Descriptive and comparative osteology of two sparid fishes from Iraqi marine waters

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Abstract:

A descriptive and comparative osteological study was performed of two sparid species: *Acanthopagrus arabicus* Iwatsuki, 2013 and *Acanthopagrus bifasciatus* (Forsskal, 1775), were collected from Iraqi marine waters, during the period from January to May 2015. Some paired head bones and vertebral column such as; premaxilla, maxilla, lower jaw; dentary, articular, operculer, preoperculer and vertebral column. The height of ascending process equally basebone length in *A. arabicus*, whereas the ascending process is longer than basebone length in *A. bifasciatus*. The maxilla of the two fishes possesses one anterior ascending process support the premaxilla. Dentary have 3-5 rows of moral-like teeth in *A. arabicus* and 4-5 rows in *A. bifasciatus*. Operculum process was a good fused with operculum bone in *A. arabicus*, whereas being prominent and end in operculum spine in *A. bifasciatus*. The vertebral column contain 23 vertebrae in *A. arabicus*, while 24 vertebrae in *A. bifasciatus*. The study showed high resemblance and some structural differences between bones of investigated species belonging to intraspecific variations, and supported to join them in one genus of the family sparidae.

Key words: Osteology, sparid fish, paired head bones, vertebral column

Introduction:

Sparidae includes about 38 genera and 154 species (Froese and Pauly, 2017). The family occurred in tropical and temperate Atlantic, Indian and Pacific Oceans (Carpenter and Johnson, 2001), usually most common along the shore from shallow water including estuaries, to deeper water as demersal inhabitants of the continental shelf and slope which is appear their ability to residence in of different environmental circumstance (Partridge *et al*., 2004).

The maximum of sparid fishes reaches about 1.2 m length, carnivores of hard-shelled benthic invertebrates. Many species have been found to be hermaphroditic, some have male and female gonads simultaneously, and others change sex as they get larger (Nelson, 2006).

This is the most common *Acanthopagrus* species in the Arabian Gulf, and east and southeast Arabian Gulf, but is not abundant. *Acanthopagrus arabicus* inhabitant throughout the Gulf in shallow waters, the species occurs depths of less than

50 m, ranging from 25–45 cm length, though typically *A. arabicus* does not grow larger than 35 cm total length, the diet consists primarily of worms, molluscs, and crustaceans (Iwatsuki *et al.*, 2014).

The doublebar seabream, *A. bifasciatus* was described originally from the Red Sea and is also found in association with reefs in shallow coastal waters (2–20 m depth) of the Arabian Gulf a popular fish food, is capture with a variety of gear, hook and line, traps and trawls. Like other sparid species, (Iwatsuki and Heemstra, 2011).

The taxonomic studies were focused in the past on the morphometric and meristic characters, but the subsequent studies verifying the important of bone in fish taxonomy (Shukla and Verma, 1972). The jaw bones are considered to be an important character to separate the groups of species in teleostean fishes, although they are remarkably variable in shape correlated to the feeding behavior (Taniguchi, 1970).

The skeleton of fishes consists of three main parts: the head skeleton, comprising the skull and related structures, the axial skeleton comprising the vertebral column plus the caudal bones, and the appendicular skeleton which comprises the skeletal support for the various fins (Watt *et al*., 1997). The head skeleton of the bony fishes is more complex than that of any other class of vertebrates; the numbers of bones are much more than in birds or mammals, (Gregory, 1933). The vertebral column of fish is made up of numerous arranged vertebrae and a variety of divisions of the vertebral column, and has used a number of names for these divisions (Desse and Desse, 1983; Wheeler and Jones, 1989).

Many studies have dealt with the osteologecal characters to the distinction between identical species of fishes, Taniguchi (1970) investigated a comparative osteology of the sciaenid fishes from Japan and its adjacent waters. Alkahem *et al*. (1990) described the osteological of four Arabian cyprinid species. Nasri *et al*. (2013) made comparative osteology of Lotaks, *Cyprinion kais* and *Cyprinion macrostomum* from Western Iran. Jalili *et al.* (2015) described the osteology of *Alburnus mossulensis* from Iranian part of the Tigris river drainage.

The present work was aimed to description and comparative some paired head bones and column vertebral of two *Acanthopagrus* species and observed the variables and make sure do these differences elevate to collect the species in one genus.

Materials and methods

A total of 100 specimens of fish included 65 individuals of *A. arabicus* , and 35 of *A* . *bifasciatus*, were collected from Iraqi marine waters North western Arabian Gulf (N 49º 29´ , 29º 51´) and (E 48º 30´, 48º 36´), during the period from January to May 2015 (Fig. 1). The fishes were collected by seine net, the specimens were weighting (wt), to nearest 0.01 g and measured the standard length (SL) in mm. The represented species were classified according to Carpenter *et al*. (1997) and Iwatsuki (2013) respectively. The specimens were boiled in water until flesh was easily removed and the bones were isolated, then left to dry. The investigated bones premaxilla, maxilla, dentaries, articular , preoperculum, opercula and vertebral column. The bones were photographed using digital camera (sony steadyshot). The nomenclature to describe the bones followed some literatures (Howes, 1982; Alkahem *et al*., 1990 and Miranda and Escala, 2005). The shape of the each bones were described in details.

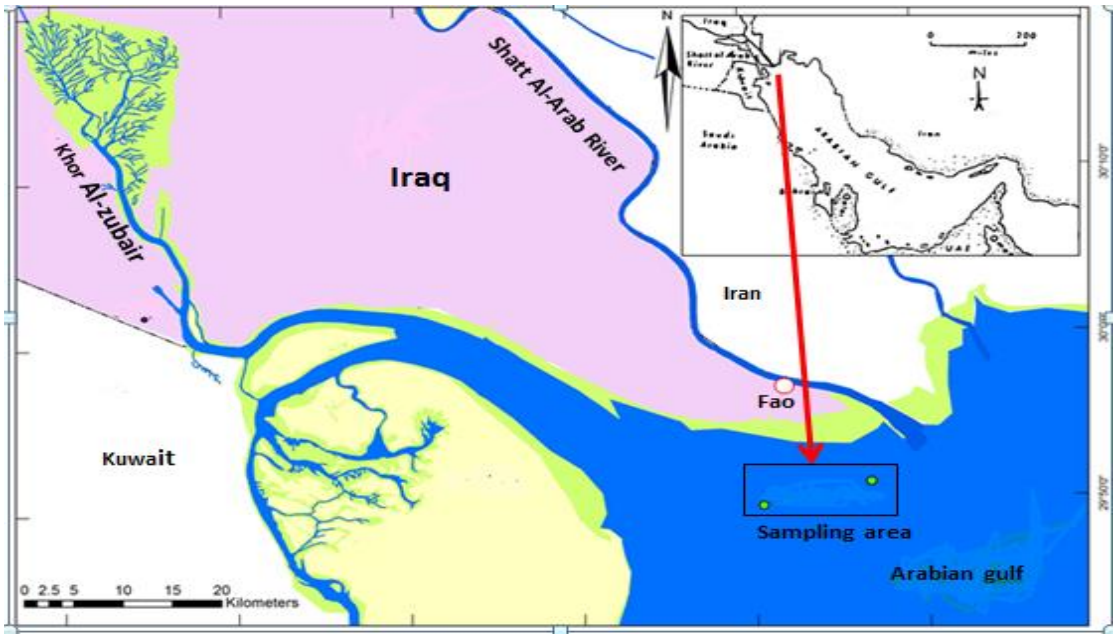

Fig. 1. Map of sampling area

Results

The upper jaw

Premaxilla: The shape of two bones appears a high degree of similarity between two investigated sparid species. The bones were sturdy and consist of ascending process and basebone length in both species. The height of ascending process equally basebone length in *A. arabicus*, whereas the ascending process is longer than basebone length (122.72%) in *A. bifasciatus*. Premaxilla in the two species bears three conical strong curved teeth in the front and 4-5 rows of moral-like teeth (Fig. 2).

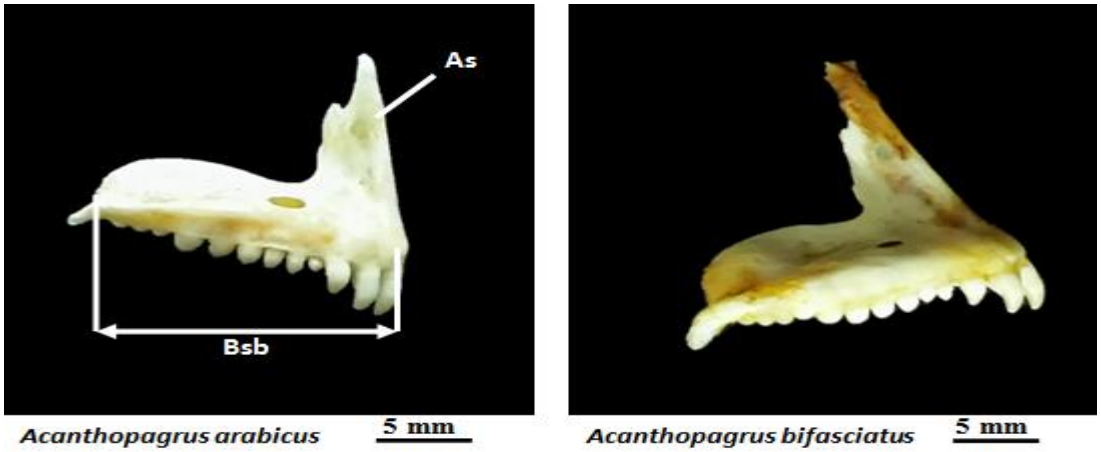

Fig. 2. The premaxilla of two investigated saprid species. As: ascending process, Bab: basebone length

Maxilla: The bones of represented sparid species characteristic by high resemblance in shape and design. Maxilla in both investigated species was thick anteriorly and at middle, while thin in the posterior process that attach with the dentary and articular bones. The maxilla of the two fishes possesses one anterior ascending process support the premaxilla (Fig. 3).

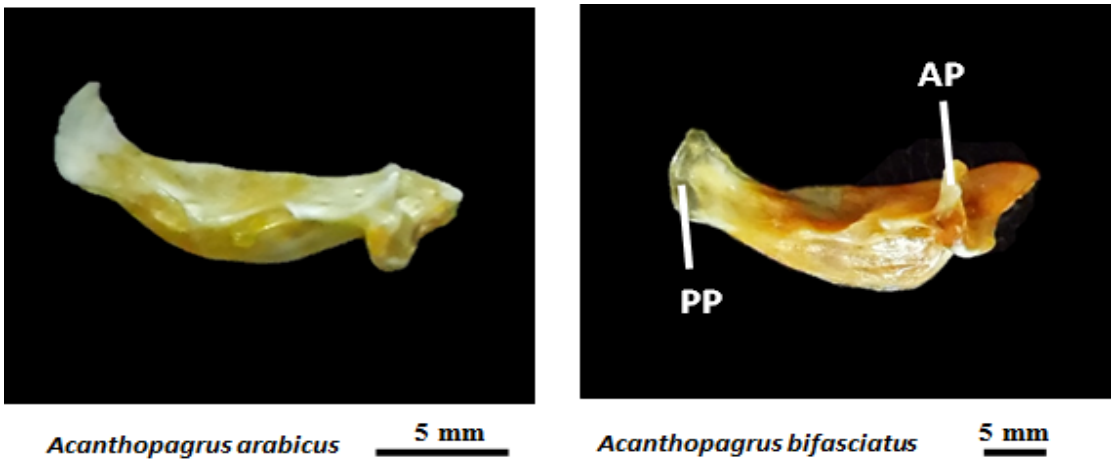

Fig. 3. The maxilla of two saprid species. AP: ascending process, PP: posterior process

The lower jaw

Dentary: Sturdy and thick bones in both examined species, they owning three pairs of conical strong curved teeth in the front, 3-5 rows of moral-like teeth in *A. arabicus* and 4-5 rows in *A. bifasciatus*, include cavity which anterior of articular bone where inserted. The dentary possess two posterior process; the dorsal coronoid process and ventral process, articulate with the anterior process of articular (Fig. 4). Dentary of two investigated species have several sensory pores in the ventrolateral surface represents the beginning of the literal line, the first three pores were rounded, but the other was elongated.

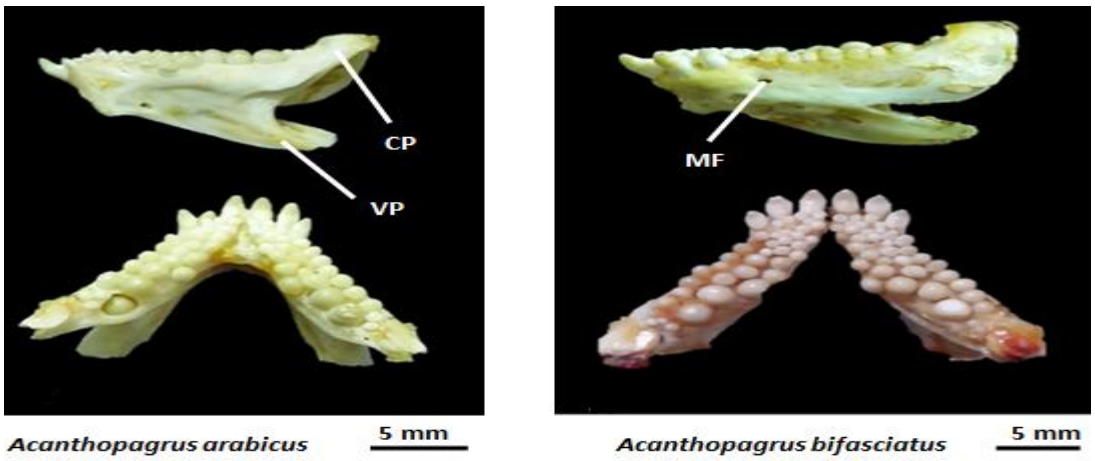

Fig. 4. The dentary of two examined saprid species. MF: mental foramen, CP: coronoid process, VP: ventral process.

Articular: The anterior portions of represented bone are pointed in the two examined species, inserted into the dentary bone cavity. The middle sector are gently concavity have two small holes with more thin in *A. bifasciatus*, while the holes are absent and the medial part has more thickness in *A. arabicus* (Fig. 5). A posterior portion are more thick in both species which fused with tiny pointed bone in called the angular which is forming a saddle-like place to articulation with the quadrate bone.

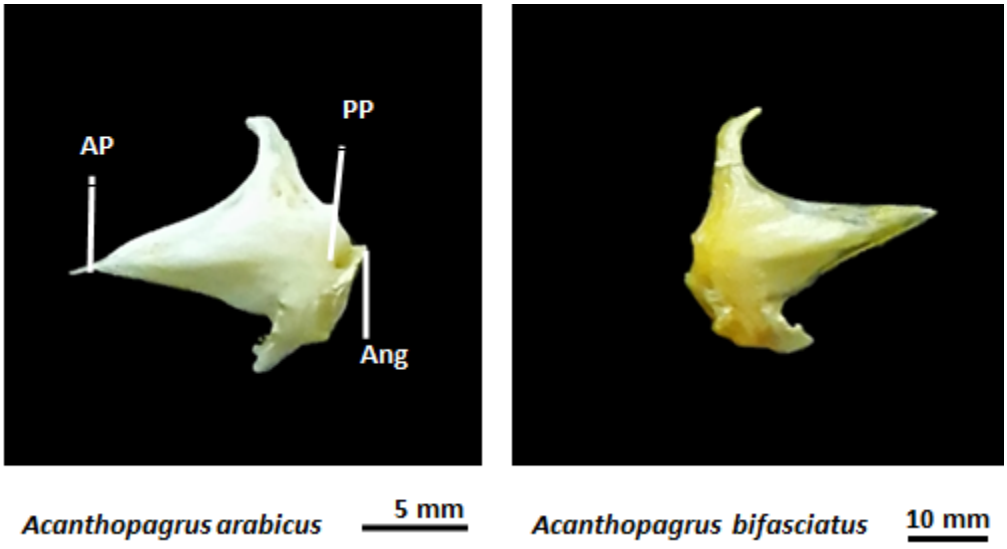

Fig. 5. Lateral view of the articular bones of two sparid fishes. AP: anterior process, PP: posterior process, Ang: the angular bone.

Opercula: The opercula majored bone cover the gills consist of operculum, preoperculum, subopercula and interoperculum.

Preoperculum: There was a high similarity between examined bones of the two sparid species, the upper angle are acute in both species, anterior wing form obtuse angle, whereas the posterior wing semicircular, homologous quadrate crest and sensory canal between two fish bones (Fig. 6).

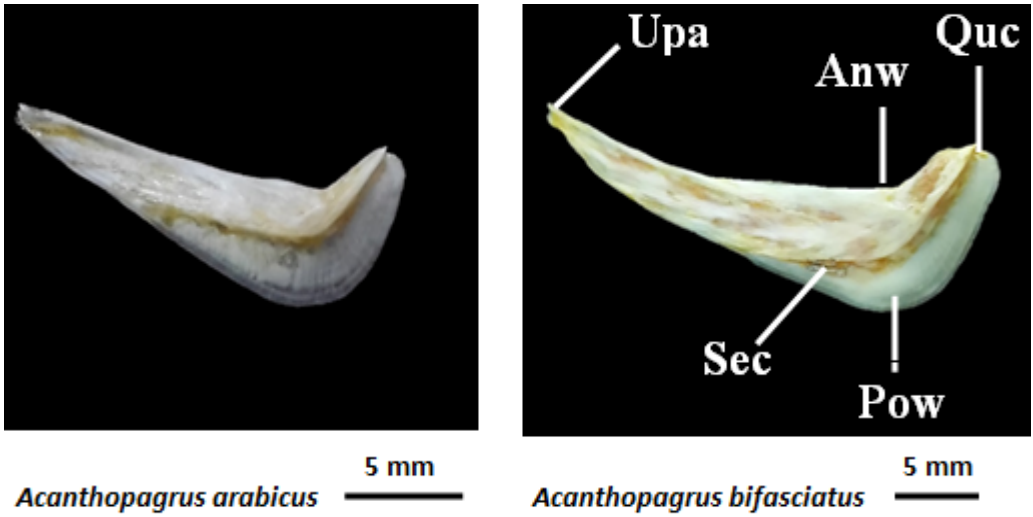

Fig. 6. Lateral view of the preoperculum bones of two sparid fishes species. Upa: upper angle, Anw: anterior wing, Pow: posterior wing, Quc: quadrate crest, sec: sensory canal

Operculum: Flat stout bones, they have large elongated articular fossa, the articular process is longer with pointed end in *A. bifasciatus*, the distance between articular process end and the superior angle is slightly concave in *A. arabicus*, but more concave in *A. bifasciatus* (Fig.7). The superior angle in low position in *A. arabicus*, while in elevated status in

A. bifasciatus. Operculum process thick and good fused with operculum bone in *A. arabicus*, whereas being prominent and end in operculum spine in *A. bifasciatus*. The posterior angle was acute in both species, the anterior margin stretch to a large distance in the two species. The inner surface contained two branches included none penetration small pores in *A. bifasciatus*, but absent in *A. arabicus*.

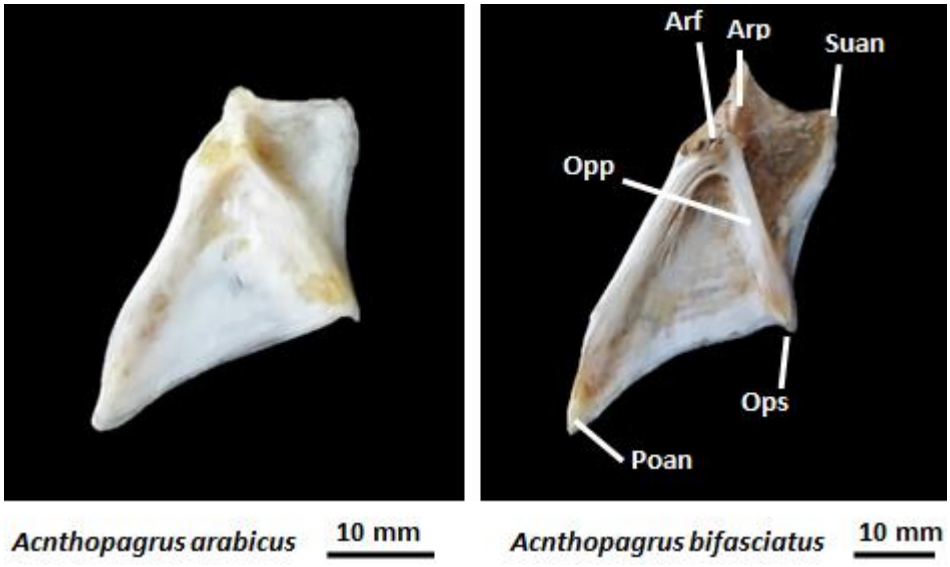

Fig. 7. The operculum bones of two sparid fishes specie. Arf: articular fossa, Arp: rticular process, Suan: superior angle, Opp: operculum process, Ops: perculum spine, Poan: posterior angle.

The vertebral column: The count of vertebrae in the two examined species appear differences, in *A. arabicus* there are 23 vertebrae, while 24 vertebrae in *A. bifasciatus*. Three postcranial vertebrae and seven abdominal vertebrae in both represented species. The caudal vertebrae were 13 in *A. arabicus*, while 14 in *A. bifasciatus* (Fig. 8).

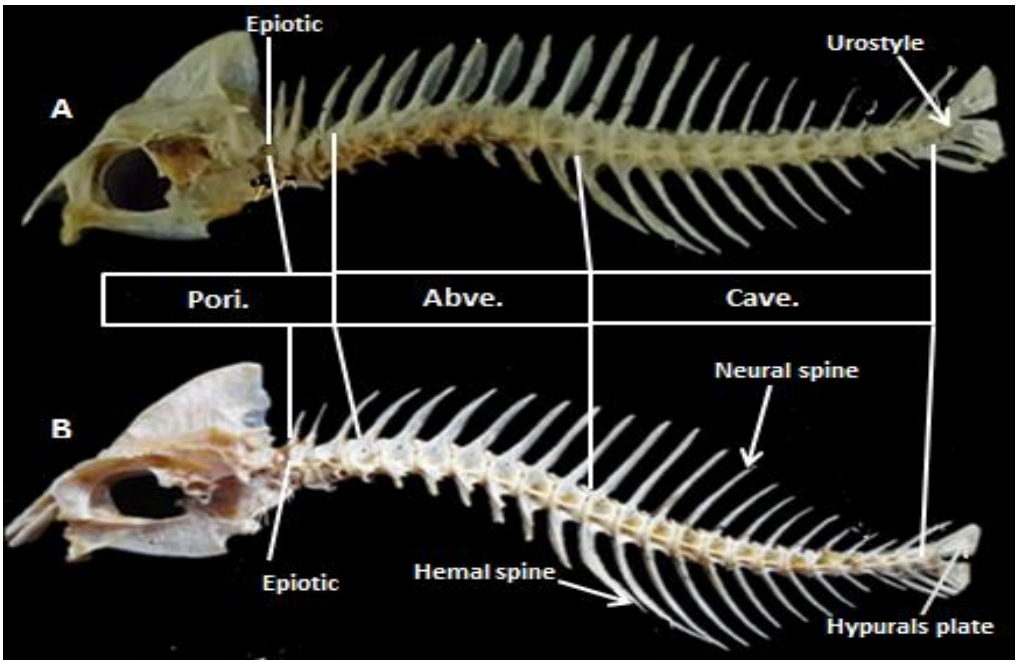

Fig. 8. The vertebral column of A: *A. arabicus*, B: *A. bifasciatus* showing types of vertebrae. Pori: Postcranial region, Abve: Abdominal vertebrae, Cave: Caudal vertebrae

Discussion:

We cannot understand how fish swims, feeds, maneuvers and breathes without knowledge the mechanism related to the bones. The changes in bones form during the adaptive variations in species are reflected the important taxonomic feature for identifying fishes species (Bond, 1979).

The morphology of bones is a valuable tool to observe the variations intraspecific and intergeneric to detect phylogeny contrast among species, genera and in the different groups of fishes, to perception influence of the interaction between environments and genetics in bones modifications that support the fauna to evolution their lifestyle (Prokofiev, 2010).

Head bones of fish have species-specific adaptive feature and are of high taxonomic value, therefore the bones of jaws are an important adjective to distinguish the species (Antovic and Siminovic, 2006).

There is a strong correlation between jaws bones design, food and feeding habits, since the highest resemblance in food and feeding behavior of the two species, this reflected the high degree of phylogeny between represented species (Prenda and Granado - Lorencio, 1992). The results shows that the ascending process equally basebone length in *A. arabicus* whereas, the ascending process is longer than basebone length (122.72%) *A. bifasciatus* this is belonging to intraspecific

differences between the two fishes which enhanced joined them in one taxa.

The shape of maxilla in present work is flat like plate bone, the anterior portion attaches the premxilla, but the posterior end being freed from the cheek to raise upper jaw mobility, and it has been observed in both investigated species this character corresponds with most of teleost's fishes structure (Nelson, 2006).

The carnivore's predatory feeding habits in fishes as adaption in actinopterygii group evolve thick jaws bones and highly specialized teeth can catch and crushes the prey, these traits were employed on the lower jaw bones design in both sparid fish and others teleost's (Taniguchi, 1970).

Lagler *et al.* (1977) reported that Preoperculum and operculum covers the branchiocraniums in bony fishes, in spite of the large degree of similarities between the present two species, however there are some variations in shape and structure of operculum bones and this differ related in the variance in rank of taxa and the interpretation of difference is due to the specificity of each species.

The vertebrae in fishes possess sample structure than other terrestrial vertebrate, because the water support the fish, therefore the vertebrae appear touching with each other. The first region post the skull is the postcranial region, the first three vertebrae distinctive in morphological design and functions which is link with the basioccipital in both *Acanthopagrus* species (Videler, 1993), the other sector of vertebral column in two sparid fish is the truncal or abdominal vertebrae portion characteristics by holding two ribs in each vertebra which make the abdominal cavity. The caudal vertebrae possess neural spine toward the dorsal and hemal spine in the lower parts. In most bony fishes the last region hypural vertebrae is modified to urostyle has a different morphological and anatomy support hypurals and fin rays of caudal fin these result agree with (Jawad, 2015).

Conclusions

The present study revealed some variables in head bones and vertebral column in spite of the existence high degree of similarity between species of two sparid fish confirming past morphological studies include the present species in one genus belonging to sparidae family.

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مقارنة وصفية عظمية لنوعين من أسماك عائلة الشانك Sparidae من المياه البحرية العراقية

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المستخلص:

أُعدت دراسة مقارنة عظمية ووصفية لنوعين من أسماك الشانك *Acanthopagrus arabicus* Iwatsuki, 2013 و *Acanthopagrus bifasciatus* (Forsskal, 1775) جمعت من المياه البحرية العراقية، خلال المدة من كانون الثاني إلى آيار 2015 لبعض عظام الرأس الزوجية والعمود الفقري : العظم قبل الفكي والفكي وعظام الفك الأسفل: العظم السني والمحوري والعظم القبل الغطائي الخيشومي والغطائي الخيشومي والعمود الفقري.أرتفاع الذراع الصاعد للعظم قبل الفكي يساوي طول قاعدة العظم في النوع *A. arabicus* واطول منهُ في *A. bifasciatus*. يمتلك العظم الفكي في النوعين ذراع صاعد واحد. يحتوي العظم السني 3−5 صفوف من الاسنان تشبه الطواحن في *A. arabicus* و4−5 صفوف في*A. bifasciatus* . ذراع العظم الغطائي الخيشومي ملتحم بصورة جيدة في *A. arabicus* ويكون بارز في *A. bifasciatus*. يحتوي العمود الفقري على 23 فقرة في *A. arabicus* بينما يضم 24 فقرة في النوع *A. bifasciatus* . أظهرت الدراسة تشابهاً كبيراً في شكل وتصميم عظام النوعين وبعض الاختلافات تعود الى التباين بين الأنواع ودعمت الدراسة ضم النوعين تحت جنس واحد يتبع عائلة الشانك Sparidae.