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An updated taxonomy of the living Alligator Snapping Turtles (*Macrochelys* Gray, 1856), with descriptions of a new tribe, new species and new subspecies.

RAYMOND T. HOSER

Snakebusters: 488 Park Road, Park Orchards, Victoria, 3134, Australia.
***Phone*: +61 3 9812 3322 *Fax*: 9812 3355 *E-mail*: snakeman@snakeman.com.au**
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ABSTRACT

Molecular studies have resolved many questions in terms of the relationships between the world's living Turtles, Terrapins and Tortoises, collectively grouped within the order Testudines. However the taxonomy has not necessarily been updated accordingly.

This paper presents a revised and updated taxonomy and nomenclature for the Alligator Snapping Turtles (genus *Macrochelys* Gray, 1856) of North America.

Formally named are one (1) new tribe, one (1) new species and one (1) new subspecies, according to the Zoological Code (Ride *et al.* 1999).

Keywords: Taxonomy; Testudines; Nomenclature; Zoological Code; new tribe; Macrochelyiini**;** new species; *Macrochelys*; *maxhoseri*; new subspecies; *muscati.*

INTRODUCTION

In spite of their general abundance in most parts of the world and familiarity to scientists for many years, the taxonomy of the turtles, terrapins and tortoises (order Testudines) has been far from stable.

In the period post-dating year 2000, a number of molecular studies have greatly resolved relationships between species, genera and higher-level groupings.

Notwithstanding this, the nomenclature has failed to keep pace with the changes in knowledge and this has been in spite of numerous pre-existing and available names for some generic groupings and taxon populations.

Drawing on the available knowledge of the phylogeny of the order Testudines and the genus *Macrochelys* Gray, 1856, I hereby present an updated taxonomy for this North American genus.

Important publications in relation to the hundreds of other described Testudine species are too many to comprehensively cite here, however some key ones to date include: Allen and Neill (1950), Alvarez *et al.* (2000), Ashton and Feldman (2003), Auffenberg (1966, 1971), Austin *et al.* (2003), Avise *et al.* (1992), Baard (1990), Barth *et al.* (2002, 2004), Beheregaray *et al.* (2003, 2004), Bickham (1981), Bickham and Baker (1976), Bickham and Carr (1983), Bickham *et al.* (1996), Blanck *et al.* (2006), Bona and De La Feunte (2005), Bour (1984, 1987), Bour and Zaher (2005), Bowen and Karl (1997), Bowen *et al.* (1993), Brinkman and Wu (1999), Brinkman *et al.* (2004a, 2004b), Broadley (1981), Burbidge *et al.* (1974), Burke *et al.* (1996), Burns *et al.* (2003). Caccone *et al.* (1999, 2002, 2004), Cann (1999), Cann and Legler (1994), Cao *et al.* (2000), Carr (1952), Carr (1981), Carr and Bickham (1986), Caspers *et al.* (1996), Cervelli *et al.* (2003), Chien *et al.* (2005), Ciofi *et al.* (2002), Clarke (1956), Claude *et al.* (2003), Conant (1975), Conant and Collins (1991), Cracraft and Donoghue (2004), Crumly (1982, 1984a, 1984b, 1993), Crumly and Sanchez-Villegra (2004), Cunningham (2002), De Broin (1988), Degenhardt (1996), De Queiroz and Ashton (2004), Derr *et al.* (1987), Diesmos *et al.* (2005), Dixon (2000), Dobie (1971), Dutton *et al.* (1996, 1999), Echelle *et al.* 2010, Engstrom and McCord (2002), Engstrom *et al.* (2002, 2004), Ernst and Barbour (1989), Ernst and Lovich (2009), Ernst *et al.* (1994), Feldman and Parham (2001, 2002, 2004), Frair (1982), Fritz and Obst (1996), Fritz (1996), Fritz *et al.* (2004, 2005a, 2005b, 2005c, 2006), Fujita *et al.* (2004), Gaffney (1975a, 1975b, 1976, 1977, 1979, 1984a, 1984b, 1988, 1996), Gaffney and Meylan (1988, 1992), Gaffney *et al.* (1991, 1998), Gaur *et al.* (2006), Georges and Adams (1992), Georges and Thomson (2006), Georges *et al.* (1998, 2002), Gerlach (2001, 2004), Glass (1949), Gmira (1993), Guicking *et al.* (2002), Hackler (2006), Hackler *et al.* (2007), Haiduk and Bickham (2002), Hartweg (1939), Hay (1908), Hedges and Poling (1999), Hedges *et al.* (1990), Herrel *et al.* (2002), Hill (2005), Hirayama (1984, 1991, 1994, 1998), Hirayama and Chitoku (1996), Hirayama *et al.* (2000), Honda *et al.* (2002a, 2002b), Hutchison (1991), Hutchison and Bramble (1981), Iverson (1991, 1992, 1998), Iverson and McCord (1994), Iverson *et al.* (2001), Iwabe *et al.* (2005), Jamniczky and Russell (2004), Janzen and Krenz (2004), Johnson (1987), Karl and Bowen (1999), Karl and Wilson (2001), Kojima and Fujiwara (2005), Kordikova (2002), Krenz *et al.* (2005), Lahanas *et al.* (1994), Lamb and Lydeard (1994), Lamb and Osentovski (1997), Lamb *et al.* (1989, 1994), Lane and Mitchell (1997), Lapparentde De Broin (2000), Lapparentde De Broin and Murelaga (1999), Le

(2006), Le and McCord (2008), Le *et al.* (2006), Legler and Georges (1993), Lenk *et al.* (1999a, 1999b), Lesia *et al.* (2003), Liao *et al.* (2001), Lieb *et al.* (1999), Limpus *et al.* (1988), Lindeman (2000a, 2000b), Lindeman and Sharkey (2001), Lo *et al.* (2006), Loveridge and Williams (1957), Mahmoud and Klicka (1979), Mannen and Steven (1999), Marlow and Patton (1981), McCord and Pritchard (2002), McCord *et al.* (1995, 2000, 2002), Megerian and Murray (1999), Meyer and Zardoya (2003), Meylan (1984, 1986, 1988, 1996), Meylan and Gaffney (1989), Meylan and Sterrer (2000), Meylan *et al.* (1990, 2000), Milstead (1969), Minx (1996), Mlynarski (197*6),* Moen (2006), Moody (1984), Morafka *et al.* (1984), Mount (1975), Mühlmann-Díaz *et al.* (2001), Near *et al.* (2005), Noonan (2000), Noonan and Chippindale (2006), Okayama *et al.* (1999), Palkovacs *et al.* (2002), Parham and Fastovsky (1997), Parham and Feldman (2002), Parham *et al.* (2001, 2004, 2006a, 2006b), Peng *et al.* (2005), Perala (2002a, 2002b, 2002c), Phillips *et al.* (1996), Praschag *et al.* (2006), Pritchard (1967, 1979, 1980, 1989, 1992), Rest *et al.* (2003), Reynoso and Montellano-Ballestros (2004), Rhodin (1994a, 1994b), Ride, *et al.* (1999), Roberts *et al.* (2004), Roman *et al.* (1999), Russello *et al.* (2005), Sasaki *et al.* (2004), Seddon *et al.* (1997), Seidel (1988, 1994, 1996, 2002), Seidel and Lucchino (1981), Seidel *et al.* (1981, 1986), Semyenova *et al.* (2004), Serb *et al.* (2001), Shaffer *et al.* (1997, 2008), Shi *et al.* (2005), Shipman (1993), Shishikawa (2002), Shishikawa and Takami (2001), Sites *et al.* (1981, 1984), Sloan and Taylor (1987), Souza *et al.* (2002, 2003), Spinks and Shaffer (2005, 2007), Spinks *et al.* (2004), Sqalli-Houssaini and Blanc (1990), Starkey (1997), Starkey *et al.* (2003), Stephens and Weins (2003), Stuart and Parham (2004, 2006), Swainson (1839), Takahashi *et al.* (2003), Tessier *et al.* (2005), Tinkle (1958), Vander Kuyl *et al.* (2002), Walker and Avise (1998), Walker *et al.* (1995, 1997, 1998a, 1998b), Weisrock and Janzen (2000), Whetstone (1978), Williams (1950), Wink (2001), Wood (1997), Wood *et al.* (1996), Wu *et al.* (1999), Yasukawa *et al.* (1996, 2001), Zangerl (1945, 1980), Zangerl and Turnbull (1955), Zangerl *et al.* (1988), Zardoya and Meyer (1998), Zardoya *et al.* (2003), Zhu *et al.* (2005) and Zug (1966, 1971).

Other genera may be the focus of later taxonomic revisions, but this paper is confined solely to the living members of the North American Genus *Macrochelys* Gray, 1856.

For a considerable time it has been known that there are populations of these Testudines, known locally as “Alligator Snapping Turtles” that do in fact warrant taxonomic recognition.

Furthermore in light of the fact that there is a good fossil record for the genus *Macrochelys* and similar species, it is appropriate that a tribe be formally named for the group, according to the rules of Zoological Nomenclature (Ride *et al.* 1999) in order to provide a reference point for other zoologists.

As a result, I formally describe a new tribe, new subspecies and new species below.

The new species described has until now been formally lumped within *Macrochelys temmincki* Troost, 1835, even though the taxonomic significance of the population has been known for some years (Hackler, 2006, Hackler *et al.* 2007, Echelle *et al.* 2009).

TRIBE MACROCHELYIINI *TRIBE NOV.*

(Terminal Taxon: *Macrochelys temmincki* Troost, 1835)

Diagnosis: This tribe as currently recognized is endemic to the United States and is the largest freshwater turtle in North America (Ernst and Barbour 1989), although fossils of specimens attributed to this tribe have been found elsewhere. They are known commonly as “Alligator Snapping Turtles” in recognition of three prominent ridges along the back and their large adult size. They are differentiated from specimens within the tribe Chelydrini Swainson, 1839 by their larger adult size and the presence of an extra row of scutes along the side of the carapace as well as a long tail that is not “saw toothed”.

The carapace (dorsal shell) length of adult Alligator Snapping Turtles ranges from 38 to 66 cm (15 to 26 in.), and the weight typically ranges from 16 to 80 kg (35 to 176 lb) (Johnson 1987, Ernst and Barbour 1989). However, weights of 100 kg (220 lb) (Pritchard 1979) and carapace lengths of 80 cm (Pritchard 1980) have been reported. The carapace is approximately two-thirds as wide as it is long, extremely rough, dark brown or gray, and without markings (Pritchard 1979). The anterior carapace margin is smooth; the posterior margin is strongly serrated; and the sides are relatively straight (Carr 1952, Mount 1975, Ernst and Barbour 1989).

The carapace bears three strong, longitudinal, dorsal keels (Pritchard 1989). An extra row of scutes (plates referred to as the supramarginals) is located on the carapace between the costals and marginals. The plastron (ventral shell) is usually dark brown or gray (but can be black or tan), reduced in size, and has a cross-shaped appearance that leaves most of the soft parts exposed (Conant 1975, Ernst and Barbour 1989).

The huge head has a pointed snout, large lateral orbits, and powerful jaws with a prominent hook at the tip of the upper jaw (Carr 1952, Ernst and Barbour 1989). A pink wormlike appendage on the tongue is attached near its center to a rounded muscular base that allows movement of the appendage for attracting prey (Mahmoud and Klicka 1979, Ernst and Barbour 1989). Numerous dermal projections (tubercles) are located on the sides of the head, chin, and neck. The skin is dark brown to gray above and lighter below; darker blotches may be present on the head. The muscular tail is approximately as long as the carapace, with three rows of tubercles above and numerous small scales below (Ernst and Barbour 1989).

Sexes appear similar but can sometimes be distinguished on the basis of size, as mature males are considerably larger than females (Ernst *et al.* 1994). Males have longer preanal tail lengths than females; the vent is posterior to the rim of the carapace (Johnson 1987, Ernst and Barbour 1989), but this is not always obvious in smaller individuals (e.g. individuals 11.3 kg (25 lb) or less) (Lane and Mitchell, 1997).

Juvenile skin is generally much rougher and has more exaggerated tubercles than that of adults (Carr 1952). The snout and tail are relatively longer than those of adults, and the juvenile tail is often longer than the carapace.

Alligator Snapping Turtles commonly occur with many other turtle species. However, as already mentioned they are only likely to be confused with the common snapping turtle (*Chelydra serpentina*), and very young individuals may possibly be confused with musk or mud turtles (Family Kinosternidae). The common snapping turtle has a smaller head, a saw-toothed tail, and lacks an extra row of scutes between the costals and marginals (Conant 1975). It also has low keels on the carapace, and its eyes are situated high enough so that the orbits can be seen when viewed from above (Ernst *et al.* 1994). The head of the alligator snapping turtle is covered with hard plates, whereas the common snapping turtle’s head is covered with soft flesh (Clarke 1956, Conant 1975). Adult musk and mud turtles are much smaller and have shorter tails, smooth shells, and hinged plastrons (Conant 1975). Alligator Snapping turtles (except for nesting females) rarely leave the water unless habitat becomes unsuitable; Common Snapping Turtles often move among water bodies (Lane and Mitchell, 1997).

The history of the genus *Macrochelys* is ancient (Zangerl 1945) thereby warranting its placement within a tribe separate from *Chelydra.*

Distribution: Living specimens occur naturally within the United States of America only. Fossil specimens are known from elsewhere.

Content: *Macrochelys* Gray, 1856.

GENUS *MACROCHELYS* GRAY, 1856

***MACROCHELYS TEMMINCKI* TROOST, 1835**

Diagnosis: As for the tribe above.

Distribution: Herein confined to the Mississippi valley drainage and nearby rivers systems only and eastwards to the waterways of the Apalachicola, Ochlockinee, Choctawhatchee and Econfina

Drainages, these four systems having the subspecies *M. temmincki muscati subsp. nov.* (see below). The nominate form of the subspecies *Macrochelys temmincki* is found in the drainages west of these, including the Pensacola Bay area, Pascagoula, Mobile Bay/Perdido, Mississippi, Trinity, Neches.

East of the above drainages the species *M. maxhoseri sp. nov.* is found. That is the Suwannee River drainage system of Florida and Georgia, USA.

MACROCHELYS TEMMINCKI MUSCATI SUBSP. NOV.

Holotype: A specimen in the Florida Museum of Natural History (FM) at the University of Florida, specimen number: 155266, from Liberty, Florida, USA.
The Florida Museum of Natural History (FM) at the University of Florida, is a government owned facility that allows researchers access to the collection as laid out on their website at: http://www.flmnh.ufl.edu

Paratypes: Specimens in the Florida Museum of Natural History (FM) at the University of Florida. Paratype one is specimen number 155267 from Liberty, Florida, USA. Paratype two is specimen number 87950 from Washington, Florida, USA. Paratype three is specimen number 88528 from Washington, Florida, USA. Paratype four is specimen number 117204 from Liberty, Florida, USA.

The Florida Museum of Natural History (FM) at the University of Florida, is a government owned facility that allows researchers access to the collection as laid out on their website at: http://www.flmnh.ufl.edu

Diagnosis: Formerly regarded as being a variant of the species *Macrochelys temmincki* Troost, 1835, this subspecies has been recognized by several authors in the recent past as warranting taxonomic recognition either as a subspecies or full species (e.g. Hackler, 2006, Hackler *et al.* 2007, Echelle *et al.* 2009, Roman *et al.* 1999) on the basis of molecular differences as detailed in their papers and recent papers by other authors.

This subspecies is also morphologically different from the nominate form by colouration and markings on the head. The lighter colouration on the head of the nominate form tends towards extremely thin lines, especially posterior to the eye. This is not the case in *Macrochelys temmincki muscati subsp. nov.* where the posterior light patches consists of a combination of moderately thin lines with even boundaries and sometimes irregular blotches in combination with these lines.

Macrochelys temmincki mucati subsp. nov. is also separated from *Macrochelys temmincki* by having an average of 2.62 supramarginals on each side of the shell as opposed to an average of 3.2 for *Macrochelys temmincki temmicki.* The nominate form (*Macrochelys temmincki temmicki*) sometimes has four on one or both sides.

Macrochelys temmincki temmicki never has two submarginal scutes, whereas this condition is common for *Macrochelys temmincki mucati subsp. nov.*.

When *Macrochelys temmincki mucati subsp. nov.* does have three submarginal scutes the third is invariably reduced in size or rudimentary.

Distribution: This subspecies accounts for all populations of the species *Macrochelys temmincki* from the Apalachicola, Ochlockinee, Choctawhatchee and Econfina Drainages. The nominate form of the subspecies *Macrochelys temmincki* is found in the drainages west of these, including the Pensacola Bay area, Pascagoula, Mobile Bay/Perdido, Mississippi, Trinity, Neches.

Etymology: Named in honour of David Muscat of Park Orchards, Melbourne, Victoria, Australia in recognition of his courageous work in maintaining ethics on local government and the Australian environment.

In 2012 Muscat, who had done considerable work for the community and as a well-known environmentalist with an exceptional track record, stood for the Manningham Local Council (Melbourne, Australia) (Mullum Mullum ward) in local government elections.

However he was not voted into office, as he should have been, because of a highly illegal and unethical conduct by other candidates and their associates.

The campaign against Muscat was intense.

It included a serious of fabricated assault charges against him, laid improperly by local police and prosecuted as a means to ensure that Muscat would be kept out of government.

The criminal conviction of Muscat was assured through a corrupt magistrate at the Ringwood Magistrate's Court in Victoria.

The campaign then included a totally dishonest hate campaign run through the local tabloid media at the behest of well-connected rival candidates. More seriously, a candidate elected to council, Paul McLeish got his seat on the council at Muscat's expense and that of other legitimate candidates.

McLeish got in on the back of votes from so-called stooge or dummy candidates brought in for the express purpose of confusing the electorate and diverting votes away from Muscat.

One of the stooge candidates of McLeish was his wife, who ran under a different name in order to hide from voters her affinities to McLeish and conceal the obvious fact that she would be diverting her "preferences" to him.

Under the voting system of Victorian local government, when no single candidate gets enough votes to get elected to the local government council (as is usual), the vote goes to "preferences" dictated by each of the other candidates. McLeish's wife would of course divert hers to her husband, in effect giving him twice the vote getting power of a single ethical candidate like Muscat, who did not resort to the use of stooges or dummies to get extra votes to get elected.

Another stooge for McLeish was Paula Piccini, wife of serial candidate for everything, Stephen Mayne, better known for his website Crikey dot com dot au which was used by him as a forum to run hate campaigns based on false information marketed as "news" and a collection of lies.

Not surprisingly, that eventually led to him paying out a sizeable amount for defaming 3AW radio Shock Jock Steve Price.

That was after Price sued Mayne for defamation in the Victorian Supreme Court.

Mayne's wife didn't even live in the Mullum Mullum electorate and in effect ran solely as a stooge of McLeish for the purposes of diverting votes to McLeish in order to make sure Muscat and other genuine candidates were not voted in.

Piccini got top billing on a long ballot paper, forcing genuine candidates to the back page of the official government "how to vote" forms ensuring that she got a high number of votes to get Mcleish elected, via the co-called donkey vote (where people number the form from top to bottom).

Meanwhile the genuine candidates on the back page (and without stooge candidates to boost votes) were effectively ignored by voters, most of whom wouldn't have even known they were running for election to council, because their details were printed on the reverse side of the official form, which was in fact ignored by most voters.

Another candidate elected to council in the 2012 election, Sophie Galbally, used the same tactics as McLeish to get elected, using a local resident Gerry Dale as her stooge candidate for the purposes of vote diversion.

In other words, there was no effective democracy in local government in Manningham in 2012 in spite of claims to the contrary by State Government officials, and this pattern was repeated across Victoria.

So while corrupt people now in control of Manningham Council and their friends in hate media like the Rupert Murdoch controlled "*Manningham Leader*" can peddle lies about environmental advocate David Muscat, it is appropriate that his valuable contribution to the Australian environment be properly and permanently recognized via a publication that confines itself to the facts and has formally named a new taxon.

MACROCHELYS MAXHOSERI SP. NOV.

Holotype: A specimen in the Florida Museum of Natural History (FM) at the University of Florida, specimen number: 165801, from Alachua, Florida, USA.
This is a government owned facility that allows researchers access to the collection as laid out on their website at: http://www.flmnh.ufl.edu

Paratypes: Specimens in the Florida Museum of Natural History (FM) at the University of Florida. Paratype one is specimen number 165800 from Columbia, Florida, USA. Paratype two is specimen number 84653 from Alachua, Florida, USA.

This is a government owned facility that allows researchers access to the collection as laid out on their website at: http://www.flmnh.ufl.edu

Diagnosis: Formerly regarded as being a variant of the species *Macrochelys temmincki* Troost, 1835, this species has been recognized by several authors in the recent past as warranting taxonomic recognition either as a subspecies or full species (e.g. Hackler, 2006, Hackler *et al.* 2007, Echelle *et al.* 2009).

Macrochelys maxhoseri sp. nov. is most easily separated from *Macrochelys temmincki* Troost, 1835 by its larger average adult size, heavier build and a greater width of the head and alveolar surfaces, making it the largest freshwater Turtle in the United States.

Macrochelys maxhoseri sp. nov. is further and definitively separated from *Macrochelys temmincki* Troost, 1835 by the (moderately distinct) lighter markings on the head (particularly posterior to the eye), tending to form wide (sometimes irregular) stripes as opposed to thinner (regular) or very thin stripes or spots or blotches.

Hackler *et al.* 2007 and Echelle *et al.* 2009 have provided a molecular justification and basis for recognition of *Macrochelys maxhoseri sp. nov.* at the species level and this is also relied upon as part of the formal diagnosis herein.

This species differs from *Macrochelys temmincki* in that in this species the abdominal scutes, normally widely separated for *Macrochelys temmincki* send forth angular median extensions that make contact with the quadrangle of umbilical scales frequently.

In line with *Macrochelys temmincki mucati subsp. nov. Macrochelys maxhoseri sp. nov.* is also separated from *Macrochelys temmincki temmicki* by having an average of about 2.6 supramarginals on each side of the shell as opposed to an average of 3.2 for *Macrochelys temmincki temmicki.* The nominate form (*Macrochelys temmincki temmicki*) sometimes has four on one or both sides.

Macrochelys temmincki temmicki never has two submarginal scutes, whereas this condition is common for *Macrochelys maxhoseri sp. nov.* and *Macrochelys temmincki mucati subsp. nov.*.

When *Macrochelys maxhoseri sp. nov.* or *Macrochelys temmincki mucati subsp. nov.* does have three submarginal scutes the third is invariably reduced in size or rudimentary.

Distribution: This taxon is restricted to the Suwannee River drainage system of Florida and Georgia, USA. Specimens from drainages west of this system remain referred to the taxon *Macrochelys temmincki* .

Etymology: Named in honour of my cousin, Max Hoser of Liverpool and Campbelltown, NSW, Australia, (born in the UK), for various contributions to herpetology in the 1970's and 1980's and social services in NSW in the period since.

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CONFLICT OF INTEREST

The author has no conflicts of interest in terms of this paper or conclusions within.