

## Occurrence of *Idiosepius* (Mollusca: Cephalopoda) in Indonesian waters

Janek von Byern<sup>1</sup> & Ristiyanti M. Marwoto<sup>2</sup>

<sup>1</sup> University of Vienna, Fac. of Life Science, Cell Imaging and Ultrastructure Research, 1090 Vienna, Austria

<sup>2</sup> Museum Zoology Bogor, Research Center for Biology – LIPI, Cibinong 16911 – Indonesia; email: rist001@lipi.go.id

### ABSTRAK

**Jenis *Idiosepius* (Mollusca: Cephalopoda) di perairan Indonesia.** Informasi dan penelitian tentang sotong mini “pygmy squid” marga *Idiosepius* yang ada di Indonesia sangat kurang, meskipun pernah dilaporkan setidaknya ada tiga jenis dijumpai di Ambon, Ternate, Banda, Balikpapan, Sibolga dan Lombok. Dalam tulisan ini diuraikan karakter morfologi, habitat dan distribusi empat jenis sotong mini jenis *I. picteti*, *I. pygmaeus*, *I. biserialis* dan *I. pygmaeus herbergeri*. Karena ukurannya yang sangat kecil, jenis sotong ini tidak diminati oleh para nelayan, sehingga hanya sedikit data yang diketahui mengenai pertumbuhan, reproduksi dan siklus hidupnya. Penelitian ini bertujuan untuk memberikan gambaran ringkas tentang sistematik, habitat, siklus hidup dan distribusi *Idiosepius*. Hasil studi ini mencatat lokasi baru (*new record*) ditemukannya sotong mini jenis *I. biserialis* dan *I. pygmaeus* khusus dari perairan pantai di Lombok. Hasil penelitian juga menunjukkan bahwa beberapa jenis *Idiosepius* memiliki sebaran yang luas di perairan Indonesia kecuali jenis *I. picteti* hingga saat ini hanya dijumpai di Ambon. Hasil studi diharapkan menambah khasanah pengetahuan tentang sotong mungil ini sekaligus memacu para peneliti untuk lebih memperhatikan genus ini.

**Keywords:** Cephalopoda, distribution, habitat, Idiosepiidae, Indo-Pacific

**Kata kunci:** Cephalopoda, distribusi, habitat, Idiosepiidae, Indo-Pacific

### Introduction

The genus *Idiosepius* has the smallest species within the cephalopods and is also named “pygmy squid”. The females reach maturity at 3 cm length, whereas the males of some species reach sexual maturity at < 1 cm (Joubin 1902; Norman 2000) with a body weight ranging from 6 mg (*Idiosepius biserialis*) to 1 g (*Idiosepius pygmaeus*) (Hylleberg & Nateewathana 1991a; Hylleberg & Nateewathana 1991b).

The animals are dorso-ventrally compressed and cigar-shaped; the fins are small, ovals elongated with the long axis parallel to the body axis (Figure 1). The arms are short and robust and almost equal in length, except for one arm that is always shorter (Hylleberg & Nateewathana 1991b). Both sexes can be distinguished easily by the modified fourth arm pair in males (Yamamoto 1949; Jackson 1988; Nabhitabhata 1998; Norman 2000).

One conspicuous morphological character of this genus is the adhesive



**Figure 1:** Individual of the species *Idiosepius pygmaeus*. The animals are small in size and live exclusively in mangrove areas in the Indo-Pacific area down to Australia.

organ (also named adhesive gland) located on the posterior part of the dorsal mantle side (von Byern *et al.* 2008; Cyran *et al.* 2008). The animals use the glue from the adhesive glands to stick to sea grass leaves or algae for camouflage when threatened by predators (Sasaki 1921). Hiding there, they also lie in wait to capture prey swimming by. Furthermore, in females, secretion of glue serves to stick the eggs on sea grass (Nesis 1982).

Collection of *Idiosepius* in Indonesian waters has long history; more than 115 years ago, Joubin (1894a) collected one male holotype sample of *I. picteti* at Ambon Island. Unfortunately, up to this day, attempts to re-collect individuals of this species in its original type locations or neighbouring island were unsuccessful. It can be assumed that this species has disappeared or even become extinct.

In 1898, Appellöf discovered *I. pygmaeus* Steenstrup, 1881 in Ternate

and Banda-Sea. This species was thought to occur only in the Philippines. Later, collections by Grimpe in 1931 in Balikpapan and Sibolga showed that *I. pygmaeus* has a wide distribution in Indonesia.

In 1927, Rensch collected 14 specimens of the genus *Idiosepius* at Ekas Bay, Lombok, Indonesia. Grimpe (1931) compared the collected material with samples of *I. pygmaeus* from several institutions and proposed that his specimens differ from *I. pygmaeus* and the other species mostly in size, contour of the adhesive organ and expression of the hectocotylus (Grimpe 1931). He therefore regarded his specimens as the subspecies *Idiosepius pygmaeus hebereri*.

Examinations by Nesis (1982), however, revealed that the morphological characteristics were insufficiently different to justify the subspecies; *Idiosepius pygmaeus hebereri* was

therefore referred to *I. pygmaeus*. In contrast to *I. picteti*, individuals of *I. pygmaeus* could still be located at their type locality (von Byern & Klepal 2007) as well as in new localities (see description of *I. pygmaeus* below).

Apart from *I. picteti* and *I. pygmaeus*, a further species, *I. biserialis*, was recently discovered in Indonesian waters (von Byern *et al.* 2005). So far, less is known about the geographical distribution and habitat of this species (see section Habitat conditions in Indonesia). Previously, it was thought to occur only in African waters (Mozambique) and Thailand.

With the present description and geographical data, we report new collection places for *Idiosepius* in Indonesia and extend the previous type localities. This will shed light on the ecology and distribution of *Idiosepius* and yield new insights into the habitat conditions of Indonesian individuals.

Nevertheless, many questions about their life cycle, geographical distribution and origin of migration remain. Further collections coupled with ecological and behavioral investigations are necessary to complete our picture of this genus.

## METHODS

*Idiosepius* specimens were collected along the bay of Lombok in November - December 2007 using a dipnet. The specimens were then preserved with ethanol 95% (partly for DNA) and 70% (for ordinary preserved collections). The specimens are deposited at the NMW (Naturhistoris-

ches Museum Wien, Austria) and MZB (Museum Zoologicum Bogoriense), Research Center for Biology – LIPI, Indonesia.

## RESULT

### Description of Indonesian *Idiosepius* species

*Idiosepius biserialis* Voss, 1962 (Figure 2A)

#### **Holotype:**

deposited at South African Museum, Cape Town, South Africa (SAM A6520)

#### **Type locality:**

Mozambique, San Jose Mission Station, Morrumbene

#### **Geographical distribution of the species or /and material examined:**

Thailand: Bang Rong, Phuket Island (8° 02.156'N; 98° 25.487' E) (von Byern & Klepal 2009) and Ko Pratong, Ranong (Hylleberg & Nateewathana 1991a)

Mozambique: Inhaca Island (26° 00.215' S, 32° 54.721' E; 26° 02.300' S, 32° 54.166' E) (Kalk, 1959; von Byern & Klepal 2009); Inhambane Bay (23° 51.184' S, 35° 22.553' E) (von Byern & Klepal 2009); Monque (23° 41.331' S, 35° 22.281' E) (Voss 1962; Adam 1986; von Byern & Klepal 2009)

Japan: Takasu, Japan. Collector: S. Shigeno (von Byern *et al.* 2005)

Indonesia: Ekas-Bay, Lombok (08° 52.020' S; 116° 27.541' E) (von Byern *et al.* 2005); Ekas-Bay, Lombok (08°

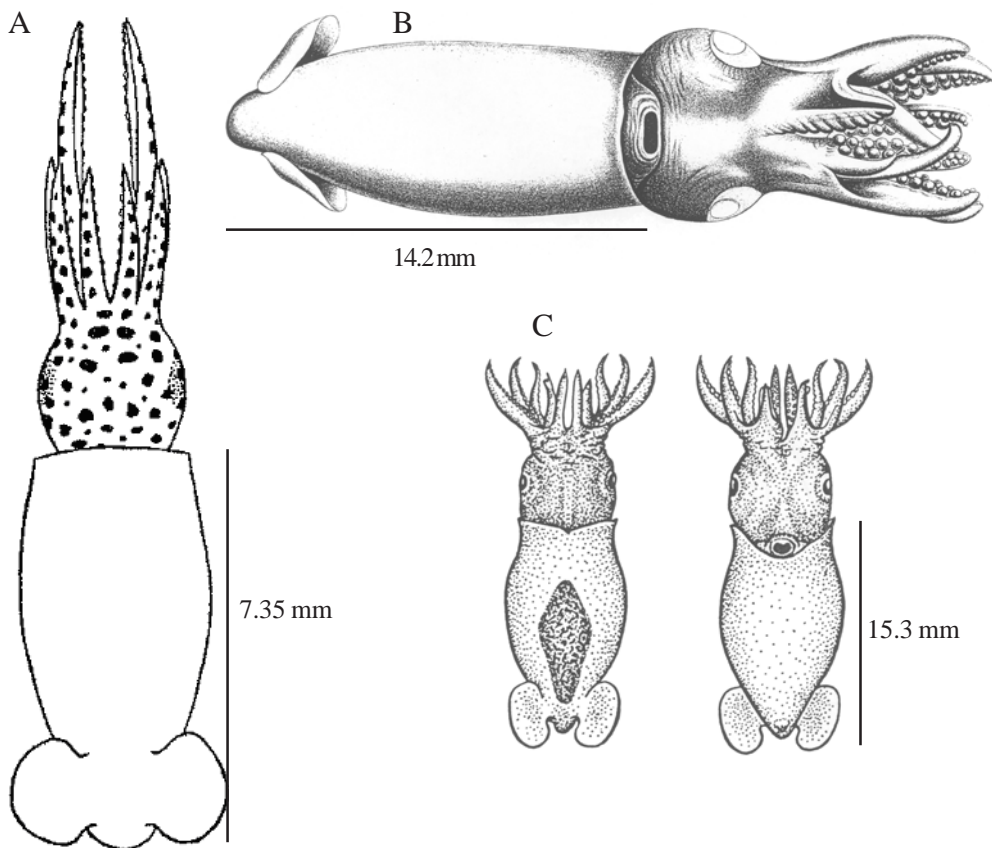
50. 357°S ; 116° 27.857° E) (08° 50. 714°S ; 116° 26.781° E) , collected November 2007 (unpubl. data)

**Morphological characteristics:**

This species has the smallest specimens of the genus. Animals from Mozambique are small, slender, with a mantle length of  $4.5 \pm 0.3$  mm (males) and  $7.38 \pm 1.31$  mm (females). The fins are semicircular and about 1/4 of the mantle length. The clubs of this species bear two rows of small suckers, which are nearly constant

in size to the end of the club. Both ventral arms in the male are hectocotyliized, bearing 1-5 suckers on the left (ventral view) and 3-8 suckers on the right ventral arm. The left arm also has two small flaps, separated by a deep cleft, at the tip. In the caught male, the hectocotyli arms are almost unequal in length: the left arm is shorter than the right one.

The specimens from Thailand are larger (ML to  $5.84 \pm 0.54$  mm males and  $7.7 \pm 1.1$  mm females). The fins are more rounded kidney-shaped and



**Figure 2:** Schematic drawing of the known *Idiosepius* species in Indonesian waters: **A)** *I. biserialis* (Voss, 1962); **B)** *I. picteti* (Joubin, 1894a) and **C)** dorsal and ventral view of *I. pygmaeus* (Nesis, 1982).

attached to the body at an angle. The tentacle clubs have two horizontal rows of suckers, sometimes also three or four oblique rows of suckers. The hectocotylized arms also bear 2-4/2-5 suckers on the left/right ventral arm. The animals from Japan are almost twice as long ( $6.34 \pm 0.89$  mm males and  $9.39 \pm 1.1$  mm females) with 3 suckers on the left and 5 on the right ventral arm. The specimens from Indonesia have a mantle length of 3 mm (and 4 suckers on each hectocotylized arm) in the one available male, while the two investigated females have a mantle length of  $5.25 \pm 0.35$  mm.

***Idiosepius picteti*** Joubin, 1894b (Figure 2B)

**Synonymy:**

*Loligo picteti* Grimpe, 1920  
*Naefidium picteti* Grimpe, 1920

**Holotype:** deposited at the Muséum d'Histoire Naturelle, Genève, Switzerland (MHNG M 3/75 747/27)

**Type locality:** Indonesia, Amboina – according to Joubin, 1894b (today Ambon Island)

**Geographical distribution:** only known from the type locality

**Morphological characteristics:** So far only the holotype is available; no additional specimens of this species have ever been found. The body is large and elongate (mantle length 14 mm). *Idiosepius picteti* has a small tentacle club with four rows of suckers. The right

ventral arm in the male is very short and broad. The oral face the arm is transversely plicate. The left ventral arm is more slender, longer and bilobate at the tip. Each ventral arm has a single small sucker near the base. Joubin (1894b) wrote that the examined specimen has no adhesive organ on its dorsal side: “Pas d’impression dorsale entre les nageoires”. Our examinations of this specimen reveal that Joubin (1894a) erred. *Idiosepius picteti* has an adhesive organ on the dorsal mantle side and is referred to the genus *Idiosepius*.

***Idiosepius pygmaeus*** Steenstrup, 1881 (Figure 2C).

**Synonymy:**

*Idiosepiion pygmaeum* Fischer, 1887  
*Idiosepius pygmaeus* Hoyle, 1886; Joubin 1894b; Appellöf 1898  
*Idiosepius pygmaeus pygmaeus* Grimpe, 1931

**Holotype:** deposited at Kobenhavns Universitet, Zoologisk Museum, Copenhagen, Denmark (ZMUC CEP-52)

**Type locality:** Philippines, Zamboanga ( $4^{\circ} 20' N$ ,  $107^{\circ} 20' E$ )

**Geographical distribution of the species or/and material examined:**

Philippines: Jolo Habor (Adam 1986)  
Thailand: Klong Mudong ( $7^{\circ} 48.107' N$ ,  $98^{\circ} 24.472' E$ ) (von Byern a & Klepal 2009), Klong Bang Rong ( $8^{\circ} 02.945' N$ ;  $98^{\circ} 25.030' E$ ) (Suwanmala

*et al.* 2006) and Ao Chalong (Hylleberg & Nateewathana 1991b)  
Singapore: Tempenisi (Adam 1986)

Australia: Townsville, North Queensland (19° 15' S, 146° 50' E) (Jackson 1988; Lewis 1991; Jackson 1992; Jackson & Choat 1992; Jackson 1993; Semmens *et al.* 1995; Pecl & Moltschaniwskyj 1997; Pecl & Moltschaniwskyj 1999)

Micronesia: Palau (Belau) Islands (Moynihan 1983)

Indonesia: Ternate (Appellöf 1898); Balikpapan (Grimpe 1931); Sibolga (Grimpe 1931) and Banda-Sea (Appellöf 1898)

New localities in Indonesia

- Ekas-Bay, Lombok (08° 52.020' S; 116° 27.541' E) (von Byern & Klepal 2007)
- Gili Sulat (08° 19.885' S; 116° 43.015' E), collected November 2007 (unpubl. data)
- Gili Lawang (08° 19.637' S; 116° 42.709' E), collected December 2007 (unpubl. data)
- Telong Elong (08° 48.730' S; 116° 30.012' E), collected December 2007 (unpubl. data)
- Rinca Island (08° 39.244' S; 119° 42.937' E), collected December 2007 (unpubl. data)

**Morphological characteristics:**

The species has a sepiolid body shape with a mean mantle length of 11.51 ± 1.52 mm in males and 16.26 ± 4.37 mm in females. The fins are small, short, rounded and slightly constricted at their base. The specimens bear 4 rows of suckers at the club of the tentacle. The

right ventral arm is stout and thick, while the left arm is thinner and slender, bilobated at the tip. According to the description of Steenstrup (1881), both ventral arms have only one sucker at their base. Later examination of this species revealed more numerous suckers in different variations on the ventral arms (Appellöf 1898). The range of sucker combinations varies from 0 to 4 suckers on the hectocotylyzed arms (Thailand). More than 30% of the specimens bear 2/3 suckers on the left/right or 3 suckers on both ventral arms.

*Idiosepius pygmaeus* from Indonesia is similar in size (11.53 ± 1.28 mm males and 15.5 ± 2.12 mm females) to *I. pygmaeus* from Thailand and bears 2 or 3 suckers on the left and 3 suckers on the right ventral arm; one individual has 1/1, another 4/4 suckers on the hectocotyli.

*I. pygmaeus* (= *Idiosepius pygmaeus hebereri*) Grimpe, 1931

**Holotype:** deposited at the Zoologisches Museum, Museum für Naturkunde der Humboldt-Universität, Institut für Systematische Zoologie, Berlin, Germany (ZMB)

**Type locality:** Indonesia, Ekas-Bay, Lombok

**Geographical distribution:**

only known from the type locality

**Morphological characteristics:**

Because of the close morphology to *Idiosepius pygmaeus*, Grimpe (1931)

subordinated this species as *Idiosepius pygmaeus hebereri*. The females of this subspecies have a mean mantle length of 14.5 mm, the males of 8.5 mm. The fins are small and have a round to almost oval form. Grimpe (1931) did not describe the number of rows on the club but later re-examination of the holotype material showed that the specimens have four rows of suckers (von Byern, unpubl. data). The left ventral arm is longer and bigger than the right arm, and also has two lobes at its tip. At its base the left arm has 3 suckers, while the right arm is more stocky and broad with 2 suckers at the base.

## DISCUSSION

### Systematics

The relationships among species within this genus remain unknown. Jereb & Roper (2005) currently place eight species within the genus: *Idiosepius biserialis* Voss, 1962, *I. macrocheir* Voss, 1962, *I. minimus* (D'Orbigny, 1845), *I. notoides* Berry, 1921, *I. paradoxus* (Ortmann, 1888), *I. picteti* (Joubin, 1894a), *I. pygmaeus* Steenstrup, 1881 and *I. thailandicus* Chotiyaputta *et al.* 1991.

Morphologically the species can be identified by the arrangement of suckers on the club (two or four rows) and the number of suckers on the ventral arms (hectocotyli) (Nesis 1982).

The species are mostly distributed in the tropical Indo-Pacific, Japan, southern Australia including Tasmania, and African waters, but individuals were also found in cooler Russian waters

(Nesis *et al.* 2002). Within the genus, *I. biserialis* has the widest geographical distribution, ranging from Japan to the Indo-Pacific (Thailand and Indonesia) (Voss 1963; von Byern *et al.* 2005); it has also been recorded in Mozambique (incorrectly annotated by Voss in 1962 as South Africa).

### Habitat and life cycle

The habitat occurrence varies within the genus: some species occur in mangrove areas (e.g. *I. pygmaeus*). Others like *I. biserialis* and *I. paradoxus* inhabit sea grass and algae areas.

All observations on this genus concerning behaviour, spawning, embryonic development and life cycle have only been made with wild-caught specimens in aquarium cultivation (Moynihan 1983; Jackson 1992). Presently, relatively little is known about the biology and life cycles of *Idiosepius*. For example, no data are available about its postembryonic life, the onset of sexual maturity or postembryonic behaviour. Some authors assume a life cycle lasting 3 months (from egg development until death) (Tracey *et al.* 2003), but this value needs verification. Moreover, the geographical distributions of all *Idiosepius* taxa are still only marginally explored. This may be explained by their small size and habitat conditions: observing specimens in their natural habitat is still difficult.

### Habitat of *Idiosepius* in Indonesia

*Idiosepius biserialis* was caught in November 2007 at low tide with a dipnet

in two sea grass areas in the northern area of Ekas-Bay, Lombok Island. These observations agree well with other collections of *I. biserialis* in Africa, Japan and Thailand, indicating that this species is specialised for sea grass areas (von Byern *et al.* 2005; von Byern & Klepal 2009). We still do not know whether the animals stay there at high tide or move elsewhere. In contrast, *I. pygmaeus* could only be found in mangrove forests and belts, such as those along the eastern part of Lombok Island at Gili Sulat, Gili Lawang, Telong Elong and Ekas-Bay, but are clearly absent in the northern, western and south-western shores of the Island. So far, no individuals of this species were ever found in sea grass or algal habitats (Suwanmala *et al.* 2006; von Byern & Klepal 2009).

Moreover, individuals of the former *I. pygmaeus hebereri* were collected in the eastern part of the Ekas-Bay in April 2004 (von Byern & Klepal 2007). During high tide, garbage, leaves and other plant material were transported here by the current. On some days this flotsam covers almost the whole water surface. Interestingly, the garbage in the water apparently does not affect *I. pygmaeus*: even compact and strongly agitated waste had no influence on their behaviour and movement. Moreover, the animals were also observed to mate within this flotsam and escape under the waste when threatened. Their occurrence between a flotsam of garbage indicates the ability to adapt to new habitats.

Additional genetic, ecological and behavioral investigations are necessary to provide a more complete picture of

the genus *Idiosepius* and provide more knowledge about their occurrence and geographical distribution in Indonesian waters.

## ACKNOWLEDGMENTS

We are very grateful to Didik Santoso, Lalu Japa & Karnan from Mataram University, Biology Department and furthermore to Mr. Mady Marcuo and the Staff of Rinca Island for helping collect the samples presented here. Our thanks go in particular to Mrs. Toifl from the ASEA-UNINET of the University of Vienna for promoting the research trip of the first author to and within Indonesia and Dr. Michael Stachowitsch from the University of Vienna for critically reading the manuscript.

## REFERENCES

- Adam, W. 1986. La radula et les mandibules de quelques espèces d'*Idiosepius* Steenstrup, 1881 (Mollusca Cephalopoda Decapoda). *Bull. de L'Institut Royal des Sci. Naturelles de Belgique* 56: 149-154.
- Appellöf, A. 1898. Cephalopoden von Ternate. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 24 (4): 570-637.
- Berry, SS. 1921. Cephalopods of the genera *Sepiolidea*, *Sepiadarium*, and *Idiosepius*. *The Philip. J. Sci.* 47 (1): 39-55.



- Chotiyaputta, CH., T. Okutani & S. Chaitiamvong 1991. A new pygmy cuttlefish from the Gulf of Thailand *Idiosepius thailandicus* n. sp. (Cephalopoda: Idiosepiidae). *Venus, The Jap. J. Malacology* 50 (3): 165-174.
- Cyran, N., W. Klepal & J. von Byern 2008. Ultrastructural characterization of the adhesive organ of Idiosepiidae Voss, 1962 (Mollusca, Cephalopoda). 3<sup>rd</sup> International Symposium "Coleoid cephalopods through time": 97-98.
- D'Orbigny, ACV. 1845. *Mollusques vivants et fossiles*. Tome Premier. Gide et Cie. Paris.
- Fischer, P. 1887. Cephalopodes Familie XIII. Idiosepiidae. *Manuel Conchyliologie et de Paleontologie Conchyologique ou Histoire Naturelle des Mollesques vivants et fossiles*. Libraire F. Savy Paris. 350-351.
- Grimpe, G. 1920. Teuthologische Mitteilungen IV. *Naefidium* n.g. pro: *Loligo picteti* Joubin 1894. *Zool. Anzeiger* 51: 208-214.
- Grimpe, G. 1931. Teuthologische Mitteilungen XIII. Über die Cephalopoden der Sunda-Expedition Rensch. *Zool. Anzeiger* 95 (5/8): 149-174.
- Hoyle, WE. 1886. Report on the Cephalopoda collected by H.M.S. Challenger during the years 1873-76. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the Years 1873-76. Zoology* 16: 1-245.
- Hylleberg, J. & A. Nateewathana 1991a. Morphology, internal anatomy, and biometrics of the cephalopod *Idiosepius biserialis* Voss, 1962. A new record for the Andaman Sea. *Phuket Marine Biol. Center Res. Bull.* 56: 1-9.
- Hylleberg, J. & A. Nateewathana 1991b. Redescription of *Idiosepius pygmaeus* Steenstrup, 1881 (Cephalopoda: Idiosepiidae), with mention of additional morphological characters. *Phuket Marine Biol. Center Res. Bull.* 55: 33-42.
- Jackson, GD. 1988. The use of statolith microstructures to analyse life-history events in the small tropical cephalopod *Idiosepius pygmaeus*. *Fish. Bull.* 87: 265-272.
- Jackson, GD. 1992. Seasonal Abundance of the small tropical Sepioid *Idiosepius pygmaeus* (Cephalopoda: Idiosepiidae) at two Localities off Townsville, North Queensland, Australia. *The Veliger* 35 (4): 396-401.
- Jackson, GD. 1993. Seasonal variation in reproductive investment in the tropical loliginid squid *Loligo chinensis* and the small tropical sepoid *Idiosepius pygmaeus*. *Fishery Bulletin* 91: 260-270.
- Jackson, GD & J.H. Choat 1992. Growth in tropical cephalopods: An analysis based on statolith microstructure. *Can. J. Fish. Aquat. Sci.* 49: 218-228.
- Jereb, P. & CFE. Roper 2005. *Cephalopods of the world - An annotated and illustrated catalogue of cephalopod species*

- known to date. No. 4, Vol. 1: Chambered nautilus and sepioids (Nautilidae, Sepiidae, Sepiolidae, Sepiadariidae, Idiosepiidae and Spirulidae). FAO species catalogue for fishery purpose. Food and Agriculture Organization of the United Nations. Rome.
- Joubin, L. 1894a. Céphalopodes d'Amboine. *Revue Suisse de Zool. et Ann. du Musèe d'Historie Naturelle de Genève* 2: 23-64.
- Joubin, L. 1894b. Note complémentaire sur un Céphalopode d'Amboine *Loligo picteti*= *Idiosepius picteti*. *Revue Suisse de Zool.* 3: 459-460.
- Joubin, L. 1902. Revision des Sepiolidae. *Mémoires de la Société Zoologique de France* 15: 80-145.
- Kalk, M. 1959. The zoogeographical composition of the intertidal fauna at Inhaca Island, Mocambique. *S. African J. Sci.*: 178-180.
- Lewis, AR. 1991. *Reproductive Biology of Idiosepius pygmaeus (Cephalopoda: Idiosepiidae) from waters near Townsville, North Queensland, Australia.* 1-82.
- Moynihan, M. 1983. Notes on the behavior of *Idiosepius pygmaeus* (Cephalopoda: Idiosepiidae). *Behavior* 85: 42-57.
- Nabhitabhata, J. 1998. Distinctive Behaviour of Thai pygmy Squid, *Idiosepius thailandicus* Chotiya-putta, Okutani & Chaitiamvong, 1991. *Phuket Marine Biological Center Special Publication* 18 (1): 25-40.
- Nesis, K. 1982. *Cephalopods of the World.* Translated from Russian by B.S. Levitov. V.A.A.P. Copyright Agency of the UdSSR for Light and Food Industry Publishing House; Moscow, 1987 TFH. Publications, Inc. Ltd., for English Translation.
- Nesis, K., ON. Katugin & AV. Ratnikov. 2002. Pygmy cuttlefish *Idiosepius paradoxus* (Ortmann, 1888) (Cephalopoda) - First record of Idiosepiidae in Russian seas. *Ruthenica* 12 (1): 81-84.
- Norman, MD. 2000. *Tintenfischfuehrer.* 1st. Jahr Verlag. Hamburg.
- Ortmann, A. 1888. Japanische Cephalopoden. *Zool. Jahrbücher* 3: 639-670.
- Pecl, G. & N A. Moltschaniwskyj 1999. Somatic growth processes: how are they altered in captivity? *Proc. Royal Soc. London.Sci.* 266: 1133-1139.
- Pecl, GT & N A. Moltschaniwskyj 1997. Changes in muscle structure associated with somatic growth in *Idiosepius pygmaeus*, a small tropical cephalopod. *J. Zoo. London.* 242: 751-764.
- Sasaki, M. 1921. On an adhering habit of a pygmy cuttlefish, *Idiosepius pygmaeus* Steenstrup. *Annotati-ones Zool. Japonenses* 10 (21): 209-213.
- Semmens, J., N A. Moltschaniwskyj & CG. Alexander 1995. Effect of feeding on the structure of the digestive gland of the tropical sepioid *Idiosepius pygmaeus*.

- J.Mar.Biol.Assoc.UK.* 75: 885-897.
- Steenstrup, J. 1881. *Sepiadarium* and *Idiosepius* two new genera of the family of Sepia. With remarks on the two related forms *Sepioloidea* d'Orb. and *Spirula* Lmk. *K.danske Vidensk.Selsk.Skrifter Raekke* 6 (Bd. 1): 211-242.
- Suwanmala, J., J. von Byern & J. Nabhitabhata. 2006. Observation of *Idiosepius pygmaeus* (Cephalopoda, Idiosepiidae) at Klong Bangrong, Phuket Island, Thailand. *Phuket Mar. Biol. Cent. Res. Bull.* 67: 49-51.
- Tracey, SR., MA. Steer & GT. Pecl. 2003. Life history traits of the temperature mini-maximalist *Idiosepius notoides* (Cephalopoda: Sepioidea). *J. Mar. Biol. Associate.UK.* 83: 1297-1300.
- von Byern, J. & W. Klepal. 2007. Occurrence of *Idiosepius pygmaeus* (Cephalopoda, Idiosepiidae) in Indonesian waters. *Ann. Nat. Hist. Mus..Wien* 108 B: 137-144.
- von Byern, J. & W. Klepal. 2009. Re-evaluation of systematic characters of *Idiosepius* (Cephalopoda, Mollusca). *Malacologica* (in press).
- von Byern, J., S. Nürnberger & S. Shigeno 2005: Distribution pattern of a minimalist - New records for *Idiosepius biserialis* (Idiosepiidae, Cephalopoda): 38-43.
- von Byern, J., L. Rudoll, N. Cyran & W. Klepal 2008. Histochemical characterization of the adhesive organ of three *Idiosepius* spp. species. *Biotech. & Histochemistry* 83 (1): 29-46.
- Voss, GL. 1962. South African cephalopods. *Transaction of the Royal Soc. of S. Africa* 36 (4): 245-272.
- Voss, GL. 1963. Cephalopods of the Philippine Islands. *U.S.National Mus. Bull.* 234: 1-180.
- Yamamoto, T. 1949. Sexual dimorphism of *Loligo bleckeri* and *Idiosepius paradoxus* on their mantle length. *Venus, the Japan. J. Malacology* 15 (5-8): 94-96.

**Memasukkan:** Maret 2009

**Diterima:** Juli 2009