

## ***Centropyge abei*, a new species of deep-dwelling angelfish (Pomacanthidae) from Sulawesi, Indonesia**

Gerald R. Allen<sup>1</sup>, Forrest Young<sup>2</sup> and Patrick L. Colin<sup>3</sup>

1) Western Australian Museum, Perth, Australia; mailing address: 1 Dreyer Road, Roleystone, WA 6111, Australia.

2) 10602 7<sup>th</sup> Avenue Gulf, Marathon, Florida 33050, USA.

3) Coral Reef Research Foundation, Box 1765, Koror, PW 96940, Palau.

Accepted: 30.01.06

### **Keywords**

Taxonomy, marine fishes, *Centropyge*, new species, Pomacanthidae, Indonesia

### **Abstract**

A new species of pomacanthid fish, *Centropyge abei*, is described from a single specimen, 90.8 mm SL, collected from a depth of 120 m during deep diving operations off Manado, Sulawesi in Indonesia during April 2005. It was also observed in similar habitat at Palau between 110-155 m using a research submersible.

The combination of morphological features that include large scales (43-45 in lateral row from upper opercle to caudal fin base), 3-4 preopercular spines, a relatively narrow supracleithrum with pronounced serrae on its posterior upper margin, serrate interoperculum, and a posterior margin of the preorbital bone that is attached and hidden by skin and scales serve to distinguish it from all known angelfishes, although it appears to be a modified *Centropyge*. Moreover, its distinctive colour pattern consisting of an extensive black area on the back and dorsal fin that grades to yellow on the side, white bar behind the head, and white caudal fin, is unlike that of any known species in the family.

### **Zusammenfassung**

Beschrieben wird die neue Kaiserfischart *Centropyge abei* nach einem einzelnen Exemplar mit 90,8 mm SL, das in einer Tiefe von 120 Metern bei Tieftauchgängen vor Manado, Sulawesi, in Indonesien im April 2005 gefangen wurde. Weitere Exemplare konnten in einem ähnlichen Habitat bei Palau in einer Tiefe von 110 bis 155 Metern von einem Forschungstauchboot aus beobachtet werden. Große Schuppen (43-45 in einer seitlichen Reihe vom oberen Operculum bis zur Schwanzflossenbasis), 3-4 Präoperculum-Stacheln, ein relativ schmales Supracleithrum mit deutlichen Sägezähnen am hinteren oberen Rand, ein gesägtes Interoperculum sowie ein Hinterrand des Präorbitalknochens, den anheftende Haut und Schuppen verdecken – das sind Merkmale, die insgesamt diese neue Art von allen anderen Kaiserfischen unterscheiden, wobei sie schon als zu *Centropyge* gehörig erscheint. Auch die einzigari-

tige Farbgebung unterscheidet sich von allen anderen Angehörigen der Familie: eine ausgedehnte schwarze Fläche am Rücken und auf der Rückenflosse, das an der Seite in einen Gelbton übergeht, ein weißer Streifen hinter dem Kopf und weiße Schwanzflosse.

### **Résumé**

On décrit une nouvelle espèce de Pomacanthidé, *Centropyge abei* à partir d'un seul spécimen, d'une LS de 90,8 mm, collecté à une profondeur de 120 m au cours de plongées profondes au large de Manado, Sulawesi, en Indonésie, au mois d'avril 2005. Cette espèce a aussi été observée, dans un habitat similaire, à Palau, entre 110 et 155 m, à l'aide d'un sous-marin de recherche.

Une combinaison de caractéristiques morphologiques: de larges écailles (43 - 45 sur le rang horizontal du haut de l'opercule à la base de la caudale), 3 - 4 rayons dors préoperculaires, un supercleithrum relativement étroit avec des dentelures prononcées sur la marge supérieure postérieure, un interopercule dentelé et une marge postérieure de l'os préorbital qui est fixée et cachée par la peau et les écailles, aident à le distinguer de tous les poissons-anges, même si elle ressemble à un *Centropyge* altéré. En outre, son patron de coloration caractéristique: une large zone noire sur le dos et la dorsale qui devient jaune sur le flanc, une barre blanche derrière la tête et une caudale blanche, ne ressemble à aucun de ceux d'espèces connues dans la famille.

### **Sommario**

Una nuova specie di pomacantide, *Centropyge abei*, è descritta sulla base di un singolo esemplare di 90.8 mm SL, raccolto a 120 m di profondità durante immersioni profonde al largo di Manado, Sulawesi in Indonesia nell'Aprile 2005. E' stato anche osservato in un habitat simile a Palau a profondità di 110-155 m utilizzando un sottomarino da ricerca. La combinazione di tratti morfologici che includono larghe scaglie (43-45 in linea laterale dall'opercolo superiore alla base della pinna caudale), 3-4 spine preopercolari, un supracleithrum relativamente stretto con pronunciate dentellature sul suo margine superiore, interopercolo seghettato, e margine posteriore dell'osso preopercolare attaccato e

nascosto dalla pelle e dalle scaglie, servono a distinguerlo da tutti gli altri pesci angelo, sebbene appaia un *Centropyge* modificato. Inoltre, la distinta colorazione consistente in un'estesa area nera sul dorso e sulla pinna dorsale che degrada nel giallo sui fianchi, una barra bianca dietro la testa e una pinna caudale bianca risulta diversa da tutte le specie note della famiglia.

### Introduction

Angelfishes of the family Pomacanthidae are among the most conspicuous inhabitants of coral reefs, occurring in both shallow and relatively deep water. Allen *et al.* (1998) reviewed the family, recognizing 83 species worldwide, including 70 from the Indo-Pacific region. A more recent (2003) treatment of the group by Debelius *et al.* recognized 75 Indo-Pacific species, including 28 Indo-Pacific members of the genus *Centropyge* Kemp, 1860.

The present paper describes a new species of deep-dwelling angelfish that is provisionally assigned to the genus *Centropyge*. It was first sighted during submersible dives along the outer slope of Palau in 2001 by the third author. A single specimen, described herein, was subsequently collected during a series of deep rebreather scuba dives by the second author off Manado, Sulawesi in Indonesia during April 2005. Although the primary goal of this expedition, to locate and film a recently described coelacanth, was unsuccessful, several valuable collections of small reef fishes were obtained.

### Materials and Methods

The specimen of the new angelfish was obtained with the aid of mixed gas, re-breather scuba equipment allowing dives to working depths of approximately 150 m. A mild anaesthetic, quinaldine sulphate, was used to partially narcotise fish specimens prior to capture with a hand net.

Standard length (SL) was measured from the front of the upper lip to the base of the caudal fin (end of hypural plate). Total length (TL) was measured from the front of the upper lip to the tip of the longest caudal fin ray. The head length was taken from the front of the upper lip to the end of the opercular membrane. The depth was measured just in front of the anal fin to the extreme base of the dorsal spines. The length of the caudal peduncle was measured horizontally from a vertical at the rear base of the anal fin to the caudal fin base. Measurements of the dorsal and anal spines and soft rays were made from the distal tips to the extreme bases of these elements (aided by x-ray). A radiograph was employed to examine various osteological features. The upper limb gill raker count is given first; the raker at the angle is included in the lower limb count.

Proportional measurements expressed in thousandths of the standard length are provided in parenthesis in the description that appears below. The holotype – and only known specimen – is deposited at Pusat Penelitian dan Pengembangan Oseanologi, Jakarta, Indonesia (NCIP).

## *Centropyge abei* n. sp.

(Figs 1-2)

**Holotype:** NCIP 6305, 90.8 mm SL, south-east side of Manado Tua (approximately 01°6.2040'S, 124°7.1222'E), Sulawesi, Indonesia, 120 m, collected with quinaldine and hand net by F. Young, 27 April 2005.

### Diagnosis

A species of the pomacanthid genus *Centropyge* with the following combination of characters: dorsal rays XIII,17; anal rays III,18; pectoral rays 16; scales relatively large, 43-45 in lateral row from upper end of gill opening to base of caudal fin; lateral line with 37 scales, terminating below end of dorsal fin, but re-appearing on 7 scales of caudal peduncle; gill rakers on first arch 5 + 12; maximum body depth 1.6 in SL; preopercular spines 3 or 4; length of primary preopercular spine 2.0 in head length; teeth tricuspid, about 50-60 in outer row in each jaw; exposed margins of preorbital, interopercle, preopercle, subopercle, supracleithrum, and posttemporal bones serrate; posterior margin of preorbital bone attached and hidden by skin and scales; live coloration yellow with black upper third of back, dorsal fin, and upper part of head. A broad white bar immediately anterior to dorsal fin origin, extending to at least level of upper opercular margin. Caudal fin and peduncle white.

### Description

Dorsal rays XIII,17 (last divided to base); anal rays III,18 (last divided to base); pectoral rays 16 (upper two and lowermost unbranched); pelvic rays 1,5; transverse scale rows from upper end of gill opening to base of caudal fin 43-45; scale rows above lateral line to origin of dorsal fin 9; scale rows below lateral line to origin of anal fin about 20; lateral line in two sections, the anterior part extending from upper edge of gill cover to below level of posteriormost dorsal fin ray containing 37 scales and the posterior part containing 7 scales along middle of caudal peduncle; transverse scale rows on opercle 7;



**Fig. 1.** Freshly collected specimens of *Centropyge abei* n. sp., holotype, 90.8 mm SL, Manado Tua, Sulawesi, Indonesia. Photo by Kotaro Yoshimura.

gill rakers on first branchial arch 5 + 12, total rakers 17, the rakers short and stubby, much shorter than gill filaments; vertebrae 10 + 14.

Body ovate, the depth 1.6 (61.3 % of SL) in SL, and compressed, the maximum width 2.6 (21.4 % of SL) in depth; head length 3.2 (30.9 % of SL) in SL; dorsal profile of forehead relatively steep and straight, forming an angle of about 45 degrees to the horizontal; snout 2.6 (12.1 % of SL) in head length, diameter of orbit 3.1 (10.0 % of SL) in head length; interorbital space slightly convex, the least bony width 3.5 (8.8 % of SL) in head length; caudal peduncle much deeper than long, the least depth 2.2 (14.3 % of SL) in head length; length of caudal peduncle 6.0 (5.2 % of SL), in head length.

Mouth relatively small, terminal, the gape forming an angle of about 30 degrees to the horizontal, the maxilla reaching a vertical at about front of anterior nostril. Upper and lower lips about equal in size, broadly scaled

except anterior edges, their maximum width contained 2.8 in diameter of orbit. Teeth slender, elongate (the longest 4.6 in orbit), close-set, flexible, tricuspid (large central cusp notably longer than smaller lateral ones), in 5-6 rows in each jaw, about 50-60 in outer row of each jaw. No teeth on roof of mouth. Tongue short and broadly rounded.

Nostrils anterior to centre of eye, the posterior opening relatively large and ovate with thin, slightly raised rims; anterior nasal opening about one-fourth size of posterior one, in a membranous tube with a posterodorsal flap; Most head pores inconspicuous (due to dense covering of tiny scales) except for prominent pore just anterior to anterior nasal opening. Gill membranes narrowly attached to isthmus. Longest gill filament on first arch contained 1.9 times in orbit. Gill rakers short, the longest 15.1 in orbit.

Upper edge of opercle obtusely rounded, without a



**Fig. 2.** Close-up photograph of head of preserved holotype of *Centropyge abei* n. sp. Photo by G. Allen.



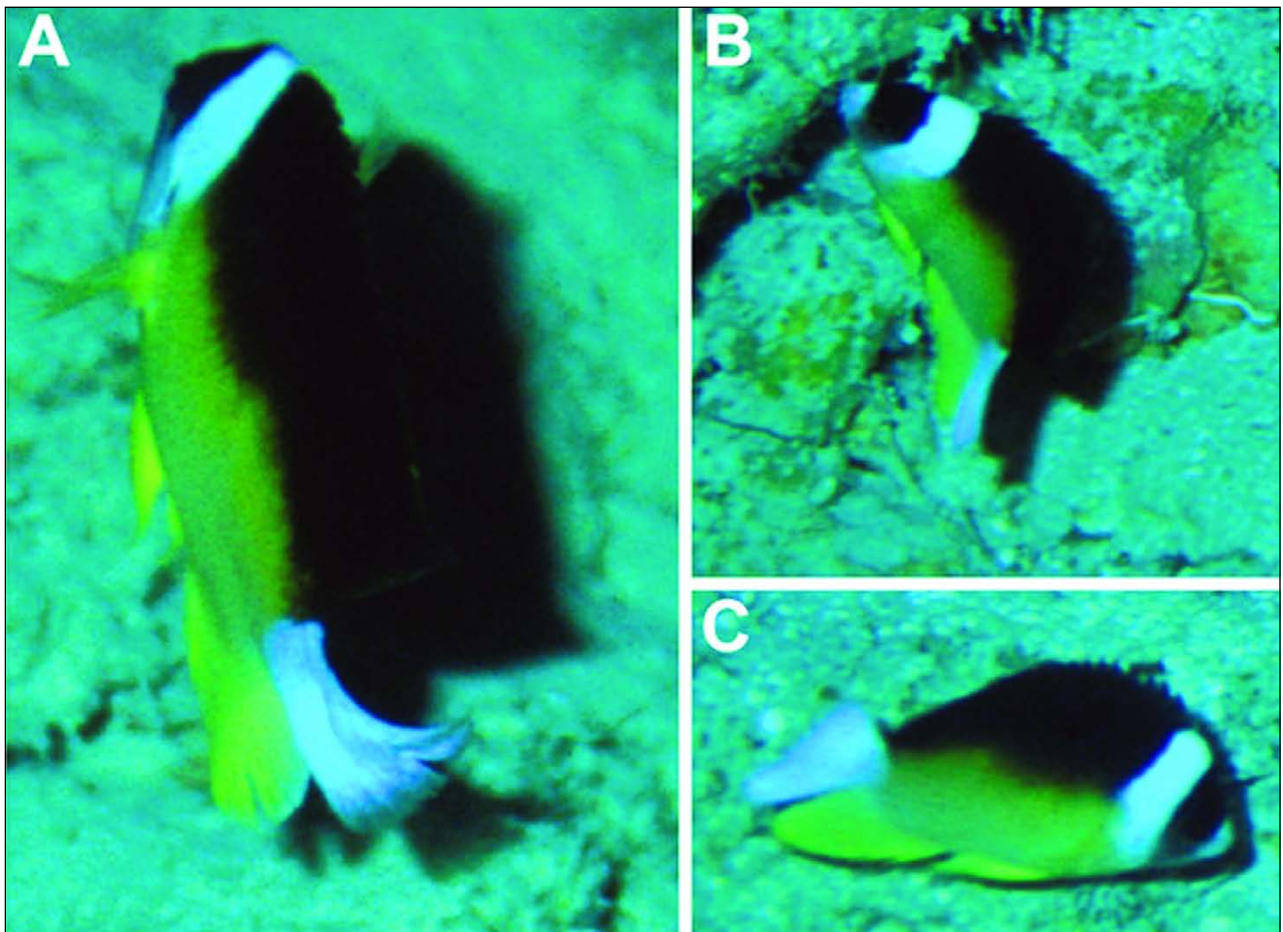
spine. A prominent large spine at corner of preopercle, longer than orbit, the spine length (measured along lower edge) contained 2.0 (15.3 % of SL) times in head length; a series of 2 (right side) or 3 smaller preopercle spines immediately below and anterior to primary spine, the largest (posteriormost) one-fourth (right side) to one-half length of primary spine; margin of preopercle with 23-25 serrae; anterior and ventral margins of preorbital with 5-9 serrae, the posterior margin attached and hidden by skin and scales; lower exposed margin of interopercle with 2-5 serrae; margin of subopercle with 12-13 serrae; exposed posterior margin of supracleithrum relatively narrow and covered with scales, its upper posterior edge with 10-13 serrae; posterior edge of posttemporal with 4-7 serrae.

Scales of body more or less arranged in regular transverse rows and coarsely ctenoid (up to 25 ctenii on exposed posterior margins); auxiliary scales mainly confined to lateral line and anteriormost portion of body; head fully scaled except anterior edges of lips; dorsal and anal fins scaled nearly to margins except anteriorly in spinous portion where fin membranes are deeply incised; caudal fin scaled nearly to posterior margin;

pectoral and pelvic fins densely scaled at base, with tiny scales extending on surface of rays (but not on membranes) nearly to posterior margin.

Lateral line relatively inconspicuous, its presence indicated by smaller scales (including tiny auxiliary scales), gently arching across back, originating at upper corner of gill opening and terminating below end of soft dorsal fin; additionally, 7 tubed scales midlaterally on caudal peduncle.

Caudal fin rounded, its length 1.2 (25.3 % of SL) in head length. Origin of dorsal fin slightly anterior to a vertical at upper end of gill opening. Dorsal spines progressively longer to last spine; first dorsal spine 2.7 (11.5 % of SL), second dorsal spine 2.1 (14.5 % of SL), third dorsal spine 1.9 (16.0 % of SL), all in head length; membranes between first eight dorsal spines and three anal spines deeply incised; posterior margin of soft portions of dorsal and anal fins angular, the longest dorsal and anal rays reaching as far posterior as level of middle of caudal fin, their length 1.5 (21.0 % of SL) and 1.4 (22.8 % of SL) respectively in head length; origin of anal fin below base of ninth or tenth dorsal spine; first anal spine 1.8 (15.5 % of SL), second anal spine 1.5 (20.7 %



**Fig. 3.** Underwater photographs of *Centropyge abei* n. sp., showing different swimming postures (A-C), approximately 12 cm TL, taken from *Deepworker* submersible at Palau in about 120 m depth. Photo by Coral Reef Research Foundation.

of SL), third anal spine 1.4 (21.4 % of SL), all in head length; pectoral fins relatively short and moderately pointed, reaching a vertical about equal to anal opening, their length 1.0 (30.2 % of SL) in head length; pelvic fin tips filamentous, nearly reaching to anal fin origin, their length 1.1 (28.9 % of SL) in head length; pelvic fin spine 1.5 (20.6 % of SL).

**Colour when fresh** (Fig. 1): lower two-thirds of body yellowish, grading to yellow-white ventrally; upper third of body dusky brown quickly grading to jet black, including dorsal fin; chalky white bar immediately anterior to dorsal fin origin, extending to level of uppermost opercle margin, its width equal to 1.0-1.3 eye diameter; upper portion of cheek charcoal, grading to black on upper part of head; lips, snout tip, lower part of head, interopercle, and opercle margin greyish white; opercle greyish white with black margin, most pronounced above pectoral fin base; pectoral, pelvic, and anal fins yellow; caudal fin and peduncle white.

Photos of live individuals taken from the submersible in Palau indicate a similar coloration with the following exceptions: 1. the snout and lips are paler (whitish); 2. the prominent white bar behind the head is broader and extends farther ventrally (to lower margin of preopercle); and 3. the dark pigmentation on the upper body is far more extensive, covering the entire upper half.

**Colour in alcohol:** most of body and lowermost part of head pale tannish; upper third of body and adjacent dorsal fin black, the coloration most intense on dorsal fin; head with dusky grey cheek, grading to black or charcoal on upper part of head; lips, interopercle, preopercle margin pale tan; opercle mainly pale tan with intense black margin on portion above pectoral fin base; distinctive white bar immediately anterior to dorsal fin origin, extending to level of uppermost opercle margin, its width about equal to eye diameter dorsally and about 1.3 eye diameter ventrally; all fins except dorsal yellowish tan.

### Remarks

The new species appears to be most closely related to the genus *Centropyge* to which it is provisionally assigned. However, it possesses several morphological peculiarities (discussed below) that are indicative of possible separate subgeneric status. We hesitate to describe it as a new subgenus in view of the current study of the familial classification by Richard Pyle of the Bishop Museum in Hawaii. Our specimen is currently being studied by Pyle and its ultimate generic status will be discussed by him in a future publication.

The genus *Centropyge* has been traditionally defined (see Weber and De Beaufort, 1936: 159; Fraser-Bruner, 1933) as relatively small angelfishes (usually < 10 cm SL) with the following combination of features: scales large, usually 50 or less in lateral row between upper operculum and caudal fin base, arranged in more or less regular transverse rows; interoperculum relatively small and serrate, remote from suboperculum; hindmar-

gin of preorbital free, prominently serrate or with strong spines; interorbital width equal to or less than eye; scales on operculum in five or fewer transverse rows.

The salient features of the new species include the following features that agree with the definition of *Centropyge*: a relatively small body size, small scales arranged in regular transverse rows, a relatively small, serrate interoperculum and the least interorbital width slightly narrower than eye diameter. However it differs from *Centropyge* in having an attached posterior margin of the preorbital and by its possession of seven transverse scale rows on the operculum. In addition, the colour pattern, particularly the broad white bar behind the head, is a feature that is absent in all other members of the genus. This marking is most prevalent in the genus *Chaetodontoplus*, which is also distinguished by very small scales (>85), spineless interoperculum, a broad interorbital that exceeds the eye diameter, and larger body size (usually >15 cm SL).

*Apolemichthys* is the only other generic possibility. Indeed, our first impression when viewing both the live fish underwater and photographs was that the new species belonged to this genus. The eight known members of this genus (Allen *et al.* 1998) have the same general body shape as the new species, similar sized scales and at least some of the species are known to frequent deep reefs in excess of 100 m. However, the new species differs in several key features that appear to preclude its inclusion, particularly the serrate interoperculum (smooth in *Apolemichthys*) and the multispined preoperculum (only one spine in *Apolemichthys*). In addition, radiograph evaluation of the new species indicates that it lacks two features which, according to Heemstra (1984: Figs. 1 and 3), appear to be uniquely derived homologous characters that may serve to distinguish *Apolemichthys* from related genera: namely, lateral expansion of the anterior 2-5 haemal spines (unmodified in *C. abei*) and a supracleithrum that is ovate or oblong with its rear edge exposed (relatively narrow with rear edge covered with large scales in *C. abei* as in other pomacanthids).

### Ecological observations

The type locality was situated in 120 m depth at the base of a 45 degree talus slope, on a general slope of 60-80 degrees that was occasionally interrupted by relatively flat plateaux. The bottom was primarily composed of variably sized rubble. The water temperature was 20-21 degrees C. The only other angelfishes seen (but not collected) at this depth were an unknown and possibly new species of *Genicanthus*, and *Centropyge tibicen*, normally a shallow reef dweller, which was common between 100-110 m.

The new species was seen on eight out of 40 submersible dives (Deepworker 2000) on the outer slope of Palau in 2001. Observations ranged between 110 and 155 m (365-515 ft) with water temperatures 17-22°C. The region is prone to rapid thermal changes of several

degrees C (Wolanski *et al.* 2002). The fish was immediately recognized as a new species on the basis of its distinct colour pattern, but since the submarine was not equipped to collect fishes, no attempt was made to capture a specimen. Still photos (and video footage) were obtained of the new fish, one of which is included as Fig. 3.

*Centropyge abei* was not common at Palau. It was seen on only eight of 40 dives within the depth range indicated in the previous paragraph. Never more than one pair was seen on a single dive, and it is likely that some of the observations on different days involved the same fish, as the dives were often made in the same locations. Either solitary individuals or pairs were observed. *Apolemichthys trimaculatus* was the only other pomacanthid seen at similar depths (110-125 m).

The Palauan habitat consisted of a very steep (60-80 degree) limestone slope with accumulations of reef limestone talus below about 120 m, forming small overhangs and crevices. The fish often sought shelter in such areas when the sub first approached, but would often re-emerge quickly and did not seem greatly disturbed by the presence of the sub and its lights within several meters. However, they fled to shelter when approached at closer range. The water was very clear and the ambient light was strong enough to clearly see the major substratum features, but it was quite dark beneath overhangs and in crevices. Currents were not strong in the areas, which had to be relatively sheltered in order for the submersible to operate safely.

The type locality (near Manado, Sulawesi) and Palau are separated by a distance of approximately 1,235 km. It likely *C. abei* is much more widespread, but due to the difficulties of sampling deep reef environments, its precise distribution remains unknown. The fish fauna of the deep reef or "twilight zone", lying between about 70-200 m is very poorly documented and holds promise for future discoveries. Limited observations suggest that numerous shallow water species penetrate to considerable depth, but the fauna also contains a wealth of undescribed deep-dwelling reef fishes.

### Etymology

The species is named *abei* in honour of Dr. Yoshitaka Abe, without whose faith, guidance and support, none of the work would have been possible. Dr. Abe is the director of Aquamarine Fukushima, a world class public aquarium in Fukushima Prefecture, Japan. He is largely responsible for many innovations in aquarium science and design including display of large tunas up to 100kg, jellyfish keeping, and the first public display of large hammerhead sharks. Aquamarine Fukushima and Dr. Abe provided the entire budget and material support for the deepwater operations that resulted in the collection of the new angelfish.

### Acknowledgements

We thank Masa Iwata for organizing the expedition

and providing financial support, Dr. Kasim Moosa for arranging for collecting permits and providing his wisdom and guidance. Ben Daughtry capably assisted on all the deep dives and assumed responsibility for the technical aspects, enabling Forrest Young to concentrate on fish collections. Captain Billy Deans managed surface operations and various aspects of diving safety. Heath Laetari, Kenichi Fuji, Kotaro Yoshimura and Larry Wright provided backup safety for the deep-diving team. Special thanks are due to Mark Erdmann for guiding us to suitable dive sites including potential coelacanth locations. Danny Charlton provided his dive facility that we used for an operational base.

Observations and photographs of the new angelfish were made possible in Palau through the charter of the Deepworker 2000 for activities associated with the US National Cancer Institute's shallow water marine collection and taxonomy contract (N02-CM-77249) to the Coral Reef Research Foundation. All CRRF submersible pilots (P. L. Colin, L. J. Bell, M. N. Dawson and L. E. Martin) contributed observations on the occurrence of this new fish.

Glenn Moore of the Western Australian Museum kindly provided a radiograph of the holotype of *C. abei*. Finally, we thank John E. Randall and Richard Pyle for critically reviewing the manuscript.

### References

- Allen, G. R., Steene, R. & M. Allen. 1998. *Guide to Angelfishes and Butterflyfishes*. Odyssey Press, San Diego.
- Debelius H., Tanaka, H. & R. H. Kuitert. 2003. *Angelfishes, A comprehensive Guide to Pomacanthidae*. TMC, Chorleywood, UK.
- Fraser-Brunner, A. 1933. A revision of the chaetodont fishes of the subfamily Pomacanthinae. *Proceedings of the Zoological Society of London* 1933 (part 3, no. 30): 543-599.
- Heemstra, P. C. 1984. *Apolemichthys kingi*, a new species of angelfish (Pomacanthidae) from South Africa, with comments on the classification of angelfishes and a checklist of the pomacanthids of the western Indian Ocean. J. L. B. Smith Institute of Ichthyology Special Publication No. 35: 1-17.
- Weber, M. & L. F. de Beaufort. 1936. *The fishes of the Indo-Australian Archipelago. VII. Perciformes (continued) families: Chaetodontidae, Toxotidae, Monodactylidae, Pempheridae, Kyphopsidae, Lutjanidae, Lobotidae, Sparidae, Nandidae, Sciaenidae, Malacanthidae, Cepolidae*. E. J. Brill Ltd., Leiden. Fish. Indo-Aust. Arch. v. 7: i-xvi + 1-607.
- Wolanski, E., P. L. Colin, J. Naithani, E. Deleersnijder & Y. Golbuu. 2004. Large amplitude, leaky, island-generated, internal waves around Palau, Micronesia. *Estuarine, Coastal and Shelf Science*, 60: 705-716.