FAUNA *of* AUSTRALIA

22. FAMILY CARETTOCHELYIDAE

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Pl. 3.9. ***Carettochelys insculpta*** (Carettochelyidae)**:** the pig-nosed turtle has a fleshy proboscis and large flippers, unlike other Australian freshwater turtles; it nests in sandbanks of rivers, northern Australia. [J. Cann]

DEFINITION AND GENERAL DESCRIPTION

The family Carettochelyidae is represented by a single extant genus and species *Carettochelys insculpta*, found only in northern Australia and southern New Guinea. *Carettochelys* is distinguished from other Australian freshwater turtles by the absence of epidermal scutes overlying the shell, which is covered instead with a continuous skin. The limbs are paddle-shaped, like those of sea turtles, and each bears two claws. The nostrils are at the anterior end of a prominent fleshy proboscis (Pl. 3.9), and give rise to the name pig-nosed turtle.

Although initially placed in the suborder Pleurodira, the side-necked turtles (Boulenger 1889, *Carettochelys* is now included in the superfamily Trionychoidea of the suborder Cryptodira (Ogilby 1907; Wermuth & Mertens 1961). It is the only extant freshwater cryptodire.

HISTORY OF DISCOVERY

Carettochelys was first described in 1886 by Dr E.P. Ramsay, from an incomplete specimen collected on the Strickland River, a tributary of the Fly River in Papua New Guinea (Waite 1905). The collectors, Walter Froggatt and Jas H. Shaw, were part of a Geographical Society of Australasia expedition. More complete specimens from this region have been described since (Waite 1905; Walther 1922).

This peculiar species generated great interest in Europe, and was often sought specifically by explorers and travellers visiting New Guinea *Carettochelys* (Boulenger 1914; de Rooij 1915, 1922; Schultze-Westrum 1963; Wermuth 1963; Cann 1974).

The existence of *Carettochelys* in northern Australia was not widely known until 1970 when a specimen from the Daly River was reported in the scientific literature (Cogger 1970; Peters 1970). Evidence of breeding populations dates back to 1918 when eggs from the East Alligator River were lodged with the Victorian Museum by P. Cahill (Georges, Choquenot, Coventry & Wellings 1989), but the presence of Aboriginal rock paintings of *Carettochelys* (Cann 1980; Dupe 1980), dating back more than 7000 years (Chaloupka pers. comm.), indicates that the species has been a long-term resident of northern Australia.

MORPHOLOGY AND PHYSIOLOGY

External Characteristics

Carettochelys is a heavy-bodied turtle, attaining about 55 cm in length (Cann 1978) and up to 22.5 kg in weight (Groombridge 1982). Its colour ranges from rich grey to grey-brown above and white, cream or yellowish below (Cogger 1992). The jaws are cream and a pale streak is present behind the eye. The carapace is elevated and rounded anteriorly, flattened laterally and has a strong median keel posteriorly. The shell is covered with a continuous skin, and epidermal scutes are absent. The fleshy, truncated, pig-like snout projects forward and downwards, its anterior and lateral surfaces are covered with tubercles and it is well-furrowed (Waite 1905; Pl. 3.9). The paddle-shaped forelimbs bear narrow crescentic scales on the rounded anterior edge. Only the first two digits are clawed and the remaining digits are strongly webbed to the tips (Ramsay 1886). The hindlegs are similar but shorter. Crescentic scales form a single line along the dorsal surface of the tail and decrease in size towards the tip. Prominent folds of skin extend laterally on each side from the undersurface of the tail across the thigh region and down the hind limbs (Pritchard 1979a).

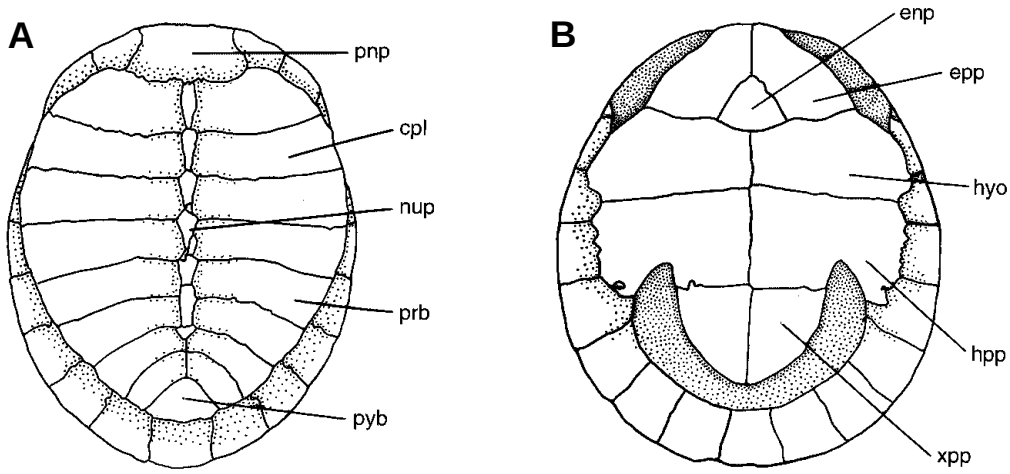

Figure 22.1 Elements of the shell of *Carettochelys insculpta* . **A**, carapace; **B**, plastron. **cpl**, costal plate; **enp**, entoplastron; **epp**, epiplastron; **hpp**, hypoplastron; **hyo**, hyoplastron; **nup**, neural plate; **pnp**, preneural plate; **prb**, peripheral bone; **pyb**, pygal bone; **xpp**, xiphyplastron. [J. Courtenay]

On emergence, hatchlings have well-formed, strong limbs, but the plastron and carapace are extremely soft (Georges & Rose in press). Loose flaps of skin along the periphery of the shell harden to form a serrated margin after about one week. Hatchlings have a tuberculate median keel. The poorly defined polygonal outline around each of these tubercles may be homologous with the scute seams of other turtles (Pritchard 1979a). These tubercles are lost as the turtle grows. Mature males have a larger tail than females of the same size.

Skeletal System

The morphology of the species was described by Ramsay (1886), Waite (1905) and Walther (1922). The large skull bears five to seven shields, the anterior and median pairs of which are fused (see Waite 1905 for further details). A characteristic, strong, lateral excavation of the robust lower jaw accommodates the insertion of the *pars superficialis* of the *m. adductor mandibulae externus* (Meylan 1988). The vertebrae are broad and the cervico-dorsal joint is double (Williams 1950). The nuchal bone of all carettochelyids has paired ventral processes just anterior to the prezygopophyses of the first thoracic vertebra, which simplifies identification of isolated nuchals in the fossil record (Meylan 1988).

The ten peripheral bones on each side of the shell are complete and well developed. The number of neural plates and their relationship to the costals is variable (Waite 1905; Longman 1913). The plastron is complete and lacks a median fontanelle. There are nine plastral elements. Several of these are not rigidly ossified together, but have cartilaginous connections which allow a certain amount of flexibility (Pritchard 1979a). The plates of the carapace, plastron and skull are covered with small, round rugosities or wavy irregular raised lines between shallow sculptures (hence *insculpta* = engraved), though these are clearly evident only in preserved specimens.

Reproduction

The eggs of *Carettochelys* are white, hard-shelled and almost round (Ramsay 1886), with a mean diameter of 38.7 ± 1.3 mm and a mean weight of 33.7 ± 3.5 g (Daly River; Webb, Choquenot & Whitehead 1986). The shells are extremely

hard compared to those of other chelonians, and are 0.39 ± 0.05 mm in thickness (Webb *et al*. 1986). The distinct shell membrane (0.067 ± 0.014 mm) is composed of four or five individual layers. The ultra-structure of the eggshell and membranes have been described in detail by Erben (1970). They account for about 16% of egg weight, and yolk and albumen each comprise about half of the remaining 84% (Webb *et al*. 1986).

Clutch sizes range from 7 to 19 in northern Australia (Webb *et al*. 1986; Georges 1987). Bimodal distributions of nesting dates provide strong evidence of multiple clutching, a conclusion supported by examination of reproductive tracts of three specimens dissected during the nesting season at Kikori, Papua New Guinea (Georges & Rose in press). There are no data to support a relationship between clutch size and adult body size, as is often the case in chelonians (Moll 1979), so it is not known how annual reproductive potential varies with size or age.

Embryology and Development

After 64 to 74 days at 30°C the embryos enter a period of diapause or aestivation within the egg (Webb *et al*. 1986). At onset of aestivation, metabolic rate decreases precipitously and embryonic growth ceases. Yolk is used during aestivation at a rate likely to exhaust supplies after about 59 days at 28° to 30°C. Incubation periods for 30 natural nests from the Kikori River of Papua New Guinea ranged from 86 to 102 days, at an average nest temperature of 31.6°C (Georges & Rose in press), suggesting that aestivation occurs in the field within this estimated limit of 59 days. Hatching can be stimulated experimentally by reducing oxygen availability, suggesting that in the field the stimulus is either the first rains of the season or flooding (Webb *et al*. 1986). The period of aestivation presumably ensures that hatching is timed to coincide with favourable environmental conditions. It may also be of adaptive value to hatch synchronously within nests, as development rates may vary considerably because of thermal gradients within nests (Georges 1992), or between nests, to satiate predators.

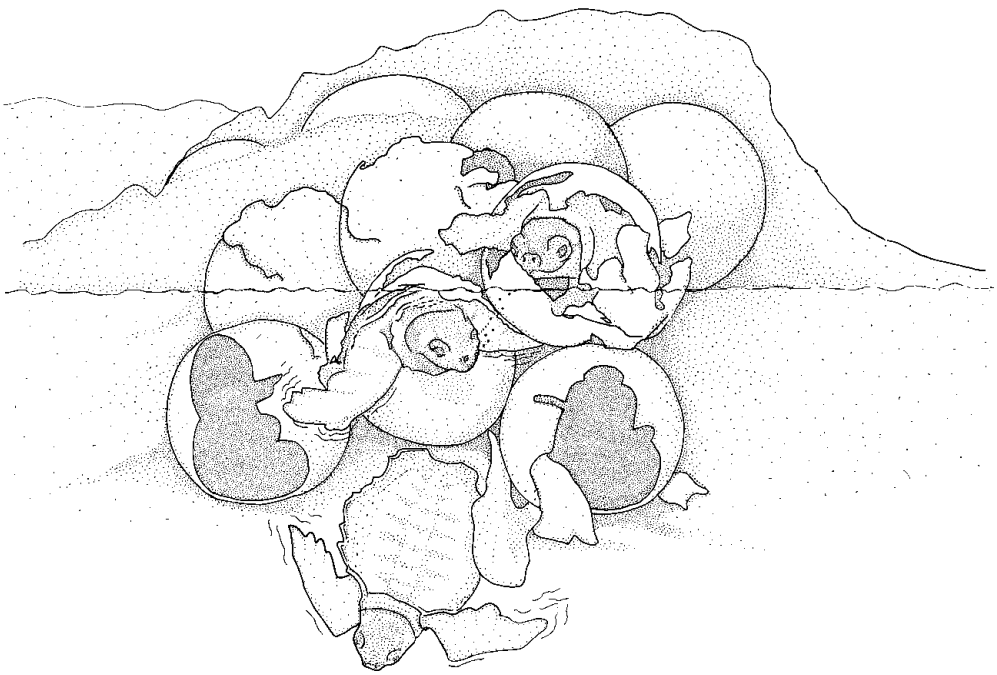

Figure 22.2 Nest site and emergent hatchlings of *Carettochelys insculpta*. Reduction of oxygen by rising floodwaters probably stimulates the eggs to hatch. (After ABC 1988) [J. Courtenay]

The hatchling sex ratio is influenced by incubation temperature both under constant laboratory conditions (Webb *et al.* 1986) and under fluctuating conditions in the field (Georges 1992). Embryos incubated at a constant 28° to 30°C become males whereas those incubated at 32°C become females (Webb *et al*. 1986). The laboratory threshold for sex determination lies somewhere between 30° and 32°C.

NATURAL HISTORY

Life History

Carettochelys was long considered one of the rarest turtles in the world (Groombridge 1982), but it is not certain whether this reputation reflects its remote distribution or its low population densities (Pritchard 1979a). Georges & Kennett (1989) found *Carettochelys* to be widespread between the tidal reaches and the head-waters of the South Alligator River, and that high densities of 33.8 ± 11.2 turtles/ha may be present in the upper reaches during the dry season. Although its distribution in Australia may be patchy, and in these terms it is rare, the species may be common locally in both Australia and Papua New Guinea (Brongersma 1958; Slater 1961; Cann 1974; Press 1986).

Little is known of the population dynamics of *C. insculpta*. Nests are subject to predation by monitor lizards and man (Cann 1974; Pernetta & Burgin 1980; Groombridge 1982; Press 1986; Georges & Kennett 1988). However, data on rates of recruitment to the breeding population or on survivorship of adult and subadult turtles are lacking, and the age at sexual maturity is unknown. Adult sex ratios are skewed in favour of females, a common trait in species with temperature dependent sex determination.

The nesting season in Australia extends between mid-August and early October in the Daly River and from mid-July to early November in the East and South Alligator rivers (Georges & Kennett 1989). *Carettochelys insculpta* nests upon sandy banks adjacent to water in the middle reaches and mouths of rivers, on sandy shores of islands in river deltas, and on coastal beaches. It prefers clear, fine sand adjacent to water, but also nests in mud and loams (Slater 1961; Rhodin & Rhodin 1977; Cann 1978; Pernetta & Burgin 1980; Webb *et al*. 1986; Georges & Kennett 1989).

Ecology

Carettochelys is known from the clear, shallow, continuously flowing waters of the Daly drainage (Cogger 1970; Cann 1972; Webb *et al*. 1986) and from billabongs and plunge pools of the South and East Alligator rivers (Legler 1980, 1982; Press 1986; Georges & Kennett 1989). There are no substantiated reports of *Carettochelys* from estuarine areas (Press 1986; Georges & Kennett 1989), unlike those for estuaries in Papua New Guinea (Groombridge 1982). The preferred substratum in the billabongs of the Alligator River region is sand and gravel, covered with a thin layer of fine silt and litter. Fallen trees and branches, undercut banks, exposed tree roots, and local accumulations of litter provide a diverse range of underwater cover for turtles. The banks of the billabongs are covered in a dense broadleafed forest, including the important turtle food, *Ficus racemosa*. The wet season habitat of *Carettochelys* in Australia is unknown.

Carettochelys is omnivorous. In the dry season, it feeds predominantly upon the fruits, seeds and leaves of a wide variety of riparian vegetation, including *Ficus racemosa*, *Syzygium forte* and *Pandanus aquaticus*, and mangroves (*Sonneratia* species) in both Australia and New Guinea. Aquatic plants, such as the eelweed *Valisneria* sp., the water nymph *Najas tenuifolia* and algae, are also eaten when available. Molluscs, crustaceans, fishes, and mammals are eaten, the last of

these presumably taken as carrion (Cogger 1970; Schodde, Mason & Wolfe 1972; Georges & Kennett 1989; Georges & Rose in press). The wide range of foods eaten provides great scope for opportunism, and the diet varies greatly between localities, according to the foods available.

Economic Significance

Carettochelys insculpta is highly prized as a food by the indigenous peoples within its range in New Guinea. In Australia, where turtles are regularly eaten by Aborigines, *Carettochelys* is favoured by some for its size and flavour (Schultze-Westrum 1963; Cann 1980; Press 1986). Georges & Kennett (1989) reported an annual take of 19 turtles by two Aboriginal families at Nourlangie Camp. Their traditional and current methods of capture were described by Georges & Kennett (1988). There are no reports of harvesting of the eggs of *Carettochelys* in Australia, unlike the situation in Papua New Guinea (Pernetta & Burgin 1980).

Carettochelys insculpta is listed by the IUCN (1991) as a threatened species in need of specific conservation measures. In Australia, *Carettochelys* benefits from State and Federal legislation prohibiting the exploitation of native fauna by all but Aboriginal peoples. However, such legislation does not protect the species from habitat destruction or modification. Within the Alligator rivers region of Kakadu National Park, feral water buffalo, *Bubalus bubalis*, can trample the sand banks and destroy nests (Georges & Kennett 1989). As a result, the species may have become much more restricted in its Australian distribution since the introduction of water buffalo (A. Carr in Pritchard 1979b). Water buffalo also forage on young plants and damage the bank structure of billabongs, thus destroying the riparian vegetation on which the turtles depend in the dry season for food. While this may initially benefit *Carettochelys* by increasing underwater cover afforded by fallen trees, branches and litter, it can only have long-term deleterious effects on the turtle populations. An intensive buffalo control program is now in place in the Park.

The catchment of the Daly River is largely unprotected and control of even the river banks and important riparian vegetation is largely in private hands. Urgent attention should be given to protecting the section of the Daly River corridor between Policeman's Crossing and the junction of the King River, and to protecting the riparian vegetation throughout the Daly drainage.

It is important to know more of the distribution, ecology and seasonal movements of *Carettochelys* in Australia in order to better assess the value of the two known major populations in the Daly River and the three Alligator rivers and their innumerable branches. Such information is also needed to assess the possible impact of proposed or potential development within catchments, and to judge the adequacy of existing reserves for protecting the species.

BIOGEOGRAPHY AND PHYLOGENY

Distribution

In northern Australia, *Carettochelys* occurs in the Daly (Cogger 1970; Cann 1972; Webb *et al*. 1986; Georges 1987), South Alligator (Schodde *et al*. 1972; Legler 1980, 1982; Georges & Kennett 1989), East Alligator (Georges *et al*. 1989) and Victoria drainages (Cogger 1992; Roberts pers. comm.). There are also anecdotal reports of the species from the Darwin, Adelaide, McKinlay and Roper rivers of the Northern Territory (Cann 1972; Bywater pers. comm.) and the Wenlock River on the west coast of Cape York Peninsula (K. Day pers. comm. in Webb *et al*. 1986).

Although a resident of Australia for many thousands of years, the absence of a fossil record in Australia, the lack of subspecific differentiation between the Australian and New Guinean populations, and the highly aquatic nature and estuarine tendencies of this species suggest that it is a relatively recent immigrant to Australia from New Guinea (Cogger & Heatwole 1981).

Carettochelys has been recorded from all the major rivers of Papua New Guinea east to the Vailala and from several of the southern flowing rivers of Irian Jaya (Georges & Rose in press).

Affinities with other Groups

Carettochelys has no close living relatives, and the debate over its affinities has been protracted (Walther 1922; Frair 1985; Meylan 1988). Current wisdom has it that the closest living relatives of the family are among the soft-shelled turtles of the family Trionychidae (Chen, Mao & Ling 1980; Frair 1983, 1985). The relationship of the Carettochelyidae to other extant chelonian families is shown in Figure 18.2.

Fossil Record

The family Carettochelyidae was widespread in the Tertiary, its distribution covering much of Laurasia by the Eocene (Meylan 1988). It was a diverse family with six genera in two subfamilies. *Allaeochelys*, *Carettochelys* and *Chorlakkichelys* form the Carettochelyinae; *Anosteira*, *Pseudanosteira* and *Kizylkumemys* form the Anosteirinae (Meylan 1988).

The fossil record from the Australasian region is confined to a single fragment of the nuchal bone and an associated external mould (Glaessner 1942). The fossil was collected from marine beds at the mouth of Mariana Creek, Vailala River, Papua New Guinea, and was dated as upper Miocene. A fossil fragment of plastron from the post-Miocene of Western Australia attributed to *Carettochelys* by Gorter & Nicoll (1978), on the basis of surface sculpturing, is apparently misidentified (Gaffney 1981).