

Chelodina burrungandjii Thomson, Kennett, and Georges 2000 – Sandstone Snake-Necked Turtle

SCOTT THOMSON^{1,4}, ROD KENNETT², ANTON TUCKER^{1,3}, NANCY N. FITZSIMMONS¹,
PHILLIPA FEATHERSTON¹, ERIKA A. ALACS¹, AND ARTHUR GEORGES¹

¹Institute for Applied Ecology, University of Canberra, ACT 2601, Australia
[arthur.georges@canberra.edu.au; nancy.fitzsimmons@canberra.edu.au;
pfeatherston@hotmail.com; erika.alacs@environment.gov.au];

²North Australian Indigenous Land and Sea Management Alliance (NAILSMA),
Charles Darwin University, Darwin NT 0909, Australia [Rod.Kennett@cdu.edu.au];

³Sea Turtle Conservation and Research, Mote Marine Laboratory,
1600 Ken Thompson Parkway, Sarasota, Florida 34236 USA [tucker@mote.org];

⁴Present Address: 700 Holly Street, Warren, Pennsylvania 16365 USA [scott.thomson321@gmail.com]

SUMMARY. – *Chelodina (Macrochelodina) burrungandjii*, the Sandstone Snake-necked Turtle (Family Chelidae), is a medium-sized turtle (carapace length to 316 mm) that occupies the sandstone plateaus and associated escarpments and plunge pools of Arnhem Land and the Kimberley Region of tropical northern Australia. First collected by scientists some 20 years ago, research on the species has been hampered by its isolation—its range is sparsely inhabited, rugged sandstone country. The species can be diagnosed by its broad and flattened skull and by the contact of the vomer and the pterygoids and shows marked differences in life history and ecology from its closest relative, *Chelodina rugosa*. These two species are found together in the rivers that drain the Arnhem Land Plateau, but are broadly parapatric, with *C. burrungandjii* occupying the streams and associated pools of the uplands and *C. rugosa* occupying the floodplains and billabongs of the lowlands. Where their distributions come in contact in the Arnhem Land region, there is evidence of hybridization and widespread introgression. This may also occur near the northern border of Western Australia and the Northern Territory but does not occur in the Kimberley Region, which is outside the range of *C. rugosa*. It is not known whether there will be adverse impacts on *C. burrungandjii* from the recent invasion of its range by the exotic and toxic cane toad, *Rhinella marina*, but its congener *C. rugosa* is reasonably susceptible to the toxins when administered experimentally. *Chelodina burrungandjii* is harvested by Aboriginal peoples throughout its range to varying degrees. The species is not considered to be threatened, though populations of this species are small, isolated, and potentially subject to risk from overharvest or collecting for trade, or toxicity from cane toad ingestion.

DISTRIBUTION. – Australia. Distributed on the sandstone plateaus and associated escarpments and plunge pools of Arnhem Land, Northern Territory, and disjunctly in the Kimberley Region of northern Western Australia.

SYNONYMY. – *Chelodina burrungandjii* Thomson, Kennett, and Georges 2000, *Macrochelodina burrungandjii*, *Chelodina (Macrochelodina) burrungandjii*, *Macrochelodina walloyarrina* McCord and Joseph-Ouni 2007.

SUBSPECIES. – None currently recognized.

STATUS. – IUCN 2011 Red List: Not listed; CITES: Not listed; Australian EPBC Act: Not Listed; Northern Territory PWC Act: Not listed.

Taxonomy. – *Chelodina burrungandjii* was described as a new species (Thomson et al. 2000) from an adult female collected by Rod Kennett in Koolpin Gorge, South Alligator River, Northern Territory (13°28'S, 132°38'E) on 6 September 1989 (Holotype: NTM 16010; Allotype: NTM 16011; adult male). The species first came to the attention of science during surveys of the Arnhem Land region by Grahame Webb in the early 1970s. Aboriginal people in the region are familiar with the turtle and have hunted it for food and ceremonial purposes for generations. The Gagadju people of Kakadu National Park recognize it as a distinct form in their language, referring to it as

“Burrungandji.” They distinguish it from “Almangiyi” (*Chelodina rugosa*), a common and closely-related species of the coastal floodplains (Lucas and Russell-Smith 1993). The Jawoyn people of the Katherine region (including Nitmiluk National Park and the southern sections of Kakadu National Park) refer to it as “Wurruyung” (Sandy Barraway, pers. comm.), but this name is used also to refer to *Chelodina rugosa*. Legler (1982) also, in an unpublished report, recognized the form as a new species, and its status as a distinct species was later confirmed by allozyme electrophoretic comparisons (Georges and Adams 1992; Georges et al. 2002).



Figure 1. A female *Chelodina burrungandjii* from the Kimberley Region of Western Australia. Note the extremely broad, flattened head that distinguishes the species from *C. rugosa*. Photo by Nancy FitzSimmons.

Similar specimens from the Kimberley region in northern Western Australia were subsequently described as a new species, *Macrochelodina walloyarrina*, by McCord and Joseph-Ouni (2007). Based on our analysis, the Arnhem Land and Kimberley forms are synonymous and identifiable as *C. burrungandjii*. Although some morphological characters distinguish the two (Thomson et al. 2000), the significance of such differences is difficult to interpret in allopatry, and the discovery of widespread introgression with *C. rugosa* (Alacs 2008) could potentially have caused morphological shifts in Arnhem Land that are not related to the normal processes of divergence of allopatric forms. We therefore consider separate specific or subspecific designation of the Kimberley form to be unwarranted at this stage, and include both the Kimberley and Arnhem

Land populations in *C. burrungandjii*. Extensive genetic studies are being conducted to clarify the situation.

Chelodina burrungandjii (Figs. 1, 2, 4) is most closely related to the Northern Snake-necked Turtle, *C. rugosa*. It belongs to a well-defined clade variously referred to as subgeneric group “B”, the *C. expansa* clade (Goode 1967; Burbidge et al. 1974; Rhodin and Mittermeier 1976), which includes described forms *C. expansa*, *C. rugosa* (including *C. siebenrocki*), and *C. parkeri*. *Macrochelodina* is an available name for this group (Wells and Wellington 1985; Iverson et al. 2001) and has recently been applied as a subgeneric group name under the genus *Chelodina* (Georges and Thomson 2010). This subgeneric group, *Chelodina* (*Macrochelodina*), is distinguished from a second subgeneric Group “A” clade (the *C. longicollis*



Figure 2. Dorsal and ventral view of the shell of *Chelodina burrungandjii* – females from the Kimberley of Western Australia. Note the proximity of the intergular to the margin of the plastron, which barely separates the gulars. Photos by Anton Tucker.

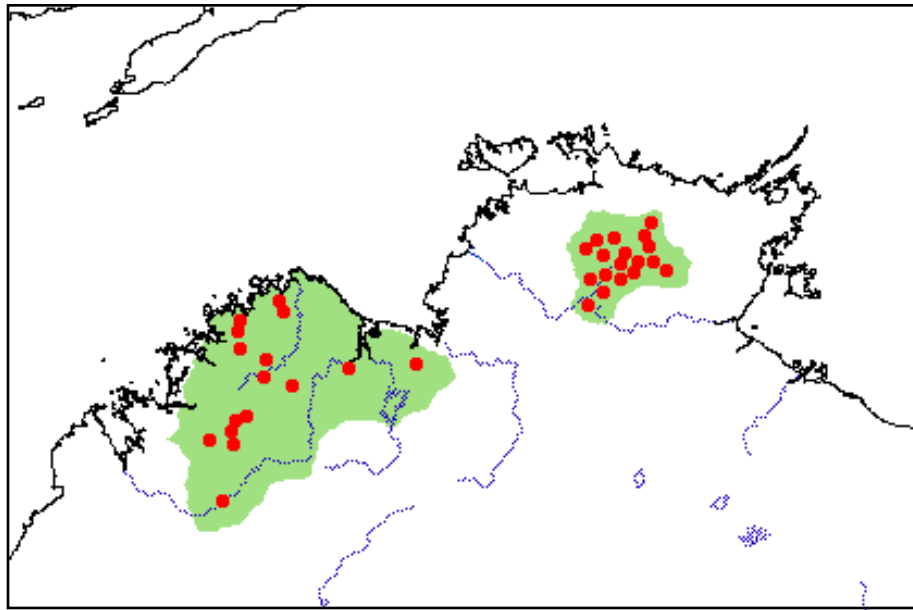


Figure 3. Distribution of *Chelodina burrungandjii* in northern Australia; the Arnhem Plateau is the disjunct area to the northeast, the Kimberley Region is to the southwest. Red dots = museum and literature occurrence records of native populations based on Iverson (1992) (partim, as *C. rugosa*), Thomson et al. (2000), and more recent and authors' data; green shading = projected distribution based on GIS-defined hydrologic unit compartments (HUCs) constructed around verified localities and then adding HUCs that connect known point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs (Buhlmann et al. 2009), and adjusted based on authors' data.

group) by their relatively longer, thicker necks, reduced plastra, broader heads, and a more attenuated mode of strike-and-gape feeding. The available name *Chelodina* has been applied to this second subgenus (Georges and Thomson 2010). *Chelodina colliei* (alternatively regarded by some as *C. oblonga*) (Thomson 2006; Turtle Taxonomy Working Group 2010) forms a third monotypic subgenus (Georges and Adams 1992; Georges et al. 1998; Georges et al. 2002) for which *Macrodiremys* (McCord and Joseph-Ouni 2007) has been rendered as a possible available name (Georges and Thomson 2010), though this remains in dispute (Kuchling 2010). *Chelodina* (*Macrochelodina*)



Figure 4. Head of *Chelodina burrungandjii* showing the stippling on the lower jaw (not diagnostic) and the prominent barbels found on many specimens. In some, the barbels form a series running along the lower surface of the lower jaw; this specimen has three pairs. Photo by Nancy FitzSimmons.

burrungandjii can be distinguished from other members of the subgenus by the distinctively shortened, broad, flat head. The oblong carapace and plastron in adults readily distinguishes this species from all other members of this group (Fig. 2) and the upward turning of the lateral marginals distinguishes it from *C. rugosa* and *C. parkeri*.

Description. — *Chelodina burrungandjii* is a medium to large snake-necked chelid turtle of up to ca. 316 mm carapace length (CL). The carapace is oblong and flared over the hind legs (Fig. 2). The widest point of the carapace is usually at marginal 8, and there is slight upturning of marginals 4–6. The scutes of the carapace are smooth but there is a fine reticulated pattern over the entire carapace. A wide cervical (nuchal) scute is usually present. The carapace is dark brown to black, occasionally brown with extensive darker mottling and striations.

The plastron is rectangular in general shape, in the sense that lines drawn to join the widest points of the anterior and posterior lobes of the plastron are roughly parallel (Fig. 2). The widest point of the anterior lobe occurs toward its posterior extent, whereas that of the posterior lobe occurs in the middle. The scutes of the plastron are smooth, despite a fine reticulate pattern in the underlying bone. The plastron and the ventral surfaces of the marginals are cream in color with no darkening of scute margins. They are commonly stained caramel brown to orange in larger, slower-growing individuals. The plastron is unusual among *Chelodina* in that the intergular is extremely wide. The most anterior point of the plastron, at the junction of the epiplastra, is not ossified. This causes the incomplete separation of the gular scutes and the encroachment of the intergular on the plastral margin in many specimens.



Figure 5. *Chelodina burrungandjii* occupies permanent billabongs and plunge pools of the sandstone plateau and associated escarpment of Arnhem Land (Northern Territory) and the Kimberley Region (Western Australia). Shown here is the Mann River, Northern Territory, where the species was first discovered by scientists. Photo by Arthur Georges.

The dorsal to mid-lateral surface of the head is covered with smooth, soft skin broken into numerous irregular uncornified scales of negligible relief, dark olive green to black in color, sometimes with fine black specks (Fig. 4). Eyes are chocolate brown with a gold, occasionally orange, ring bordering the pupil. Upper rhamphotheca are olive with light black flecks. Lower rhamphotheca are olive with numerous black/brown striations. Tympanum is light olive with dark mottling. Barbels are variable in number, typically two are prominent, but up to four run in a line along the inside edge of each lower jaw (Fig. 4).

Ventral surface of head and throat in adults is covered with loose granular skin. Granules beneath the head often line up to form striations radiating back from the apex of the chin. In most animals, the ventral surface of the head and neck is cream to white; in others, the granulations may be alternating gray and white to form a speckled pattern. The dorsal surface of the neck is dark olive green with dark mottling, which occasionally coalesces to black and is covered in small low blunt tubercles.

Dorsum of limbs and tail have similar coloration to dorsum of neck; ventral surface of limbs and tail are uniform cream with slight granulation. Crescent shaped scales on limbs are colored as per dorsum of limbs, even when extending onto the lighter latero-ventral surfaces.

The inguinal and axillary pockets are cream to white, typically unremarkable; rarely with heavy gray/mauve blotches evenly spaced and extending back from the sides of the neck. In juveniles, the speckled pattern of the ventral surfaces of the head and neck is usually absent. Instead, the ventral surface of neck and limbs are cream-colored, as are the inguinal and axillary pockets.

In many specimens, the intergular barely separates the gular shields to make contact with the anterior margin of the bony plastron – a small sliver of cartilage separates the intergular from the anterior margin of the plastron in these live specimens. The speckled neck coloration of *C. burrungandjii* does not occur in other Australian *Chelodina*, nor is it as pronounced as that seen in *C. parkeri*, a related species from New Guinea that has prominent head striping and a post-tympanic white patch (Rhodin and Mittermeier 1976; Pritchard 1979).

Unique among the members of the *Macrochelodina* subgenus is the presence of an expanded contiguous neural series (sensu Thomson and Georges 1996) of between three and five neurals, as observed in specimens from Arnhem Land. On the basis of this and other characters, the Kimberley form of *C. burrungandjii* has variously been regarded as a separate species from the Arnhem Land form (A. Rhodin, unpubl. data; Thomson et al. 2000). The paper describing the Kimberley form as a separate species (McCord and Joseph-Ouni 2007) is of uncertain status for nomenclatural purposes (the name may or may not be available) and the data therein have not undergone rigorous scientific peer review (the taxon may or may not be valid) (Kuchling 2010). As outlined above, we assign populations from both the Kimberley Region and Arnhem Land to *C. burrungandjii* in line with the classification and synonymies of Georges and Thomson (2010).

The largest recorded mature female from the Northern Territory had a CL of 271.3 mm and the largest mature male 220.2 mm (Thomson et al. 2000). The mean length of the five largest females was 250.9 ± 2.3 mm (SE) and of the five largest males was 211.3 ± 2.8 mm, so the species demonstrates sexual size dimorphism, as in other *Chelodina*. In the Kimberleys, the largest female was 316.1 mm and largest male was 263.2 mm; the mean length of five largest females was 311.0 ± 1.6 mm; mean length of five largest males was 255.8 ± 3.5 mm (Tucker and FitzSimmons, unpubl. data). Mature males also have longer, thicker tails than females, a character that develops with onset of sexual maturity, as in other chelid turtles (Georges 1983).

Distribution. — Australia, on the sandstone plateaus and associated escarpments and plunge pools of Arnhem Land, Northern Territory, and disjunctly in the Kimberley Region of northern Western Australia. Reported from the Wilton (Roper River drainage), Blyth-Cadel, Liverpool-Thompkinson, Mann, East and South Alligator, and Katherine (Daly River drainage) rivers of Arnhem Land, and the Victoria, Ord, Pentecost (including Durack R.), Drysdale, King Edward (including Carson R.), Mitchell, Isdell, and Fitzroy drainages of the Kimberley Region.

Habitat and Ecology. — *Chelodina burrungandjii* occupies permanent freshwater habitats ranging from pools in rocky sandstone gorges on and at the base of escarpments (Fig. 5), to more open riverine and billabong habitats with fringing riparian vegetation (e.g. *Pandanus aquaticus*) and often with dense submergent and emergent aquatic vegetation (e.g. *Nymphaea* spp., *Nymphoides* spp.) (Thomson et al. 2000). In the Katherine River, it occurs in microsympatry with *Emydura subglobosa worrelli* and in the Alligator Rivers region it occurs sympatrically with the common sawshell turtle, *Myuchelys latisternum*. More rarely, it can be found with *Elseya dentata* in plunge pools below the escarpment. In the Kimberleys, *C. burrungandjii* can be found with *Emydura victoriae* and *Elseya dentata*.

Reproduction. — There are few data on the reproduction of *C. burrungandjii*, and no data on their nesting. Examination of the ovaries of specimens collected in October–November suggests that the species nests in the dry season (Thomson et al. 2000). Corpora lutea are present on ovaries in June–July (Tucker and FitzSimmons, unpubl. data). Local Aboriginal people who report that they find nests of *C. burrungandjii* during the dry season indicate that the species digs nests in riverside sand banks like a freshwater crocodile (Phyllis Windjarra pers. comm., Sarah Flora, pers. comm.). These observations and the species occupation of permanent billabong or riverine habitats suggests that *C. burrungandjii* does not nest underwater like its congener *C. rugosa* whose unusual nesting behavior reflects its preference for seasonally ephemeral flood plain habitat (Kennett et al. 1993a, b).

The male pattern of testicular activity (Thomson et al. 2000) appears to be broadly similar to that of *C. rugosa* in which testes and epididymes become enlarged in October–November and peak in January, followed by spermiation through February–March as testes and epididymes regress. Mating in *C. rugosa* is presumed to commence in January–February and may continue for several months (Kennett 1994, 1999).

Diet. — *Chelodina burrungandjii* is predominantly carnivorous, feeding mainly on fish and shrimp. Nine of 30 turtles from Arnhem Land examined by Thomson et al. (2000) (39% excluding 7 with empty stomachs) had fed on fish, which accounted for 31% by weight of the pooled stomach contents. Fish species included the Northern Purple-Spotted Gudgeon (*Mogurnda mogurnda*) but unidentified species were also present. *Chelodina burrungandjii* feeds voraciously in captivity and will devour 10–15 fish in a few minutes. Sixteen turtles (70%, excluding 7 with empty stomachs) had fed on *Macrobrachium* shrimp, which comprised 49% by weight of the total diet (Thomson et al. 2000). Legler (1982) also reported a predominance of shrimp and fish in the diet and also recorded Atyid shrimp, Orthoptera, and crab (probably *Holothusiana*). *Chelodina burrungandjii* also feeds on plant material; five individuals (22% excluding 7 with empty stomachs) contained vegetation in their stomachs, which comprised 20% by weight of the pooled stomach contents (Thomson et al. 2000). In all but one case, vegetative matter comprised

the entire stomach contents. One individual had consumed 6.3 g plant material, including leaves from a Freshwater Mangrove (*Barringtonia acutangula*) and bark, double the average weight of stomach contents (3.0 ± 0.52 g, $n = 23$). In one sample, the leaf material was folded and glued together presumably as shelter for an aquatic invertebrate and the leaf may have been ingested along with the invertebrate as the intended prey. Two individuals each contained an unidentified seed capsule. Feces from an individual from the Mann River comprised leaves only. Sample sizes were inadequate for analysis but there did not appear to be sex or size bias in diet composition except that larger individuals (usually females) tended to consume larger individual prey items. Fish were the most common prey item in the Kimberley (56% of 81 stomach samples) (Featherston 2008), particularly the Western Rainbow Fish (*Melanotaenia australis*) and Flathead Goby (*Glossogobius girus*). Less common prey items were freshwater crabs (9.9%) and prawns (7.0%). A large number of water striders (Gerridae) were found in two stomachs. Some stomachs contained other aquatic macroinvertebrates, terrestrial insects, and spiders. Detritus, terrestrial plant matter and aquatic plant material was observed in several samples, but always as very small volumes. There were no significant differences in diet between males and females.

Population Status. — Little is known of the population status of *C. burrungandjii*, but it inhabits the headwaters of major rivers of tropical northern Australia, and as such can be regarded as occupying a series of disjunct populations. As these areas have not been subject to widespread habitat alteration as in other parts of Australia, the populations of *C. burrungandjii* can be regarded as relatively secure. Mark-recapture studies on four populations in the Kimberleys from 1999–08 indicate stable population status (Tucker and FitzSimmons, unpubl. data).

Threats to Survival. — There are no data indicating the existence of major threats to *C. burrungandjii*. The exotic cane toad (*Rhinella marina*, formerly *Bufo marinus*) has expanded its range to include Arnhem Land and has recently invaded the Kimberley. This toad, its eggs and tadpoles are toxic to many predators, and have been implicated in anecdotal reports of declines in populations of congeneric *C. rugosa* in the Gulf Country of Queensland and the Northern Territory, and a recent study indicates that this species is reasonably susceptible to cane toad toxin when administered experimentally (Smith and Phillips 2005). However, data collected to explicitly address this issue in wild populations are lacking for either species, and there is no evidence of turtle kills in Northern Territory studies after the arrival of cane toads in Arnhem Land, despite extensive study of *C. rugosa* in that region (Fordham 2007).

Populations of *Chelodina burrungandjii* are in some cases small and isolated (e.g., Immimbar) and potentially repositories of genetic variability. This makes them vulnerable to overharvesting or targeted collecting for the illegal pet trade; however, *C. burrungandjii* is rarely collected by Aboriginal people in the Northern Territory, and the combina-

tion of poor access and legislative controls makes collecting for the pet trade difficult. There are no data on the levels of Aboriginal harvest in the Kimberley.

Widespread hybridization (Georges et al. 2002) and introgression (Alacs 2008) between *C. burrungandjii* and *C. rugosa* suggests that these two taxa have come into contact relatively recently. The phylogeographic basis of this remains a mystery (it may involve the repeated intermittent pattern of connection and isolation of Australia and New Guinea), but as it is a natural process not aided or impeded by human activities, we do not regard it as a threat.

Conservation Measures Taken. — *Chelodina burrungandjii* benefits from State and Federal legislation that controls the exploitation of native fauna. It is protected by the Environment Protection Biodiversity Conservation Act (1999) in Kakadu National Park and elsewhere in the Northern Territory by the Territory Parks and Wildlife Conservation Act (2005). Export from Australia is regulated under the Environment Protection and Biodiversity Conservation Act (1999), which requires a Management Program that is approved by the relevant Australian Government Minister.

The species occurs in Kakadu and Nitmuluk National Parks, which affords the species considerable protection in the Northern Territory. Several National and Conservation Parks afford protection in Western Australia: Drysdale River, Prince Regent, Mitchell River, King Leopold Range, Windjana Gorge, and Tunnel Creek.

The species is not listed on the IUCN Red List or on the CITES appendices, although the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group preliminarily assessed the species as Least Concern in 2010 (Turtle Taxonomy Working Group 2010).

Conservation Measures Proposed. — No additional conservation measures are proposed at this time. Monitoring for potential increases in exploitation or other developing threats should be carried out as appropriate.

Captive Husbandry. — The National Aquarium in Baltimore, USA, has a number of specimens of *C. burrungandjii* in its collection, but as yet no records of successful breeding.

Current Research. — In the Kimberley, long-term study sites have been established at four rivers and data are being collected on demography, reproductive condition, habitat use and dietary ecology (Tucker et al., unpubl data). Phylogeographic and population genetic studies are being conducted that cover the range of the species (Alacs 2008).

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