

Research Article

Taxonomic update and illustrated key of Zeiformes from Chile (Pisces: Actinopterygii)

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ABSTRACT. The Chilean fishes of the order Zeiformes are rare in museum collections, the lack of scientific expeditions to the submarine ridge and the scarcity of new specimens records in Chilean shelves, as well as the lack of biological studies, probably accounts for its apparent rarity. In the last two decades, fishes of the order Zeiformes in Chile have undergone major changes in their taxonomic categories and in the record of new species. In Chile, there are five families, 7 genera and 11 species. They live in benthic and bathypelagic realms and are distributed at depths of 30 to 1500 m. Also, the literature of these species, is scattered, hindering their taxonomic and systematic knowledge, which makes difficult their study and better understanding as a group. It also prevents progress in such important aspects like their phylogenetic relationships, the state of vulnerability of their populations and other biological aspects. In order to contribute to the knowledge and its identification, a bibliographical compilation and a tentative illustrated identification key that unifies all the existing information in a single document, is presented. This may constitute a new tool to contribute to the growing interest in biodiversity studies in the south eastern Pacific Ocean.

Keywords: Zeiformes, fishes, taxonomy, illustrated key, Chile.

INTRODUCTION

The fishes of the order Zeiformes are marine, cosmopolitan, bathy- and benthopelagic, with preference of cold and temperate waters and found at various depths in the southeastern Pacific and Atlantic Ocean (Heemstra, 1980; Lloris, 1981, 1986; James *et al.*, 1988; Pequeño *et al.*, 1992; Yearsley & Last, 1998; Tyler *et al.*, 2003; Pequeño & Matallanas, 2004; Nakabo *et al.*, 2006; Nelson, 2006; Nolf & Tyler, 2006).

Many species of this order are deep-sea fishes, found at depths that may exceed 1000 m. Some species, however, especially in the family Zeidae, live at depths of 100-300 m (Nelson, 2006; Nolf & Tyler, 2006). The Zeiformes are characterized by having a high and compressed body, with the dorsal and anal profile bordered by the presence or absence of small thorns or shields. They possess five to eight branchiostegal rays, being gas-bladder and orbited-sphenoid bone absent. Eyes are large and well apparent; mouth is widely protractile. The single dorsal fin has spines and supplemental soft rays. Anal fin has 0 to 4 spines with soft rays. The pectoral fins are short and rounded. The

pelvic fin, which can be very apparent, possesses one spine and five to 10 soft rays. The caudal fin, usually with 11 rays (with the only exception of the family Grammicolepididae with 13 rays), may be rounded, truncated or split (Heemstra, 1980; Nelson, 2006; Nolf & Tyler, 2006).

In Chile, information about of Zeiformes species is scarce, probably due to the casual captures and the limited access of the seamounts (Pequeño, 1989; Meléndez *et al.*, 2001; Pequeño *et al.*, 1992; Pequeño & Matallanas, 2004). The members of this order are rare in museum collections, the lack of scientific expeditions to the submarine ridge and the scarcity of new specimens records in Chilean shelves, as well as the scarcity of biological studies, probably accounts for its apparent rarity.

Due to this lack of knowledge, the present work attempts to create a bibliographical compilation to display the current taxonomic status of the species in this order, together with a tentative illustrated identification key that unifies all the existing information in a single document.

MATERIALS AND METHODS

For the revision and updating of the order Zeiformes of Chile, the classification criteria provided by Nelson (2006) and Eschmeyer (2015) were considered. For the validation of the nomenclature, the criterion of Eschmeyer (2015) was used.

Due to the difficulty to obtain fresh specimens or in museum collection, the description of figures as well as the morphological, environmental, geographical distribution and bathymetric parameters, has been compiled from the following sources: Heemstra (1980, 1986a, 1986b); Lloris (1981); Karrer (1986); Karrer & Heemstra (1986); Parin (1989, 1991); Pequeño *et al.* (1992); Parin *et al.* (1997); Yearsley & Last (1998); Bianchi *et al.* (1999); Vasconcelos *et al.* (2003); Pequeño & Matallanas (2004); Nakabo *et al.* (2006); Nolf & Tyler (2006); Santini *et al.* (2006); Schwartz (2008); Carvalho-Filho *et al.* (2012); Martins & Schwingel (2012) and Froese & Pauly (2015).

The acronyms referred in the text are (Leviton *et al.*, 1985): BMNH British Museum of Natural History. BSKU Kochi University, Department of Natural Science, Faculty of Science, Kochi, Japan. CSIRO The Australian National Fish Collection, Common Wealth Scientific and Industrial Research Organization, Division of Marine and Atmospheric Research, Hobart, Tasmania, Australia. RMNH Naturalis (Nationaal Natuurhistorisch Museum; formerly Rijksmuseum van Natuurlijke Historie), Postbus 9517, 2300RA Leiden, The Netherlands. SAM South Australia Museum, North Terrace, Adelaide, South Australia 5000, Australia. SU Stanford University. USNM National Museum of Natural History, Washington D.C., USA. ZIN Zoological Institute, Academy of Sciences, St. Petersburg, Russia. ZMB Universität Humboldt, Zoologisches Museum, Invalidenstrasse 43, 1040 Berlin N-4, Alemania. ZMMU Uppsala Universitet, Zoologiska Museet, Uppsala, Sweden.

IUCN classification nomenclature (Red List UICN 2013.2): DD Data Deficient, LC Least Concern, NT Near Threatened, NE Not Evaluated and VU Vulnerable.

RESULTS

In Chile, the Order Zeiformes is composed of five families (Oreosomatidae, Parazenidae, Zenionidae, Grammicolepididae and Zeidae), seven genera (*Cyrtomimus*, *Grammicolepis*, *Neocyttus*, *Pseudocyttus*, *Sethopristes*, *Zenion* and *Zenopsis*) and 11 species (*C. stelgis*, *G. brachiusculus*, *N. psilorhynchus*, *N. rhomboidalis*, *P. maculatus*, *S. eos*, *Z. hololepis*, *Z.*

japonicus, *Z. conchifer*, *Z. nebulosa* and *Z. oblonga*) (Pequeño, 1989, 1997; Pequeño & Matallanas, 2004).

The species appear in systematic order according to Eschmeyer (2015) criteria.

Family: OREOSOMATIDAE

Subfamily: OREOSOMATINAE

***Neocyttus psilorhynchus* Yearsley & Last, 1998 (Fig. 1)**

psilorhynchus, *Neocyttus* Yearsley & Last, 1998. Holotype: CSIRO H 2865-01. Paratypes: CSIRO H 2864-01 (1), H 2864-03-13 (1), H 2865-02 (1), H 3294-03 (1), H 3593-01 (1). Current status: Valid as *Neocyttus psilorhynchus* Yearsley & Last, 1998 (Yearsley & Last, 1998; Eschmeyer, 2015).

Distribution: Southeastern Pacific: Chile (James *et al.*, 1988; Parin, 1991; Yearsley & Last, 1998).

Habitat: Benthopelagic (James *et al.*, 1988; Parin, 1991; Yearsley & Last, 1998; Froese & Pauly, 2015).

Depth: 750-1170 m (James *et al.*, 1988; Parin, 1991; Yearsley & Last, 1998; Froese & Pauly, 2015).

IUCN information (Red List 2013):

- Classification: NE

- Population trend: Unknown

- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

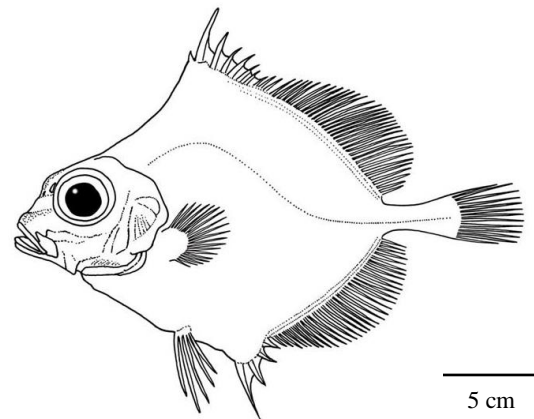


Figure 1. Oreosomatidae: *Neocyttus psilorhynchus* (Modified from Yearsley & Last, 1998).

***Neocyttus rhomboidalis* Gilchrist, 1906 (Fig. 2)**

rhomboidalis, *Neocyttus* Gilchrist 1906. Lectotype: SAM 11972. Paralectotypes: SAM 11973 (1). Nontypes: BMNH 1904.5.28.14-15 (2). Lectotype: designated by Yearsley & Last (1998). Current status: Valid as *Neocyttus rhomboidalis* Gilchrist, 1906 (Yearsley & Last, 1998) (Eschmeyer, 2015).

Distribution: Southern Circumglobal; Southeastern Pacific: South of Chile, Canal Bárbara and seamounts

Table 1. Basic biological parameters analyzed in Chilean Zeiformes species. TL = total length; SL = standard length (male specimens only).

Taxa	Biological parameters						
	Maximum age (years)	Madurity length (cm)	Maximum length (cm)	Fecundity rate	Resilience	Vulnerability	
Oreosomatidae							
<i>Neocyttus psilorhynchus</i>	X	X	22,4	X	Low	Low	
<i>Neocyttus rhomboidalis</i>	100	34 (29-34)	40	Low	Very low	High to very high	
<i>Pseudocyttus maculatus</i>	100	40-41	68	Low	Very low	High to very high	
Parazenidae							
<i>Stethopristes eos</i>	X	X	X	X	?	Low	
Zenionidae							
<i>Cyttomimus stelgis</i>	X	X	X	X	Medium	Low	
<i>Zenion hololepis</i>	X	X	12	X	?	Low	
<i>Zenion japonicum</i>	X	X	10	X	?	Low	
Grammicolepididae							
<i>Grammicolepis brachiusculus</i>	X	X	64 LT	X	Low	Moderate to high	
Zeidae							
<i>Zenopsis conchifer</i>	X	X	80 LT	X	Low	Moderate to high	
<i>Zenopsis nebulosa</i>	45	25-40	70	X	Medium	High	
<i>Zenopsis oblonga</i>	X	X	X	X	Low	Moderate to high	

of Juan Fernández Archipelago (James *et al.*, 1988; Parin, 1991; Pequeño *et al.*, 1992; Pequeño 1997; Yearsley & Last, 1998, Meléndez *et al.*, 2001).

Habitat: Benthopelagic (James *et al.*, 1988; Parin, 1991; Yearsley & Last, 1998; Froese & Pauly, 2015).

Depth: 200-1240 m (usually 450-800 m) (James *et al.*, 1988; Parin, 1991; Yearsley & Last, 1998; Froese & Pauly, 2015).

IUCN information (Red List 2013):

- Classification: NE

- Population trend: Unknown

- Biological parameters: Known basic biological data (Table 1) (Froese & Pauly, 2015).

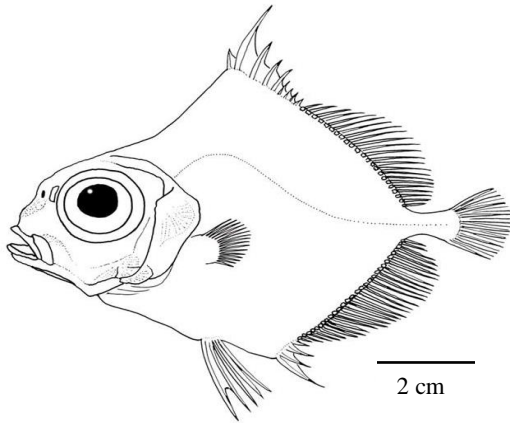


Figure 2. Oreosomatidae: *Neocyttus rhomboidalis* (Modified from Yearsley & Last, 1998).

Subfamily: PSEUDOCYTTINAE

***Pseudocyttus maculatus* Gilchrist, 1906 (Fig. 3)**

maculatus, *Pseudocyttus* Gilchrist 1906. Holotype (unique): SAM 17938. Current status: Valid as *Pseudocyttus maculatus* Gilchrist, 1906 (Eschmeyer, 2015).

Distribution: Southwest Atlantic: off Suriname, off Uruguay to Argentina and the Falklands; Southeast Atlantic: Namibia to South Africa, including the northern part of Walvis Ridge; Bellingshausen and Australian-Antarctic Basin to New Zealand, New South Wales and Tasmania, Australia and the Kerguelen Islands; Southeastern Pacific: off southern Chile (Heemstra, 1980; James *et al.*, 1988; Eschmeyer, 2015).

Habitat: Benthopelagic (James *et al.*, 1988; Froese & Pauly, 2015).

Depth: 400-1500 m (usually 900-1100 m) (James *et al.*, 1988; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: DD
- Population trend: Decreasing
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

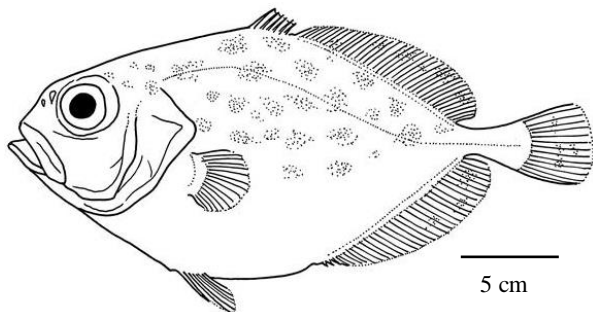


Figure 3. Oreosomatidae: *Pseudocyttus maculatus* (Modified from Nolf & Tyler, 2006).

Family: PARAZENIDAE

Subfamily: CYTTOPSINAE

***Stethopristes eos* Gilbert, 1905 (Fig. 4)**

eos, *Stethopristes* Gilbert 1905. Holotype: USNM 51626. Paratypes: SU 8649 (1), USNM 51685 (1). Current status: Valid as *Stethopristes eos* Gilbert, 1905 (Eschmeyer, 2015).

Distribution: Northeast Pacific: Hawaiian Ridge, Hawaiian Islands; Southeastern Pacific: Chile, Salas y Gomez submarine ridges (Parin, 1991; Eschmeyer, 2015).

Habitat: Benthopelagic (Parin, 1991; Froese & Pauly, 2015)

Depth: 343-686 m (Parin, 1991; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Unknown (Table 1) (Froese & Pauly, 2015).

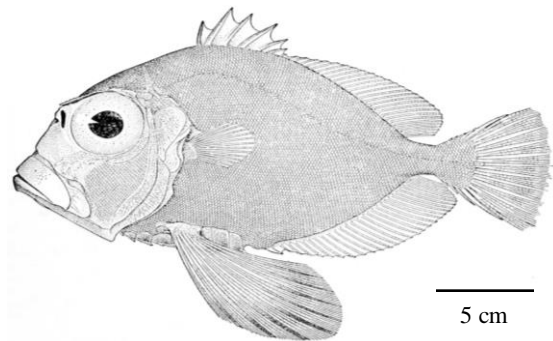


Figure 4. Parazenidae: *Stethopristes eos* (Taken from www.gbif.org/species/125707281).

Family: ZENIONIDAE

***Cyttomimus stelgis* Gilbert, 1905 (Fig. 5)**

stelgis, *Cyttomimus* Gilbert 1905. Holotype (unique): USNM 51622. Current status: Valid as *Cyttomimus stelgis* Gilbert, 1905 (Eschmeyer, 2015).

Distribution: Pacific: Chesterfield Islands, New Caledonia, Hawaiian Ridge, Hawaiian Islands; Southeastern Pacific: Nazca and Salas y Gomez submarine ridges (Parin, 1991; Eschmeyer, 2015).

Habitat: Benthopelagic (Parin, 1991; Froese & Pauly, 2015)

Depth: 351-644 m (Parin, 1991; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Unknown (Table 1) (Froese & Pauly, 2015).

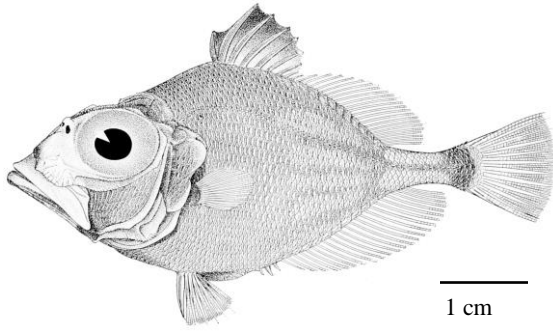


Figure 5. Zenionidae: *Cyttomimus stelgis* (Modified from Nolf & Tyler, 2006).

***Zenion hololepis* (Goode & Bean, 1896) (Fig. 6)**

hololepis, *Cyttus* Goode & Bean 1896. Lectotype: USNM 39296. Paralectotypes: USNM 39297 (2). Current status: Valid as *Zenion hololepis* (Goode & Bean, 1896) (Eschmeyer, 2015).

Distribution: Western Indian Ocean: Tanzania and off Delagoa Bay, Mozambique; Western Central Pacific, Western Atlantic: Antilles and Venezuela; Northwest Atlantic: Canada; Eastern Atlantic; South China Sea; Southeastern Pacific: Nazca and Salas y Gomez submarine ridges. (Parin *et al.*, 1997; Pequeño & Matallanas, 2004).

Habitat: Benthopelagic (Parin, 1991; Froese & Pauly, 2015)

Depth: 180-700 m (Parin, 1991; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

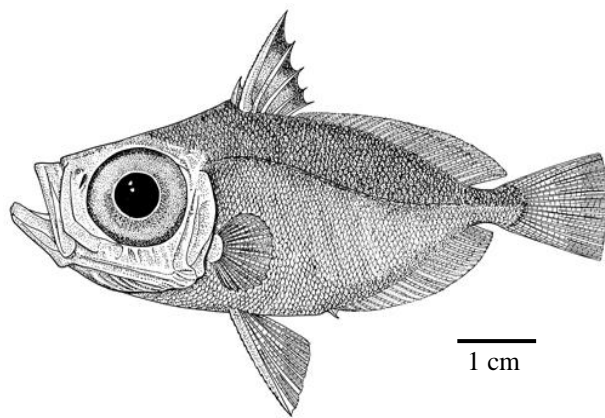


Figure 6. Zenionidae: *Zenion hololepis* (Modified from Martins *et al.*, 2012).

***Zenion japonicum* Kamohara, 1934 (Fig. 7)**

japonicum, *Zenion* Kamohara 1934: Kamohara "neotype": BSKU 9394. Current status: Valid as *Zenion japonicum* Kamohara, 1934 (Eschmeyer, 2015).

Distribution: Southeastern Pacific: Nazca and Salas y Gomez submarine ridges (Pequeño, 1989; Froese & Pauly, 2015).

Habitat: Benthopelagic (Froese & Pauly, 2015)

Depth: 200-400 m (Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

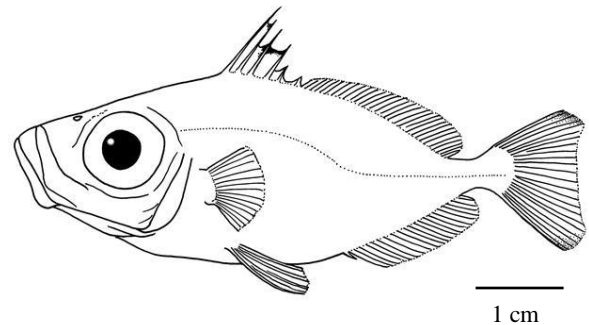


Figure 7. Zenionidae: *Zenion japonicum* (Modified from <http://zukan.com/fish/internal2043>).

Family: GRAMMICOLEPIDIDAE

Subfamily: GRAMMICOLEPIDINAE

***Grammicolepis brachiusculus* Poey, 1873 (Fig. 8)**

brachiusculus, *Grammicolepis* Poey 1873. Holotype (unique): skeletonized, probably lost. Current status: Valid as *Grammicolepis brachiusculus* Poey, 1873 (Eschmeyer, 2015).

Distribution: Eastern Atlantic: Spain to the Gulf of Guinea and southward to Durban, South Africa; Western Atlantic: Georges Bank to off Suriname; North Pacific: Japan and Hawaii Brazil, Southeastern Pacific: Chile, San Felix Island (Pequeño & Matallanas, 2004; Eschmeyer, 2015).

Habitat: Bathypelagic (Froese & Pauly, 2015)

Depth: 300-1026 m (usually 500-700 m) (Pequeño & Matallanas, 2004; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

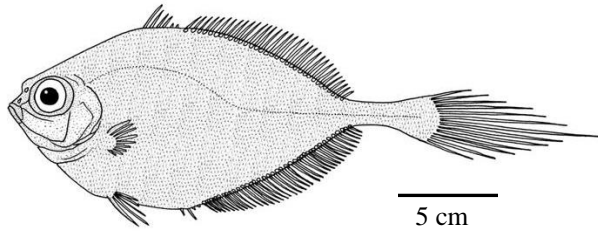


Figure 8. Grammicolepididae: *Grammicolepis brachiusculus* (Modified from Vasconcelos *et al.*, 2003).

Family: ZEIDAE

***Zenopsis nebulosa* (Temminck & Schlegel, 1845) (Fig. 9)**

nebulosus, *Zeus* Temminck & Schlegel 1845. Lectotype: RMNH 816 (stuffed). Paralectotypes: RMNH D814-815 (2, stuffed), 1429 (2, dry), D2326 (1, stuffed), D2361 (1, stuffed); ZMB 1660 (1). Current status: Valid as *Zenopsis nebulosa* (Temminck & Schlegel, 1845) (Eschmeyer, 2015).

Distribution: Indo-Pacific: Japan, northwest shelf of Australia to Broken Bay in New South Wales, New Zealand, and elsewhere in the region; Eastern Pacific: off central and southern California, USA, Southeastern Pacific Ocean, seamounts of the Nazca Ridge (Parin *et al.*, 1988; Eschmeyer, 2015).

Habitat: Benthopelagic (Parin *et al.*, 1988; Froese & Pauly, 2015)

Depth: 30-800 m (usually 50-600 m) (Parin *et al.*, 1988; Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

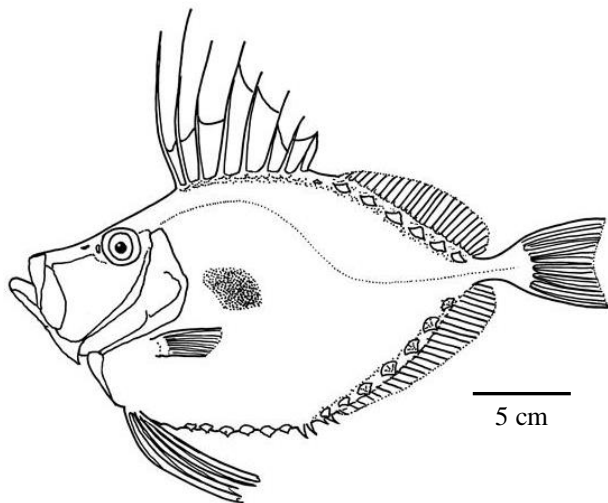


Figure 9. Zeidae: *Zenopsis nebulosa* (Taken from Bray, 2011).

***Zenopsis conchifer* (Lowe, 1852) (Fig. 10)**

conchifer, *Zeus* (Lowe 1852). Sintypes: BMNH 1857.6.13.184 (1, skin). Current status: Valid as *Zenopsis conchifer* (Lowe, 1852) (Eschmeyer, 2016).

Distribution: Cosmopolitan (Heemstra, 1980); South-eastern Pacific Chile: Juan Fernández Archipelago (Pequeño & Matallanas, 2004).

Habitat: Benthopelagic (Froese & Pauly, 2015)

Depth: 50-600 (usually 150-300 m) (Froese & Pauly, 2015)

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

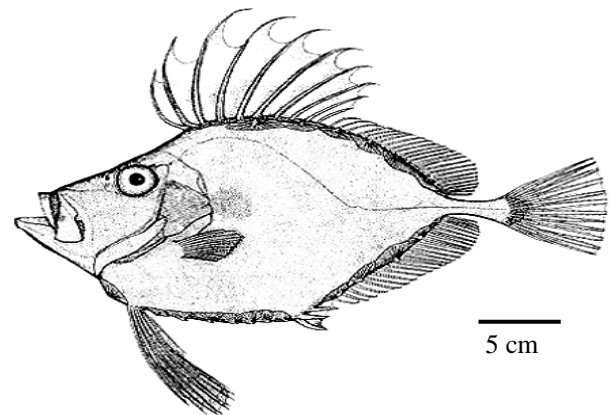


Figure 10. Zeidae: *Zenopsis conchifer* (Modified from de Silvestre & Schwingel, 2012).

***Zenopsis oblonga* Parin, 1989 (Fig. 11)**

oblongus, *Zenopsis* Parin 1989: Holotype: ZIN 47739. Paratypes: USNM 285048 (1); ZIN 47740 (3), 47751 (1), 48052 (1); ZMMU P-17078-79 (1, 1, apparently not received), P-17081 (1), uncat. (1). Current status: Valid as *Zenopsis oblonga* Parin, 1989 (Eschmeyer, 2015).

Distribution: Eastern Pacific, seamounts of the Nazca and Salas y Gómez submarine ridges (Parin, 1989; Eschmeyer, 2015).

Habitat: Benthopelagic (Parin, 1989; Froese & Pauly, 2015).

Depth: 210 m (Parin, 1989; Froese & Pauly, 2016).

IUCN information (Red List 2013):

- Classification: NE
- Population trend: Unknown
- Biological parameters: Scarcely known (Table 1) (Froese & Pauly, 2015).

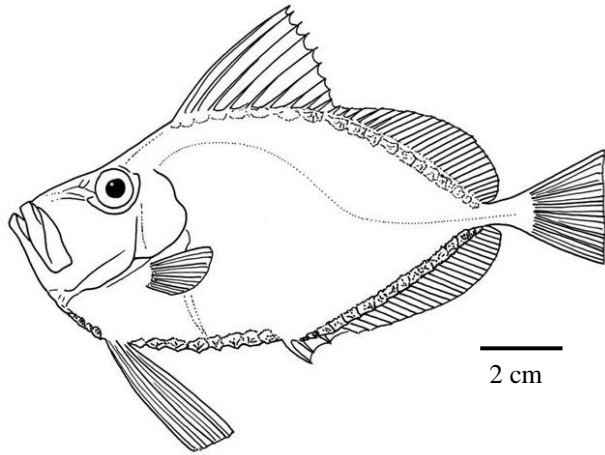


Figure 11. Zeidae: *Zenopsis oblonga* (Modified from Parin, 1989).

Tentative identification key for the Zeiformes fishes from Chile

The term "tentative" is applied in this key due to the limited information of these taxa (juvenile or adult, male or female), to carry out an accurate diagnosis.

1a. Preorbital distance greater than the eye diameter. Dorsal fin with 7 to 11 spines. Pelvic spine present or absent and 5 to 10 soft rays. Presence of dorsal and ventral bony bucklersZEIDAE (2)

2a. With 2-5 dorsal bony bucklers and 1-9 ventral bony bucklers; dorsal fin with 10 spines*Zenopsis conchifer*.

2b. With 5-9 dorsal bony bucklers and 2-12 ventral bony bucklers; dorsal fin with 8 spines(3)

3a. With 5-7 dorsal bony bucklers and 5-12 ventral bony bucklers*Zenopsis nebulosa*.

3b. With 6-9 dorsal bony bucklers and 2-11 ventral bucklers.....*Zenopsis oblonga*.

1b. Preorbital distance shorter than the ocular diameter. The base of dorsal and anal fins without bony shields.....(4)

4a. Preorbital distance subequal to ocular diameter. Dorsal fin with 7 spines. Spiny keel of preanal shields. Pelvic fins large, contained 2 times in the standard length. PARAZENIDAE. Monotypic family*Stethopristes eos*

4b. Preorbital distance shorter than the ocular diameter.....(5)

5a. Mouth very little. Upper jaw length, contained 2 times in eye diameter. Scales narrow and elongated vertically. Base of the dorsal and anal fins, spiny. Caudal fin with 13 rays....GRAMMICOLEPIDIDAE. Monotypic family.....*Grammicolepis brachiusculus*.

5b. Mouth large or moderate. Upper jaw length subequal or 2 times smaller than the eye diameter. Scales little or absent. Caudal fin with 11 rays(6)

6a. Height of the body, subequal to cephalic length. Dorsal fin with 5 to 10 spines. Anal fin with one spine weak or absent. Pelvic fins with one serrate spine and 6 soft rays.....ZENIONIDAE (7)

7a. Eye contained two times in head. Mouth terminal; high body; dorsal fin with 8 spines*Cyttomimus stelgis*.

7b. Eye contained more than two times in head. Mouth supra, dorsal fin with 5 to 7 spines(8)

8a. Anal fin with 2 spines and 23-29 soft rays. First spine of dorsal fin shorter than to second spine. Body and head reddish.....*Zenion hololepis*.

8b. Anal fin with 1 spine and 23-24 rays. First spine of dorsal fin larger than to second spine silver colored body leaden; top of the spines blackish.....*Zenion japonicum*.

6b. Body height, greater than cephalic length. Dorsal fin with 4 to 8 spines. Anal fin with 1 to 4 spines. Pelvic fins with 1 spine and 5 to 7 rays ...OREOSOMATIDAE (9)

9a. Body profile oval, with dark spots in juveniles specimens. First dorsal fin with six spines*Pseudocyttus maculatus*.

9b. Body profile rhomboidal, without spots. First dorsal fin with 8-9 spines(10)

10a. Caudal peduncle, thin and long. Pectoral fin with 19-21 rays. Maxilar edge reach the anterior eye edge. Rostrum without scales between the lacrimal and supraorbital crest.....*Neocyttus psilorrhynchus*.

10b. Caudal peduncle, wide and short. Pectoral fin with 16-18 soft rays. Maxilar edge not reach the anterior eye edge. Rostrum with scales between the lacrimal and supraorbital crest.....*Neocyttus rhomboidalis*.

DISCUSSION

The fishes of the Order Zeiformes fishes contains six families and 322 species. They are widespread in all oceans, in the southeastern Pacific and Atlantic Ocean, and the species live near the bottom at 2 to more than 1000 m. The most species live on the continental slope often around the seamounts (Heemstra, 1980; Pequeño *et al.*, 1992; Nelson, 2006).

In Chile, this order is represented by five families: Oreosomatidae, Parazenidae, Zenionidae, Grammicolepididae and Zeidae. The family Oreosomatidae is known primarily from off South Africa and southern Australia (Nelson, 2006). Most of the species of Oreoso-

matidae are found in the southeastern Pacific, inhabiting continental slopes down to about 1000 m deep. However, there are records of the catch of a *Neocyttus rhomboidalis* in southern Chile (Canal Barbara), which would mean an extension of its distribution in the Pacific Ocean (Pequeño *et al.*, 1992).

The second, Parezenidae, is a monotypic family. This taxon is distributed in the Atlantic and Pacific oceans. In Chile is found in the Salas y Gomez submarine ridge (Parin *et al.*, 1997; Eschmeyer 2015).

Another family of Zeiformes, is Zenionidae. This family is found primarily off southern Africa and tropical western Pacific. In Chile, the three species are found in Nazca, and Salas y Gomez submarine ridge (Parin, 1989; Parin *et al.*, 1997, Pequeño & Matallanas, 2004; Eschmeyer, 2015).

The monotypic family Grammicolepididae, is found in Eastern Atlantic, Western Atlantic, north Pacific and Hawaii. In the Atlantic is found in Brazil. In South Pacific is found in Chile (San Felix Island) (Pequeño & Matallanas, 2004; Eschmeyer 2015).

The last family Zeidae inhabits in the Atlantic and South Pacific Ocean of Perú and Chile, Salas y Gomez submarine ridges (Tyler *et al.*, 2003; Eschmeyer, 2015).

Another relevant aspect of the Order Zeiformes in Chile is its taxonomy that differs from that presented by Pequeño (1989, 1997). The six species considered in the literature have increased to 11, due to new captures (Parin *et al.*, 1997; Yearsley & Last, 1998; Pequeño & Matallanas, 2004). The exclusion of the family Caproidae from the Zeiformes, and its incorporation in Perciformes, based on the proposals by Tyler *et al.* (2003), is another relevant change in these taxa (Nelson, 2006; Nolf & Tyler, 2006; Eschmeyer, 2015).

The best known family is Oreosomatidae, with three species (Karrer, 1986; Lloris, 1986; James *et al.*, 1988; Parin *et al.*, 1997; Meléndez *et al.*, 2001). A fourth species *Alloctytus verrucosus* (Gilchrist, 1906) is uncertain, being presumably present in Chilean waters (SPRFMO, 2007). However, no evidence supporting the latter is available. This family has been enriched with a third species, *Neocyttus psilorhynchus*, that is found in the southwest and southeastern Pacific (Yearsley & Last, 1998).

Species of the family Zeidae have increased their nominal number, with two new species: *Zenopsis conchifer* captured in the seamounts of Juan Fernandez Archipelago and *Z. oblonga* captured in seamounts of Nazca and Salas y Gomez (Parin, 1989; Parin *et al.*, 1997; Pequeño & Matallanas, 2004; Santini *et al.*, 2006; Martins & Schwingel, 2012).

Another family that adds to the order Zeiformes is Grammicolepididae with *Grammicolepis brachius-*

culus Poey, 1873 captured at the west of Desventuradas Islands (Pequeño & Matallanas, 2004).

The synonyms used in some species may be confused. This is the case of *Zenion hololepis* with *Zenion japonicum*. Both were considered as synonymous for a long time, but now they are accepted as independent species (Pequeño & Matallanas, 2004; Eschmeyer, 2015).

Another relevant taxonomic change is *Stethopristes eos* Gilbert, 1905, previously included in the family Zeidae (Pequeño, 1989; Parin *et al.*, 1997). This taxon is included as part of the family Parazenidae (Tyler *et al.*, 2003; Eschmeyer, 2015).

The lasting species included in the family Parazenidae, Zenionidae and Zeidae, remain all as slightly studied taxa, without new reports of captures in Chilean waters. Consequently, the biological information of these taxa is scarce and incomplete.

The species of the family Oreosomatidae (as well as the other members of zeiform families), have been partially known and studied. For their nominal species *Neocyttus rhomboidalis*, *Pseudocyttus maculatus* biological information has been recorded, while for the third species *Neocyttus psilorhynchus* only the maximum length is currently known. 90% of the species are not evaluated, 9.1% are classified as Data Deficient (DD), with a decreasing population or unknown trend (Red List, 2014). The present lack of information could be covering up a potential vulnerability of these species. For instance, seamounts are unique ecosystems, but is little known about them. They are extremely fragile to disturbance caused by fishing, so they have been classified as Vulnerable Marine Ecosystems (SUBPESCA, 2015). To protect these ecosystems and to propose protective actions to be taken, it is necessary to know its ichthyofauna.

In general, fishes of the order Zeiformes in Chile have been poorly studied. For this reason, it is not enough to have new records of capture, but more biological studies (maximum age, size of maturity, maximum size, fertility rate) and new explorations to seamounts, are necessary also to know the current and actual state of this group of fishes in Chilean waters.

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REFERENCES

- Bianchi, G., K.E. Carpenter, J.P. Roux, F.J. Molloy, F.J. Boyer & H.J. Boyer. 1999. FAO species identification field guide for fisheries purposes. The living resources of Namibia. FAO, Rome, 285 pp.
- Bray, D. 2011. Mirror dory, *Zenopsis nebulosa*, in Fishes of Australia. [<http://www.fishesofaustralia.net.au/home/species/1867>]. Reviewed: 7 April 2015.
- Carvalho-Filho, A., G. Marcovaldi, F.A. Ribiro, I.G. Palva & C.L.S. Sampaio. 2012. New records of *Grammicolepis brachiusculus* Poey, 1873 (Zeiformes: Grammicolepididae) in Brazilian waters, with a key to Western Atlantic species of Grammicolepididae. Check List, 8(4): 626-629.
- Eschmeyer, W. (ed). 2015. Catalog of fishes: genera, species, references. California Academy of Sciences, San Francisco. [<http://researcharchive.calacademy.org/research/ichthyology/catalog-/fishcatmain.asp>]. Reviewed: 10 February 2015.
- Froese, R. & D. Pauly. 2015. FishBase. World Wide Web electronic publication. (www.fishbase.org). Reviewed: 12 February 2015.
- Heemstra, P.C. 1980. A revision of the zeid fishes (Zeiformes: Zeidae) of South Africa. Ichthyol. Bull. J.L.B. Smithsonian Inst. Ichthyol., 41: 1-18.
- Heemstra, P.C. 1986a. Family N°138: Zeidae. In: M. Smith & P.C. Heemstra (eds.). Smith's sea fishes. Springer-Verlag, New York, London, pp. 435-438.
- Heemstra, P.C. 1986b. Family N°141: Zeniontidae. In: M. Smith & P.C. Heemstra (eds.). Smith's sea fishes. Springer-Verlag, New York, London, 441 pp.
- International Union for Conservation of Nature (IUCN). 2013. Red list of threatened species. Version 2013.2. IUCN 2013, International Union for Conservation of Nature.
- James, G.D., T. Inada & I. Nakamura. 1988. Revision of the oreosomatid fishes (Family Oreosomatidae) from the southern oceans, with a description of a new species New Zealand. J. Zool., 15: 291-326.
- Karrer, Ch. 1986. Family N°139: Oreosomatidae In: M. Smith & P.C. Heemstra (eds.). Smith's sea fishes. Springer-Verlag, New York, pp. 438-440.
- Karrer, Ch. & P.C. Heemstra. 1986. Family N°140: Grammicolepididae In: M. Smith & P.C. Heemstra (eds.). Smith's sea fishes. Springer-Verlag, New York, pp. 440-441.
- Leviton, A.E., R.H. Gibbs, Jr., E. Heal & C.E. Dawson. 1985. Standards in Herpetology and Ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia, 1985(3): 802-832.
- Lloris, D. 1981. Peces capturados en el SO africano durante la campaña "Bengula-I" Noviembre 1979. Res. Exp. Cient., 9: 17-28.
- Lloris, D. 1986. Ictiofauna demersal y aspectos biogeográficos de la costa sudoccidental de Africa. (S.W.A./Namibia). Monogr. Zool. Mar., vol. I: I-CCI Tab., pp. 9-432.
- Martins, R.S & P.R. Schwingel. 2012. Biological aspects of the sailfin dory *Zenopsis conchifer* (Lowe, 1852) caught by deep-sea trawling fishery off Southern Brazil. Braz. J. Oceanogr., 60(2): 171-179.
- Meléndez, C.R., H. Dyer & D. Bryan. 2001. Nuevo registro de *Neocyttus rhomboidalis* Gilchrist, 1906 Zeiformes Oreosomatidae en aguas circundantes a Robinson Crusoe, Archipiélago de Juan Fernández, Chile. Not. Mens. Mus. Nac. Hist. Nat., Santiago, 346: 12-14.
- Nakabo, T., D.J. Bray & U. Yamada. 2006. A new species of *Zenopsis* (Zeiformes: Zeidae) from the South China Sea, East China Sea and off Western Australia. Mem. Mus. Victoria, 63(1): 91-96.
- Nelson, J. 2006. Fishes of the world. John Wiley & Sons, New York, 624 pp.
- Nolf, D. & C. Tyler. 2006. Otolith evidence concerning interrelationships of caproid, zeiform and tetraodontiform fishes. Bull. Inst. R. Sci. Nat. Belg., 76: 147-189.
- Parin, N.V. 1989. *Zenopsis oblongus* sp. n. (Osteichthyes, Zeidae) from the Naska Ridge. Zool. Zh., [In Russian, English summary], 68(4): 150-153.
- Parin, N.V. 1991. Fish fauna of the Nazca and Sala y Gomez submarine ridges, the easternmost outpost of the Indo-West Pacific zoogeographic region. Bull. Mar. Sci., 48(3): 671-683.
- Parin, N.V., Y. Pavlov & D.P. Andrianov. 1988. Ecology of the mirror dory, *Zenopsis nebulosus*, of the submarine Nazca ridge. J. Ichthyol., 28: 106-115.
- Parin, N.V, A.N. Mironov & K.N. Nesis. 1997. Biology of the Nazca and Sala y Gomez Submarine Ridges. An outpost of the Indo-West Pacific Fauna in the Eastern Pacific Ocean: composition and distribution of the fauna its communities and history. Adv. Mar. Biol., 32: 147-242.

- Pequeño, G. 1989. Peces de Chile. Lista sistemática revisada y comentada. *Rev. Biol. Mar.*, Valparaíso, 24(2): 1-132.
- Pequeño, G. 1997. Peces de Chile. Lista sistemática revisada y comentada: *addendum*. *Rev. Biol. Mar. Oceanogr.*, 32(2): 77-94.
- Pequeño, G. & J. Matallanas. 2004. First record of the Family Grammicolepididae, with *Grammicolpis brachiusculus* Poey, 1873, in the Southeastern Pacific Ocean (Osteichthyes: Zeiformes). *J. Ichthyol.*, 44 (Suppl. D): S145-S149.
- Pequeño, G., A. Cea-Egaña & W. Sielfeld. 1992. Primer registro en Chile para tres especies de peces teleósteos marinos, en base a fotografías. *Bol. Soc. Biol. Concepción*, 63: 169-173.
- Santini, F., J.C. Tyler, A.F. Bannikov & D-S. Baciú. 2006. A phylogeny of extant and fossil buckler dory fishes, family Zeidae (Zeiformes, Acanthomorpha). *Cybium*, 30(2): 99-107.
- Schwartz, F.J. 2008. Occurrences of dory, lumpfish and snailfish in North Carolina and adjacent ocean waters. *J.N.C. Acad. Sci.*, 12(4): 159-160.
- South Pacific Regional Fisheries. Management Organization (SPRFMO) 2007. Information describing Oresomatidae (*Allocyttus niger*, *Neocyttus rhomboidalis* and *Pseudocyttus maculatus*) fisheries relating to the South Pacific Regional Fisheries Management Organization. SPRFMO-IV-SWG-11: 1-16.
- Subsecretaría de Pesca y Acuicultura (SUBPESCA). 2015. Subsecretaría de Pesca y Acuicultura, Ministerio de Economía, Fomento y Turismo de Chile. Resolución Ex. N°451 de 17/2/2015, Valparaíso.
- Tyler, J.C., B. O'Toole & R. Winterbottom. 2003. Phylogeny of the genera and families of zeiform fishes, with comments on their relationships with tetraodontiforms and caproids. *Smith. Contr. Zool.*, 618: 1-110.
- Vasconcelos, P., M.M. Santos & M.B. Gaspar. 2003. First record of *Grammicolepis brachiusculus* in Portuguese waters. *J. Fish Biol.*, 63: 533-537.
- Yearsley, G.K. & P.R. Last. 1998. *Neocyttus psilorhynchus*, a new oreosomatid (Pisces, Zeiformes) from southern Australia and New Zealand. *New Zeal. J. Mar. Freshwat. Res.*, 32: 555-579.

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