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LORDOSIS-KYPHOSIS IN *ARGYROSOMUS REGIUS* ASSO, 1801 OBTAINED FROM TRIPOLI, LIBYA

SUMMARY

On November 28, 2023, one specimen measuring 344 mm total length and weight 650 g of the atherinid fish *Argyrosomus regius* displays a continuous incidence of lordosis-kyphosis was obtained from a local fish market in Tripoli, Libya. Externally, the specimen showed one major hunch just behind the head and under the spinous part of the first dorsal fin and another smaller laterally slightly extended hump in the caudal region under the soft part of the dorsal fin. The X-ray examination showed that both the abdominal and the caudal vertebral regions were affected by this anomaly. To describe the case of abnormality, the length of the vertebral column from the anterior end of the first vertebra to the posterior end of the last vertebra was divided by fish total length to make a ratio that was incorporated to compare the abnormal with the normal fish. The values for the nine angles lay between the lines passing through the sides of the vertebral column was obtained. Also, the ratio of the vertebral column to the fish total length of deformed and normal specimens of this species was calculated. Possible causes for these anomalies are considered.

INTRODUCTION

Amid the challenges that fishes face during their growth, there are diverse kinds of anomalies in the skeletal system which can impact the shape, growth, and the existence of the entities. skeletal deformities exist in wild populations, though they are relatively rare either because they are comparatively infrequent or due to the reduced capability of abnormal fish in their natural habitation (Gavaia *et al*., 2009, Bogutskaya *et al*., 2011, Jawad *et al*., 2015a, 2016).

Irregularities in the vertebral column like lordosis (ventral curvature) and kyphosis (dorsal curvature) have been identified in several species both cultured and from wild populations (Afonso *et al*., 2000, Sfakianakis *et al*., 2004, Kranenbarg *et al*., 2005, Jawad, 2014, Jawad *et al*., 2015a, 2015b). Lordosis is maybe the furthermost well investigate vertebral column irregularity in fishes. It can distress every area of the vertebral column (Fjelldal *et al*., 2009). Kyphosis is contemplated less customary than lordosis (Boglione *et al*., 2013).

The meagre is a marine fish species that sometimes enters the brackish water (Riede, 2004). It lives at depth range 15 - 300 m (Schneider, 1990) and it distributed in the Eastern Atlantic from Norway to Gibraltar and Congo, including the Mediterranean and the Black Sea. This species migrated to the Red Sea via the Suez Canal (Riede, 2004). The individuals of this species reach a max total length of 2300 mm (Maigret and Ly, 1986), with a common total length of 1500 mm (Chao and Trewavas, 1990). Individuals of this species are migratory shifting along shore or offshore onshore in response to temperature alterations (Griffiths and Heemstra, 1995).

In the present investigation, we provide a morphological account of an incidence of lordosis-kyphosis in the teleost species *A. regius* obtained from a local fish market in Tripoli, Libya. This is the first report of such deformity in this species from the entire Mediterranean Sea region.

MATERIALS AND METHODS

On November 28, 2023, one specimen of *A. regius* displays a continuous incidence of lordosis-kyphosis was obtained from a local fish market in Tripoli, Libya (Fig. 1a). For comparison, an X-ray image of a normal specimen of this species was obtained from the fish Ichthyological collection of the Muséum National d'Histoire Naturelle of Paris (Fig. 1b). The abnormal specimen was fixed in 70% ethanol and deposited in the fish collection of Zoology Department/Science faculty/ University of Tripoli, Libya. An x-ray was taken for the abnormal specimen and compared with that of the normal specimen. The length of the vertebral column from the anterior end of the first vertebra to the posterior end of the last vertebra was divided by fish total length to make a ratio that was incorporated to compare the abnormal with the normal fish. The angle of vertebral bend was measured from the centre of the deformity, which in the present case was in the abdominal and the caudal regions, using a digital protractor. To evaluate the degree of irregularity in the deformed individual, we measured the value of the angle located between two sides of the vertebral column.

Fig. 1 - *Argyrosomus regius*, a. abnormal specimen, 344 mm TL; b. normal specimen, 624 mm TL.

RESULTS

The measurements of the abnormal fish were 344 mm total length, 255 mm standard length, and 114 mm head length compared to the normal specimen, which measured 624 mm total length, 375 mm standard length, and 87 mm head length, and weight 650g (Fig. 1a, b). The external appearance of the abnormal specimen showed one major hunch just behind the head and under the spinous part of the first dorsal fin and another smaller laterally slightly extended hump in the caudal region under the soft part of the dorsal fin showed to (Fig. 1a).

The radiograph of the normal and the abnormal specimens (Fig. 2a. b) showed that the normal specimen has 24 vertebrae (13 abdominal and 11 caudal), while the abnormal specimen has 26 vertebrae (13 abdominal and 13 caudal). In the abnormal specimen, the whole thoracic vertebrae and the entire caudal vertebrae were implicated in the curving upward and downward of the vertebral column.

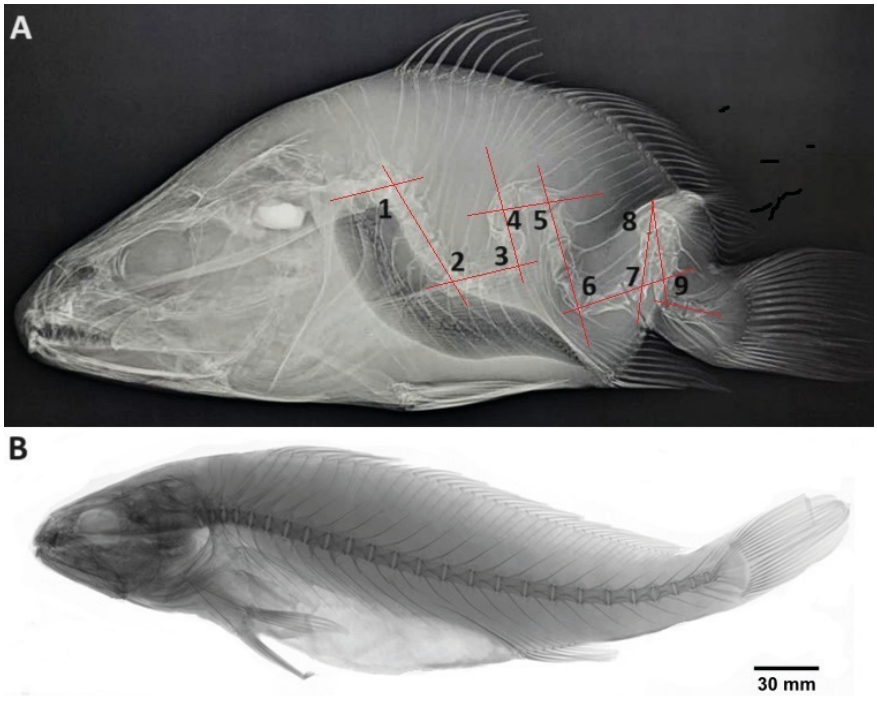

Fig. 2 - Radiograph of *Argyrosomus regius***,** a. abnormal specimen, 344 mm TL; b. normal specimen, 337.5 mm (source of X-ray: MNHN-IC-0000-7535).

In the abdominal region of the deformed specimen, there are three arches (1st descending arch, 1st L-shape curved, and 1st ascending arch) with five angles (angles 1-5), while there are four arches (1st curved form arch, 2nd L-shape arch, 2nd ascending arch, 2nd descending arch, and 3rd L-shape arch), with four angles (angles 6-9) in the caudal region (Fig. 2a).

The 1st descending arch contained 1-4 abdominal vertebrae, the 1st L-shape arch comprised of 5-8 abdominal vertebrae, the 1st ascending arch encompassed 9-12 abdominal vertebrae, the 1st C-shape arch covered the caudal vertebrae 1-3, the 2nd L-shape arch constituted of 5-7 caudal vertebrae, the 2nd ascending arch has the caudal vertebrae 8-9, the 2nd descending arch covers the caudal vertebrae 10-11, and the 3rd L-shape arch showed to have the caudal vertebrae 12-13. (Fig. 2a).

The ratio of vertebral column to fish TL in the deformed specimen was 0.47, while it was 0.65 in the normal specimen. The values of angles "1-9" were 109°, 110°, 105°, 93°, 100°, 104°, 112°, 84°, and 115° respectively (Fig. 2a).

The other abnormalities observed in the deformed specimen are the de-

formed neural and haemal spines in addition to the centra of the vertebrae. Such deformities are observed in all vertebrae of the vertebral column.

DISCUSSION

A considerable sum of existing literature is obtainable on wild fish anomalies (Divananch *et al*., 1996, Jawad *et al*., 2013a, 2013b, Jawad and Liu, 2015) that designates the reasons of the variable abnormalities. They contain both genetic (Ishikawa, 1990) and epigenetic issues as conceivable sources of such anomalies (Fjelldal *et al*., 2009), as well as habitat setting such as temperature, light, salinity, pH, low oxygen concentrations, inadequate hydrodynamic conditions, and parasites (Chatain, 1994, Gavaia *et al*., 2009). It is likely that the abnormal *A. regius* specimen had faced disapproving habitat impacts that could have led to this type of vertebral irregularities. Since the deformed specimen was an adult, the distortion was not lethal, but it surely impacting its flexibility and swimming in some way. Excluding the repetitive lordotic-kyphotic curvatures, the remaining parts of the fish body were seemingly in a good condition.

The external features changes of lordosis and kyphosis displayed in the specimen inspected were associated to anterior-posterior (i.e., cranial-caudal) compression along the vertebral column. Physical signs were present in the x-ray showing that the normal amphicoelous (hourglass) shape of vertebrae was distorted so that vertebral height was reduced on the convex side and was greater on the concave side of the curvature. Moreover, the vertebrae near the apex of the curvature (lordotic vertebra number) were wedged. The midline width was also significantly reduced in some vertebrae. Comparable variations were detected in *Poecilia reticulata* by Gorman *et al*. (2010). They recommend that the perceived deviations in vertebral bone build up could be because of either (1) the distortion of normal vertebral shape, or (2) the active remodelling of vertebral osteoid bone because of external impacts. The second reason was defined in animal models with tempted curvature in several teleost species (Huysseune *et al*., 2000, Kranenbarg *et al*., 2005). Many investigations showed that bone modelling can be impacted by raised water oxygen levels through the influence on bone mineral composition (Helland *et al*., 2005). It has been known that the specimens of *A. regius* are reared in the Egyptian waters from the Mediterranean Sea at Dummit, Port Said, and Port Fouad. The water around these areas is proved to be of a low oxygen level (Geriesh *et al*., 2019; Morsy *et al*., 2022), with high variation in water temperature (El-Zeiny *et al*., 2022). In such habitat, hypoxia can progress and lead to teratogenic incidences for the musculoskeletal system throughout embryonic growth and the first larval stage. Hypoxia can also incite cell apoptosis, a main procedure in these stages (Shin *et al*., 2004).

The consecutive occurrence of lordosis and kyphosis (L-K) in the inspected specimen could have been hereditarily regulated. This is proposed by Afonso *et al*. (2000) in a comparable incidence they explored in *Sparus aurata*. In the investigation at hand, even though the reason of lordosis-kyphosis was not inspected, the hypothesis of inherited participation could not be disqualified and designated that a vertebral irregularity could contain of a consecutive repetition of lordosis and kyphosis (L-K syndrome).

The Dummit, Port Said, and Port Fouad areas, where the deformed fish specimen examined are described to have a high level of contamination in trace metals (Okbah *et al*., 2014; El Baz and Khalil, 2018). Trace metals can diminish collagen production leads to protoplasmic poisoning and change the integrity of bones (Luh *et al*., 1973, Bhatnager and Hussain1977, Iguchi and Sano, 1982). Economic consequences of vertebral anomalies are imperative in regard of decreased weight and more prominently the considerably lessened value per kg of selling fish. Consequently, more attempts to recover the management of fisheries industries must be put in action to discover the several etiological sources of abnormalities before additional serious incidences are made.

In conclusion, this study describes a case of consecutive lordosis – kyphosis was described from one marine fish species *A. regius* obtained from a local fish market in Tripoli, Libya. This species is usually catch and brought to Libyan fish market from Dummit, Port Said, and Port Fouad areas in Egypt. This deformity is observed in both the abdominal and caudal regions of the vertebral column and occurred in severe form. The *A. regius* species seems to show high susceptibility to the issues producing such abnormality. The outcomes of the present investigation can be deliberated as initial health status indicators for the Egyptian waters of the Mediterranean Sea and propose that this sea habitat should be explored further regarding the pollution so put forward a suitable and precise plan to regulate its condition.

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AUTHOR contributions

Laith Jawad: introduced the idea, wrote the manuscript, and follow up the process of the publication,

Hanan Shtewi and Hend Ensair: collected the specimen, obtained X-tray image, and provide measurements for the deformed specimen.

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