

# A new record of the brassy chub, *Kyphosus vaigiensis* (Actinopterygii: Perciformes: Kyphosidae), from the Mediterranean Sea

Lilia Labiba GROUD<sup>1</sup>, Lamya CHAOUÏ<sup>1</sup>, M. Hichem KARA<sup>1</sup>

<sup>1</sup> Laboratoire Bioressources Marines, Université d'Annaba Badji Mokhtar, Annaba, Algeria

<http://zoobank.org/FF5F15F1-2CC6-461F-8A39-27A0733EFC76>

Corresponding author: M. Hichem Kara ([kara\\_hichem@yahoo.com](mailto:kara_hichem@yahoo.com))

**Academic editor:** P. Karachle ♦ **Received** 14 July 2020 ♦ **Accepted** 6 February 2021 ♦ **Published** 12 July 2021

**Citation:** Groud LL, Chaoui L, Kara MH (2021) A new record of the brassy chub, *Kyphosus vaigiensis* (Actinopterygii: Perciformes: Kyphosidae), from the Mediterranean Sea. *Acta Ichthyologica et Piscatoria* 51(2): 219–223. <https://doi.org/10.3897/aiep.51.64069>

## Abstract

One individual of the brassy chub, *Kyphosus vaigiensis* (Quoy et Gaimard, 1825) (41.5 cm TL, 1.27 kg TW), was caught off Annaba, on the eastern coasts of Algeria in December 2013. This circumtropical fish is found for the first time on the south-western Mediterranean coasts. The chronology of its records in the Mediterranean supports the hypothesis of its Atlantic origin.

## Keywords

alien species, first record, *Kyphosus vaigiensis*, Mediterranean, Algeria

## Introduction

The taxonomy of sea chubs (Kyphosidae, *Kyphosus*) was confused for a long time (Orsi Relini 2017). The perciform family Kyphosidae currently accommodates 12 species in two genera: *Neoscorpis* Smith, 1931 and *Kyphosus* Lacepède, 1801 (see Knudsen and Clements 2013, 2016; Knudsen et al. 2019). Their morphology is uniform with only subtle variations among species (Humann 1994). The genus *Kyphosus* is represented by 11 species widely distributed in the Atlantic, Indian, and the Pacific oceans (Sakai and Nakabo 1995, 2014, 2016; Knudsen and Clements 2013). All of them are herbivorous fishes and occur in shallow waters (0–10 m depth) in tropical and temperate rocky reefs (Topp 1970).

In the Mediterranean, two species of Kyphosidae have been reported: the beaked chub, *Kyphosus sectatrix* (Linnaeus, 1758), and the brassy chub, *Kyphosus vaigiensis* (Quoy et Gaimard, 1825). The former is more common in subtropical to temperate seas, but can also be encountered in more tropical areas (Knudsen and Clements 2013). It

was listed in the Mediterranean fish fauna (Tortonese 1975, 1986) based on old records (1846–1903) of a few individuals at Trieste, Palermo, and Genoa in Italy (Orsi Relini et al. 2011). Since then, it has been reported several times in the western and central Mediterranean, often under invalid names such as *Kyphosus saltatrix* (Linnaeus, 1758) (see Kiparissis et al. 2012; Lelong 2012; Elbarassi et al. 2013) or *Kyphosus sectator* (Linnaeus, 1758) (see Hemida et al. 2004; Francour and Mouine 2008). Initially thought to be restricted to the Indo-Pacific, *K. vaigiensis* is a circumtropical species distributed along the Indian, Atlantic, and Pacific oceans, the Red Sea, and the Mediterranean (Knudsen and Clements 2013, 2016; Bañón et al. 2017; Evans et al. 2020). Not native to the Mediterranean, it was first reported three times under the species name *Kyphosus incisor* (Cuvier, 1831): twice in the vicinity of Almunécar (Granada, Spain) in the western Mediterranean Sea in June 1998 (Azzurro et al. 2013) and May 2013 (Peña-Rivas and Azzurro in Bilecenoglu et al. 2013) and along the Ligurian coast (Camogli, Italy) in July 2009 (Orsi Relini et al. 2011). Ligas et al. (2011)

had confused it with an individual of *Kyphosus saltatrix* (see Knudsen and Clements 2013; Mannino et al. 2015) found in August 2009 not far from the port of Livorno in Italy. Additional occurrences were reported thereafter in Sicily (Mannino et al. 2015), Malta (Vella et al. 2016), Israel (Goren et al. 2016), Cyprus (Michailidis and Rousou in Gerovasileiou et al. 2017), and Turkey (Kiyaga et al. 2019). With the exception of Orsi Relini et al. (2011) who found 2 individuals of this species (only one of which was measured), all the other authors report only one specimen.

*Kyphosus vaigiensis* is inshore species found over hard bottoms. It can also occur offshore under floating objects or following ships (Nelson 1994). It feeds mainly on algae, including sargassum (Carpenter 2002). Silvano and Güth (2006) highlight the omnivory of this species in a Brazilian subtropical reef. Some data on the biology of its reproduction on the Colombian coasts are given by Rueda et al. (2015), but its biology and ecology are in general poorly known (Silvano and Güth 2006).

The present note describes a new record of *K. vaigiensis* in the Mediterranean. This species is reported for the first time on the coasts of North Africa.

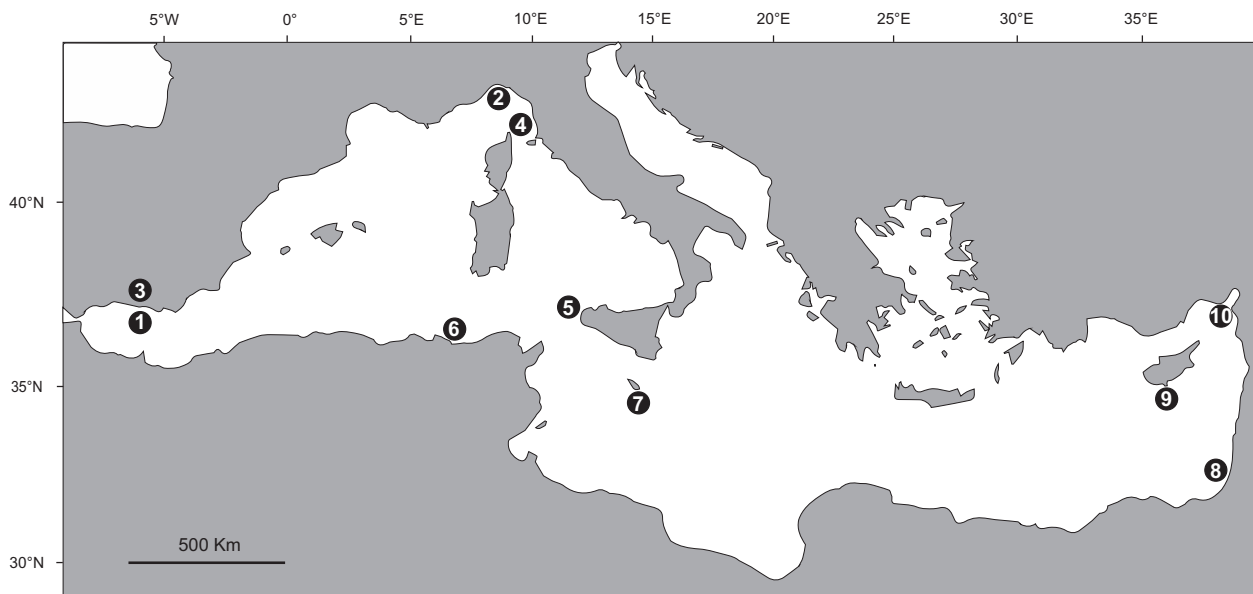
## Methods

On 18 December 2013, one individual of *K. vaigiensis* was recorded from the Gulf of Annaba (Fig. 1). Caught using a trammel net, it was found at a fishmonger among a batch of salemas, *Sarpa salpa* (Linnaeus, 1758). It was photographed, weighed, and identified based on both meristic and morphometric characters. These were taken

following standard procedures used in other descriptions of sea chubs (Carpenter 2002; Sakai and Nakabo 2004; Orsi-Relini et al. 2011; Azzurro et al. 2013). The specimen was fixed in formalin and deposited in the fish collection of the Marine Bioresources Laboratory at the Annaba University, Algeria. Since this report in 2013, a survey has been conducted with fishermen in the region to find out if other individuals of *K. vaigiensis* have been seen. This survey was carried out based on photographs.

## Results

The meristic and morphometric data of the fished specimen (Fig. 2) are listed in Table 1. They agree with the different descriptions of *K. vaigiensis* given by other authors (Sgano 1981; Carpenter and Niem 2001; Carpenter 2002; Orsi Relini et al. 2011; Azzurro et al. 2013; Sakai and Nakabo 2014, 2016). Morphologically, its body is oval shaped and moderately deep. The head is short with a small and horizontal mouth whose maxilla is slipping under edge of preorbital bone. Head profile in front of eye is gently convex (instead of a bump in *K. sectatrix*). Each jaw is provided with a regular row of close-set incisor-like, round-tipped teeth. Their bases set horizontally, resembling a radially striated bony plate inside mouth. Scales are ctenoid, small and rough to touch, covering most of the head. Color is dorsally grey to silvery on the belly. Series of longitudinal yellow-golden stripes across the body. On head, there are two brassy horizontal bands separated by a silver stripe under the eye. Fins and opercular membrane are dark.



**Figure 1.** Map pointing out the capture locality of *Kyphosus vaigiensis* on Algerian coasts and chronology of the other records in the Mediterranean: 1 = Azzurro et al. (2013) (31 cm TL, 0.45 kg TW), 2 = Orsi Relini et al. (2011) (48 cm TL, 1.80 kg TW), 3 = Bilecenoglu et al. (2013) (46 cm TL, 1.64 kg TW), 4 = Ligas et al. (2011) (49.5 cm TL, 1.65 kg TW), 5 = Mannino et al. (2015) (47.5 cm TL), 6 = presently reported finding (45.1 cm TL, 1.27 kg TW), 7 = Vella et al. (2016) (15.7 cm TL, 0.49 g EW), 8 = Goren et al. (2016) (42.0 cm SL), 9 = Michailidis and Rousou in Gerovasileiou et al. (2017) (27.2 cm TL, 403 g TW), 10 = Kiyaga et al. (2019) (53.1 cm TL, 2.27 kg TW).



**Figure 2.** Specimen of *Kyphosus vaigiensis* (41.5 cm TL, 1.27 kg TW) caught in the Gulf of Annaba, Algeria in December 2013.

**Table 1.** Morphometric and meristic characters of *Kyphosus vaigiensis* captured off Annaba coast (eastern Algeria) in December 2013.

Morphometric characters [cm]	
Total length	41.5
Fork length	38.0
Standard length	31.0
Head length	9.2
Head depth at end of operculum	13.0
Head depth at end of orbit	9.5
Head width at operculum	6.2
Eye diameter	2.0
Pre-orbital length	3.0
Post-orbital length	4.3
Body width at dorsal origin	6.1
Body width at anal origin	5.0
Body height	15.5
Pre-dorsal length	11.2
Pre-anal length	21.0
Caudal peduncle depth	3.5
Caudal peduncle length	4.0
Dorsal fin base length	16
Pectoral fin length	6.5
Pectoral fin base length	2.0
Pelvic fin length	6.0
Pelvic fin base length	2.0
Anal fin base length	9.6
Caudal fin height (vertically extended)	16.0
Caudal fin length	9.0
Intermasal space	2.4
Inter-orbital distance	4.2
Upper jaw length	3.0
Lower jaw length	1.8
6 <sup>th</sup> dorsal fin spine (longest)	3.7
4 <sup>th</sup> dorsal fin ray (longest)	2.9
Total weight [g]	1270
Meristic characters	
Dorsal fin spines and soft rays	XI + 13
Anal fin spines and soft rays	III + 12
Pectoral fin rays	17
Pelvic fin spines and soft rays	I + 5
Caudal fin rays	18
Pored scales in lateral line	60
Scales rows above lateral line	11
Scales rows below lateral line	17
Gill rakers on first arch (upper limb + lower limb)	10 + 19
Incisor-like teeth on upper jaws	31
Incisor-like teeth on lower jaws	32

## Discussion

The morphology of the caught specimen, as well as its chromatic, meristic, and metric characteristics, confirm that it represents *K. vaigiensis*, as described in the literature (Tortonese 1975, 1986; Sgano 1981; Carpenter 2002; Knudsen and Clements 2013; Carpenter and De Angelis 2016; Sakai and Nakabo 2016) and by the authors of other records of this species in the Mediterranean (Ligas et al. 2011; Orsi Relini et al. 2011; Azzurro et al. 2013; Mannino et al. 2015; Goren et al. 2016; Vella et al. 2016; Michailidis and Rousou in Gerovasileiou et al. 2017; Kiyaga et al. 2019). In particular, Azzurro et al. (2013) insist on the morphological characters which differentiate *K. vaigiensis* from its congener *K. sectatrix*, two very similar species who cohabit in the Mediterranean: anal fin with 12 or 13 soft rays (11, rarely 10 or 12 in *K. sectatrix*), 19 to 22 gill rakers on the lower limb of first gill arch (16 to 19, rarely 19 in *K. sectatrix*) and the gently convex head profile in front of eye (a distinct bump in *K. sectatrix*).

Among the fifteen fishermen we surveyed, two confirmed that they had encountered this fish once. A single individual in the first case (date not specified) and two in the second (in 2019), both of size not exceeding 30 cm. However, given the morphologic similarity between the two species *K. vaigiensis* and *K. sectatrix*, it was not possible to confirm which of the two species it was.

This additional record of *K. vaigiensis* from the Mediterranean confirms its spread along the North-African coast. None of the ichthyological inventories carried out on the Algerian coasts had mentioned it (Dieuzeide et al. 1954; Djabali et al. 1993; Derbal and Kara 2001). This species is the tenth non-indigenous marine fish recorded in Algeria, but the first of circumtropical origin. All the other alien species that arrived are Lessepsian migrants of Indian or Indo-Pacific origin (Kara and Bourehail 2020).

The introduction of *K. vaigiensis* in the Mediterranean could be attributed to the natural expansion of its range

(Zenetos et al. 2012). Its adults can travel long distances (Azzurro et al. 2013) and its juveniles are pelagic and found associated with floating objects (Knudsen and Clements 2016). Thereby, it would have arrived actively or passively through the Suez Canal or the Strait of Gibraltar. However, the chronology of its occurrences which shows a clear spatial progression from west to east and a recent entry (after 2015) into the eastern Mediterranean supports the hypothesis of its Atlantic origin. Otherwise, Annaba being a port city, receiving hundreds of ships per year from all regions of the world (around 10 000 visit Algerian ports each year; Cheniti et al. 2018), its coasts are exposed to the introduction of exotic species. Thus, the recorded *K. vaigiensis* individual would have arrived by ships' ballast water from one of its natural geographic ranges. Indeed, sea chubs are often observed around ships in subtropical waters waiting for the dumping of garbage (Orsi Relini et al. 2011) and are commonly referred to as "rudderfish" (Evans et al. 2020). This behavior exposes them to being "embarked" on board the boats. Thus, their presence in the Mediterranean can also be considered as human-mediated as proposed by Lo Brutto (2017).

## References

- Azzurro A, Pena-Rivas L, Lloris D, Bariche M (2013) First documented occurrence of *Kyphosus incisor* in the Mediterranean Sea. *Marine Biodiversity Records* 6: e98. <https://doi.org/10.1017/S1755267213000717>
- Bañón R, Barros-García D, de Carlos A (2017) Integrative taxonomy supports the presence of two species of *Kyphosus* (Perciformes: Kyphosidae) in Atlantic European waters. *Scientia Marina* 81(4): 467–475. <https://doi.org/10.3989/scimar.04601.08A>
- Bilecenoglu M, Alfaya J, Azzurro E, Baldacconi R, Boyaci Y, Circosta V, Compagno L, Coppola F, Deidun A, Durgham H, Durucan F, Ergüden D, Fernández-Álvarez F, Gianguzza P, Giglio G, Gökoğlu M, Gürlek M, Ikhtiyar S, Kabasakal H, Karachle P, Katsanevakis S, Koutsogiannopoulos D, Lanfranco E, Micarelli P, Özvarol Y, Pena-Rivas L, Poursanidis D, Saliba J, Sperone E, Tibullo D, Tiralongo F, Tripepi S, Turan C, Vella P, Yokeş M, Zava B (2013) New Mediterranean Marine biodiversity records (December, 2013). *Mediterranean Marine Science* 14(2): 463–480. <https://doi.org/10.12681/mms.676>
- Carpenter KE (2002) Kyphosidae: sea chubs. In: Carpenter KE (Ed.) *FAO species identification guide for fishery purposes. The living marine resources of the western central Atlantic. Vol. 3. Bony fishes. Part 2. (Opistognathidae to Molidae), sea turtles and marine mammals.* FAO, Rome, 1684–1687.
- Carpenter KE, De Angelis N [Eds] (2016) *The living marine resources of the Eastern Central Atlantic. Vol. 2: Bivalves, gastropods, hagfishes, sharks, batoid fishes, and chimaeras.* FAO Species Identification Guide for Fishery Purposes. FAO, Rome, 665–1509.
- Carpenter KE, Niem VH [Eds] (2001) *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol. 5. Bony fishes part 3 (Menidae to Pomacentridae).* FAO, Rome, 2791–3380.
- Cheniti R, Rochon A, Frihi H (2018) Ship traffic and the introduction of diatoms and dinoflagellates via ballast water in the port of Annaba, Algeria. *Journal of Sea Research* 133: 154–165. <https://doi.org/10.1016/j.seares.2017.07.008>
- Derbal F, Kara MH (2001) Inventaire des poissons des côtes de l'Est algérien. *Rapport Commission Internationale de la Mer Méditerranée* 36: 258.
- Dieuzeide R, Novella M, Roland J (1954) Catalogue des poissons des côtes algériennes. II. Ostéoptérygiens. *Bulletin de la Station d'Aquaculture et de Pêche de Castiglione, n. s., Alger*, 258 pp.
- Djabali F, Brahmi B, Mammasse M (1993) Poissons des côtes algériennes. *Pelagos Numéro spécial*, 215 pp.
- Elbaraasi H, Bogarara O, Elsilini O, Bojwari J (2013) First record of the Bermuda sea chub, *Kyphosus saltatrix* (Actinopterygii: Perciformes: Kyphosidae), in the coastal waters of Libya. *Acta Ichthyologica et Piscatoria* 43(3): 251–253. <https://doi.org/10.3750/AIP2013.43.3.09>
- Evans J, Arndt E, Schembri PJ (2020) Atlantic fishes in the Mediterranean: Using biological traits to assess the origin of newcomer fishes. *Marine Ecology Progress Series* 643: 133–143. <https://doi.org/10.3354/meps13353>
- Francour P, Mouine N (2008) First record of *Kyphosus sectator* (Kyphosidae) along the French Mediterranean coast. *Cybium* 32(3): 275–276.
- Gerovasileiou V, Akel EHKh, Akyol O, Alongi G, Azevedo F, Babali N, Bakiu R, Bariche M, Bennoui A, Castriota L, Chintiroglou CC, Crocetta F, Deidun A, Galinou-Mitsoudi S, Giovos I, Gökoğlu M, Golemaj A, Hadjioannou L, Hartingerova J, Insacco G, Katsanevakis S, Kleitou P, Korun J, Lipej L, Malegue M, Michailidis N (2017) New Mediterranean Biodiversity Records. *Mediterranean Marine Science* 18(2): 355–384. <https://doi.org/10.12681/mms.13771>

Until now, records of *K. vaigiensis* in Mediterranean are limited to one or two isolated individuals. As *K. sectatrix* (see Francour and Mouine 2008), it can be considered a neocolonizer species sensu Quignard and Tomasini (2000). However, in the current context of seawater warming, the ability of *K. vaigiensis* to travel over large distances and its thermophilic character could in the future facilitate its establishment in the Mediterranean. In this situation, its coexistence with the indigenous sparid *Sarpa salpa*, the only herbivorous fish species in the Mediterranean, would reproduce the interaction scenario between *Sarpa salpa*, *Siganus luridus* (Rüppell, 1829), and *Siganus rivulatus* Forsskål et Niebuhr, 1775 which happened in the eastern Mediterranean.

## Acknowledgments

The authors thank the Algerian Ministry of Higher Education and Scientific Research (General directorate for scientific research and technology development, GDRS-DT) which financially supported this study, within the framework of the National Funds of Research (NFR).

- Goren M, Galil B, Roy G, Nir S (2016) First record of the brassy chub *Kyphosus vaigiensis* (Quoy et Gaimard, 1825) in the Eastern Mediterranean (Osteichthyes: Perciformes: Kyphosidae). *Zoology in the Middle East* 62(4): 319–322. <https://doi.org/10.1080/09397140.2016.1250710>
- Hemida F, Kanoun N, Golani D, Ben Souissi J, Guelorget O, Capapé C (2004) Records of the Bermuda sea chub, *Kyphosus sectator* (Linnaeus, 1758) (Osteichthyes: Kyphosidae) from the coastal waters of Algeria (southern Mediterranean). *Annales. Series Historia Naturalis* 14(1): 49–52.
- Humann P (1994) Reef fish identification: Florida, Caribbean, Bahamas. 2<sup>nd</sup> edn. New World Publications, Jacksonville, 396 pp.
- Kara MH, Bourehail N (2020) First record of the Indo-Pacific yellow-tail barracuda *Sphyræna flavicauda* (Actinopterygii: Perciformes: Sphyrænidae) in the Western Mediterranean. *Acta Ichthyologica et Piscatoria* 50(3): 363–366. <https://doi.org/10.3750/AIEP/02987>
- Kiparissis S, Loukovitis D, Batargias C (2012) First record of the Bermuda sea chub *Kyphosus saltatrix* (Pisces: Kyphosidae) in Greek waters. *Marine Biodiversity Records* 5(e11): e11. <https://doi.org/10.1017/S1755267211001199>
- Kiyağa VB, Mavruk S, Özyurt CE, Akamca E, Coşkun Ç (2019) Range extension of *Kyphosus vaigiensis* (Quoy et Gaimard, 1825) in the northeastern Mediterranean, İskenderun Bay, Turkey. *Turkish Journal of Zoology* 43(6): 644–649. <https://doi.org/10.3906/zoo-1901-1>
- Knudsen SW, Clements KD (2013) Revision of the fish family Kyphosidae (Teleostei: Perciformes). *Zootaxa* 3751(1): 1–101. <https://doi.org/10.11646/zootaxa.3751.1.1>
- Knudsen SW, Clements KD (2016) World-wide species distributions in the family Kyphosidae (Teleostei: Perciformes). *Molecular Phylogenetics and Evolution* 101: 252–266. <https://doi.org/10.1016/j.ympev.2016.04.037>
- Knudsen SW, Choat JH, Clements KD (2019) The herbivorous fish family Kyphosidae (Teleostei: Perciformes) represents a recent radiation from higher latitudes. *Journal of Biogeography* 46: 2067–2080. <https://doi.org/10.1111/jbi.13634>
- Lelong P (2012) A new record of Bermuda sea chub, *Kyphosus saltatrix* (Linnaeus, 1758), (Osteichthyes, Kyphosidae) from Galite Islands (Tunisia, southern Mediterranean). *Marine Life (Marseille)* 18(1): 3–7.
- Ligas A, Sartor P, Sbrana M, de Ranieri S (2011) A new record of *Kyphosus saltatrix* (Pisces: Kyphosidae) along the Italian coasts (north-western Mediterranean). *Marine Biodiversity Records* 4: e6. <https://doi.org/10.1017/S1755267210001211>
- Lo Brutto S (2017) The case of a rudderfish highlights the role of natural history museums as sentinels of bio-invasions. *Zootaxa* 4254(3): 382. <https://doi.org/10.11646/zootaxa.4254.3.8>
- Mannino AM, Balistreri P, Iacifano D, Galil BS, Lo Brutto S (2015) An additional record of *Kyphosus vaigiensis* (Quoy et Gaimard, 1825) (Osteichthyes, Kyphosidae) from Sicily clarifies the confused situation of the Mediterranean kyphosids. *Zootaxa* 3963(1): 45–54. <https://doi.org/10.11646/zootaxa.3963.1.3>
- Nelson JS (1994) *Fishes of the world*. 3<sup>rd</sup> edn. John Wiley and Sons, New York, 600 pp.
- Orsi Relini L (2017) Notes on recent revisions of the taxonomy of Kyphosidae. *Biologia Marina Mediterranea* 24(1): 206–208.
- Orsi Relini L, Costa MR, Relini M (2011) First record of the yellow sea chub *Kyphosus incisor* in the Mediterranean. *Marine Biodiversity Records* 4: 1–3. <https://doi.org/10.1017/S1755267209991096>
- Quignard JP, Tomasini JA (2000) Mediterranean fish diversity. *Biologia Marina Mediterranea* 7: 1–66.
- Rueda M, Bolivar VW, Bustos-Montes D, Osorio SP, Sanjuanelo A, Rodriguez A, Correa MC (2015) Parametros biológico-pesqueros del striped chub (*Kyphosus incisor*) relevantes para su manejo y conservacion en el parque nacional natural old providence McBean lagoon. *Bolletín Investigacione Marine Coasts* 44(1): 71–92. <https://doi.org/10.25268/bimc.invemar.2015.44.1.21>
- Sakai K, Nakabo T (1995) Taxonomic review of the Indo-Pacific kyphosid fish, *Kyphosus vaigiensis* (Quoy and Gaimard). *Japanese Journal of Ichthyology* 42(1): 61–70. <https://doi.org/10.11369/JJI1950.42.61>
- Sakai K, Nakabo T (2004) Two new species of *Kyphosus* (Kyphosidae) and a taxonomic review of *Kyphosus bigibbus* Lacepède from the Indo-Pacific. *Ichthyological Research* 51(1): 20–32. <https://doi.org/10.1007/s10228-003-0186-2>
- Sakai K, Nakabo T (2014) Taxonomic review of *Kyphosus* (Pisces: Kyphosidae) in the Atlantic and Eastern Pacific Oceans. *Ichthyological Research* 61(3): 265–292. <https://doi.org/10.1007/s10228-014-0395-x>
- Sakai K, Nakabo T (2016) Kyphosidae. In: Carpenter KE, De Angelis N (Eds) *The living marine resources of the Eastern Central Atlantic*. Vol. 4. FAO, Rome, 2680–2685.
- Sgano T (1981) Kyphosidae. In: Fischer W (Ed.) *FAO species identification sheet for fishery purposes*. Eastern Central Atlantic (Fishing Areas 34, 47 in part). Vol. 2. FAO, Rome.
- Silvano RAM, Güth AZ (2006) Diet and feeding behavior of *Kyphosus* spp. (Kyphosidae) in a Brazilian Subtropical Reef. *Brazilian Archives of Biology and Technology* 49(4): 623–629. <https://doi.org/10.1590/S1516-89132006000500012>
- Topp RW (1970) Behavior and color change of rudderfish, *Kyphosus elegans*, in Gulf of Panama. *Copeia* 4(4): 763–765. <https://doi.org/10.2307/1442322>
- Tortonese E (1975) *Fauna d'Italia. Osteichthyes (Pesci Ossei)*, Vol. 11. Calderini, Bologna, 636 pp.
- Tortonese E (1986) Kyphosidae. In: Whitehead PJP, Bauchot ML, Hureau JC, Nielsen J, Tortonese E (Eds) *Fishes of the northeastern Atlantic and the Mediterranean*, Vol. 2. UNESCO, Paris, 912–913. <https://doi.org/10.2307/1444931>
- Vella N, Vella A, Darmanin SA (2016) The first record of the lowfin chub *Kyphosus vaigiensis* (Quoy et Gaimard, 1825) from Malta. *Journal of Black Sea/Mediterranean Environment* 22(2): 175–181.
- Zenetos A, Gofas S, Morri C, Rosso A, Violanti D, Garcia Raso JE, Cinar ME, Almogi-Labin A, Ates AS, Azzurro E, Ballesteros E, Bianchi CN, Bilecenoglu M, Gambi MC, Giangrande A, Gravili C, Hyams-Kaphzan O, Karachle PK, Katsanevakis S, Lipej L, Mastrototaro F, Mineur F, Pancucci-Papadopoulou MA, Ramos Espla A, Salas C, San Martin G, Sfriso A, Strefataris N, Verlaque M (2012) Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. *Mediterranean Marine Science* 13(2): 328–352. <https://doi.org/10.12681/mms.327>