

## A New Species of *Luteuthis* (Mollusca: Cephalopoda: Octopoda: Cirrata) from the South China Sea

Steve O'Shea<sup>1</sup> and Chung Cheng Lu<sup>2,\*</sup>

<sup>1</sup>National Institute of Water and Atmospheric Research, Wellington, New Zealand

<sup>2</sup>Department of Zoology, National Chung Hsing University and Department of Invertebrate Zoology, National Museum of Natural Science, Taichung, Taiwan 402, R.O.C.

(Accepted November 30, 2001)

**Steve O'Shea and Chung Cheng Lu (2002)** A new species of *Luteuthis* (Mollusca: Cephalopoda: Octopoda: Cirrata) from the South China Sea. *Zoological Studies* 41(2): 119-126. *Luteuthis shuishi* sp. nov., the 2nd known species in a recently described cirrate family and genus, Luteuthidae and *Luteuthis*, previously known from the southwestern Pacific, is described from the South China Sea. Pre-fixed (fresh) morphologies of this species, and of the type species of the genus *L. dentatus* O'Shea, 1999 are provided. The relationship between *Luteuthis* and *Grimpoteuthis tuftsi* Voss and Percy, 1990 is evaluated. We suggest that *G. tuftsi* be placed in the family Luteuthidae, but because of a lack of adequate comparative material, no formal action is taken to prescribe it to a new genus. Previous family and generic diagnoses are amended to take into account the increased species and associated anatomical diversity.  
<http://www.sinica.edu.tw/zool/zoolstud/41.2/119.pdf>

**Key words:** Cirrates, *Luteuthis*, *Grimpoteuthis*, *Opisthoteuthis*, Systematics.

During April 1995, the FRV *Fishery Researcher No. 1* (FRV *Shui Shi I Hao*), of the Taiwan Fisheries Research Institute, Keelung, Taiwan, conducted a research cruise to survey the benthic and midwater faunas of waters proximate to the Dong-Sha Islands (Pratas Islands); rich hauls of cephalopods were collected during this cruise. The fauna from this area has recently been reviewed (Norman and Lu 2000), wherein a preliminary checklist of cephalopod taxa known from the South China Sea is provided. The specimen previously listed as *Grimpoteuthis* sp. (Norman and Lu 2000) is herein described.

Although 9 cirrate taxa in the genera *Cirrothauma*, *Grimpoteuthis* (sensu lato) and *Opisthoteuthis* have been recorded from the northwestern Pacific and the Indo-Pacific region, none was known from the South China Sea. Therefore, description of one of these cirrate species adds considerably to local cephalopod diversity, in addition to considerably increasing the known distribution of

a very rare family and genus previously known from the southwestern Pacific only.

### SYSTEMATICS

#### Family Luteuthidae

Type of family: *Luteuthis dentatus* O'Shea, 1999: 53.

**Diagnosis** (amended): Cephalopodal mass moderately elongate along anteroposterior axis of animal; areolar spots absent; web simple; web nodules absent; cirri commencing between suckers 4 and 5; cirri very short, length about 2% ML or < 50% greatest sucker diameter, present to arm tips; sucker aperture crenulate, with toothlike structures. Intrapallial septum thick, short, oriented along anteroposterior axis of mantle; gills of 'half orange' type of Robson (1932: 124); shell complex, W shaped, lateral wings with keeled, at times inrolled,

\*To whom correspondence and reprint requests should be addressed. Fax: 886-4-285-1797. E-mail: cclu@dragon.nchu.edu.tw

margins, tapering to acute offset points; basal shelf deflected ventrally beneath saddle. Radula well developed, palatine teeth present or absent. Digestive gland bilobed or entire; intestine shorter than or of equivalent length to esophagus. Optic lobe ovoid; optic nerve single. Male accessory glands 2 and 3 dominating accessory gland complex, accessory glands 1–3 arranged in a linear sequence; penis well developed.

*Luteuthis* O'Shea, 1999: 56.

**Diagnosis:** As for the family: digestive gland bilobed; mantle, head, arms, and web effectively translucent and colorless to slightly pinkish red.

***Luteuthis shuishi* sp. nov.**

(Figs. 1-5, 8-10; Table 1)

**Material examined:** 1 ♀, holotype, NMNS (National Museum of Natural Science, Taichung, Taiwan) Reg. 002157-00088, ML 185 mm (pre-fixed), 87.5 mm (preserved), 19°30.1'N, 114°09.8'E – 19°33.7'N, 114°12.7'E, 754 – 767 m, 23 Apr. 1995, FRV *Fishery Researcher No. 1*, Cruise: FR-95-3, Station 28.

**Reference material:** *Luteuthis dentatus* O'Shea, 1999: holotype, NMNZ (National Museum of New Zealand) M. 131564, ♂, ML ca. 98 mm (fixed), 40°01.3'S, 167°49.9'E, 991 m, 29 July 1989, BT 6. 9°C, FV *Oyang 86*, col. B. Connel, Trip 375/16; NZOI (New Zealand Oceanographic Institute, now NIWA) Stn Z9721, ♂, ML ca. 230 mm (fixed), 37°14.2'S, 167°22.4'E, 1050 m, 04 Mar. 1999, FV *Atlantic Elizabeth*, col. A. Knox, Trip 1204/17 (Fig. 6). *Grimpoteuthis tuftsi* Voss and Percy, 1990, USNM (United States National Museum of Natural History) 730714, holotype, ♂, ML 101 mm, 45°05.2'N, 134°43.4'W, 3900 m, 09 Oct. 1972, RV *Yaquina*; USNM 817583, paratypes, ♀ ♀, ML ca. 60, 57 mm, 45°05.2'N, 134°43.4'W, 3900 m, 09 Oct. 1972, RV *Yaquina*.

**Recognized distribution:** known from the type locality only.

**Description:** External facies: Figs. 1-3 pre-fixed, Figs. 5, 6 preserved, animal medium-sized, ML (fixed) to 87.5 mm, TL to 371 mm. Mantle saccular, wider than long (MW ca. 1.5 x ML), anterior margin broadly rounded; head indistinct, mantle and nuchal constrictions not apparent; eyes and eye apertures large, ventrolaterally oriented. Neither inter- nor sub-orbital knobs apparent on dorsal mantle surface. Preserved animal with pronounced surface wrinkling and skin folds over mantle, head, arms, and web indicative of severe preservation shrinkage (Figs. 4, 5); mantle dermis thick. Fins large, broad, sub-

terminal, anterior fin margin nearly straight (slightly convex); posterior margin more convex; fin margins delicate; fin basally constricted proximal to attach with mantle; muscular portion of fins extending about 1/2 fin length.

Mantle aperture reduced, closely fitting around base of funnel; mantle attached to ventral surface of arms 4 proximal to base, at level equivalent to suckers 1 and 2 on oral face of arms. Funnel short, weak, attached to ventral surface of arms 4, protruding through mantle aperture. Funnel organ and mantle cavity details not detected due to poor preservation.

Dorsal arms long, slender, arm length 75% TL; ventral arms short, arm length 38% TL; arm formula 1.2.3.4 or 2.3.4.1 (right hand side and left hand side, respectively). Web single, although all sectors damaged; web depth ca. 24.3% AL, web formula approximately A.B.C.D.E. or A=C.B.D.E. Cirri short, about 2% ML or 40% greatest sucker diameter, and apparent at level of 4th to 6th suckers on all arms; cirri attaining greatest length along mid-portion of each arm and apparent to distalmost remaining suckers. First 3 or 4 suckers of moderate size, thereafter sucker diameter gradually increasing, with similarly sized suckers present to mid-point of all arms, thereafter suckers very gradually decreasing in diameter distally to the last remaining one. Suckers small, with diameter about 5% ML, with moderate suction chamber, well-developed muscular suction pad, and muscular sucker wall, sucker aperture with 16-18 well-developed hardened radiating processes (see O'Shea, 1999: fig. 37B). Some large processes occasionally scalloped, superficially giving the appearance of 2 processes. Suckers well spaced in remnant web sectors, weakly invested into or proud of oral face of arms; along distal 1/2 of each arm, suckers crowded, their bases touching; up to 57 suckers present along any arm.

Dorsal and ventral surfaces of mantle, head, and arms 1-4 white to translucent; distal margin of fin and oral face of arms beside each sucker row pinkish red; cirri darker red; eye scarlet.

Shell (Fig. 7a-d) effectively W shaped, light honey colored, translucent, flexible, with a highly polished surface. Lateral wings well developed, broad, lobelike, with strongly keeled margins; wing terminally rounded, with a fine, frayed offset-center pointed tip. Lateral wing margin keels extending over saddle, meeting mid-way dorsally as a pronounced downward-deflected prominence; basal shelf platelike, deflected posteroventrally.

Optic lobe large (Fig. 8), spherical; optic nerve branching pattern symmetric; optic nerve single,



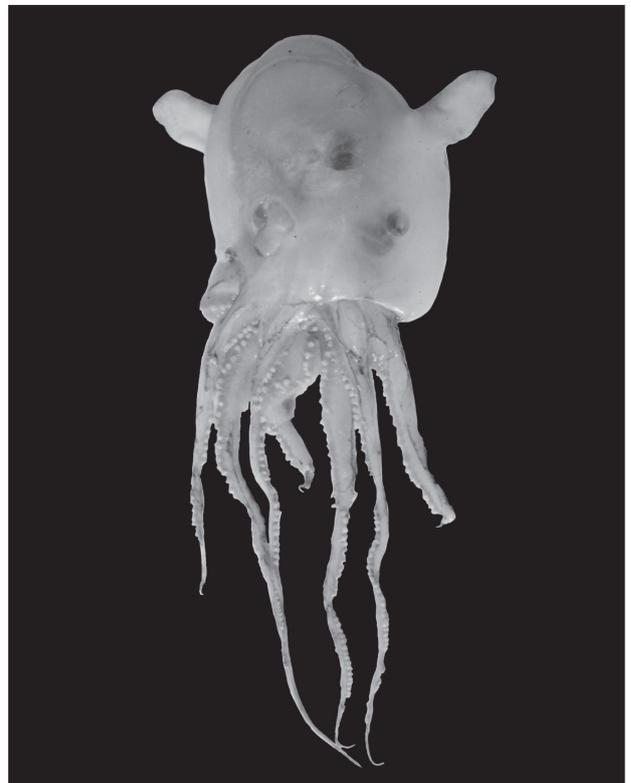
**Fig. 1.** *Luteuthis shuishi* sp. nov., dorsal view of fresh specimen.



**Fig. 2.** *Luteuthis shuishi* sp. nov., ventral view of fresh specimen.



**Fig. 3.** *Luteuthis shuishi* sp. nov., lateral view of fresh specimen.



**Fig. 4.** *Luteuthis dentatus* O'Shea, 1999, ventral view of fresh specimen (NZOI Stn Z9721).

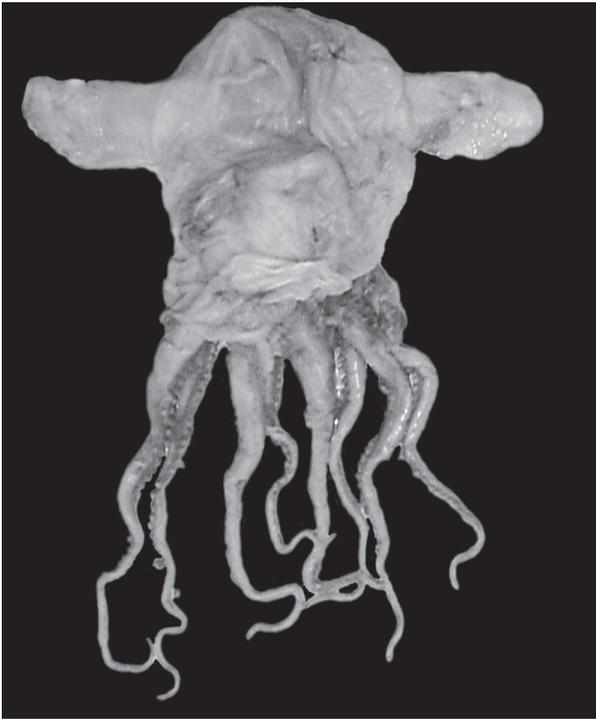


Fig. 5. *Luteuthis shuishi* sp. nov., dorsal view of preserved specimen.



Fig. 6. *Luteuthis shuishi* sp. nov., ventral view of preserved specimen.

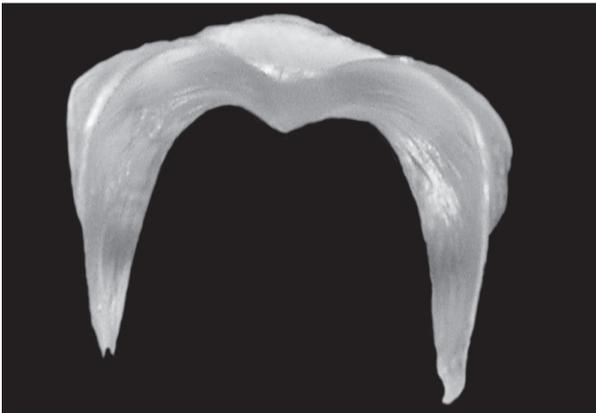


Fig. 7a. *Luteuthis shuishi* sp. nov., ventral view of shell.

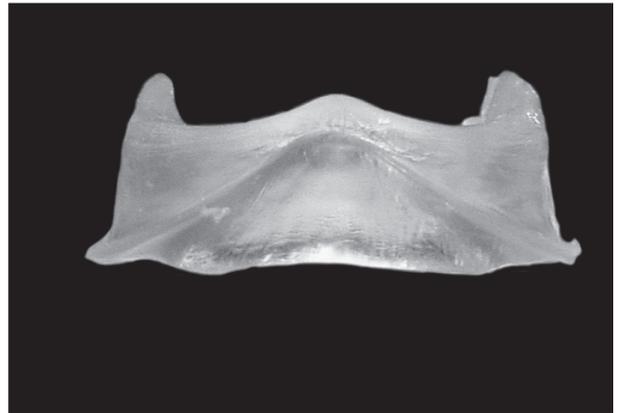


Fig. 7b. *Luteuthis shuishi* sp. nov., posterior view of shell.



Fig. 7c. *Luteuthis shuishi* sp. nov., dorsal view of shell.



Fig. 7d. *Luteuthis shuishi* sp. nov., lateral view of shell.

thick, with multiple small branches into back of eyeball; white body light brown, doughnut shaped. Viscera poorly preserved; distal oviduct and oviducal gland remaining. Eggs recovered free within the mantle cavity attaining dimensions of 17.8 long by 11.0 mm wide; 1 egg with smooth capsule present.

Buccal mass well preserved; radula present, well developed (Fig. 9); ribbon long, with about 46 transverse rows of teeth; each transverse row with 8 rows of long, narrow homodont teeth; central tooth with blunt tip and irregular sides;  $L_1$  thin, long, simple, and sharply pointed;  $L_2$  thicker than central tooth, with blunt-pointed tip;  $M_1$  thicker than  $L_2$  with irregular outer side and blunt tip, right  $M_2$  with simple sides and blunt tip; left  $M_2$  missing. Palatine teeth not apparent. Upper beak (Fig. 10a, b) tall; hood darkly pigmented, hood and lateral wall margins translucent; hood short; jaw with single pronounced tooth; rostrum slightly deflected downwards, with rounded tip. Lateral walls almost parallel sided, with square crest. Lower beak (Fig. 10c, d) tall (height 75% of width and 83% of base length), darkly

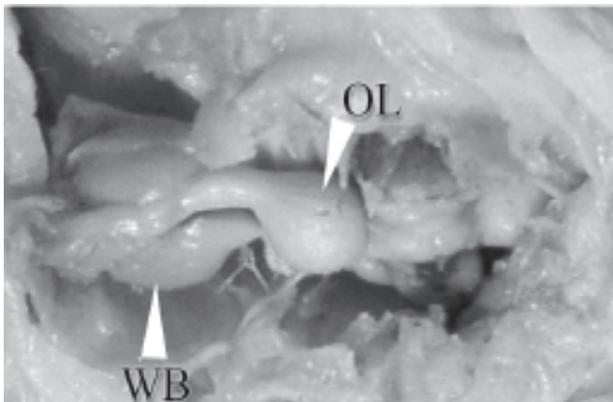


Fig. 8. *Luteuthis shuishi* sp. nov., left white body (WB) and left optic lobe (OL).

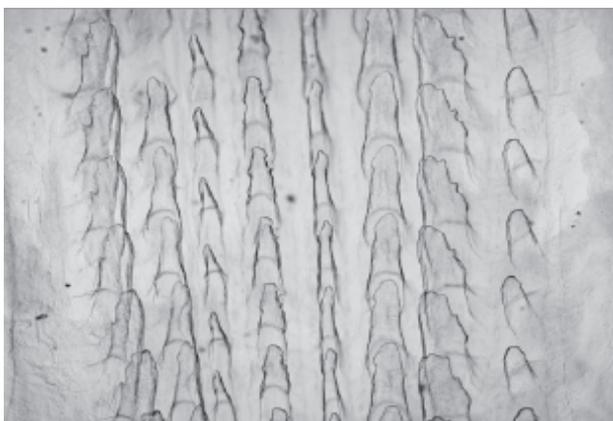


Fig. 9. *Luteuthis shuishi* sp. nov., radula.

pigmented, hood, lateral wall, and wing margins translucent; lateral wall with moderate notch and weakly convex crest; hood short, projecting forward rather weakly, posterior of hood with shallow notch; rostrum blunt; lateral wings very long, with 1 weak fold on each side, running from jaw angle to lower corner of lateral wall.

Raw measurements and counts for the holotype are presented in table 1.

**Etymology:** The specific epithet *shuishi* is taken from F.R.V. *Shui Shi I Hao* (FRV *Fishery Researcher No. 1*), the vessel that collected this unique specimen.

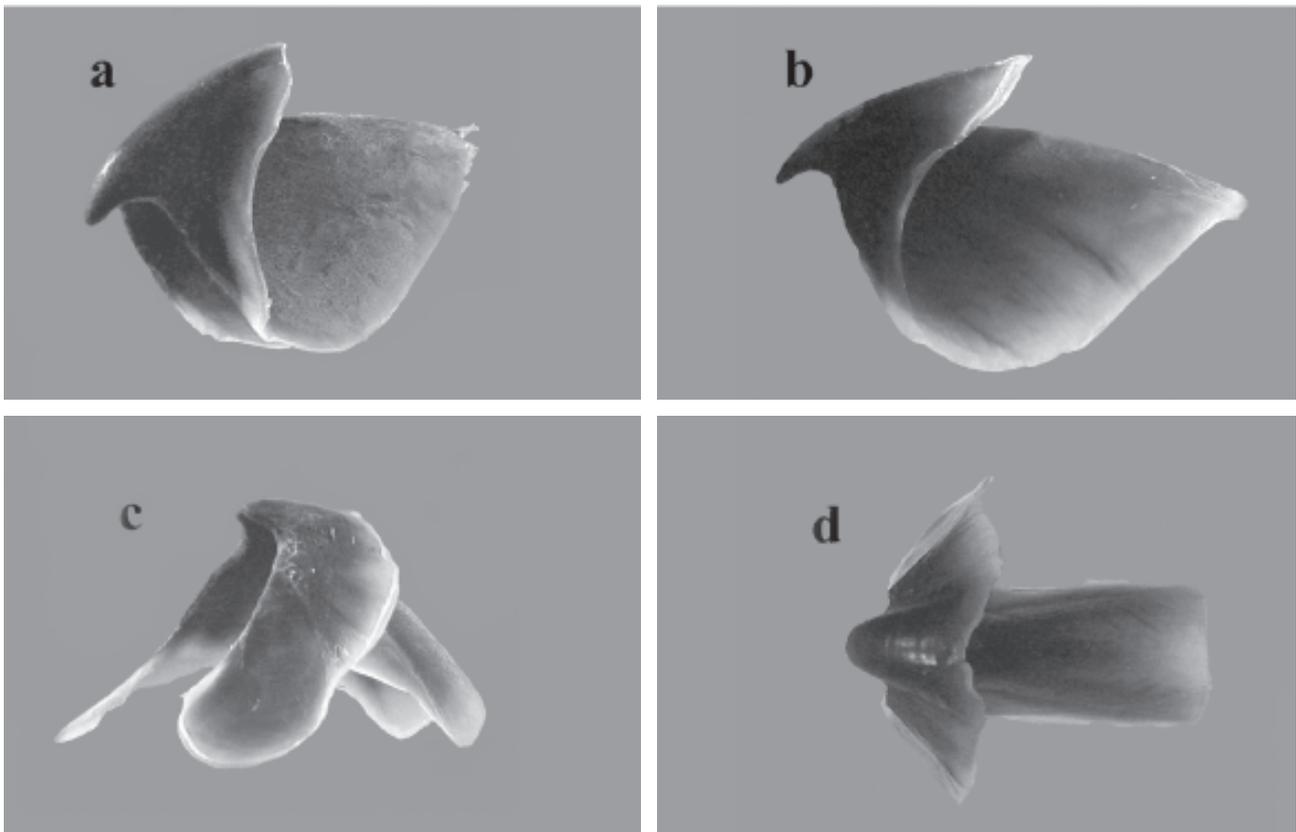
**Remarks:** Octopods are traditionally divided into the 2 suborders, Cirrata and Incirrata. Young (1989) proposed "Cirroctopoda" for Cirrata and "Octobranchia" for Incirrata. This usage was reinforced in Young (1997) and Boletzky (1999). However, R.E. Young and M. Vicchione (1996) had demonstrated the octopods to be monophyletic. In this paper we follow the traditional usage.

Only recently has the 2nd known specimen of the type species of this family and genus, *Luteuthis dentatus* O'Shea, 1999, been collected, fortunately enabling pre-fixed morphologies of both species to be presented (Figs. 1-5). Preservation artefacts in species of this genus are so severe that differentiating them on the basis of those indices cited as basic to cephalopod descriptions (Roper and Voss 1983) is dubious. Fresh-dead animals differ demonstrably in overall facies.

*Cirrothauma murrayi* Chun, 1911; *Grimpoteuthis* (sensu lato) *meangensis* Hoyle, 1885; *G. (s. l.) pacifica* Hoyle, 1885; *Opisthoteuthis albatrossi* (Sasaki, 1920); *O. japonica* Taki, 1962; *O. californiana* Berry, 1949; *O. depressa* Ijima and Ikeda, 1895; and *O. extensa* Thiele in Chun, 1915 are all known from the northwestern to Indo-Pacific region (see Voss 1988). Of these taxa, the lack of a lens on the eye, an iris, shell structure, presence of a secondary web, extreme cirrus length, and sucker modification immediately differentiate *Cirrothauma* from *Luteuthis*. Suckers of *G. (s.l.) pacifica* are described as having faint radial markings on them, but the animal is described as deep purplish-red, paler outside the umbrella and on the fin (Hoyle 1886: 62); body pigmentation differentiates these 2 species. Shell details differentiate *L. shuishi* sp. nov. from *G. (s.l.) meangensis*, although the largest New Guinea specimen may not be conspecific with the dissected smaller individual from the Kermadec Islands (for which the shell structure is known). Shell structure serves to differentiate *Luteuthis* from all species attributed to *Opisthoteuthis*.

**Table 1.** Raw measurements and counts of holotype of *Luteuthis shuishi* sp. nov. (\*denotes damage; R/L denotes right/left hand side)

Measurement/Count/ Formula	mm or count (#)		mm
Total length	371.0	Cirrus length - arm 1 R	1.5
Mantle length	87.5	Cirrus length - arm 2 R	1.1
Mantle width	130.0	Cirrus length - arm 3 R	1.0
Pallial aperture	30.0	Cirrus length - arm 4 R	1.5
Funnel length	25.5	Arm 1 sucker diameter R/L	3.9/4.0
Fin length outer	87.0	Arm 2 sucker diameter R/L	3.9/3.9
Fin length inner	95.0	Arm 3 sucker diameter R/L	3.9/3.9
Fin width	48.0	Arm 4 sucker diameter R/L	3.7/4.0
Eye orifice	8.0	Gill lamella count	—
Arm 1 length R/L	250*/238	Upper beak:	
Arm 2 length R/L	280/259	Rostral length	4.6
Arm 3 length R/L	278/244	Hood length	18.5
Arm 4 length R/L	223/242	Crest length	32.4
Right arm formula	?1.2.3.4	Shoulder length	12.6
Left arm formula	2.3.4.1	Lateral wall height	17.4
Web depth A	67.5	Lower beak:	
Web depth B R/L	53/60	Rostral length	3.6
Web depth C R/L	51/68	Hood length	9.4
Web depth D R/L	39/50	Crest length	23.4
Web depth E	30	Shoulder length	11.2
Web formula right	A.B.C.D.E	Lateral wall height	9.5
Web formula left	A=C.B.D.E	Wing length	20.0
Arm 1 sucker count R/L	#47*/35*	Beak height	19.2
Arm 2 sucker count R/L	#57*/44*	Beak base length	23.2
Arm 3 sucker count R/L	#46*/43*		
Arm 4 sucker count R/L	#36*/40*		

**Fig. 10.** *Luteuthis shuishi* sp. nov., a and b: upper beak; c and d: lower beak.

From *Luteuthis dentatus* (Fig. 6), *L. shuishi* differs in having shorter arms, a different pigmentation regime, and a mantle that attaches directly to the ventral surface of arms 4. Although much anatomical detail of *L. shuishi* cannot be determined, this species differs so significantly in morphology and shell detail from other locally known cirrate genera that re-identification should prove no problem.

A relationship between *Grimpoteuthis tuftsi* Voss and Percy and the New Zealand *Luteuthis dentatus* O'Shea, 1999 was proposed earlier (O'Shea 1999). Subsequent to this, a more-detailed examination of type material by one of us (O'Shea) indicated that the relationship is closer than previously recognized. We now consider that *Grimpoteuthis tuftsi* should be accommodated in the family Luteuthidae in a genus distinct from *Luteuthis*. We are, however, reluctant to describe such a novel genus in this contribution because of a lack of adequate comparative material. Regardless, the familial diagnosis of Luteuthidae proposed by O'Shea (1999) is amended to accommodate the non-bilobed nature of the digestive gland in *G. tuftsi*. *Luteuthis* can be differentiated from *G. tuftsi* on the bases of digestive gland morphology and general body pigmentation.

The sucker morphology of *Luteuthis* is similar to that described for *Cirroteuthopsis massyae* Grimpe, 1920, wherein the sucker aperture is described with some 23 radiating ridges, resembling shallow-pointed teeth (as *Cirroteuthis umbellata* Massy, 1909: 4, 5 [not Fischer, 1883]; Robson 1932: 160). The corresponding figure for *Luteuthis dentatus* has appreciably fewer ridges (10), although it is possible that the structures reported by Massy are not homologous with those of *Luteuthis*; *L. shuishi* sp. nov. has some 16-18 toothlike structures in the sucker aperture. The otherwise inadequate description of *Cirroteuthopsis* precludes further evaluation of its relationship to *Luteuthis* spp., or to the n. gen. *tuftsi*. The only other cirrate described with a radula, *Cirroteuthis macrope* Berry, 1911, was referred to *Vampyroteuthis infernalis* Chun (Pickford 1949); no other cirrate is known that possesses either radular or palatine teeth.

The combination of characters and character states of 8 well-developed rows of teeth, bilobed digestive gland, male reproductive system with accessory glands arranged in a linear sequence, crenulate sucker apertures, and an intestine shorter than or of equivalent length to the esophagus serves to differentiate *Luteuthis* from all other known cirrate genera. Despite this easy recognition, the systematic position of the Luteuthidae is problematic. The family possesses an interesting combination of char-

acters and character states. For instance, the intestine is shorter than, or of comparable length to the esophagus, and the optic lobe is spherical and the nerve single-character states common to Grimpoteuthidae and Cirroteuthidae. Yet species of *Luteuthis* have a bilobed digestive gland, a character state recognized only in some species of *Opisthoteuthis*. What differentiates the Luteuthidae from all other families is the combinations of the following characters or character states: possession of a well-developed radula (and palatine teeth in the type species of the genus), a W-shaped shell, sucker morphology, and the male reproductive system in which accessory glands are arranged in a linear series. Further evaluation of relationships among the Luteuthidae and other cirrate families would benefit from molecular analysis of tissues. Suitable tissue samples of the type species of *Luteuthis* are only now available to do this.

**Acknowledgments:** CCL wishes to thank Prof. I. C. Liao, Director of the Taiwan Fisheries Research Institute for the permission to attend the cruise, the skipper and crew of the *F.R.V. Shui Shi I Hao*, and the scientific crew on board for their assistance during the cruise. The support through various grants from the National Science Council of R.O.C which enabled CCL to participate in the cruise (NSC84-2311-B-178-005) and investigate the cephalopod fauna of Taiwanese and adjacent waters is gratefully acknowledged (NSC86-2311-B-110-001R, NSC87-2611-B-110-007, NSC88-2311-B-005-029). We wish to thank Dr. P. H. Ho of the National Museum of Marine Biology and Aquarium, Checheng, Pingtung, Taiwan, for providing the magnificent photographs of the fresh animal, and to Mr. W. S. Chung of the Department of Zoology, National Chung Hsing University for taking the preserved animal photographs as well as making the plates. We also like to thank Mr. Kwen Shen Lee, Collection Manager of the Invertebrate Section of the National Museum of Natural Science, Taichung, Taiwan who has patiently answered many queries and allowed us access to the collection. We must also thank the following individuals and organizations for their help: the Ministry of Fisheries Scientific Observer Programme (New Zealand) for collection of *Luteuthis dentatus* specimens; Bruce Marshall for access to the National Museum of New Zealand collections; and Mike Sweeney and Clyde Roper for access to the United States National Museum, Smithsonian Institution collections.

## REFERENCES

- Boletzky Sv. 1999. Brève mise au point sur la classification des céphalopodes actuels. B. Soc. Zool. Fr. **124**: 271-278.
- Fischer P. 1883. Note préliminaire sur une nouvelle espèce du genre *Cirroteuthis*. J. Conchyl. **31**: 402-404.
- Hoyle WE. 1886. Report on the Cephalopoda collected by the H.M.S. *Challenger* during the years 1873-1876. *Challenger Rept.* **16**: 1-245.
- Massy AL. 1909. The Cephalopoda dibranchiata of the coasts of Ireland. Sci. Invest. Fish. Ire. 1907, I: 1-39, 3 pls.
- Norman MD, CC Lu. 2000. Preliminary checklist of the cephalopods of the South China Sea. Special edition on the Biodiversity of the South China Sea. Raffles Bull. Zool. **Suppl. no. 8**: 539-567.
- O'Shea S. 1999. The marine fauna of New Zealand: Octopoda (Mollusca: Cephalopoda). Nat. Inst. Water Atmosph. Res. (NIWA) Biodivers. Mem. **112**: 1-280.
- Pickford GE. 1949. *Vampyroteuthis infernalis* Chun, an archaic dibranchiate cephalopod. Part 2. External anatomy. Dana Rept. **32**: 1-132.
- Robson GC. 1932. A monograph of the Recent Cephalopoda. Part 2. The Octopoda (excluding the Octopodinae). London: Brit. Mus. (Nat. Hist.). 359 pp.
- Roper CFE, GL Voss. 1983. Guidelines for taxonomic descriptions of cephalopod species. Mem. Nat. Mus. Vict. **44**: 49-63.
- Voss GL. 1988. The biogeography of the deep-sea Octopoda. Malacologia **29**: 295-307.
- Voss GL, WG Pearcy. 1990. Deep-water octopods (Mollusca: Cephalopoda: Octopoda) of the northeastern Pacific. Proc. Calif. Acad. Sci. **47**: 47-94.
- Young JZ. 1989. The angular acceleration receptor system of diverse cephalopods. Philos. T. Roy. Soc. B **325**: 189-238.
- Young JZ. 1997. The classification of octopods. Vie Milieu **47**: 177.
- Young RE, M Vecchione. 1996. Analysis of morphology to determine primary sister-taxon relationships within coleoid cephalopods. Am. Malacol. Bull. **12**: 91-112.

## 南中國海一新種有鬚亞目章魚

Steve O'Shea<sup>1</sup> 盧重成<sup>2</sup>

本文描述採自南中國海屬於最近命名的 *Luteuthidae* 科、*Luteuthis* 屬的一新種有鬚亞目章魚 *Luteuthis shuishi*。其所屬的科、屬原只採自西南太平洋。本文亦描述本種及該屬模式種 *L. dentatus* O'Shea, 1999 年新鮮標本的形態。*Luteuthis* 屬與 *Grimptoteuthis tuftisi* Voss and Pearcy, 1990 之間的關係亦予考慮。我們建議 *G. tuftisi* 應歸屬於 *Luteuthidae* 科，但由於缺乏適當的比較材料，我們在此不正式描述新屬。本文亦修正、補充原來的科、屬的定義。

**關鍵詞：**有鬚亞目章魚，盧氏蛸屬，葛氏蛸屬，面蛸屬，分類。

<sup>1</sup>National Institute of Water and Atmospheric Research, Wellington, New Zealand

<sup>2</sup>國立中興大學動物學系