MORPHOLOGICAL ABNORMALITIES IN SKATES AND RAYS (CHONDRICHTHYES) FROM OFF SOUTHEASTERN BRAZIL

Anomalias morfológicas em raias (Chondrichthyes) da região Sul do Brasil

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ABSTRACT

In this paper, the authors report morphological abnormalities observed in six species of skates and rays from off southeastern Brazil, between 2005 and 2008 as follows: the rio skate, Rioraja agassizi (Müller and Henle, 1841); the spotback skate, Atlantoraja castelnaui (Ribeiro, 1907); the eyespot skate, A. cyclophora (Regan, 1903); the pelagic stingray, Pteroplatytrygon violacea (Bonaparte, 1832); the roughtail stingray, Dasyatis hypostigma (Santos and Carvalho, 2004); and the shorthose guitarfish, Zapteryx brevirostris (Müller and Henle, 1841). The abnormalities observed included pectoral fins non-adherent to the head; incomplete pectoral fin, anophthalmia, and presence of a single clasper. The percentage of abnormal specimens ranged from 0.1 to 1.3. Potential causes of the abnormalities probably occurred during embryonic development, for instance pectoral fins had failed to fuse together in front of the head in early development. Additionally, unfavorable environmental conditions cannot be excluded, such as the role of chemical pollutants playing a role in embryonic development of skates in egg cases.

Key words: Chondrichthyes, skates, rays, abnormalities, embryonic development, pollution, southeastern Brazil

RESUMO

No presente trabalho foram reportadas anomalias morfológicas observadas em seis espécies de raias capturadas no sudeste brasileiro, entre 2005 e 2008 como segue: raias-emplastro, Rioraja agassizi (Müller e Henle, 1841), Atlantoraja castelnaui (Ribeiro, 1907), A. cyclophora (Regan, 1903); raia-preta, Pteroplatytrygon violacea (Bonaparte, 1832); raia-prego, Dasyatis hypostigma (Santos e Carvalho, 2004); e raia-viola, Zapteryx brevirostris (Müller e Henle, 1841). As anomalias observadas incluíram nadadeiras peitorais não aderidas à cabeça, anoftalmia e presença de um só clasper. A porcentagem de anomalias variou entre 0,1 e 1,3. As causas potenciais das anomalias ocorrem provavelmente durante o desenvolvimento embrionário, as nadadeiras peitorais não conseguiram se fundir à região frontal da cabeça. Provavelmente também as condições ambientais desfavoráveis tais como os poluentes químicos, podem ser também consideradas, pois exercem importante influência no desenvolvimento dos embriões nas cápsulas ovígeras.

Palavras-chaves: Chondrichthyes, raias, anomalias, desenvolvimento embrionário, poluição, Sudeste do Brasil.
INTRODUCTION

Abnormalities were listed in fish species by Dawson (1964, 1966, 1971) and Dawson & Heal (1971); they concern colour (full or partial albinism), the genital apparatus (total, semi or pseudo hermaphroditism) and morphological deformities (teratological cases, also called ‘monstrosities’ by authors). It appears that the latter were more frequently recorded in osteichthyan species than in chondrichthyan species, probably because of the low commercial interest that characterize the latter for several years and also because of the difficulty in obtaining a significant number of specimens to detect such abnormalities (Hoenig & Walsh, 1983). Moreover, chondrichthyan (846 species) are qualitatively less represented than osteichthyan (more than 50,000 species) were recorded throughout the world to date (Lecointre & Le Guyader, 2001; Compagno, 2005) and they represent only a minor group in terms of catches, in 1997 for instance, they accounted for only 0.65% of total world catches and 0.85% of total world captures (Vannuccini, 1988), even if off Brazil some sharks such as blue shark, Prionace glauca (Linnaeus, 1758) are mainly targeted by pair troll fishery off “Laje de Santos”, Santos, during August 2007 (NUPEC 2142). An abnormal Dasyatis hypostigma was provided also by a fisherman; the specimen was caught at depths of 20 m, with muddy bottoms, by pair troll fishery off “Laje de Santos”, Santos, during August 2007 (NUPEC 2142).

RESULTS

Atlantoraja castelnaui and A. cyclophora
A total number of 107 specimens of A. castelnaui were collected. In May 2005, a single abnormal subadult specimen was captured. Total length and DW of the specimen were 875 and 610 mm respectively (Figure 1-A). The abnormality consisted of an incomplete fusion of the left pectoral fin with the head, resulting in gap or cleft between the pectoral fin and rostrum. Percentage of abnormalities was 0.9 (Table I).

In all, 770 A. cyclophora were collected. The same abnormality described for A. castelnaui was observed on a single specimen of A. cyclophora, though the gap was deeper in this case (Figure 1-B) and also located on the left body side. This specimen was caught in October 2005, and had TL and DW of 494 and 355 mm respectively. Percentage of abnormalities was 0.1 (Table I).

Rioraja agassizi
A total of 1,023 specimens were collected. The percentage of abnormalities was 0.5 (Table I). In two specimens incomplete fusion of the pectoral fin with the head was noted. The first one was an adult female caught in April 2005, with DW of 344 mm.
A total of 223 specimens were collected. Percentage of abnormalities was 1.3 (Table I). In June, 2007, a mature male specimen 450 mm DW and 960 mm TL was captured. In this specimen the left clasper and the left pelvic fin were absent. Lack of right clasper suggests a probable case of hermaphrodism or semi hermaphrodism, the specimen will be thoroughly studied in a further paper (Figure 2-B).

The second specimen was a mature female, with 475 mm TW and 1080 mm TL captured in September, 2007 (Figure 2-C). This female presented a deep incomplete fusion of the pectoral fin with the head and the embryo with the pelvic waist.

The third specimen was 80 mm DW and 175 mm TL male embryo (Figure 2-D), captured in March, 2008. The yolk sac in this specimen had been already consumed. The specimen showed an incomplete fusion of the left pectoral fin and the body and also an asymmetry regarding the pectoral fins.

**Zapteryx brevirostris**

The female guitarfish, *Zapteryx brevirostris* measuring 216 mm DW was donated in October, 2006 by a fisherman and caught inshore of Santos Bay, at depths of 20 m, by pair trawling. This specimen was anophthalmic (Figure 3). Percentage of abnormalities is unknown (Table I).

**DISCUSSION**

In Table II, we have summarized reports of abnormalities observed in skates and rays in different marine areas. It appears that pectoral fins non-adherent to head were the most frequently recorded. This abnormality is due to fact that the
pectoral fins had failed to fuse together in front of the head in early development (Bigelow & Schroeder, 1953). Moreover, Thorson et al. (1983) described embryonic development in two freshwater stingrays Potamotrygon constellata (Vaillant, 1880) and P. motoro (Müller & Henle, 1841): in early embryo the stingray’s pectoral fins begin separate, then fuse in medium embryos and finally form the complete disc in near term embryo. Basing of these atypical characteristics Day (1880-1884) described a separate species, Cerapoptera ehrenbergi from an abnormal longtail butterfly ray Gymnura poecilura (Shaw, 1804). Pectoral non-adherent to the head were frequently observed in skates (see Table I), according to Gudger (1933), at about 35 cases were reported in literature between 1810 and 1932. Further, other cases were also reported, but a bit less in rays than in skates (Tortonese, 1956; Dawson, 1964, 1966, 1971; Dawson & Heal, 1971), in agreement with records included in Table II. Additionally, to our knowledge, anophthalmy in an elasmobranch species was firstly observed in the bluntnose stingray, Dasyatis hypostigma (Santos & Carvalho, 2004) captured off Rio de Janeiro by Gomes et al. (1991), who noted that such abnormality occurred during development of optic peduncle. The second record was described in this paper in Zapteryx brevirostris.

Table II - Different kinds of abnormalities recorded in batoids (by family and species) in the present study and elsewhere by other authors.

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Abnormality</th>
<th>Reproductive mode</th>
<th>Capture site</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinobatidae</td>
<td>Rhynchobatus djiddensis</td>
<td>Pectoral non adherent to the head</td>
<td>Viviparous</td>
<td>Indian waters</td>
<td>Luther (1961)</td>
</tr>
<tr>
<td>Rhinobatidae</td>
<td>Zapteryx brevirostris</td>
<td>Anophthalmic</td>
<td>Viviparous</td>
<td>Off southern Brazil</td>
<td>This study</td>
</tr>
<tr>
<td>Torpedinidae</td>
<td>Torpedo marmorata</td>
<td>Pectoral non adherent to the head</td>
<td>Viviparous</td>
<td>Adriatic Sea</td>
<td>ValIe (1931)</td>
</tr>
<tr>
<td>Torpedinidae</td>
<td>Torpedo marmorata</td>
<td>Pectoral non adherent to the head</td>
<td>Viviparous</td>
<td>Adriatic Sea</td>
<td>Jardas and Homen (1977) Ben Brahim and Capapé (1997)</td>
</tr>
<tr>
<td>Torpedinidae</td>
<td>Torpedo torpedo</td>
<td>Surnumerary dorsal fin</td>
<td>Viviparous</td>
<td>Northern Tunisian waters</td>
<td>This study</td>
</tr>
<tr>
<td>Rajidae</td>
<td>A. atlantoraja castelnaui</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off southern Brazil</td>
<td>Moreau (1881)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>A. cyclophora</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off southern Brazil</td>
<td>Bureau (1890)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>A. platana</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off southern Brazil</td>
<td>Pellegrin (1900)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>R. asterias</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off Atlantic coast of France</td>
<td>Jugeat (1921)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>R. asterias</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off Atlantic coast of France</td>
<td>Jugeat (1926)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>R. asterias</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off Atlantic coast of France</td>
<td>Legendre (1935)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>R. brachyura</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off coast of Scotland</td>
<td>Williamson (1909)</td>
</tr>
<tr>
<td>Rajidae</td>
<td>R. clavata</td>
<td>Pectoral non adherent to the head</td>
<td>Oviparous</td>
<td>Off Atlantic coast of France</td>
<td>Vaillant (1908)</td>
</tr>
</tbody>
</table>
Unfavourable environmental conditions probably play a role in occurrence of abnormalities (see Table II), such as large exposure to pollutants. It could explain why they are more observed in oviparous species than in viviparous species. In the former, embryos develop in egg cases directly deposited in waters, while in the latter, embryos are protected during development by mother’s uteri. For instance, Casarini et al. (1996), reported that of 192 *R. agassizi* collected off Santos, 11 were abnormal, the percentage of 5.7 was considerably higher than herein recorded (Table I). The most common abnormality in these specimens was rostral abnormality, though in some specimens the lack of one pelvic or dorsal fins and left eye was also observed. For these authors, those abnormalities could be the result of the exposure to chemically contaminated sites, as high values of heavy metal concentrations in Santos Bay show have been noted, as Cu, Zn, Hg and Cd (Boldrini & Pereira, 1987; Tommasi, 1985).

Comparing to literature, the abnormalities percentage was low (0.1 to 0.9) for the coastal *Rioraja*
agassizi, Atlantoraja castelnau, A. cyclophora and A. platana. Similar patterns were observed for Pteropatrygon violacea (1.3%) was low. Until 2008 the percentage (5.7%) of abnormalities for Rioraja agassizi presented by Casarini et al. (1996), collected off Santos was the highest register of occurrence found in literature. Due to the lack of other studies to establish comparisons, further researches could be done.

According to Bensam (1965), embryonic deformities could be caused by intrauterine pressure exerted by other embryos. However, Bonfil (1989) discarded this hypothesis as embryos of a given litter would be exposed to the same space and growth conditions and for this author, the origin of pre-natal abnormalities would be related to mutation or other developmental irregularities.

Rosa et al. (1996) describe an abnormal freshwater stingray Potamotrygon motoro where both pectoral fins were anteriorly detached from the head, their anterior tips barely reaching the level of the rostrum. For Radcuffe (1928 apud Rosa et al., 1996) this malformation could be caused by a disturb in the initial stages of ontogeny known as “shark stage”, where the embryo still have the fins separated from the head, resembling a shark embryo. According to Rosa et al. (op. cit) the fact that adult rays with this kind of abnormality occur alive and in seemingly good condition means that this deformity would not interfere in the biological activities, mainly feeding.

CONCLUSION

The abnormalities occurred in different body parts, but in rostral would be the most commonly for many skates and rays. Nevertheless they do not hinder their development, as such deformities were observed mostly by adults. The percentage of abnormalities estimated is not representative of the real number because in all cases samples came from fisheries, where the total captured is uncertain. In order to obtain a more accurate percentage, samples from scientific surveys should be considered.

In future studies, it is highly recommended to preserve abnormal specimens in order to perform further analysis on the deformities and it causes, such as radiography and dissection. It remains difficult to assess the causes of the abnormalities in such a few specimens as the recorded in the present study. However, we believe that the observations presented inhere may be the base of future research on this unexplored area.

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