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Additions to Benthopelagic Fish Fauna of the Aden Gulf-Arabian Sea (Actinopterygii: Bramidae and Sternoptychidae)

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Abstract: During April 2006, for the first time in the Aden Gulf 34 specimens of Bramids were caught by means of pelagic longline at depths varying between 350-480 m. Specimens were thoroughly studied, morphological and biological features were recorded immediately while they were iced fresh. As a result of the present study *Taractes rubescens* Jordan and Evermann from the family Bramidae (Perciformes) and *Argyropelecus aculeatus* Valencienn from the family Sternoptychidae (Stomiiformes) were newly recognized in Aden Gulf and consequently the Arabian Sea. A big fish size, high falcate front of dorsal and anal fins and widely forked crescent-shaped caudal fin is the main distinctive characteristics of *Taractes rubescens*. Most of the morphometric traits are well expounded and given here for first time. As well as, some important biological characteristics were noticed. From this study it can concluded that deep Aden gulf still holds a lot of attractive conditions for oceanic and deep water marine organisms, which need profound and meticulously long-term scientific investigations.

Key words: Arabian Sea, *Taractes rubescens*, Sternoptychidae, morphology, Bottom fauna, Aden Gulf, *Argyropelecus aculeatus*

INTRODUCTION

It is not surprising that the fauna of the Aden Gulf and Arabian Sea is relatively diverse and can attract many other oceanic fish representatives. It has long been considered one of the richest basins in the tropical circumference, due to an upwelling phenomenon that leads to extremely high primary and secondary productivity (Rao *et al*., 1981; Wilson *et al*., 2003). Up until now, it shared a world fish fauna of more than 88 families and 290 species, more than 60% of which are food fishes (Druzhinin, 1973; Fischer and Bianchi, 1984).

Although, the Family Bramidae (Perciformes) is represented by a relatively limited number of genera and subsequent species, its members are distributed world-wide and are mainly benthopelagic. There are bramids in all tropical-temperate seas, occurring even in the North Atlantic (Mead, 1972; Sauskan, 1988). Most of the bramids are valuable food fishes (Last and Moteki, 2001). They are highly migratory, oceanodromous (FAO. Fisheries Department, 1994).

The main subject of the present study, *Taractes rubescens* is a cosmopolitan species, mainly in tropical seas, widespread in the Pacific and the Atlantic (Masuda *et al*., 1984; Froese and Pauly, 2006; Richards, 2006). It has been recorded from Hawaii to Panama, the Mexican gulf, the Canary Islands and from Senegal to Namibia off the West and South

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African coasts (Bianchi *et al*., 1999; Shao, 2005; Haedrich, 1986; Thompson and Russell, 1996). Juveniles have been found near the Galapagos Islands in August and in Hawaiian waters in May (Okiyama, 1993). It is rarely found in subtropical and temperate seas (Gomes, 1990). This species is not yet recorded from the Northern Indian Ocean (Froese and Pauly, 2006), although it had so far been observed from east Africa up to equator in the Indian Ocean (Fisher and Bianchi, 1984; Gomes, 1990; Shao, 2005).

The Family Sternoptychidae (Stomiiformes) has a large number of species distributed in tropical oceans. They are restricted to the benthopelagic deep habitats; they are sluggish fishes without fishery interests (Weitzman, 1986; Quero *et al*., 1990).

One of the representative of this family, *Argyropelecus aculeatus* is widely distributed in tropical and subtropical seas; it is reported from the Southeast to the Western Pacific; Indo-pacific and toward the South Western Indian ocean-Reunion island (Weitzman, 1986; Letourneur *et al*., 2004; Froese and Pauly, 2006). Bianchi *et al*. (1999) and Froese and Pauly (2006) remarked that it is from Eastern and Western Atlantic: Portugal to Senegal and Namibia to South Africa.

Until recently, only one genus of bramids-*Brama* sp., was known in the Aden Gulf (Anonymous, 2001). In now a days, the increased demand for valuable and pricy species obliged Yemeni fishermen, to go for fishing to the bottom of the gulf and faraway to the Arabian Sea for valuable bottom dwellers. One of these dwellers has become an unexpected and unfamiliar to them, but of high quality fish-keeled pomfret, which is the subject of our present study. This species brings in its stomach another new representative of deep sea bottom fauna, the *A. aculeatus*. Both species will be added to Aden Gulfs diverse fish fauna as a new record.

MATERIALS AND METHODS

Fishing Area

The region of studied specimens of pomfret fishing was at the point coordinates 14° N and 53° E: it extended over 10 sites, from 13° 40"N 51° 33' E upon 15° 27'N 54° 00'E (Fig. 1). This location is characterized by being considered just on the geographical boundary line between the Aden Gulf and the Arabian Sea. This region is influenced yearly

Fig. 1: The location and coordinates of *Taractes rubescens* fishing sites in Aden Gulf. Symbol : The specimens with *Argyropelecus aculeatus*

by two distinct, dry (unlike the usual monsoon concept) monsoon seasons; the North East one, which prevails between October and April and the South West monsoon, which occurs between May and September. The latter creates a well known cause in making the region so bioproductive and diverse in marine life-the upwelling (Wyrtki, 1973; Schott and McCreary, 2001; Wilson *et al*., 2003). The second characteristic is the relatively deep, rocky and rough topography of the ridge between which the largest and the deepest Sheba trench is lies.

Specimens

During a commercial fishing trip (Brum Ocean 1) by the Brum Fisheries Company during 8-19 April 2006 in the above region, Ras Fartek. Thirty four specimens of Bramids from the genus *Taractes* (Lawe 1843) were caught for the first time in the Aden Gulf and the northwestern Arabian Sea. The fishing gears and method were pelagic longline at depths varying between 350-480 meters. The fishing operation begun 8th of April 2006 at the location 13° 40N 51° 33 E and ended 19th April 2006 at location of 15° 27'N 54° 00E.

All mentioned specimens were thoroughly studied. Morphological and biological features were recorded immediately while they were kept on fresh ice. They were very well preserved. All morphometric (plastic) features were measured to the nearest millimeter by slide rule and dividers (Table 1). The meristic characteristics were counted in a typical manner (Table 1). Morphometric and meristic characteristics measurements followed Last and Moteki (2001) discription. Furthermore, we gave and confirmed two body lengths as an authorative

Table 1: Some morphometric data on *Taractes rubescens* from Aden Gulf-Yemen coast (n-34)

Characteristics	Mean±SE	Ranges
Total length (cm)	85.4±0.24	80.3-95.0
Forked length (cm)	76.8±0.20	69.2-86.0
Standard length (cm)	71.7±0.23	68.0-78.0
Total body weight (Kg)	8.7±0.41	6.2-10.1
Age (Years)	9	7-9
As % % in Fork Length		
Head Length (HL)	29.34±0.15	28.1-29.3
Preorbital length (Snout length)	7.7±0.11	7.3-8.2
Eye diameter (horizontal)	5.3±0.12	4.7-5.9
Prepectoral length	29.3±0.16	27.3-31.2
Predorsal length	39.1±0.17	36.8-41.1
Preanal length	58.0±0.23	54.7-63
Dorsal base length	40.0±0.24	37.0-42.1
Anal base length	22.7±0.19	20.1-24.5
Pectoral fin length	32.11±0.21	29.6-35.4
Ventral fin length	10.93±0.13	9.8-12.5
Max. body depth (prior dorsal origin)	35.4±0.30	32.5-38.7
Min. body depth (Peduncle depth)	6.56±0.12	5.6-7.2
Height of dorsal fin	19.1±0.29	17.1-19.7
Height of anal fin	16.7±0.26	15.6-18.4
As % % in Head Length		
Preorbital length (Snout length)	26.35±0.18	23.5-30.0
Eye diameter (horizontal)	18.97±0.22	16.7-19.1
Post orbital distance	53.2±0.19	51.0-55.5
Interorbital width	30.7±0.15	28.7-35.1
Upper jaw length (n-16)	42.7	40.8-43.9
Lower jaw length (n-16)	38.6	37.0-40.0
Head depth (at posterior eye edge)	94.75±0.25	91.3-102.0
Meristic characteristics		
Number of Vertebrae	39	39-42
Scales in lateral line+Peduncle scutes	45+4 (3)	43-47
Gill rakers	11	8-12
Rays in Dorsal fin	29	27-29
Rays in Anal fin	19	19-21
Rays in Pectoral fin	19	19-21
Rays in Ventral fin	7	7-7

source for relative calculations of the body part measurements, the Total Length (TL) and the Forked Length (FL). Because there were no more pores (neuromasts) on prolonged scales after the enlarged solid scales on the caudal peduncle, the number of well defines lateral line scales was counted up to the last body pore scale prior to the first enlarged bony scale of the peduncle keel. The length of the caudal peduncle was measured from the vertical line of anal fin end to the end of hypurale. The predorsal, preanal and preventral distances were measured as direct measurements between the tip of the snout and the insertion of each of them. In measuring the height of the dorsal and anal fins, we took into account the length of the longest ray of both fins, which was actually the third ray.

The color pattern is described from newly fished fishes, in addition to in hand, very well maintained specimens, though the color of this fish is clearly uniform.

Studied specimens were gutted, sexed and aged to record the general biological characteristics following Pravdin (1966) and Lagler (1971). Age was determined by well annulled and clear scales using typical binocular.

Throughout the gut content examination of the pomfret, we encountered a precious obscure deep sea fish from the order Stomiiformes, family Sternoptychidae. It was examined carefully, identified and recorded for the first time in this region.

Taractes rubescens identification was ascertained with Headrich (1986) and Okiyama (1993), *Argyropelecus aculeatus* was identified according to and with the guidance of Badcock (1984), Weitzman (1986), Harold (1999) and Bigelow and Schroeder (2002).

RESULTS

The results of our identification confirms the already published data and the characteristics have led us to ascertain that the fish dealt with is undoubtedly and precisely *Taractes rubescens* (Jordan and Evermann 1887) (Perciformes: Bramidae), which has a common name-Pomfret or keeled pomfret (Fig. 2). It is recorded here and added to Aden Gulf for the first time. The same result can correspond with our pomfrets prey, the hatchet fish-*Argyropelecus aculeatus* (Valenciennes 1850) (Stomiiformes: Sternoptychidae).

The color of pomfret was stable and distinct; this phenomenon facilitates the procedure of identification and makes it more accurate. In general, the color for the entire body is dark bluish black with a juicy brown shine (reflection) when it is fresh. In some specimens, the

Fig. 2: *Taractes rubescens* (Jordan and Evermann 1887), specimen of 86 cm TL from Aden Gulf (2006)

lower lateral half become more or less silvery without losing the stated general uniform pattern, which corresponds to all fins, except the pectorals, which have a dusky color, somewhat pale and translucent on the rear underside.

Scales are relatively large at the lateral sides when they serially or gradually diminish toward the marginal body profile, including the dorsal, anal and caudal fins. They cover the entire body including all head parts and even the maxillary bone, but not the snout or the preopercule. This pattern continues to cover the entire mid fins and the interior parts of the caudal fin. Scales have a brick-shape when they are naturally laid on the skin as a vertical slanting rectangular (oblong). This pattern can give scales a cosmoid appearance, which is exactly the opposite, because except for a thin peg like base (anterior part) firmly embedded in the skin, it is hard to pull out; the lax posterior part of scale, although it is relatively thin, smooth, slim and easy to break (fragile) when dealt with, is well adherent. There are two axillary scales, well grown at the base of pectoral fin, the length of which is about 12% of the fin length. Another branched and very thin axillary scale posteriorly developed into 4 leaflets with a silky, velvety dark brown structure and touch when the fish is fresh; its length about 19% of the pectoral fin length. Both pectoral axillary scales are usually well hidden behind the fin base unless the latter is inverted. Behind the ventral fin there is an axillary scale too, which is relatively long (about 70% of ventral fin length) and pointed in shape.

The lateral line was well visible and arched parallel to the dorsal profile, then sloped down sharply under about the middle of the dorsal fin base to cross about 4-5 scale rows. It then returned to be horizontal just before the first scute and ended with 3-4 enlarged scales modified into big scutes, which together formed a prominent, relatively strong keel at the main length of the caudal peduncle (Fig. 3). There are distinctly visible transverse grooves on the dorsal and ventral sides of the caudal fin base (the end of caudal peduncle).

In general, Table 1 can clearly demonstrate the morphometric characteristics of the newly discovered *T. rubescens* in the Aden Gulf.

Although, the caudal peduncle is relatively long and thin (15% FL and high only 6, 6% FL), the fish has a well-ordered body, that is regular, deep and relatively stout and fleshy, as well as being moderately laterally compressed. The nape and predorsal profile was slightly arched and even tended to be flat. The head was compressed and moderately rounded, its length about 1.1 times its height (Table 1). The snout was short but larger than the horizontal diameter of the eye. The mouth is extremely oblique, such that the upper jaw

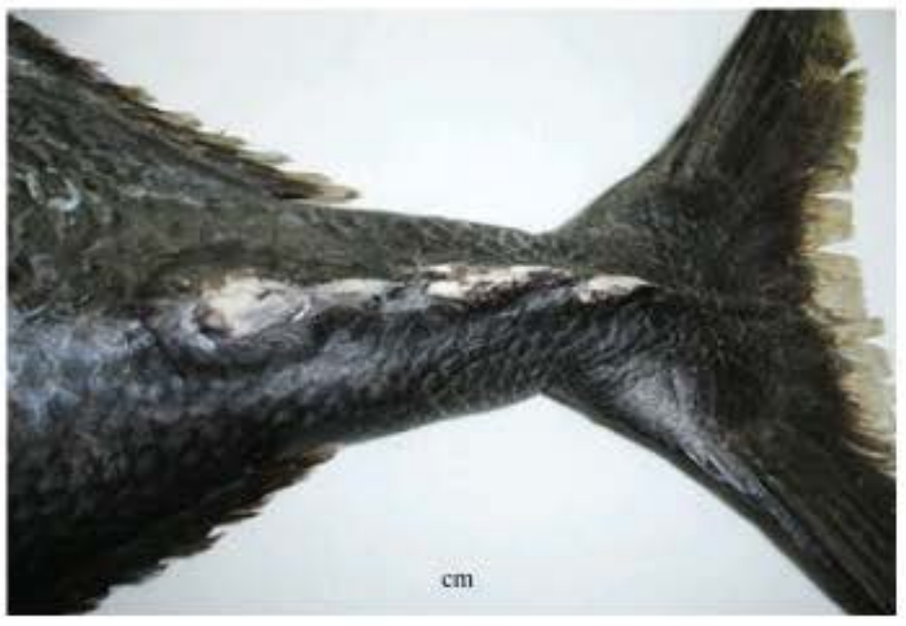

Fig. 3: Caudal peduncle scutes, showing keel pattern of *Taractes rubescens* from Aden Gulf (specimen of 86 cm TL)

is nearly vertical when it is opened; a relatively large, maxillary bone extends below the posterior edge of the eye; it is scaled and with relatively broad end. Both jaws are equipped with a large number of moderate, firm sharp and somewhat conical teeth, interspersed with small teeth; there are no teeth on the vomarine cartilages and palatine bones. It seems that the teeth are arranged in an irregular, staggered multiserial pattern. The gill rakers are hard, thorny, coarse and relatively long and they span to the middle of the adjacent one if oppressed; there are 8-12 (mainly 11) on the first gill arch.

The dorsal fin originates at about the end of the first third of the body length, having a long base, two times longer than the anal fin base and both usually have high falcate lobes at their front. Dorsal fin rays varied within a restricted range-7-29 (mostly 29); also, the anal fin rays varied: 19-21 (mostly 19). The outer contour of both fins bends abruptly behind about 4th ray, so that the ray's rear 2nd third of those fins are much shorter, resembling finlets (Fig. 2).

The pectorals are based a little below the mid body height and are long, about one third of the body's forked length; it is inserted near the vertical line between the opercule edge and the ventral fin base, reaching the opposite mid of dorsal fin base; the rays number between 19-21 (mostly 19). The ventral fin is relatively short (one third of the pectoral) and has one non spine hard ray followed by 6 branched and scaled rays with a dusky color on lower side.

Although, the caudal fin is widely forked, it is more likely to be crescent or sickle-shaped. It is stiff; the upper lobe is longer than the lower one; the distance between their tips equal the body depth. Caudal fin rays are moderately erect with the pale (whitish) colored margin of those in the middle of fin (Fig. 2). The numbers of pyloric caeca were 7 without variations.

As deduced from Table 1, the fish is large. All fished fishes were mature, in the stage of spawning, with some males and females having ripe staged gonads. Water temperature at the catching site was 28-29.2°C. Undoubtedly this was a spawning flock of *T. rubescens*: fecundity, as we calculate, varied between 603840 and 1082500 eggs (829066 as mean-11specimens); egg diameter was small 0.4-0.9 mm (0.76 mm as mean); mean gonadosomatic index was 5.7 for females and 1.8 for males, the sex ratio (female/male) is estimated here to be 56/44%.

The food items were concentrated exclusively on seemingly small fries, barracuda (Sphyraenidae)-7-20 cm long and squids (*Loligo* sp.) 5-12 cm long. All dissected guts were filled by food, which means that instead of spawning, these fishes were voracious and actively preying.

The readings of well annulled scales show that the age of our specimens was 7-9 years old.

Concerning the founded hatchet fish in the guts of *T. rubescens*, they were defined and identified as *Argyropelecus aculeatus* (Valenciennes 1850), which were also recorded in the Aden gulf for the first time (TL 5.8-6.2; SL 5.1-5.7 cm). This fish is so small and bizarre and characterized by such distinctive traits that it could not be mistaken with other fishes of the region (Fig. 4).

The body is extremely laterally compressed, short and deep, especially in the foreword half; its maximum depth (the vertical line connecting dorsal fin origin and just before pubic spine) is 63% of its standard length. The ventral profile is sharply interrupted upward, just before the ventral fin, after which the profile becomes horizontal and less deep-the depth of the caudal peduncle is 13.5% of the standard length. The ventral contour of the forward half has sharp emerging scutes, creating a serrated profile. The eye is relatively big-32.1% of the

Fig. 4: *Argyropelecus aculeatus* (Cuvier and Valencienn 1849), specimen of 4.8 cm standard length from Aden Gulf (2006)

head length or 11.5% of the standard length, it is nearer to the snout profile than to the mouth. The mouth relatively is very large, wide and strongly oblique; the lower jaw length is about half of the body height or 85% of the head length; the upper jaw is vertical, like the body axis. There are 15 relatively long but separate gill rakers. We recognize discordant teeth only on the lower jaw and there are several-15 on each side, looking more like a canine. The preoperculum is armed with two outwardly-directed small spines; the upper one curves downward, the lower, which is in the corner of lower edge of Preoperculum, is sharp and curves rearward.

The exact numbers of soft rays of dorsal and anal fins were 9 and 12, respectively. The dorsal blade (first dorsal fin) is supported by 6 spines. The pectoral fin consists of 9 soft rays. The vertebrae are consecutively straight horizontally and number 33-35.

Although, the specimens were ingested in the pomfret gut, the color remained glistening silvery, with distinct dark finger tip-like photophores. These photophores lie in specific serial patterns-rows: Six on each side of the base of lower jaw-chin; twelve along each side of the lower edge of the abdomen, along top of which, a row of 6 photophores, in addition to two more elongated, are just behind the pectoral fin base; another 6 lie along the anal fin base. Four relatively small photophores are under each side of the rear caudal peduncle.

DISCUSSION

The distinct traits of studied *T. rubescens* make it possible to conclusively identify; and it can be easily distinguished from other species of Bramidae, especially the nearest *T. asper* and *Taractichthys* sp., by its prominent peduncle scute pattern (keel) and length of the body compared to others, in addition to specific meristic characteristics like long pectoral fin, number of vertebrates, dorsal and anal fin rays and the color pattern.

Although, the majority of studied morphological features and traits of the present specimens almost agree with the ranges of other researchers (Smith, 1965, 1986; Fischer and Bianchi, 1984; Gomes, 1990; Shao, 2005), however, some meristic traits are very slightly differs from those of this species in western central Atlantic (rays of dorsal, anal and pectoral fins of which were 30-32, 21-23, 19-22, respectively); vertebrae and gill rakers were within the range (Mead, 1972; Richards, 2006).

Taractes rubescens up until now, has not been fished, mentioned or dealt with from the Arabian Sea and consequently the Aden Gulf. Regarding its absence in Indian Ocean, the

published data is usually in agreement (Mead, 1972; Fischer and Bianchi, 1984; Smith, 1986; Gomes, 1990; Shao, 2005; Richards, 2006). Even the well studied species from bramids *Brama* spp. until now have not been confidently and decidedly listed in the Aden Gulf. The main checklist or annex of the few publications lack mention or are devoid of this genus (Druzhinin, 1973; Anonymous, 2001).

Many researchers affirm the obsolescence of the lateral line in adult *Taractes rubescens* and some other related genera (Smith, 1965, 1986; Gomes, 1990). However, in our specimens, the lateral line is manifestly and completely extended with permanent pores (neuromastes) and easy countable (Fig. 2); it has a specific pattern, despite the fact that all our specimens were mature.

One can find very limited information about the life history characteristics of bramids, thus, making it difficult compare. Although, the available data concern two species belonging to the same family, *Taractichthys* and *Eumegistus*, their size, age, feeding habits and reproductive traits are considerably concordant with our results (Dotsu, 1980; Prutko, 1986; Smith, 1986; Richard, 2006).

From the body shape and fin patterns, especially the caudal fin and the tail, *Taractes rubescens* is typically a long swimmer and a well oceanodromous migrant, for where ever this migration is from, it is evidently not a resident (FAO. Fish Department, 1994; Wootton, 1998).

Concerning hatchet fish-*A. aculeatus*, we can corroborate that it is not a coincidence to find this fish in the pomfret gut, as there is evidence for fish residing in the bottom of the concerned region; it does not matter here if this was an old but not recorded dweller or a newly invading under the latest environmental events.

In general, the body form, meristic and morphometric features of the studied *A. aculeatus*, in spite of their limitations, conform to that from the concerned literature (Weitzman, 1986; Froese and Pauly, 2006).

From the present and other recent findings one can concludes that deep Aden Gulf still holds a lot of attractive environmental and biological conditions for oceanic and deep water marine organisms, which need profound and meticulously long-term scientific investigations.

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