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ORIGINAL ARTICLE

Morphological abnormalities in the Chilean Eagle ray *Myliobatis chilensis* (Myliobatiformes: Myliobatidae) off the Peruvian coast, Southeast Pacific

Miguel Valderrama-Herrera[1], Keny Kanagusuku*[2], Sergio Ramírez-Amaro[3]

Edited by
Juan Carlos Salcedo-Reyes
salcedo.juan@javeriana.edu.co

1. Escuela de Biología Pesquera, Universidad Nacional de Trujillo, Jirón San Martín 341, Centro Histórico 13001, Trujillo, Perú.

2. Laboratorio de Ecología Marina, Carrera de Biología Marina, Universidad Científica del Sur, Lima, Perú.

3. Instituto Español de Oceanografía (IEO-CSIC), Centre Oceanogràfic de les Balears, Palma, Illes Balears, Spain.

*kkanagusuku@cientifica.edu.pe

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Abstract

Records about morphological abnormalities in rays of the genus *Myliobatis* are scarce worldwide. In the present study, three specimens exhibiting different malformations were identified during the monitoring of the reproductive biology of the Chilean eagle ray *Myliobatis chilensis*, conducted from 2017 to 2018 in the fishing port of Salaverry (northern Peru). The identified specimens included: (i) a female with split pectoral fins, (ii) a male with an unfused-to-the-head pectoral fin, and (iii) a female with a short and thick tail. Here we report and discuss the implications and likely causes of these first three cases of morphological abnormalities in *M. chilensis* from the western Pacific.

Keywords: Myliobatidae; malformations; description; Peru

1. Introduction

Since the 19th century, morphological abnormalities have been reported in elasmobranchs (sharks and rays). Reports about "monstrous" specimens have shown that some of these were eventually given new generic names such as *Cephaleutherus*, *Propterygia*, *Hieroptera*, *Eleutherocephalus*, *Ceratoptera* and *Planerocephaus* (Chhapgar, 1964). Currently, these abnormalities are being better understood as more information becomes available on the literature. There are fewer reports on rays compared to sharks, possibly due to a low commercial interest; which are less targeted by fisheries (Hoenig and Walsh, 1983). The anomalies described include unusual characteristics such as a lack of fusion of the pectoral fin to the head (Ribeiro-Prado *et al.*, 2008; Escobar-Sánchez *et al.*, 2009; Mnsari *et al.*, 2010; Blanco-Parra and Niño-Torres, 2011; Mejía-Falla *et al.*, 2011; Suresh and Raffi, 2012; Wosnick *et al.*, 2019), albinism and leucism (De Jesus-Roldan, 1990; Quigley *et al.*, 2018), tail anomalies (Orlov, 2011; Bhagyalekshmi and Kumar, 2019; Marouani *et al.*, 2019), internal aberrations (Ribeiro-Prado *et al.*, 2008; Torres-Huerta *et al.*, 2015), and cephalic and pelvic fin anomalies (Da Silva and Casas, 2020; Ehemann *et al.*, 2021).

The Chilean eagle ray *Myliobatis chilensis* Phillipi, 1892 inhabits the Eastern Pacific, and its widespread distribution is influenced by the temperate waters of the Humboldt current from Chile to Peru (Dulvy *et al.*, 2020). This species is frequently captured by artisanal fisheries mainly on the northern coast and is the only batoid fished (Clemente, 2010) to satisfy the meat demand for the preparation of local dishes, such as "chinguirito" (dried up ray meat) or "tortilla de raya" (ray omelet). However, despite being a frequently captured species, little is known about its biology being classified as a "Vulnerable" (VU) species in the Red List of the International Union for the Conservation of Nature (IUCN) (Dulvy *et al.*, 2020).

The present article describes and reports, for the first time, the different malformations discovered in the Chilean Eagle ray *M. chilensis*.

2. Materials and methods

Three unusual specimens of *M. chilensis* were collected from the landings of artisanal captures in the Salaverry Artisanal Fishing Pier (8°13′26.43″S; 78°58′56.27″W) from October 2017 to November 2018 (**Figure 1**). This field work is part of a reproductive biology research conducted by the Universidad Nacional de Trujillo. Among these specimens, two were captured in the fishing zone located between 8°20′S; 79°15′W and 8°20′S; 79°20′W and one was captured near Pacasmayo (114 km north). The three specimens were caught using trammel nets with a mesh width of 8 to 14 inches.

Following the checklist proposed by Chirichigno and Velez (1998), the specimens were identified and measured (the checklist includes morphological measures for elasmobranch). The maturity of each specimen was determined according to the characteristics described by Capapé *et al.* (2007); Grijalba-Bendeck *et al.* (2018). Dorsal and ventral photographs and radiographs of the specimens were taken. Only one specimen (the largest female) was be eviscerated to visualize gonads. Finally, the specimens were deposited in the Marine Biology Research Laboratory at the Universidad Científica del Sur, where they were preserved in 10 % formalin and assigned catalogue numbers MC01-2018, PESY-010201, and PESY-010202.

3. Results

One of the malformed specimens, the female labelled MC01-22018, exhibited unusual pectoral fins. Each fin had a slit that divided the fin in anterior and posterior lobes, giving the appearance of two fins on each side (**Figure 2**). The anterior lobes were slightly larger than the posterior ones (**Table 1**), and the fifth gill slits on both sides of the specimen were reduced. Radiographies showed that both the coracoid and ischiopubic portions were like that of normal specimens. However, a division of the distribution of the pectoral radials was observed in the pectoral fins, causing them to be distributed by both lobes; one apparently had some dermal rays (of the edge of the lobe) fused. This specimen was identified as immature since its size was among the smallest individuals of biological monitoring. Measurements of this specimen were: disc length (DL) = 20.1 cm and disc width (DW) = 38 cm (taking the length of anterior lobes).

The second specimen (PESY-010201) was a male with a DL of 21 cm and a DW of 39 cm (Table 1). This individual showed undeveloped non-calcified claspers, which correspond to an immature stage, and revealed incomplete fusion between the propterygium and the cephalic area (**Figure 3**). The labial cartilage was rolled in loop-like shape, while part of the left pectoral fin was separated from the head leaving an aperture. This entanglement had a diameter of 2 cm and was located in the anterior margin of the pectoral fin, separated 1.5 cm from the head. This gap that extended to the second gill slit, made this slit and the first to remain permanently open. The X-ray images (Figure 3) clearly show all five gill arches, where the ceratobranchial (first arch) and epibranchial (second arch) cartilages are not united with right pectoral fin.

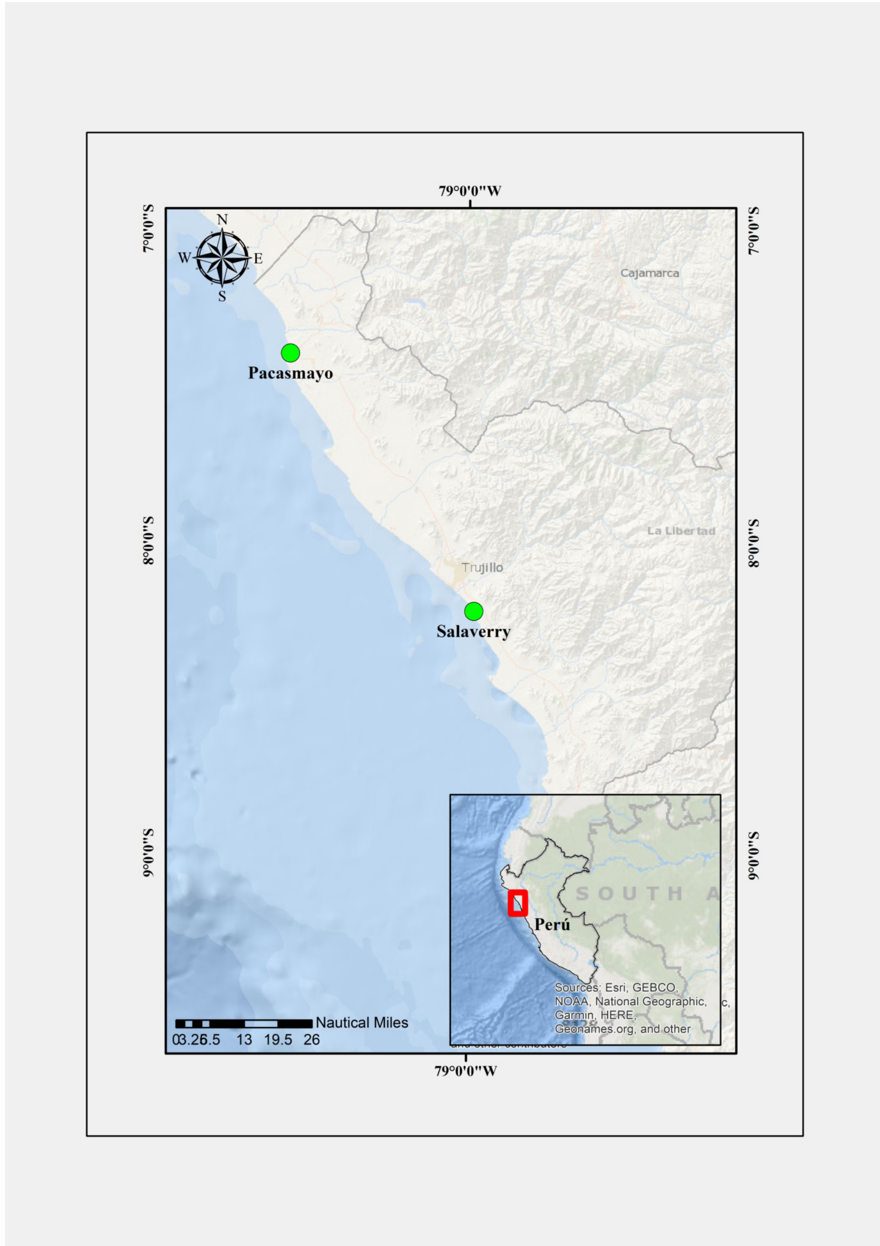

Figure 1. Map of the coast of La Libertad, Peru, showing the two referenced fishing communities. Specimens were landed in Salaverry.

The third specimen (PESY-010202), a female, was the largest of the three with a DL of 33 cm and a DW of 66.2 cm (Table 1). This female presented a short thick tail, of 8.5 cm long and 3 cm wide (**Figure 5**). The rest of the body showed the usual anatomical features. The specimen's maturity stage was determined when inspecting its gonads. Due to the absence of mature oocytes and size and amount of the epigonal organ, it was classified as sub-adult (Capapé *et al.*, 2007; Yamaguchi *et al.*, 2021).

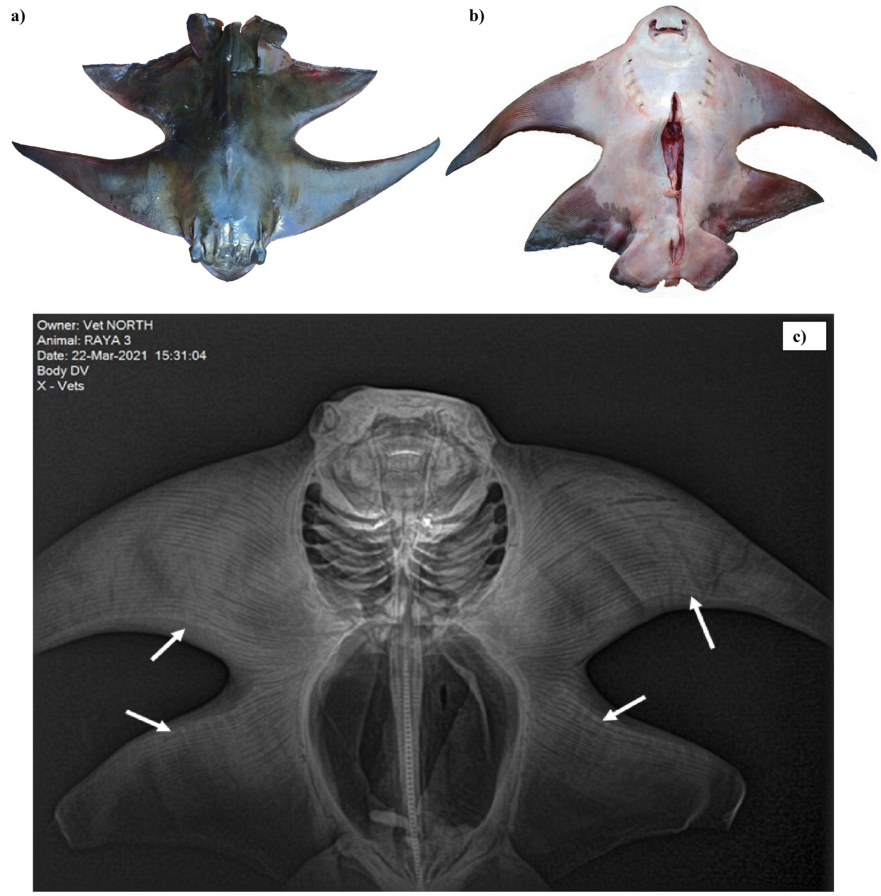

Figure 2. MC01-2018: Immature female specimen with divided pectoral fins. (a) Dorsal and (b) ventral views. In the radiography (c), pectoral radial fusion is shown; this could be similar to the crurae located in the pelvic fins.

4. Discussion

Reports of morphological anomalies in elasmobranchs throughout the Eastern Pacific are scarce and most are relatively recent (Clark, 2002; Escobar-Sánchez *et al.*, 2014) (**Table 2**). Specifically, in Peru there is only one report of an abnormality in a *Prionace glauca* embryo (Kanagusuku *et al.*, 2020). Likewise, worldwide records of anomalies in the genus *Myliobatis* are limited to only three cases: (i) albinism (De Jesus-Roldan, 1990), (ii) cephalic anomalies (Ramírez-Amaro *et al.*, 2013) in *Myliobatis californica*, and (iii) hermaphroditism in *M. aquila* (Rafrafi-Nouria *et al.*, 2017). Thus, this study is the first report of morphological anomalies in *Myliobatis chilensis* and the second report of anomalies in Peru.

Pectoral fin malformations, as seen in specimen MC01-2018, are rare. The lack of scarring and the bilateral symmetry of this specimen rule out the possibility of a predator attack or small vessel propeller impact. The limited opening of the fifth-gill slits could follow from the adjacent fin malformation. The fin lobes may have independent movement because of the apparent fusion of the pectoral radials near the edges of the fins called “crurae” (Figure 2c), which move independently of the striped pelvic and pectoral fins (Shibuya *et al.*, 2015).

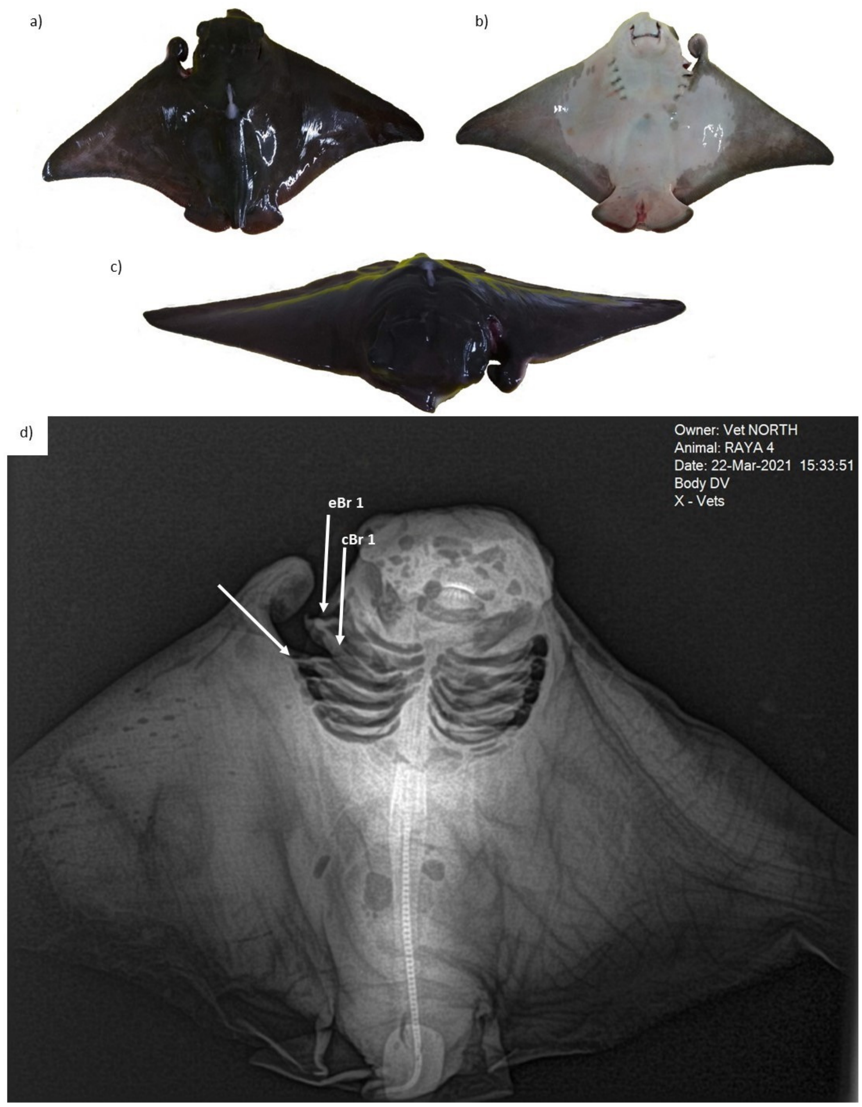

Figure 3. PESY-010201: Immature male specimen revealing a unilateral disconnection between the pectoral fin and the cephalic area, (a) dorsal, (b) ventral, and (c) frontal views. In the radiography (d), the first ceratobranchial (cBr1) and epibranchial (eBr1) cartilages are joint to each other but not to the lateral cartilage (propterygium). The second branchial cartilages are untied with the propterygium; the peculiar union is indicated.

Figure 4. Close-up look of the head and loop (rolled cartilage not fused to the head) of specimen PESY-010201. Ventral (left) and lateral (right) view.

Table 1. Meristic data (in centimeters) of the three *Myliobatis chilensis* specimens with malformations.

Trait	Specimen 1 (MC01-2018) (cm)	Specimen 2 (PESY-010201) (cm)	Specimen 3 (PESY-010202) (cm)
Total length	-	21.0	33.0
Disc width (DW)	38.0	39.0	66.2
Disc length (DL)	20.1	21.7	34.6
Pre-Oral distance	2.3	3.3	5.4
Preorbital length	2.3	2.2	2.5
Interorbital distance	5.6	3.6	6.3
Internarial distance	2.0	2.0	3.2
Mouth width	2.5	2.5	3.7
Distance between the first gill slits	6.3	6.4	9.2
Distance between the fifth gill slits	4.3	4.6	6.2
Clasper length	-	1.0	-
Separation between Loop – Head	-	1.5	-
Loop diameter	-	2.0	-
Height from the second gill slit	-	4.0	-
Tail length	-	-	8.5
Tail width	-	-	3

Of the three anomalies, the second one (PESY-010201) - lack of fusion between head and fins- is the most frequent (**Table 3**). This condition has been reported in other batoid species such as *Raja asterias* (Moreau, 1881; Bureau, 1890; Pellegrin, 1900; Jugeat, 1921, 1926, cited by Ribeiro-Prado *et al.* (2008)), *R. clavata* (Vaillant, 1908; Williamson, 1909; Legendre, 1936; Du Buit, 1967; Jurden and Homen, 1977, cited by Ribeiro-Prado *et al.* 2008), *Gymnra poecilura* (Day, 1878, cited by Suresh and Raffi 2012; Bennett, 1964; Easarwan, 1967, cited by Ribeiro-Prado *et al.* 2008; Suresh and Raffi 2012) *G. altavela* (Narvaez and Osaer, 2016), *Hemitrygon akajei* (Furumitsu *et al.*, 2018), *Dasyatis brevis* (Lamilla *et al.* 1995, cited by Schmid *et al.* 2019) *Hypanus longa* (Escobar-Sánchez *et al.*, 2009) *H. dipterurus* (Blanco-Parra and Niño-Torres, 2011). Furthermore, it has also been previously reported in embryos of *Urotrygon rogersi* (Mejía-Falla *et al.*, 2011) and *Zapteryx brevirostris* (Wosnick *et al.*, 2019).

The radiography (Figure 3d) showed that the pectoral fin was detached from the cephalic area. This failure to fuse likely occurred during the early embryonic stages (Miyake *et al.*, 2008). In some species belonging to Myliobatiformes, due to the structure of anterior cranial areas, the rostral cartilage and nasal openings may alternate during embryonic development (Miyake *et al.*, 2008). Stress during embryonic stages and congenital or genetic disorders may be the causes of this malformation (Bigelow and Schroeder, 1953; Tortonese, 1956). Swenson *et al.* (2018) suggest that this morphology may occur when the molecular mechanisms underlying pectoral fin fusion are interrupted. On the other hand, this type of anomaly may be due to anthropogenic impact (*e.g.,* ghost fishing gear or vessel strikes), as recently documented in *Mobula alfredi* and *Mobula birostris* in Maldives (Strike *et al.*, 2022).

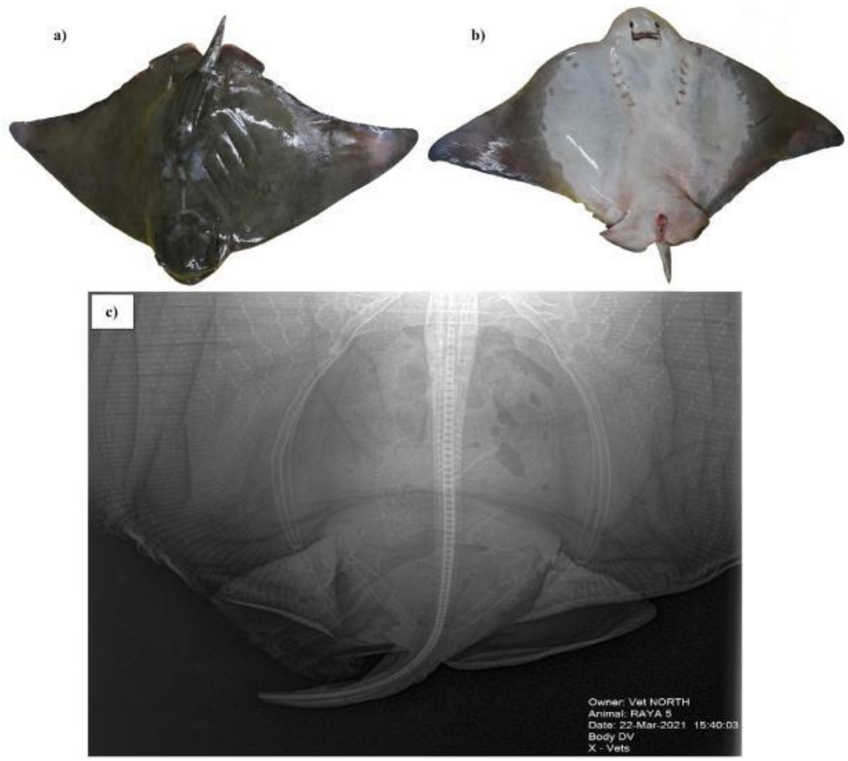

Figure 5. Specimen PESY-010202: Sub-adult, female with a reduced tail, (a) dorsal and (b) ventral views. In the radiograph (c) no singularities were found in the region around the tail.

This abnormality will affect locomotion, prey detection, and prey capture efficacy. Thus, facing the other specimens, PESY-010201 might require particular adaptations and additional energy investment for survival. Nevertheless, it showed a similar body condition to that of the other captured individuals. No apparent sign of malnutrition was evident. Therefore, this specimen was presumably able to reach maturity.

Variation in tail malformations is not uncommon in the batoid group. One specimen of *Raja clavata* exhibited a below-average length and S-shaped tail with fused caudal vertebrae (Capapé *et al.*, 2018). Two embryos of *Hemitrygon akajei* revealed unusual curvatures in the posterior section of their tails (Furumitsu *et al.*, 2018). Two types of tail malformations were observed in *Orbiraja powelli*, a male with an additional caudal fin and a female with an abnormal conic tissue growth at the rear end of an already unusual short tail (Bhagyalekshmi and Kumar, 2019). Marouani *et al.* (2019) recorded four individuals of the *Raja* genus in the gulf of Gabès, Tunisia: A *R. radula* and two *R. clavata* specimens with an unusually short tail and absence of dorsal and caudal fins, and a tailless *R. clavata* individual. Orlov (2011) also reported an absent tail in a *Bathyraja richardsoni* female from the mid-Atlantic ridge, suggesting a predator attack; however, this was unlikely due to the normal skin pigmentation in the posterior section and the absence of scars (Marouani *et al.*, 2019). Since the tail base of the third *M. chilensis* (PESY-010202) specimen is unusually thick, its lacks a posterior tip scar, and, as in other Myliobatiformes, *Myliobatis* tails are long and thin, it is unlikely that this tail was the result of a predator attack. The radiography of this specimen did not reveal abnormal tail region cartilage growth, and this anomaly did not significantly affect the specimen's swimming ability or development. The pectoral fins of Myliobatidae species are responsible for turning movements, contrary to members of the Rajidae family, which have a thicker tail that helps to direct their motion (Parson *et al.*, 2011). Furthermore, the lack of a tail could condition the defense of the specimen since it harbors the lacerating spine and reduces movement stability.

The morphological abnormalities of the three specimens could agree with a congenital disorder. According to Bigelow and Schroeder (1953), the lack of fusion of the pectoral fins and the detachment of the pectoral fins from the head are secondary developments in batoid embryos. Furumitsu *et al.* (2018) studied *Hemitrygon akajei* development in its different embryonic stages. In the early stages, when the pectoral fin begins to develop, fins do not surpass the posterior margin of the gills. As the spindle-shaped embryo matures, the fins elongate, reaching the rear edge of the eyes and then stretching (resembling two horns) so that the folds of the fins reach the front edge of the mouth, where they eventually merge. Subsequently, the branchial filaments, which protrude from the gill slits, are reabsorbed, and embryonic development ends with the pigmentation of the body. An alteration during this process may underlie the observed morphological malformations.

Mnsari *et al.* (2010) described malformations in two *Torpedo torpedo* embryos. The first embryo revealed the absence of a large part of the left pectoral fin, leaving a curvature on the edge of the fin, with a slight prolongation that should have joined the cephalic zone. The second embryo possessed an undeveloped right pectoral fin and a small gap (a minimal non-adherence to the head, not as prominent as in the first *T. torpedo* specimen).

The anomalies in the three specimens described in the present study suggest that they are not fatal but could reduce individual competitivity or survival as they would limit movement and constrain food obtention. Oldfield (2005) reported the birth in captivity of a specimen of *Potamotrygon motoro* with both pectoral fins unfused to the head, known as the batman ray. This specimen was able to feed with no apparent problems and developed. In this case, the malformation did not limit development even when compared to other individuals of its species sharing the habitat and posed no disadvantage. On the other hand, two specimens of *Neotrygon kuhli*, identified in the bay of Manmar, India (Ranjith *et al.*, 2018), lacked the fusion of the pectoral fin in the cephalic area. Likewise, two Torpedo torpedo juvenile individuals with unfused pectoral fins were reported in the lagoon of Bizerte, Tunisia (El Kamel-Moutalibi *et al.*, 2011). A specimen of *Gymnura altavela* was also recorded in the Gran Canaria Island, Spain (Narvaez and Osaer, 2016). Arguably the swimming of the specimen was unique, moving in a rostral position slightly pointed upwards. Several authors have described the importance of the rostral sensory system (Maruska, 2001; Jordan, 2008; Rangel *et al.*, 2017), suggesting that prey detection and capture skills could also be affected.

The three cases of morphological abnormalities reported here could be the result of different factors such as genetics (Ramírez-Hernandez *et al.*, 2011; Ball *et al.*, 2013; Bhagyalekshmi and Kumar, 2019), parasitism (Heupel *et al.*, 1999; Bejarano-Álvarez and Galván-Magaña, 2013; Bhagyalekshmi and Kumar, 2019; Schmid *et al.*, 2019), marine pollution or non-favorable environmental parameters (Mnsari *et al.*, 2010; Bukola *et al.*, 2015; Jawad *et al.*, 2018). The transformation of the desertic coast of the Libertad region into enormous agro-industrial plots by the Chavimochic irrigation project resulted in contamination by nitrogenic compounds and phosphates from agricultural residues (Bukola *et al.*, 2015), such as fertilizers and pesticides and likely led to embryo malformations and neoplastic processes (Austin, 1999). However, to date, no study has measured the effect of these compounds in this area. Thus, it is central to continue recording local malformation cases. Moreover, environmental studies on the causality of these malformations are needed to confirm the presence of heavy metals and evaluate possible environmental effects in the specimens.

Table 2. Malformations in elasmobranchs reported across the Eastern Pacific.

Species	Family	Capture site	Abnormality	Reference
Bathyraja aleutica	Arhynchobatidae	USA	Albinism	Bigman *et al.* 2015
Bathyraja trachura	Arhynchobatidae	USA	Albinism	Bigman *et al.* 2015
Carcharhinus porosus	Carcharhinidae	Colombia	Bicephaly	Muñoz-Osorio *et al.* 2013
Carcharhinus obscurus	Carcharhinidae	Mexico	Cyclopia and albinism	Bejarano-Álvarez and Galván-Magaña, 2013
Dasyatis longa	Dasyatidae	Mexico	Lack of fusion between pectoral fins and the head.	Escobar-Sánchez *et al.* 2009
Galeocerdo Cuvier	Carcharhinidae	Mexico	Albinism	Sandoval-Castillo *et al.* 2006
Hypanus dipterurus †	Dasyatidae	Mexico	Lack of fusion between pectoral fins and the head.	Blanco-Parra and Niño-Torres, 2011
Mustelus californicus	Triakidae	USA	Albinism	Cohen, 1973
Myliobatis califórnica	Myliobatidae	Mexico	Albinism	De Jesús-Roldán, 1990
Myliobatis califórnica	Myliobatidae	Mexico	Presence of cephalic horns	Ramírez-Amaro *et al.* 2013
Myliobatis chilensis	Myliobatidae	Peru	Pectoral fins division	Present study
Myliobatis chilensis	Myliobatidae	Peru	Lack of fusion between pectoral fins and rostrum.	Present study
Myliobatis chilensis	Myliobatidae	Peru	Reduced tail	Present study
Narcine entemedor	Narcinidae	Mexico	Albinism	Sandoval-Castillo *et al.* 2006
Notorhynchus cepedianus	Hexanchidae	USA	Partial albinism	Herald, 1953
Prionace glauca	Carcharhinidae	Chile	Disprosopia	Hevia-Hormazabal *et al.* 2011

Table 2. Malformations in elasmobranchs reported across the Eastern Pacific.

Prionace glauca	Carcharhinidae	Mexico	Bicephaly, anophthalmia, cranial malformations.	Bejarano-Álvarez *et al.* 2011
Prionace glauca	Carcharhinidae	Mexico	Bicephaly	Galván-Magaña *et al.* 2011
Prionace glauca	Carcharhinidae	Peru	Disprosopia and toracic lordosis	Kanagusuku *et al.* 2020
Raja alba	Rajidae	Chile	Lack of fusion between pectoral fins and the head.	Lamilla *et al.* 1995
Raja radiata	Rajidae	Mexico	Lack of fusion between pectoral fins and the head, deformed mouth, Eyes covered with skin.	Escobar-Sánchez *et al.* 2008
Rhinoptera steindachneri	Myliobatidae	Mexico	Bicephaly	Castro-Aguirre and Torres-Villegas, 1979
Squatina californica	Squatinidae	Mexico	Albinism and synophthalmia	Escobar-Sánchez *et al.* 2014
Urobatis halleri	Urotrygonidae	Mexico	Eye malformations, dark mucus	Rubio-Rodríguez *et al.* 2010
Urobatis halleri	Urotrygonidae	Mexico	Anophthalmia	Ehemann *et al.* 2021
Urobatis macultaus	Urotrygonidae	Mexico	Reduced tail	Ehemann *et al.* 2021
Urotrygon chilensis	Urotrygonidae	Mexico	Lack of fusion between pectoral fins and the head, absence of clasper, abnormal liver	Torres-Huerta *et al.* 2015
Urotrygon chilensis	Urotrygonidae	Mexico	Reduced tail	Ehemann *et al.* 2021
Urotrygon nana	Urotrygonidae	Mexico	Lack of fusion between pectoral fins and the head and anophthalmia	Torres-Huerta *et al.* 2015

Table 2. Malformations in elasmobranchs reported across the Eastern Pacific.

Urotrygon rogersi	Urotrygonidae	Mexico	Lack of fusion between pectoral fins and the head and anophthalmia	Torres-Huerta *et al.* 2015
Urotrygon rogersi	Urotrygonidae	Mexico	Abnormal growth deposition of connective tissue in the spine	Ehemann *et al.* 2021

† Reported as *Dasyatis dipterura*

Table 3. Reported cases of lack of fusion of the pectoral fin and the head in batoids.

Species	**Family**	**Capture site**	**Reference**
Aetobatus narinari	Myliobatidae	India	Chhapgar, 1964
Atlantoraja castelanui	Rajidae	Brazil	Ribeiro-Prado *et al.* 2008
Atlantoraja cyclophora	Rajidae	Brazil	Ribeiro-Prado *et al.* 2008
Atlantoraja platana	Rajidae	Brazil	Ribeiro-Prado *et al.* 2008
Dasyatis brevis	Dasyatidae	Chile	Lamilla *et al.* 1995
Gymnura altavela	Gymnuridae	Canary Islands	Narváez and Osaer, 2016
Gymnura poecilura	Gymnuridae	India	Day, 1878
Gymnura poecilura	Gymnuridae	India	Bennett, 1964
Gymnura poecilura	Gymnuridae	India	Easrawan, 1967
Gymnura poecilura	Gymnuridae	India	Suresh and Raffi, 2012
Hemitrygon akajei	Dasyatidae	Japan	Furumitsu *et al.* 1971

Table 3. Reported cases of lack of fusion of the pectoral fin and the head in batoids.

Himantura uarnak	Dasyatidae	India	Nair and Chellam, 1971
Himantura uarnak	Dasyatidae	Syria	Unpublished
Hypanus dipterurus †	Dasyatidae	Mexico	Blanco-Parra and Niño-Torres, 2011
Hypanus guttatus	Dasyatidae	Brazil	Schmid *et al.* 2019
Hypanus longus ‡	Dasyatidae	Mexico	Escobar-Sánchez *et al.* 2009
Myliobatis chilensis	Myliobatidae	Peru	This report
Neotrygon kuhlii	Dasyatidae	India	Ranjith *et al.* 2018
Potamotrygon motoro	Potamotrygonidae	Brazil	Rosa *et al.* 1996
Potamotrygon motoro	Potamotrygonidae	Captivity	Oldfield, 2005
Pteroplatrygon violácea	Potamotrygonidae	Brazil	Ribeiro-Prado *et al.* 2008
Raja asterias	Rajidae	Atlantic coast of France	Moreau, 1881
Raja asterias	Rajidae	Atlantic coast of France	Bureau, 1890
Raja asterias	Rajidae	Atlantic coast of France	Pellegrin, 1900
Raja asterias	Rajidae	Atlantic coast of France	Jugeat, 1921
Raja asterias	Rajidae	Atlantic coast of France	Jugeat, 1926
Raja brachyura	Rajidae	Atlantic coast of France	Legendre, 1935
Raja clavata	Rajidae	Atlantic coast of France	Vaillant, 1908
Raja clavata	Rajidae	Scotland	Williamson, 1909
Raja clavata	Rajidae	Atlantic coast of France	Legendre, 1936
Raja clavata	Rajidae	Atlantic coast of France	Du Buit, 1964

Table 3. Reported cases of lack of fusion of the pectoral fin and the head in batoids.

Raja clavata	Rajidae	Adriatic Sea	Jardas and Homen, 1977
Raja miraletus	Rajidae	Northern Adriatic Sea	Jardas and Morovic, 1973
Raja radiata	Rajidae	Atlantic coast of France	Letaconnoux, 1949
Raja radiata	Rajidae	Sea of Cortez	Escobar-Sánchez *et al.* 2008
Raja rádula	Rajidae	Tunisia	Capapé and Pantousier, 1975
Rioraja agassizi	Rajidae	Brazil	Casarini *et al.* 1996
Rioraja agassizi	Rajidae	Brazil	Ribeiro-Prado *et al.* 2008
Rostroraja alba	Rajidae	Adriatic Sea	D'Ancona, 1933
Rostroraja alba	Rajidae	Adriatic Sea	Anisits, 1912
Torpedo marmorata	Torpedinidae	Adriatic Sea	Valle, 1931
Torpedo marmorata	Torpedinidae	Adriatic Sea	Jardas and Homen, 1977
Torpedo nobiliana	Torpedinidae	Atlantic	Palmer and Wheeler, 1955
Torpedo torpedo	Torpedinidae	Tunisia	El Kamel *et al.* 2009
Torpedo torpedo	Torpedinidae	Tunisia	Mnsari *et al.* 2010
Torpedo torpedo	Torpedinidae	Tunisia	El Kamel *et al.* 2011
Urotrygon chilensis	Urotrygonidae	Mexico	Torres-Huerta *et al.* 2015
Urotrygon nana	Urotrygonidae	Mexico	Torres-Huerta *et al.* 2015
Urotrygon rogersi	Urotrygonidae	Mexico	Torres-Huerta *et al.* 2015
Urotrygon rogersi	Urotrygonidae	Colombia	Mejía-Falla *et al.* 2011

† Reported as *Dasyatis dipterura*, ‡ Reported as *Dasyatis longa*

5. Conclusions

In summary, the present study reported three specimens of the Chilean eagle ray *Myliobatis chilensis* with the following morphological abnormalities: (i) split pectoral fins, (ii) a pectoral fin not fused to the head, and (iii) a short thick tail. These specimens were recorded in the same year, in the landings of the same port, and in closely located fishing areas. We have reported the three first cases of morphological abnormalities in *M. chilensis*, furthering the information on abnormal specimens across the eastern Pacific. We reaffirm our suggestion to continue studying these cases to understand their causes thoroughly.

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7. Conflict of interest

The authors declare having no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria, educational grants, speaker membership participation, employment, consultancies, stock ownership, or other equity interest, and expert testimony or patent arrangements, or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Anomalías morfológicas en la raya águila chilena *Myliobatis chilensis* (Myliobatiformes: Myliobatidae) de la costa peruana, Pacífico sudeste

Resumen: Los registros de anomalías morfológicas en rayas del género *Myliobatis* son escasos a nivel mundial. Sin embargo, durante el monitoreo de la biología reproductiva de la raya águila chilena *Myliobatis chilensis*, que se llevó a cabo en el puerto pesquero de Salaverry (norte de Perú) de 2017 a 2018, se identificaron tres especímenes con distintas malformaciones. Los especímenes identificados incluyeron: (1) una hembra con aletas pectorales hendidas (ii) un macho con aleta pectoral separada de la cabeza y (iii) una hembra con cola corta y gruesa. Aquí se reportan y discuten las implicaciones y posibles causas de estas tres anomalías morfológicas en *M. chilensis* del Pacífico occidental.

Palabras Clave: Myliobatidae; malformaciones; descripción; Perú.

Anormalidades morfológicas na raia águia chilena *Myliobatis chilensis* (Myliobatiformes: Myliobatidae) ao largo da costa peruana, sudeste do Pacífico

Resumo: Os registros sobre anormalidades morfológicas em raias do gênero *Myliobatis* são escassos em todo o mundo. No entanto, três espécimes com diferentes malformações foram identificados durante o monitoramento da biologia reprodutiva da raia águia chilena *Myliobatis chilensis*, realizado de 2017 a 2018 no porto de Salaverry (norte do Peru). Os espécimes identificados incluíam: (i) uma fêmea com barbatanas peitorais divididas, (ii) um macho com uma barbatana peitoral sem fundar na cabeça, e (iii) uma fêmea com uma cauda curta e grossa. Neste estudo relatamos e discutimos as implicações e causas prováveis desses três primeiros casos de anormalidades morfológicas em *M. chilensis* no Pacífico ocidental.

Palavras-chave: Myliobatidae; Malformações; Descrição; Peru.

Miguel Valderrama-Herrera Marine biologist from the Universidad Nacional de Trujillo. M. Valderrama-Herrera has experience in the rehabilitation of aquatic fauna and has worked in environmental consulting. His research focuses on elasmobranch reproduction and taxonomy. Currently he works on shark conservation.

ORCID: 0000-0003-2555-0415

Keny Kanagusuku Biologist, graduated from the Master in Ecosystems and Aquatic Resources at the Universidad Nacional Mayor de San Marcos. K. Kanagusuku teaches Marine Biology undergraduate courses at the Universidad Científica del Sur. Currently she works her MSc dissertation on shark dermal denticles, as a taxonomic tool in elasmobranch research related with taxonomy, dermal denticles, malformations, embryonic development, and physiology.

ORCID: 0000-0002-6896-6552

Sergio Ramírez-Amaro Marine biologist from the Universidad Autónoma de Baja California, México and PhD in Marine Ecology from the Universitat de les Illes Balears, Spain. His research focuses on the ecology and genetic of chondrichthyan fishes (sharks, skates, and chimaeras). Currently, S. Ramírez-Amaro conducts postdoctoral research at Instituto Español de Oceanográfia.

ORCID: 0000-0002-0298-0749