC TO A NEOTROPICAL AREA (SOUTHEASTERN BRAZIL)

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The Rio skate *Rioraja agassizi* (MÜLLER; HENLE, 1841) is an endemic species distributed over a restricted neotropical area extending from Rio de Janeiro, Brazil, to Uruguay and southern Argentina (ODDONE et al., 2006, 2007a,b). This species inhabits coastal waters from the shore down to 130 m (FIGUEIREDO, 1977), feeding on benthic organisms, mainly crustaceans and teleosts (MUTO et al., 2001). ODDONE et al. (2007a) noted that male *R. agassizi* attained sexual maturity at 320 mm and females at 400 mm of total length (TL). From samples collected off Santos, southeast Brazil, ODDONE et al. (2007b) observed that mean female total length was significantly higher than that of males. Additionally, the largest male and female specimens had a TL of 549 mm and 472 mm, respectively. Southward, between Uruguay (34°S) and northern Argentina (42°S), COLONELLO et al. (2007) also recorded that males mature at TL of 400-500 mm and females at 500-550 mm. Off Puerto Quequén (Argentina), ESTALLES et al. (2009) noted that the smallest adult male and the smallest adult female were of 485 mm and 530 mm TL, respectively, while all males and females were adult over 590 mm and 629 mm, respectively. Therefore, in the three areas quoted, female *R. agassizi* were larger than the males - thus providing another instance of the sexual dimorphism in size recorded for rajoid species (see MELLINGER, 1989).

Further, latitudinal differences in size were observed between specimens from these areas, probably due to environmental factors, a phenomenon first recorded by LELOUP and OLIVEREAU (1951) in oviparous elasmobranch species and which has been frequently reported in rajoid species (CAPAPÉ et al., 2004, 2007 a). Such a pattern has also been observed in the egg cases extracted in utero from female *R. agassizi*, that were larger off Puerto Quequén (ESTALLES et al., 2009) than those off Southern Brazil (ODDONE et al., 2006).

ODDONE et al. (2007a) noted that reproductive activity was continuous for specimens from southeastern Brazil, with vitellogenesis, ovulation, egg-laying and presence of sperm in seminal vesicles being observed all the year round. Additionally, ODDONE et al. (op. cit.) suggested an annual cycle for *R. agassizi*, with reproductive activity peaking at least once a year. Similar patterns were observed by ESTALLES et al. (2009) who noted a peak of reproductive activity in spring for specimens collected off Puerto Quequén.

From studies related to the brown ray *Raja miraletus* LINNAEUS, 1758 and the rough ray *R. radula* DELAROCHE, 1809 caught in Tunisian waters (CAPAPÉ; QUIGNARD, 1975), and more recently related to the thornback ray *R. clavata* LINNAEUS, 1758 from off the Languedocian coast (CAPAPÉ et al., 2007b), two categories of oocytes have been distinguished: translucent oocytes and yolky oocytes. Among the latter, three batches of yolky oocytes were considered, i.e., one batch of large oocytes generally ready to be ovulated, and two batches of large and small developing oocytes, respectively. Each batch exhibited oocytes similar in size and mass. CAPAPÉ and QUIGNARD (1975) estimated the fecundity of rajid species based on maximal numbers of small,

medium and large yolky oocytes counted in females. For rajoids, CAPAPÉ and QUIGNARD (1975) noted that total number of oocytes increased with the size of the female. However, some small and medium yolky oocytes did not attain their full development (or, *did not develop*) and disappeared and that, further, some fully yolky oocytes underwent atresia and were probably reabsorbed by the ovaries, others were unfertilized, or not encased in egg cases. All oviparous elasmobranch species are serial spawners (HOLDEN, 1975), so production of egg cases cannot be precisely assessed. In this paper fecundity was assessed by using HOLDEN's (1975) indirect method, based on the estimation of the average number of egg cases laid by adult females. Previously, HOLDEN et al. (1971) had noted that the rate of egg case laying by the thornback ray in aquaria was one egg case per day and this rate was continuous for 26 days. Then HOLDEN (1975) regarded the month in which this production was at a maximum as corresponding to a rate of one egg case laid; then the rate for other months would be proportional to the occurrence of eggs egg cases in that month multiplied by the number of days for each month. Consequently, in order to assess fecundity following HOLDEN (1975), we have only considered two categories of adult females in our sample: bearing egg case and non-bearing egg case. Specimens were collected from commercial fishing landings at Guarujá, São Paulo State, Brazil, monthly from March 2005 to April 2006. The study area was situated between latitudes 23°37'S and 27°40'S, at depths of between 10 and 146 m. The number of females collected per month is presented in Table 1. Additionally, we provide the estimate of the average number of egg cases laid by adult female *R. agassizi* following HOLDEN (1975) (Table 2). Seemingly the egg case production attained its maximum number in September. Based on this number, we estimated the number of egg cases produced at 124, presuming that one egg case is produced per day. However, HOLDEN (1975) and ELLIS; SHAKLEY (1995) reported that the daily interval between depositions of successive pairs of eggs ranged from 0 to 2 days. CAPAPÉ et al. (2006) noted that the rate of egg cases produced by *R. miraletus* kept in aquaria was one egg case every two days.

Table 1. Monthly collection of adult female *Rioraja agassizi*, bearing egg case and non-bearing egg case.

	Months												
Category of adult females	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Non- bearing egg case	19	41	116	179	84	75	62	56	16	24	65	27	764
Bearing egg case	3	1	16	44	24	31	18	28	15	5	12	12	209
Total	22	42	132	223	108	106	80	84	31	29	77	39	973

Table 2. Estimation of the average number of egg cases laid by a mature female *Rioraja agassizi* following the method of Holden (1975).

	Egg cases and rate of laying			
Months	Proportion with egg case	Relative proportion	Days	Number of eggs laid
Jan.	0.16	0.17	31	5.3
Feb.	0.02	0.02	28	0.6
Mar.	0.14	0.15	31	4.7
Apr.	0.25	0.27	31	8.1
May	0.29	0.31	31	9.6
Jun.	0.41	0.44	30	13.2
Jul.	0.29	0.31	31	16.4
Aug.	0.50	0.53	31	16.4
Sep.	0.94	1.00	30	30
Oct.	0.21	0.22	31	5.7
Nov.	0.18	0.19	30	5.7
Dec.	0.44	0.46	31	14.3
Total				124.3

Should *R. agassizi* produce one egg case per day its annual fecundity could reach 124, but should egg case production occur every two days, fecundity could be 62. The fecundity previously assessed for rajoid specimens from British marine waters by HOLDEN et al. (1971) and HOLDEN (1975) was, respectively, 150 and 140 egg cases per year. CAPAPÉ (1976) reported a fecundity of 141-167 for *R. clavata* from the northern Tunisian coast and CAPAPÉ et al. (2007 b) one of between 108 and 162 for specimens from the Languedocian coast, southern France. CAPAPÉ; QUIGNARD (1975) noted that the respective fecundity of *R. miraletus* and *R. radula* from the Tunisian coast ranged from 40 to 72 and 80 to 154 egg cases. On the other hand, CAPAPÉ et al. (2007a) estimated the fecundity range of *R. miraletus* from the Senegalese coast at between 71 and 178 egg cases. The fecundity estimation of *R. agassizi* falls within the range observed for other rajoid species. This would suggest that oviparous elasmobranchs are not very prolific, as is already known. However, when compared with that of other elasmobranch fishes, fecundity in skates would be high, especially in relation to viviparous species, in agreement with MELLINGER (1989).

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