

Egg capsule morphology of *Parascyllium variolatum* (Duméril, 1853) (Chondrichthyes; Parascylliidae), with notes on oviposition rate in captivity

J. CARUSO*† AND P. H. F. BOR‡

*Melbourne Aquarium, P. O. Box 479, Collins Street West, Melbourne, Victoria, 8007 Australia and ‡Lepelaarsoord 6, 2317 XK Leiden, The Netherlands

(Received 12 March 2006, Accepted 9 January 2007)

The egg capsule of *Parascyllium variolatum* is described for the first time, based on 57 eggs laid by three captive fish over a 167 day study period at Melbourne Aquarium. The egg capsule is bulbous, bearing two elongated horns. An indistinct or rudimentary third horn may be present. Aprons present; fibres present; small lateral fringes present. Notes on oviposition rates are also discussed and were shown to vary from 12 to 39 days with one or two eggs being deposited each time.

© 2007 The Authors

Journal compilation © 2007 The Fisheries Society of the British Isles

Key words: egg capsule morphology; oviposition rate; Parascylliidae; *Parascyllium variolatum*.

The Parascylliidae is a little-known group of sharks consisting of two genera (*Cirrhoscyllium* and *Parascyllium*) with at least seven species (Last & Stevens, 1994; Compagno, 2001; Goto, 2001; Goto & Last, 2002). The genus *Parascyllium* is comprised of four species; necklace carpet shark *Parascyllium variolatum* (Duméril, 1853), collared carpet shark *Parascyllium collare* Ramsay & Ogilby, 1888, rusty carpet shark *Parascyllium ferrugineum* McCulloch, 1911, and ginger carpet shark *Parascyllium sparsimaculatum* Goto & Last, 2002, all endemic to the waters around southern Australia. Over the years there has been much confusion over egg capsules relating to this genus and oviposition rates are presently unknown.

There have been egg capsules previously described as belonging to *Parascyllium* species and currently some of these old accounts are still used. Whitley (1938, 1940) explained that ‘some naturalists’ had ‘provisionally regarded’ a smooth egg capsule with tendrils as belonging to *P. collare*. It is likely, however, that this smooth egg capsule belonged to a catshark of the Scyliorhinidae. Whitley (1938, 1940) also described another egg capsule as possibly belonging to *Parascyllium*, and referred to it as a ‘laminated egg’. He later discovered that this

†Author to whom correspondence should be addressed. Tel.: +61 3 9923 5956; fax: +61 3 9620 0222; email: jcaruso@melbourneaquarium.com.au

'laminated' egg capsule belonged to a scyliorhinid shark; 'the Tasmanian swell shark (*Cephaloscyllium*)' (Whitley, 1944). Some authors, however, have continued to ascribe scyliorhinid egg capsules to *Parascyllum* spp., most notably *P. ferrugineum* and *Parascyllum multimaculatum* Scott, 1935 (= *P. ferrugineum*) (Coleman, 1980; Michael, 1993, 2001; Stevens, 1999; Compagno, 2001). To add to this confusion, Whitley (1938, 1940) also described 'an unusual kind of egg' as possibly belonging to the southern round skate *Irolita waitei* (McCulloch, 1911) (misspelt as *I. waitii*). Whitley's speculation over the origin of this egg capsule was resolved in 1944 when he illustrated an embryo found within a similar egg capsule. He identified the 4 inch (102 mm) embryo as 'a rusty catshark (*P. ferrugineum*)' (Whitley, 1944). Unfortunately, Whitley's 1944 discoveries were overlooked by successive authors and his original findings continued to be referenced. Hence, as a result of all this uncertainty and confusion, it is important that egg capsule descriptions of *Parascyllum* species are established. The objective of this study was to describe the egg capsule morphology and provide notes on the oviposition rate for *P. variolatum*.

For the purpose of this study, a total of 57 eggs (material: A 29281-001–A 29312-001, 53 egg capsules, Museum Victoria, Australia; private collection, four egg capsules, J. Caruso, Melbourne Aquarium, Australia) were collected from three *P. variolatum* housed at Melbourne Aquarium. In order to determine oviposition rates, each fish was given a code (Pv01, *c.* 695 mm total length, L_T ; Pv02, *c.* 720 mm L_T ; Pv03, *c.* 735 mm L_T : all measurements taken on 1 July 2003) and monitored during the study period of 5 May 2003 to 18 October 2003.

All eggs collected were placed in jars, dated, and preserved in a solution of 70% ethanol. After the measurements were taken, some egg capsules were preserved dry for comparative analysis with fresh capsules. All except one of the egg capsules were used for morphometric measurements (one egg was not measured due to irreparable damage). The length of an egg capsule did not include the horns or aprons. The width measured was maximum width, including lateral fringes. The depth was maximum depth (seven full eggs and one damaged egg were not measured for depth). Horns were measured in their natural position. All measurements were taken using a vernier digital 200 mm calliper and rounded to the nearest mm (Fig. 1).

Data on oviposition rates were recorded by visual and physical examinations of each individual's abdomen. Such examinations were not conducted every day, as the fish were not always visible or accessible. Visual examinations were made by observing the state of the abdomen. Swelling of this region was noted as signs of egg capsule development. If visual signals were present, the necklace carpet sharks were physically examined by hand, as developed egg capsules could be felt prior to oviposition.

One side of the egg capsule consists of a convex or bulbous surface. The opposite side consists of a flatter surface that is slightly convex. One end of the egg capsule bears an elongated horn that is usually twisted. The opposing end bears a shorter horn that is arched, with some horns possessing a slightly curved tip. Directly across from this short horn, an indistinct, or rudimentary, third horn may be present (Fig. 1). Small lateral fringes extend along the edges. Distinct anterior and posterior fields are present; aprons present at both ends. Weak longitudinal striations are present on both sides of the capsule (Fig. 2).

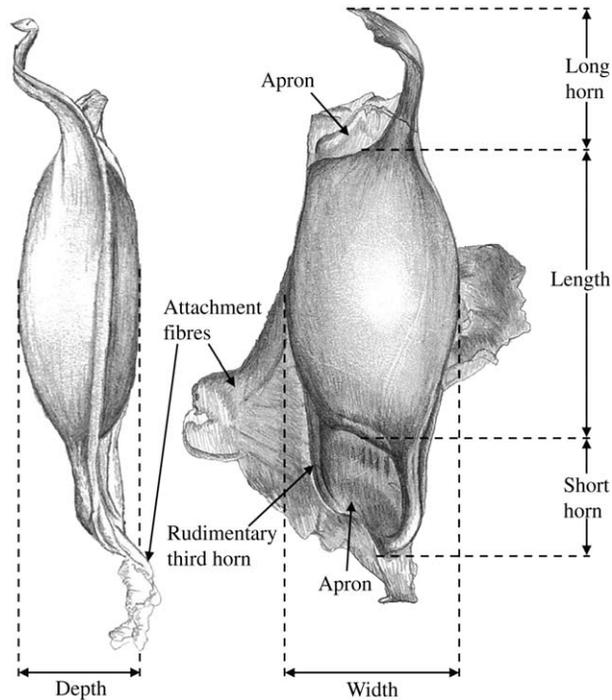


FIG. 1. Illustration of two fresh egg capsules showing morphometric measurements and terminology.

The egg capsule is coated with fine, thread-like fibres which are easier to see on dried specimens where they appear stringy along the surface and are arranged longitudinally. These longitudinal fibres are primarily attached along the bulbous surface. Attachment fibres form a mass, generally extending from the lateral edges and aprons (Fig. 1). The colour of fresh egg capsules is light golden to dark brown with fibres golden yellow. Dried specimens appear dark brown to black, with golden or mustard coloured fibres. Fresh egg capsules are thin and appear slightly translucent when held up to a bright light, with the capsule being flexible yet tough. Dried egg capsules are thin, brittle and translucent when held up to a bright light (with fibres removed).

The egg capsules measured 50–63 mm (mean \pm s.d. = 56 ± 3 mm) in length and 33–38 mm (mean \pm s.d. = 35 ± 1 mm) in width. The length of the short horn was 17–24 mm (mean \pm s.d. = 20 ± 2 mm) and the long horn 22–37 mm (mean \pm s.d. = 29 ± 3 mm). The depth measured 21–26 mm (mean \pm s.d. = 24 ± 1 mm).

Oviposition rates were found to vary from 12 to 39 days. The eggs (one or two), were deposited each time during the night, although there may have been one or two occasions when an egg was deposited during the day. The oviposition rates of each fish were quite consistent, with the exception of the 39 day interval of Pv01 (see Table I). It appears that there may have been a temporary pause or interruption during egg capsule production, as there were no other instances of such a large interval period. The actual cause of this 'interruption' was unknown (Table I).

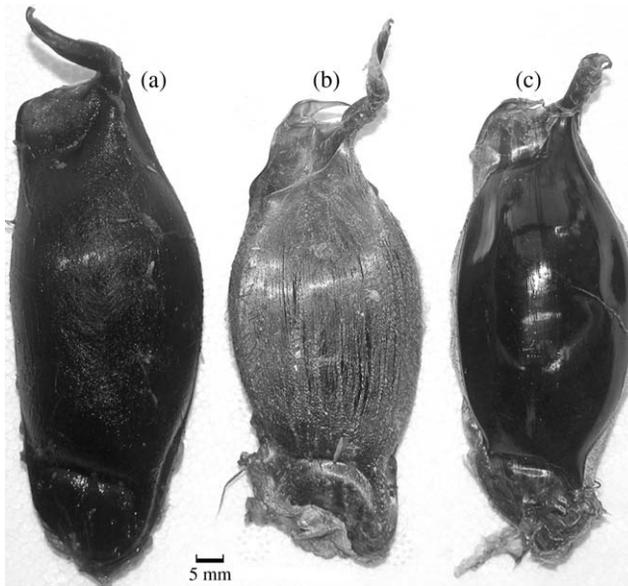


FIG. 2. Egg capsules of *Parascyllium variolatum*. (a) Fresh egg capsule, (b) dried egg capsule with fibres and (c) dried egg capsule with fibres removed.

It is unclear when 11 eggs were deposited, or which of the fish laid them. As a result, these egg capsules were not included in Table I.

Swelling of the abdominal region was the first noticeable sign that eggs were being developed. In addition, the fish often developed an arch along their dorsal surface. The arch was present in the area above the pectoral fin bases and across to the cloaca. It was found to be quite prominent at times and most noticeable when the fish were resting. It also varied depending on the individual. Once fully developed, egg capsules could be distinctly felt prior to oviposition. Around this time, indentations could occasionally be seen on the fish, particularly when a pair of eggs were being developed. They appeared to be caused by the position of the egg capsules bulging outwards within the uterus, as eggs could be felt posterior to the indentations. The location of the indentations were approximately halfway between the posterior edge of the pectoral

TABLE I. Oviposition rates for Pv01, Pv02 and Pv03 from first known date of oviposition

Pv01	Period between oviposition (days)	27 May 2003	16	16	12	39	12	15	15	14	
	Number of eggs	2	1	1	2	1	1	1	1	2	
Pv02	Period between oviposition (days)	28 May 2003	18	14	15	16	17	14	16	16	14
	Number of eggs	2	2	2	2	2	2	1	1	2	2
Pv03	Period between oviposition (days)	17 June 2003	20	16	17	15/16*	14/16*	18/19*	17		
	Number of eggs	2	2	2	2	1/1	1/1	1/1	2		

*Subsequent intervals were determined from when the second egg was deposited.

fins and base of the pelvic fins and was most noticeable on Pv03 (Fig. 3). Swelling subsided following oviposition and the abdomen was often soft and tender upon touch.

Results from this study illustrate that the egg capsule of *P. variolatum* is quite distinctive with its bulbous appearance and its curved and twisted horns. It seems almost impossible to confuse it with any other known Chondrichthyan egg capsule, except perhaps other *Parascyllium* species.

It is now recognized that the egg capsule initially described by Whitley (1938, 1940) and originally assigned to the southern round skate, did in fact belong to a *Parascyllium* species, possibly *P. variolatum*. Furthermore, it is now clear that *P. variolatum* does not produce egg capsules with tendrils. The confusion that arose due to Whitley's original findings in 1938, were later resolved in 1944 when he corrected his original comments over the origin of the egg capsules in question. Whitley's (1944) article, however, appears to have been largely overlooked and as a result, his original descriptions have continued to be cited.

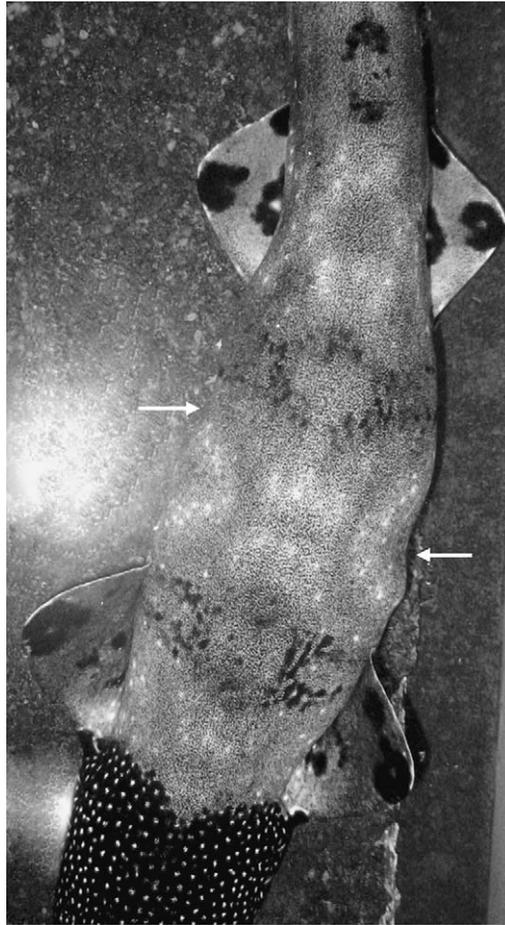


FIG. 3. Specimen Pv03 showing indentations of the abdomen (—>) 1 day before laying two eggs.

Based on Whitley's (1944) findings and the findings of this study, it is probable that egg capsules from *P. variolatum* and *P. ferrugineum*, are quite similar in morphology. Given the current lack of information regarding this genus, it is important that in future, formal egg capsule descriptions of *Parascyllium* species be sought after. If *Parascyllium* egg capsules can be correctly identified and assigned to a single species, it may be possible to gather useful and important life-history information on this little-known genus.

We are indebted to A. Schot for valuable comments on the earlier versions of the manuscript, and also to J. Denis (Melbourne Aquarium) for vital feedback, assistance in editing this paper and providing the illustrations. We thank all staff at Melbourne Aquarium, in particular O. Elford for her assistance in collecting eggs, P. Eyre for his invaluable comments, and the curatorial staff for all of their assistance and support. We also thank M. van Oijen and K. Meath for their contributions to this paper.

References

- Coleman, N. (1980). *Australian Sea Fishes South of 30° S*. Sydney: Doubleday.
- Compagno, L. J. V. (2001). Sharks of the world. An annotated and illustrated catalogue of shark species known to date, Vol. 2. *FAO Species Catalogue for Fishery Purposes* **1** (Vol. 2).
- Goto, T. (2001). Comparative anatomy, phylogeny and cladistic classification of the order Orectolobiformes (Chondrichthyes, Elasmobranchii). *Memoirs of the Graduate School of Fisheries Sciences, Hokkaido University* **48**, 1–100.
- Goto, T. & Last, P. R. (2002). A new parascylliid species, *Parascyllium sparsimaculatum*, from Western Australia (Elasmobranchii: Orectolobiformes). *Ichthyological Research* **49**, 15–20.
- Last, P. R. & Stevens, J. D. (1994). *Sharks and Rays of Australia*. Melbourne: CSIRO.
- Michael, S. W. (1993). *Reef Sharks and Rays of the World. A Guide to their Identification, Behaviour, and Ecology*. Monterey, CA: Sea Challengers.
- Michael, S. W. (2001). *Aquarium Sharks & Rays. An Essential Guide to their Selection, Keeping, and Natural History*. Neptune City, NJ: T.F.H. Publications Inc.
- Stevens, J. D. (Ed.) (1999). *Sharks*, 2nd edn. Sydney: Weldon Owner.
- Whitley, G. P. (1938). The eggs of Australian sharks and rays. *Australian Museum Magazine* (September 30), 372–382.
- Whitley, G. P. (1940). *The Fishes of Australia*, Part 1. Sydney: Royal Zoological Society of New South Wales.
- Whitley, G. P. (1944). Interesting sharks' eggs. *Australian Museum Magazine* (August 1), 260–261.