

Myuchelys bellii (Gray 1844) – Western Saw-shelled Turtle, Bell's Turtle

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SUMMARY. – *Myuchelys bellii* is an intermediate-sized short-necked freshwater turtle (Family Chelidae) with a range restricted to upland streams in the Namoi, Gwydir, and Border Rivers catchments of the Murray-Darling Basin, New South Wales and Queensland, Australia. Sexual size dimorphism is moderate, with adult males (up to 227 mm carapace length) smaller than females (up to 300 mm). The species occupies streams between 600 and 1100 m elevation that contain permanent pools deeper than about 2 m, frequently with granite boulders and bedrock, and often with underwater caverns formed by boulders, logs, and overhanging banks. In areas of lower water velocity, the typical substratum is coarse granitic sand overlain by fine silt, algal growth, and dense beds of macrophytes. The species has a nonspecialized omnivorous diet, which includes aquatic plants, algae, sponges, terrestrial fruits, aquatic insects, crayfish, and carrion. The species lays a single clutch of between 8 and 23 eggs per year in September–December and has one of the lowest reproductive outputs of any Australian chelid. Eggs hatch after 49–51 days, and hatchlings average 26.7 mm in carapace length. The species relies on aquatic respiration through cloacal bursae during inactive winter months to hibernate at depth, and has a crepuscular habit during the active months, using shallows and riffle zones for foraging at night. Threats include ongoing loss of riparian vegetation, loss of lotic habitat from water resource development and associated infrastructure, and physical modifications resulting from land clearing and livestock grazing, such as increased turbidity and infilling of deep pools. There is concern also for the impact of exotic nest predators, exotic fish, translocation of other native turtle species, and disease. No major conservation initiatives are currently directed at the species, but are planned under the draft recovery strategy of the NSW Office of Environment and Heritage. It is regarded as potentially vulnerable to extinction.

DISTRIBUTION. – Australia. Restricted to upland streams of the Namoi, Gwydir, and Border Rivers catchments of the inland Murray-Darling Basin in northeastern New South Wales and extreme southeastern Queensland.

SYNONYMY. – *Phrynops bellii* Gray 1844, *Hydraspis bellii*, *Elseya bellii*, *Wollumbinia bellii*, *Wollumbinia bellii bellii*¹, *Elseya latisternum bellii*, *Myuchelys bellii*, *Elseya dorriani* Wells 2002¹ (*nomen nudum*), *Wollumbinia bellii dorriani*¹.

SUBSPECIES. – None currently recognized.

STATUS. – IUCN 2015 Red List: Endangered B1+2c (as *Elseya bellii*, assessed 1996), TFTSG Draft Red List: Endangered (EN, assessed 2011); CITES: Not Listed; Environment Protection and Biodiversity Conservation Act 1999: Vulnerable; New South Wales National Parks and Wildlife Act 1979: Vulnerable; Queensland Nature Conservation Act 1992: Least Concern.

Taxonomy. – *Myuchelys bellii* has an interesting taxonomic history. It was described by Gray (1844) as *Phrynops bellii* from a single specimen of unknown provenance (but evidently presumed to be from South America) in the collection of Thomas Bell (Nowak-Kemp

and Fritz 2010), and subsequently renamed *Hydraspis bellii* (Gray 1856). It was not recognized as an Australian species until the end of the 20th century. After Legler (1981) reported the occurrence of saw-shelled turtles in the headwaters of the Namoi and Gwydir river systems in New South Wales, 54 allozyme (nuclear) markers were used to demonstrate that Gwydir specimens were an apparently undescribed species with a close phylogenetic relationship to *Elseya latisternum* (Georges and Adams 1992).

¹ Notwithstanding their inclusion in this synonymy, the authors do not consider the names *Wollumbinia* and *dorriana* to be available names for the reasons outlined in Georges and Thomson (2010).



Figure 1. Adult female *Myuchelys bellii* from Bald Rock Creek, Border Rivers Catchment, Queensland, Australia. Photo by Darren Fielder.

Concurrently, investigative work by Rhodin (unpubl. data) clarified the identity and origin of the holotype of *Phrynops bellii*, and Cann (1998) provided circumstantial evidence that the type specimen was sourced from the Namoi and Gwydir river systems of Australia. Recent morphometric analyses have also supported Cann's (1998) match with the holotype specimen of *Phrynops bellii* (Fielder, 2013). The species was first transferred to the genus *Elseya* by Cann (1998), who also reported the occurrence of a population of similar turtles in Bald Rock Creek in the Queensland portion of the Border Rivers catchment, but was uncertain of its status.

The generic name *Wollumbinia* was coined by Wells (2007) to include *E. bellii*, but appeared in an electronic document without peer review and is of disputed status with respect to the International Code of Zoological Nomenclature (ICZN 1999); we do not regard it as an available name. In any case, we follow the recommendations of Kaiser et al. (2013) and regard the Wells (2007) document as neither a scientific paper (*sensu* CBE 1968) nor a publication for the purposes of nomenclature. Thomson and Georges (2009) instead placed *E. bellii* in the genus *Myuchelys*, which they separated from *Elseya*, a classification followed in the revision by



Figure 2. Ventral and dorsal views of male *Myuchelys bellii* from Bald Rock Creek, Border Rivers catchment, Queensland, Australia. Photos by Darren Fielder.



Figure 3. Lateral views of the heads of **A:** a young *Myuchelys bellii* and **B:** an aged individual, both from Roumalla Creek, Gwydir River catchment, New South Wales, Australia. Note the prominent and well-defined head shield with its projection down the parietal ridge toward the tympanum, the enlarged pointed tubercles on the neck and the low rounded tubercles on the temporal region. Photos by Arthur Georges.

Georges and Thomson (2010). Subsequent molecular and morphological assessments have found no substantive genetic (Fielder et al. 2012) or morphological (Fielder 2013) differences among populations from the Gwydir, Namoi, and Border Rivers catchments. They found little evidence to support any taxonomic subdivision of *M. bellii* at the species or subspecies level, as suggested by Cann (1998:208, 212). *Myuchelys bellii* and *M. latisternum* are sister taxa (Fielder et al. 2012; Le et al. 2013).

Description. — Adults (Fig. 1) are of intermediate size in comparison with other chelid turtles, but *M. bellii* is the largest species in *Myuchelys*. Sexual size dimorphism is moderate, with adult males (up to 227 mm carapace length) smaller than females (up to 300 mm carapace length) (Fielder 2013).

Carapace uniform light to dark brown (Fig. 2), broadly oval, only slightly broader posteriorly than anteriorly, with a serrated posterior margin in juveniles, which may persist to adulthood, but more usually the carapace margin becomes scalloped or smooth with age; scutes smooth without ridges; cervical (nuchal) scute usually present, but absent as a rare variant; suture between the second and third costal scutes contacting the seventh marginal scute; suture between the third and fourth costal scutes contacting the ninth marginal scute. Shell lacking a well-developed series of exposed neural bones.

Plastron in adults is cream or pale yellow, with extensive dark blotches or streaks, which when augmented by staining can result in a black plastron (Fig. 2). In individuals with lighter plastra, borders between the plastral scutes rendered distinct by darker coloration; similar darker coloration ventrally at the junctions of the marginal scutes; gular scutes separated by the intergular scute, which is not in contact with the pectoral scutes; pronounced angle between plastron and bridge at the level of the abdominal scute.

Dorsal surface of head with a prominent shield, entire, extending posteriorly and laterally down the side of the head toward but not contacting the tympanum (Fig. 3); surface of the temporal region covered with distinct irregular scales of low relief (Fig. 3); maxillary triturating surfaces simple, no prominent medial alveolar ridge; two prominent barbels; iris variable in color, often olive-gray or chocolate brown, without leading or trailing dark spots; cream, yellow or salmon lateral stripe extends from the corner of the mouth, through the lower extent of the tympanum and down the full length of the neck, less distinct with age; a temporal stripe is absent (Fig. 3).

Neck slate gray dorsally, with prominent pointed tubercles (Fig. 3), gray ventrally with or without cream or salmon flecks. Forelimbs each with five claws, hindlimbs with four claws, slate gray above and below, often lighter shades of gray below. Tail gray without distinctive markings, round in cross section, always shorter than half of carapace length; precloacal tail length greater than postcloacal length only in adult males.

Hatchlings almost circular in outline (mean carapace length 26.7 ± 0.3 mm; mean carapace width 26.8 ± 0.6 mm, $n = 16$), with moderate serration of the margins



Figure 4. Ventral and dorsolateral views of a hatchling *Myuchelys bellii* from the Bald Rock Creek, Border Rivers catchment, Queensland, Australia. Photos by Darren Fielder.

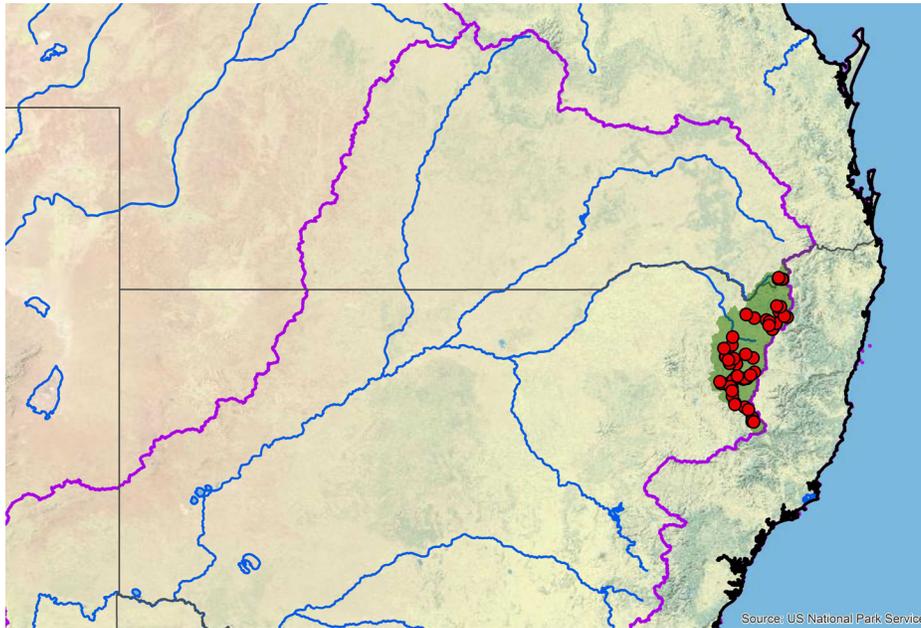


Figure 5. Distribution of *Myuchelys bellii* in eastern Australia. Purple lines = boundaries delimiting major watersheds (level 3 hydrologic unit compartments – HUCs); red dots = museum and literature occurrence records based on Cann (1998) plus more recent data, and the authors' personal data; green shading = projected historic native distribution based on GIS-defined level 10 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; TTWG 2014), and adjusted based on authors' subsequent data.

of the carapace laterally and posteriorly; light brown with numerous dark speckles giving an overall darker appearance; plastron black, bridge and ventral surfaces of marginal scutes cream; light stripe from corner of mouth down the neck cream or yellow; ventral tail tip cream (Fig. 4).

Distribution. — *Myuchelys bellii* inhabits the northeastern part of the inland Murray-Darling Basin in southeastern Australia (Fig. 5). In New South Wales it occurs in the Namoi River system within and upstream of Warrabah National Park, the Gwydir River system upstream of Copeton Dam, the Severn River system within and upstream of the Severn River Nature Reserve, and the Deepwater River upstream of its confluence with the Bluff River (Chessman 2015). In Queensland it is probably restricted to a section of Bald Rock Creek in and adjacent to Girraween National Park (Fielder 2010). A single sighting in the Severn River (a different river from the one of the same name in New South Wales) near Ballandean (SSC 2008) may be unreliable.

Habitat and Ecology. — *Myuchelys bellii* occupies upland streams (between 600 and 1100 m elevation) that contain permanent pools deeper than about 2 m, frequently with granite boulders and bedrock (Fig. 6). Its habitat is often complex, with underwater caverns formed by boulders, logs, and overhanging banks. In areas of lower velocity, the typical substratum is coarse granitic sand overlain by fine silt, algal growth, and dense beds of macrophytes (Cann 1998; Fielder 2010). The larger, deeper waterholes tend to have the most abundant local

populations because they provide daytime refuges, with foraging in shallow pool areas and riffles occurring at night (Chessman 2015). *Myuchelys bellii* is a riverine species and does not appear to inhabit lentic water bodies separate from flowing streams, such as constructed farm ponds or natural wetlands.

The regions inhabited by *M. bellii* in all three catchments have temperate climates with warm wet summers (December through February, 24–30°C average maximum air temperature), cold dry winters (June through August, 12–16°C average maximum air temperature) and average annual rainfall of ca. 700–850 mm (Australian Bureau of Meteorology, Climate Data Online, <http://www.bom.gov.au/climate/data/>). Water temperatures at 30 cm depth in Bald Rock Creek ranged seasonally between 5 and 30°C (Fielder 2012). Pools in upland streams can freeze over in winter, and snow falls sporadically across its range.

Myuchelys bellii is omnivorous with a tendency toward herbivory. Examination of feces revealed a varied diet consisting of aquatic plants (emergent and submerged), filamentous green algae, freshwater sponges, terrestrial fruits (including exotic blackberries), aquatic insects, *Euastacus suttoni* crayfish, and carrion, along with sediment and terrestrial leaves (Cann 1998; Fielder et al. 2015). There is no indication of a specialized diet.

Myuchelys bellii takes up oxygen directly from the water using cloacal bursae that contain intermediate papillae lobe specialization structure by comparison with those of other chelid turtles (reviewed by Fielder 2012). During winter in Bald Rock Creek, single uninterrupted submergences



Figure 6. Typical habitat of *Myuchelys bellii*. **Top:** Bald Rock Creek, Border Rivers catchment, Queensland. **Bottom:** Roumalla Creek, Gwydir River catchment, New South Wales. Photos by Darren Fielder (top) and Arthur Georges (bottom).

can last up to 15.5 days. The species is similar to *Elseya albagula* and *Rheodytes leukops* in its ability to use aquatic respiration to support prolonged submergences and dives, especially at lower water temperatures, and its crepuscular peaks in activity (Fielder 2012). *Myuchelys bellii* also hibernates in deep water (>3 m) as an overwintering strategy when ambient water temperatures drop to about 5°C during July (Fielder 2012). Basking occurs throughout the active months when animals emerge fully to bask on granite boulders or protruding logs (Fielder 2012).

On average, 78% of adult females in Bald Rock Creek ovulated each year, laying a single clutch of eggs during the months of September through December (Fielder et al. 2015). This proportion fluctuated annually, with all or most adult females breeding in some years, while a considerably lower proportion bred in other years. Females nested in loamy granitic soil on sloping river banks close to the water's edge.

Clutch size averaged 18.3 eggs (range 8 to 23, n=5), with an average clutch mass of 157.4 g, a single clutch per season, and an annual frequency of breeding females calculated across seven consecutive breeding seasons of 0.78 (Fielder et al. 2015). Thus the best estimate for annual fecundity is

14.3 eggs per adult female (clutch size x clutch per season x average proportion of females breeding annually), giving *M. bellii* one of the lowest annual reproductive outputs of any Australian chelid (reviewed by Fielder et al. 2015). Eggs had a mean mass of 8.6 ± 0.1 g, and were 30.6 ± 0.1 mm in length and 21.9 ± 0.1 mm in width (2 clutches), and hatched after 49 and 51 days of incubation at 29°C. Hatchlings averaged 26.7 ± 0.3 mm in carapace length, 26.8 ± 0.6 mm in carapace width and 3.5–6.0 g in mass (n = 16) (Fielder 2010).

Sex ratios uncorrected for differences in age at maturity were significantly biased in favor of females in the Namoi River basin (1:2.7, n = 63, p<0.01) but not significantly different in the Border Rivers and Gwydir River basins (Fielder et al. 2015). In Bald Rock Creek, males achieved sexual maturity at 10 years of age (162 mm carapace length) and females at 20 years (215 mm) (Fielder et al. 2015). Growth rates varied with age and sex, with rapid growth in carapace length of 28–39 mm in the first year of life, reducing to less than 2 mm per year, often zero, after males and females reached carapace lengths of approximately 180 and 220 mm, respectively (Fielder et al. 2015). Longevity is estimated to be greater than 40 years.

Myuchelys bellii is commonly found together with *Chelodina longicollis* and rarely with *Emydura macquarii*, and the downstream boundary of its range abuts the upland limit of *Chelodina expansa*.

Population Status. — The species is locally abundant but with a restricted range. Estimates for Bald Rock Creek indicate a viable, but small, population of 319 individuals (Fielder et al. 2015). The populations in the Namoi and Gwydir River systems likely number many thousands of individuals, but those in the Severn and Deepwater River systems of the Border Rivers catchment appear to be smaller (Chessman 2015).

Threats to Survival. — *Myuchelys bellii* has delayed age at first breeding, low annual fecundity, and high



Figure 7. *Myuchelys bellii* is susceptible to eye diseases such as cataracts, which can lead to blindness. Photo by Darren Fielder.

adult survivorship and longevity (Type III survivorship) (Fielder et al. 2015). Species with these life-history traits can be detrimentally susceptible to sustained low levels of recruitment, taking decades to manifest as population decline. Reports of high predation rates by introduced red foxes (*Vulpes vulpes*) on nests of *E. macquarii* in the Murray-Darling Basin (>93%; Thompson 1983; Spencer 2002) imply that predation by foxes on *M. bellii* populations may be high in areas where fox control is limited or non-existent. In addition, Australian native fish species such as Murray cod (*Maccullochella peelii*) and golden perch (*Macquaria ambigua*), as well as exotic fishes (e.g., redbfin perch [*Perca fluviatilis*] and rainbow trout [*Oncorhynchus mykiss*]), have been translocated or introduced within the range of *M. bellii* and may have a detrimental impact on hatchling survival (Fielder 2012; Fielder et al. 2015).

The habitat of *M. bellii* in all three catchments is subject to ongoing loss of native riparian vegetation and loss of lotic habitat from water resource development and associated infrastructure. Physical modifications resulting from land clearing and livestock grazing, such as increased turbidity and infilling of deep pools, may reduce habitat availability and quality for *M. bellii*. In addition, about 10% of *M. bellii* in New South Wales are suffering from an undiagnosed eye disease that can cause blindness (Cogger et al. 1993:13) (Fig. 7), and several turtle deaths from recreational fishing have been recorded (Fielder et al. 2015). The potential effects of anthropogenic climate change through prolonged drought or increasing ambient water temperatures on *M. bellii* populations remain unknown.

A significant long-term concern for *M. bellii* is the translocation of other turtle species into its range. In 2008, an adult male *M. latisternum*, a species not native to the Murray-Darling Basin, was caught at Girraween National Park within the range of *M. bellii*. Furthermore, an aquatic survey in 2014 in the upper Condamine River drainage at Toowoomba (within the Murray-Darling Basin) revealed a viable breeding population of *M. latisternum* (Fielder, unpubl. data). This population appears to be gaining a foothold after being present for some years, with the potential to spread. Such translocations pose a long-term risk to *M. bellii* through either competition or interbreeding, since the two species are sister taxa.

Together, these threatening processes, in conjunction with a low intrinsic rate of population increase and a restricted distribution, make *M. bellii* vulnerable to extinction.

Conservation Measures Taken. — The species is currently listed on the IUCN Red List as Endangered based on a 1996 assessment, and by the IUCN Tortoise and Freshwater Turtle Specialist Group as Endangered based on a 2011 draft assessment. It is not listed by CITES. Nationally it is listed as Vulnerable by the Environment

Protection and Biodiversity Conservation Act 1999, Vulnerable by the New South Wales National Parks and Wildlife Act 1979, and Least Concern by the Queensland Nature Conservation Act 1992.

In New South Wales, *M. bellii* has been assigned to the ‘landscape-managed management stream’ of threatened species. A targeted strategy for such species is currently being developed by the New South Wales Office of Environment and Heritage. In addition, the former Namoi Catchment Management Authority instigated a fox control program along the Macdonald and upper Namoi rivers in 2013.

The small Queensland population is mostly contained within Girraween National Park and is being actively managed by the Queensland Parks and Wildlife Service. Management initiatives include protecting its limited available habitat and establishing protocols to restrict the take of water for toilets and recreational users during drought. In addition, an active program controls introduced goldfish (*Carassius auratus*) and foxes (*Vulpes vulpes*) in the park. These measures need to continue, as well as the restoration of riparian vegetation and instream habitats that were previously lost to impoundment and mechanical removal (Fielder et al. 2015).

The species occurs in the following protected areas: Warrabah National Park and Severn River Nature Reserve in New South Wales, and Girraween National Park in Queensland.

Conservation Measures Proposed. — We suggest that *M. bellii* should be considered for listing as Vulnerable in Queensland, as we conclude that it meets the relevant criteria through its small population size and greatly restricted distribution. Such a listing would align its conservation status with the national and New South Wales listings and promote integrated conservation efforts across its distribution.

The NSW Office of Environment and Heritage, in its recently released “action toolbox”, has recommended that (a) the distribution of the species be further investigated through trapping and basking surveys, (b) procedures for locating and protecting nests be evaluated or, if this is not possible, that the option of a headstarting program be considered, (c) that there be investment in the management and rehabilitation of riparian vegetation, including restricting access to stock and exotic feral pests such as pigs, and (d) that the community be engaged in developing and implementing options for ameliorating the impact of water resource development in the reaches where the turtle resides.

There is also a need for increased education and awareness about the adverse impacts of releasing pet turtles outside of their natural ranges, and a concerted effort to control or eradicate the invasive *M. latisternum* population in the upper Condamine River system. Education of the

fishing community throughout the range of *M. bellii* could improve the attitudes of anglers toward turtles caught on their fishing lines.

Captive Husbandry. — There is no published information on captive husbandry requirements. No captive breeding is being undertaken to our knowledge, and no assurance colonies have been established.

Current Research. — None in Queensland. The status of populations in New South Wales is being assessed by B. Chessman.

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