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Anatomy of Vertebral Column of the Silver-Cheeked Toadfish *Lagocephalus Sceleratus* on Derna Coast, East, Libya

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ABSTRACT

An evaluation study was conducted on the successive vertebrae that form the backbone of the *Lagocephalus sceleratus* fish species from the coast of Derna (Derna Port), East of Libya. The spine of this species has been divided distinctly into three different major regions (parts of the fish body). This division is more complicated than the classical division of the stem and tail segments. Its distinctive appearance can be clearly demonstrated in the case of regionalization in the spine of this species, that changes could be appeared, through the length difference of vertebrae in different areas of the spine, these morphological descriptive measures reflect the morphological status of the skeletal structure, which could be associated with swimming and movement manner of Toadfish.

تشريح العمود الفقري لسمكة الأرنب (أبو نفاخ) *Lagocephalus sceleratus*
من ميناء درنة - شرق ليبيا

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أجريت دراسة للفقرات المتتالية التي تشكل المحور الفقري لسمكة الأرنب (البو نفاخ) *Lagocephalus sceleratus* من ميناء درنة ، شرق ليبيا ، وقد تم تقسيم العمود الفقري لهذا النوع إلى ثلاث مناطق رئيسية مختلفة ، هذا التقسيم يعتبر أكثر تعقيدا من التقسيم القديم في التسلسل او مؤخرة الأجزاء . كما أن مظهرها المميز يمكن ان يظهر بوضوح حالة التأقلم في العمود الفقري لنوع سمكة الدراسة، تلك التغيرات يمكن تظهر من خلال الاطوال المختلفة للعمود الفقري في مساحات مختلفة، هذه المقاييس الوصفية المورفولوجية تعبر عن حالة مورفولوجية لتركيب الهيكل العظمي يمكن أن تكون مرتبطة مع أسلوب السباحة والحركة لسمكة أبو نفاخ .

INTRODUCTION

The silver-cheeked toadfish Lagocephalus sceleratus is one of the known invasive species in the Mediterranean Sea that enters through the Suez Canal, where the first appearance of it in the Mediterranean sea was record in 2003 (Feliz & Er 2004, Akyol et al. 2005). This species was found at a depths ranging of 8 - 180 meters. The first

samples (specie) were observed in Turkey coast and the coast of the occupied Palestine (Golani, 2010). In the Libyan waters, this species was recorded for the first time in Ain Ghazala lagoon near Tobruk (Kara et al., 2015). In some countries, the Lagocephalus sceleratus is accidentally harvested in fishing gear. There is an interest in the growth of fish stocks, targeting these species in the eastern Mediterranean to control their populations (Akyol et al., 2005). The most abundant of Lessepsian migrant fish in the Mediterranean coasts from the non-indigenous ,and also distributed on the eastern coasts (Başusta et al., 2013; Akyol et al., 2005) . In a study to the TTX levels in different tissues of *Lagocephalus sceleratus* where the highest in gonads and the lowest in muscle samples (Kosker et al., 2023) Especially the European markets prevent entering these poisonous fish, although they are chopped, served, and sold in the Egyptian market (Halim and Rizkalla 2011). In other countries, the production of toadfish fisheries is affected by the prevention of buying (Katikou et al. 2009). Biometrical studies are included as biological methods to understand this species; especially the skeleton gives the body shape to vertebrates, supports weight, assists muscles in movement production, and protects soft tissues. In general, the skeletal system in bony fish is made up of the skull, spine, ribs, thoracic belt, pelvic fins, and some small bones such as flap-supports, which support soft tissue and thorax. (Alline, 1986)

As a part of skeleton; regionalization degree of the vertebral column in vertebrates varies significantly; if we talk about the morphological differences in regions of vertebral column (Kubo & asano, 1990 and desse et al., 1989). In bony fishes; Grande & Bemis, (1998) divided two regions of the vertebral column as: (a) the pre-anal abdominal region and (b) post-anal caudal region. However, in these regions, there is diversity in vertebral form (Grande & Bemis, 1998; Bemis & Forey, 2001) . The spine in general is composed of a number of vertebrae, which are divided into trunk and caudal vertebrae. Each trunk vertebrae are a semicircular center, with a nasal spike that emerges as an external growth of the neural arch, surrounding a nervous canal through the spinal cord, which passes and ends with two transverse axes connected by a rib on each side. The caudal vertebrae consist of the previous parts, in addition to a bump in the form of a haemal thorn, based on the haemal arch that surrounds the haemal channel, through the postcard in a vein, ends the spine in the caudal fin, with several small magnets, forming the so-called hypural plate (Al-Balawai, 2005). It is considered one of the most harmful invasive species in the Mediterranean, because of its affect on marine biological diversity (Ulman et al., 2021). Jawad (2013) stated that the backbone of the L. lagocephalus is composed of 18 vertebrae, and each vertebra is characterized by its two-torsion body except for the last vertebrae, which is located at the end of the vertebral column and has evolved formally, and fused with some hypural plates. The spinal section was divided into two main regions; a frontal region was composed of abdominal vertebrae and a posterior region with caudal vertebrae Lindsey, (1978) and weihs, (1989) mentioned that the vertebral column has an important role in fish locomotion mechanism. Jawad and Al-Hassan, (2003) stated that this structure is subjected; during the developmental stages, to different biological strains which are notified by morphological peculiarities, locally and specifically (Kubo & Asano, 1990). According to Vronskii & Nikolaitchouck, (1989); the axial musculature is strongly related with the vertebral column, anatomically and functionally. In order to reveal such relationship, studying the morphological characteristics of vertebral column is essential.

In this work, a comprehensive osteological study of the vertebral column of the Silver-cheeked toadfish Lagocephalus sceleratus will be defined, to follow up the morpho-functional hypothesis and then to open the door for the next literature about the movement physiology and the body structure in this fish in the eastern Libyan coast, where there is no such available data for this species.

MATERIALS AND METHODS

1.2. Study area:

A specimen of Lagocephalus sceleratus was caught used by a local fisherman on the port of Derna in August 2023. harbor, at the junction of 58 58° 00 N - longitude and 54 54° 18" E - latitude (MBRC, 2005) (Fig. 1). This port is located at a narrow coastal plain; It is five kilometers width, where the mountain edge provides protection from the southern winds. This port was built on a rocky area, which is called Ras al-Metariyas (Abu-Madinah, 2008).

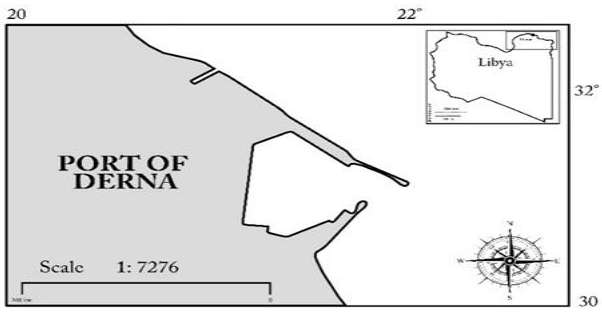

Fig. (1): The map coasts of Derna, eastern coast, Mediterranean Sea, Libya

2.2. Classification and measurements:

The collected specimen was brought to the Laboratory at Zoology of the Faculty of Science at Omar Al-Mukhtar University, Al-Bayda in which it was classified and identified using the following taxonomic references (Whitehead et al., 1984; Nelson, 2006; Calypso, 2000 Golani et al., 2006; Ben-Abdalla et al., 2009). The total

length of the fish (cm.) was measured and recorded from the front of the head to the end of the caudal fin. The total weight of the fish (gm) was also determined.

3.2.1. Used Materials:

Autopsy kit, gas of cooking, cooking utensils, Sodium hypochlorite, 5%, Hydrochloric acid, and Hydrogen peroxide 6%.

2.3.2. The method of work (Methodology) :

According to Jawad, (2013), after the fish had been classified and the measurements were taken, it was cleaned. It removed the internal intestines, and then cook the fish in boiled water for a quarter of an hour, to facilitate the meat removal, and to use of autopsy tools to remove the meat from the skeleton more carefully. The remaining cleaning process is followed by placing it in 5% hydrochloric acid for 24 hours, to dispose of the meat residue in the bone. After complete cleaning (Fig. 2) (Fig. 3), the hydrogen oxide 6% was sprayed to put the tag on the separated bones and to be photographed later when these bones will be reassembled after cleaning and use the glue to rebuild the bones whole again.

Figure 2 : A sample of the *Lagocephalus sceleratus* fish in the zoology laboratory of the Faculty of Science at Omar Al-Mukhtar University.

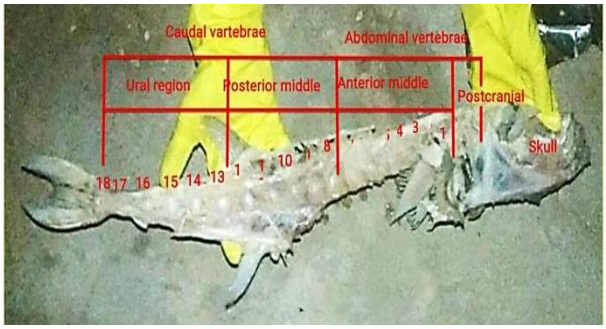

Figure 3. [A] Port of Derna, eastern coast of Libya; [B] Measuring the specimen of Lagocephalus sceleratus , and [C] Clarification of the spine parts of *L. sceleratus* from Derna coast, Libya according to Jawad, (2013)

RESULTS AND DISCUSSION

In this study, the vertebral column of the specimen was composed of 18 vertebrae and divided into two main regions: a frontal region composed of abdominal vertebrae and a posterior region; with two caudal vertebrae with two braces. The frontal region is divided into two regions: the post-cranial region includes the first and second vertebrae of the spine, and the frontal central region extends from the 3rd to the 8th vertebrae. According to Jawad and Al-Hassan, (2013); the first vertebra, which is named as post-cephalic vertebra is designed to articulate with the skull, talking about the posterior region. To form a link between the two main elements of the axial skeleton (skull and column vertebrate), this function requires some morphological specificity, compared to the other vertebrae of the post-cranial region, as an anterior ventral concavity, which this first vertebra is articulated with the basi-occipital, to form a link with the next vertebra (Videler, 1993). Meanwhile, the following four vertebrae 2nd - 6th are considered transition vertebrae because of their increase in the vertebral biometric parameters (Ramzu & Meunier, 1999)

Looking to the posterior area; it is also divided into middle and posterior areas , which extend from the 9th to the 12th vertebrae, Jawad and Al-Hassan, (2013) reported that if 3rd - 8th and 9th – 12th, which are located in the pre-caudal and caudal regions, respectively, composed of truncal and caudal vertebrae to forms morphological units, with a regular increase in these two regions, until a maximum value before decreasing progressively. The border is located between the abdominal and caudal segments, at the level of the 8th vertebrae; the first eight vertebrae are indicated with the viscera. Meanwhile, the characteristic character of the caudal vertebrae is the presence of two braces. The first vertebrae – after the skull – were created to for connecting the posterior region of the skull, to formulate the following vertebrae as a link between the skull and spine as major axial skeleton components (Al-Shubka, 2009).

The area of the Urals includes the vertebrae from the 13th - the 18th vertebrae, directed to the tail, and characterized by a slight increase then decrease of the first three values of the analyzed parameters. The vertebrae 14th - 16th as Jawad and Al-Hassan, (2013) recorded as maximum-sized vertebrae, as a structural response to the presence of maximal mechanical constraints. Ending with different anatomy of haemal arches and spines in the last vertebrates.

Ramzu et al., (1992) hypothesized about the sudden development variations in the postcranial and ural

regions; although the maximum constraints of the middle regions. This development is appeared in the mechanical constraints of swimming; Webb, (1978) stated that toadfishes swim using the "ostraciform mode"; where these species simulate rowing with the caudal fin; the caudal peduncle and fin act in a sculling style.

The parametrical variation might express the major role performed by the caudal vertebrae in the movement process of swimming. According to Bainbridge, (1963), at different phases of one beat, any slight increase or decrease in the surface area of the caudal fin, its region responds to the alternate contraction of the intrinsic muscles on their lateral sides could create a torsion in the caudal peduncle. All of this to create a support to move in the water column.

Ward & Brainerd, (2007); Jawad & Al-Hassan, (2013) linked the changes in the length of the abdominal and caudal vertebrates, and the value of the aspect ratio of both their regions. Eventually, the skeleton of this species still needs more studies, to identify, understand and stimulate another field in the future.

C0NCLUSION

The successive vertebrae that form the backbone of the *Lagocephalus sceleratus* has been divided distinctly into three different major regions. This division is more complicated than the classical division of the stem and tail segments which reflect the morphological status of the skeletal structure, which could be associated with swimming and movement manner of Toadfish.

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