A new species of long-necked turtle (Pleurodira: Chelidae: *Chelodina*) from the late Miocene Alcoota Local Fauna, Northern Territory, Australia

The new species *Chelodina* (*Chelodina*) *murrayi* is described from the late Miocene Alcoota Local Fauna of central Australia, in the Northern Territory. The new species is based on shell fragments and can be diagnosed by a ventrally reflexed anterior margin of the plastron, a ventrally narrowed cervical scute and strongly dorsally curved margins of the carapace extending from approximately peripheral two to peripheral nine or ten as well as by a unique combination of characters. Within *Chelodina* the new species is part of the nominal subgenus and within that subgenus it is most closely related to the *Chelodina (Chelodina) novaeguineae* species group. This is not only the oldest record but also the most southerly occurrence of this species group.

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Introduction

9   *Chelodina* is an extant genus of chelid turtle found in Australia, New Guinea, East Timor and
10 Roti Island, Indonesia (Georges & Thomson, 2010). Popularly known as long-necked or snake-
11 necked turtles they are readily distinguished from other Australasian chelids by their elongated
12 necks, four-clawed forelimbs and contacting gular scutes on the plastron (Cogger, 1975; Georges
13 & Thomson, 2010). The genus is also distinguished by a distinctive skull morphology including
14 the loss of the temporal bar, fusion of the frontals, nasals separated by an anterior process of the
15 frontals and an extensive quadrate-basisphenoid contact (Gaffney, 1977). Gaffney (1977)
16 proposed that the genus shares closer relationships with long-necked South American chelids
17 (such as *Hydromedusa* and *Chelus*) than with short-necked Australasian chelids on the basis of
18 shared derived morphological features. However phylogenetic analyses of nuclear and
19 mitochondrial genes indicate that reciprocal monophyly of South American and Australasian
20 chelids is a much more likely scenario (Seddon et al., 1997; Georges et al, 1998). In keeping with
21 its probable monophyly, Georges et al. (1998) unwittingly resurrected the old name Chelodininae
22 Baur, 1893 for the Australasian clade when they proposed the same name as new. Within
23 Chelodininae, *Chelodina* is invariably the sister taxon of all other Australasian chelids in all
24 analyses where Chelodininae is recovered, or the taxon sampling is restricted to chelodinines
25 (Georges & Adams, 1992; Seddon et al., 1997; Georges et al., 1998; Thomson & Georges, 2009).

26 Within *Chelodina* three separate species groups can be recognised on the basis of morphology
27 and electrophoretic analysis of allozymes (Burbidge, Kirsch & Main, 1974; Georges, Adams &
28 McCord, 2002). These groups have been assigned separate generic names (Wells & Wellington,
29 1985; McCord & Ouni, 2007) but a recent synthetic work on Australian turtle taxonomy has
30 treated them as subgenera (Georges & Thomson, 2010) and this practice is followed here. *C.*
31 (*Chelodina*) includes smaller species with broad plastron and a slender head and neck with a
32 length that does not exceed that of the carapace (Georges & Thomson, 2010). *C.*
33 (*Macrochelodina*) includes larger species with a long broad head and neck that exceeds the length
34 of the carapace and a narrow plastron. *C.* (*Macrodiremys*) includes a single species, *C.*
35 (*Macrodiremys*) *colliei*, which is outwardly similar to *C.* (*Macrochelodina*) but has some unusual
36 characters such as a continuous row of exposed neural bones in the carapace and a lack of
37 posterior expansion of the carapace (Burbidge, Kirsch & Main, 1974; Georges & Thomson,
38 2010). Furthermore molecular phylogenetics has consistently found *C.* (*Macrodiremys*) *colliei* to
39 be more closely related to *C.* (*Chelodina*) than to *C.* (*Macrochelodina*), supporting its separation
40 from the latter (Seddon *et al*. 1997, Georges *et al*. 1998; Georges, Adams & McCord, 2002).

The fossil record of *Chelodina*

41

42   *Chelodina* has a long fossil record, as one might expect from such a deep branch within
43   Chelodininae. However it is much sparser than the fossil record of the short-necked chelodinine
44   clade.

45   The earliest specimens referred to *Chelodina* have been found in the Eocene deposits of Redbank
46   Plains in south eastern Queensland. Here there are three forms known from incomplete shells,
47   one of which has been named *C. alanrixi* (Lapparent de Broin & Molnar, 2001). None of these
48   forms can be easily assigned to the extant subgenera, not least because the material is limited and
49   incomplete. In the case of *C. alanrixi* there are some similarities with *C.* (*Macrochelodina*) but
50   there are also some notable plesiomorphies such as a complete row of exposed neural bones in
51   the carapace and a posterior vertebral scute that is as wide as the suprapygal scute (Lapparent de
52   Broin & Molnar, 2001). These indicate that *C. alanrixi* could well belong to the *Chelodina* stem-
53   group, rather than to any of the recognised subgenera but this will need to be tested with more
54   complete fossils and a phylogenetic analysis of *Chelodina* ingroup relationships that includes
55   fossils.

56   There is a considerable gap between the Eocene and the next oldest occurrences of *Chelodina* in
57   the early to middle Miocene carbonate deposits of Riversleigh in Queensland and Bullock Creek
58   in the Northern Territory. *Chelodina* has been recorded from two sites at Riversleigh, Gag Site
59   and Quentin's Quarry, both of which have been assigned to system C (Archer et al., 1989).
60   However, constrained seriation analysis indicates that Quentin's Quarry is referrable to the early
61   Miocene Wipajirian Australian Land Mammal Age, whereas Gag Site belongs to the younger
62   middle Miocene Camfieldian ALMA (Megirian et al., 2010). The Quentin's Quarry specimen is
63   an intriguing skull fragment that exhibits several distinct autapomorphies and cannot be easily
64   placed in any of the extant subgenera (White, 1997). The specimen from Gag site is a
65   fragmentary shell that would appear to have affinities *C.* (*Macrochelodina*) based on the absence
66   of exposed neural bones and the length of its intergular scute which is only slightly longer than
67   the midline contact of the pectoral scutes (Gaffney, Archer & White, 1989).

68   The Camfield beds of Bullock Creek are Camfieldian in age and have produced two distinct
69   *Chelodina* species. Both species are only known with certainty from isolated epiplastra (Megirian
70   & Murray, 1999). One of these, *Chelodina* sp. B, may belong to *C.* (*Chelodina*) based on the
71   squared-off profile of the anterior lobe of the plastron.

72   The record becomes a little better in the Plio-Pleistocene. From Tara Creek in Queensland there is
73   a *Chelodina* specimen that is likely to be similar in age to the nearby Bluff Downs local fauna
74   (Gaffney, 1981). The Bluff Downs local fauna is Early Pliocene in age and belongs to the
75   Tirarian ALMA (Megirian et al., 2010). The specimen is unusual in that it lacks a finely
76   ornamented surface even though the seams between scutes are well-marked (Gaffney, 1981).
77   Based on the narrow anterior lobe of the plastron, a long inter-pectoral seam which exceeds the
78   length of the intergular scute (Gaffney, 1981, fig. 8), this specimen would appear to be a member
79   of *Chelodina* (*Macrochelodina*).

80 From the Pliocene Bluff downs local fauna itself there is a single nuchal bone that has been
81 identified as *Chelodina* based largely on the presence of a broad, square-shaped cervical scute
82 (Thomson & Mackness, 1999). The specimen was tentatively assigned to the nominate subgenus
83 (as the '*Chelodina longicollis* group') on the basis of its well developed ornamentation. However,
84 as the authors themselves note, this is a variable character, for example *Chelodina*
85 (*Macrochelodina*) *insculpta* also has well-developed surficial ornamentation (Thomson, 2000,
86 fig. 4).

87 *Chelodina* (*Macrochelodina*) *insculpta* is a named fossil species based on fragments from the
88 Plio-Pleistocene of the Darling Downs that bear a close resemblance to *C*. (*M*.) *expansa* but differ
89 from it in a having a less flared margin of the carapace (Thomson, 2000).

90 Lapparent de Broin & Molnar (2001) point out that a posterior plastral fragment figured by
91 Gaffney (1981, fig. 18a) belongs to *Chelodina* based on the rounded shape of the posterolateral
92 margin of the ischiadic scar on the dorsal surface of the xiphiplastron and the rounded nature of
93 the fine tubercles that decorate its ventral surface. This fragment comes from the late Pleistocene,
94 or Naracourtean, Katapiri Formation of Lake Kanunka, in the Tirari Desert of central South
95 Australia. A second probable Pleistocene from central South Australia is represented by an
96 isolated cervical vertebra from Cooper Creek (Gaffney, 1981). Unfortunately neither specimen
97 displays diagnostic characters that would allow determination of their subgeneric affinities.
98 Nonetheless these specimens are interesting because they show that *Chelodina* was surviving in
99 central Australia until quite recently, well outside its present range.

100 Lastly there is a Naracourtean (late Pleistocene) record of *Chelodina* from Henshkes Cave, in
101 south eastern South Australia based on isolated plastron elements (Gaffney, 1981). These are
102 similar to the extant *C*. (*Macrochelodina*) *expansa* (Gaffney, 1981).

103 While it is highly likely that remains of the widespread, common species *C*. (*Chelodina*)
104 *longicollis* are present in some of many Naracourtean vertebrate faunas of south eastern
105 Australia, none have been positively recorded.

106 Thus *C*. (*Chelodina*) has an exceptionally poor fossil record, if any at all, with just a couple of
107 fragmentary possible occurrences reported in the literature. Here I describe a new species of this
108 subgenus from the late Miocene vertebrate fossil locality of Alcoota Station, Northern Territory.
109 This is the first definite occurrence of the subgenus in the fossil record and the first diagnosable
110 extinct species in the subgenus.

111 **Geological Setting**
112 The Waite Formation is a late Neogene filling of the Waite Basin, a small intracratonic basin
113 located in the Northern Territory to the northeast of Alice Springs (Woodburne, 1967). It is a
114 coarsening-upward sequence of fluviatile silts and sands with minor limestone beds (Woodburne,
115 1967). Two vertebrate fossil-bearing horizons are known, one giving rise to the older Alcoota
116 local fauna and the other the younger Ongeva local fauna (Woodburne, 1967; Megirian, Murray

117 & Wells, 1996). The Alcoota Local Fauna is found in an extensive, dense, jumbled bone bed. The
118 bone bed is thought to have formed from a debris flow that incorporated the skeletons of many
119 hundreds of animals that had died in a drought-related mass mortality event around a major
120 waterhole in an ancient river system (Murray & Vickers-Rich, 2004). Almost all of the bones in
121 the deposit are disarticulated and randomly scattered. The bulk of the fossils belong to terrestrial
122 species, dominated by the small macropodine wallaby, *Dorcopsoides*, several diprotodontid
123 marsupials and large dromornithid birds (Murray & Megirian, 1992). Turtles are rare in this
124 deposit and are only known from isolated bones of the shell. These fragments have received little
125 attention in the scientific literature. They were first mentioned by Newsome & Rochow (1964)
126 and then again by Gaffney (1981). Neither were able to identify the limited material as anything
127 more precise than 'Testudines indeterminate'. An intensive collecting program led by the
128 Museum and Art Gallery of the Northern Territory over the past three decades has produced
129 many more pieces of turtle shell, including diagnostic elements that allow a new species to be
130 recognised.

131 **Systematic palaeontology**

132 TESTUDINES Linnaeus, 1758

133 PLEURODIRA Cope, 1864

134 CHELIDAE Gray, 1831

135 CHELODININAE Baur, 1893

136 ***Chelodina*** Fitzinger, 1826

137 *Chelodina* (*Chelodina*) (Fitzinger, 1826)

138 *Chelodina* (*Chelodina*) *murrayi* sp. nov.

139 urn:lsid:zoobank.org:act:9DDFE14D-8E52-4F7D-B148-F552100865C9

140 *Holotype*. NTM P5364, right epiplastron (Figure 1).

141 *Referred Specimens*. NTM P5337, peripheral, probably left peripheral 2; NTM P5369, left
142 hyoplastron; NTM P5370, nuchal; NTM 5371, left peripheral 8; NTM 5373, peripheral, probably
143 left peripheral 10; NTM P5374, right xiphiplastron; NTM P5375, left hypoplastron; NTM P5376,
144 mid-series costal; NTM P5377, proximal end of right costal 7; NTM P5378, indeterminate
145 peripheral; NTM P5409, distal end of right costal 2; NTM P9810, left hypoplastron; NTM
146 P9892, right hypoplastron; plus many other poorly informative shell fragments that are
147 unregistered in the NTM palaeontology collection.

148 *Locality and Horizon*. All specimens come from the lower bone bed of the Waite Formation on
149 Alcoota Scientific Reserve, 200 km northeast of Alice Springs, Northern Territory, Australia. The

150   lower bone bed (Alcoota Local Fauna) is Late Miocene in age or Waitean in terms of Australian
151   Land Mammal Ages (Megirian et al., 2010).

152   *Etymology*. In recognition of Peter Murray, who has led two decades of excavation at Alcoota and
153   has published many significant contributions to our knowledge of the site.

154   *Diagnosis*. A species of *C.* (*Chelodina*) with the following autapomorphies: a sharp, ventrally-
155   curved lip along the anterior margin of the gular scute of the plastron. Ventral side of the cervical
156   scute of the carapace is 55% of the width of the dorsal side. Dorsally-curved lateral margins of
157   the peripheral extending away from the bridge area both anteriorly and posteriorly, perhaps as far
158   as peripheral 2 anteriorly and peripheral 10 posteriorly.

159   *Differential Diagnosis*. Apart from the diagnostic autapomorphies mentioned above *C. (C.)*
160   *murrayi* has a unique combination of characters that allow it to be distinguished from all other
161   Australasian chelids. It can be distinguished from all short-necked Australasian chelids by the
162   presence of a midline contact between the gular scutes, anterior to the intergular scute on the
163   plastron. It can be distinguished from *Chelodina* (*Macrodiremys*) *colliei* by the lateral expansion
164   of the anterior lobe of the plastron, the location of the triple junction between the intergular,
165   humeral and pectoral scutes on the epiplastron and a robust, medially extended anterior bridge
166   strut of the hyoplastron. It can be distinguished from species of *Chelodina* (*Macrochelodina*) by
167   the lateral expansion of the anterior lobe of the plastron, a broad, tear-drop shaped sutural surface
168   on the anterior bridge strut, absence of a well-defined line on the anterior bridge strut
169   demarcating the attachment of the dermis and the short junction of the pectoral scute pair that
170   was exceeded in length by the intergular scute. Within *Chelodina* (*Chelodina*) it can be
171   distinguished from *C. (C.) longicollis* and *C. (C.) steindachneri* by a large anterior bridge strut
172   that almost certainly extended onto the pleural bones. The strongly dorsally curved margins of the
173   peripheral bones distinguish it from *C. (C.) steindachneri*, *C. (C.) pritchardi* and *C. (C.) reimanni*
174   which have no marginal curving. The well-developed and extensive nature of this curving also
175   serves to distinguish the new species from *C. (C.) novaeguineae* and *C. (C.) canni* which only
176   develop weak marginal curving in the bridge region. It can be distinguished from *C. C. (C.)*
177   *pritchardi*, *(C.) novaguineae*, *C. (C.) mccordi*, and *C. (C.) reimanni* by the widening of the
178   anterior plastral lobe anterior to the axial notch. The lack of a distinct lateral bulge of the femoral
179   scute on the xiphiplastron distinguishes it from *C. (C.) longicollis*, *C. (C.) novaeguineae* and *C.*
180   *(C.) reimanni*. Finally the failure of the intergular scute to extend broadly onto the hyoplastra
181   distinguishes this species from *C. (C.) canni*.

182   **Description**

183   **Carapace**
184   *Nuchal bone*. The nuchal bone (NTM P5370) is the most informative part of the carapace that has
185   been recovered from Alcoota (Fig. 2). It is a roughly trapezoidal, bilaterally symmetrical plate
186   that is only marginally longer than it is wide at its posterior end. The lateral edges that contacted
187   the first peripherals on each side are gently concave whereas the posterior margin that would

188   have sutured with the first pair of costals is convex. The seams that mark the boundaries of the
189   scutes on the dorsal surface of the nuchal indicate that the anterior end was covered by a central
190   cervical scute which was flanked on each side by the first pair of marginal scutes. The cervical
191   scute is broadly rectangular and is 1.27 times longer than it is wide. Posteriorly the dorsal surface
192   of the nuchal bone was covered entirely by a large first vertebral scute. The dorsal profile of the
193   nuchal bone is gently concave. Ventrally the fine reticulate ornament and scute seams extend
194   posteriorly for 20 mm before reaching the crescent-shaped scar that marks the attachment of the
195   skin to the ventral surface of the carapace. The portion of the cervical scute that continues onto
196   the ventral surface of the carapace is strongly narrowed relative to the dorsal portion. Its width is
197   51 per cent of the dorsal portion of the scute. The anterior rim of the nuchal is not curved
198   dorsally, unlike the margins of all the known peripherals.

199   *Costal bones*. There are several costal bone fragments, of which NTM P5377, the proximal end
200   of a right costal 7, is the most informative (Figure 3A-D). The costal bone extends all the way to
201   the midline indicating that there was no exposed neural bone on the midline. Other fragments
202   from the medial ends of costals also lack an exposed neural bone, indicating that there were at
203   most one or two discontinuous exposed neurals, if any at all. Dorsally the bone is traversed by a
204   single longitudinal seam that in life divided the fourth pleural scute from the fourth or fifth
205   vertebral scute. The dorsal surfaces of all of the costal bones are rugose with rounded irregular
206   ridges that tend to become elongated and transversely aligned toward the distal end (fig. 3E).
207   These replace the rounded flat tubercles separated by a network of finely etched grooves that are
208   seen on the ventral surface of the plastron and the dorsal surface of some of the peripherals. A
209   fossa with a sharp anterior rim excavates the ventral surface along the posterior margin, near the
210   medial end. This represents the anterior part of the iliac scar. The medial ends of this specimen
211   and other costal bones do not curve ventrally indicating that a longitudinal median furrow was
212   not present.

213   *Peripheral bones*. All of the preserved peripheral bones (NTM P5337, P5371, 5373 and P5378)
214   have dorsally curved margins. The anterior most preserved peripheral (NTM P5337) is almost
215   certainly peripheral 2 (Fig. 4A-F), while the posterior most one (NTM P5373) is probably a
216   peripheral 10 based on the sinuous posterior sutural line that would have contacted the pygal
217   (Fig. 4G-L). These indicated that the upcurved margins of the shell extended well anterior and
218   posterior of the bridge. The margin of peripheral 2 is particularly strongly curved, similar to the
219   degree displayed by peripherals from the bridge region of *C. (C.) longicollis* even though this
220   specimen is clearly not from the bridge (fig. 4B). The dorsal surface of the peripherals is
221   ornamented with fine irregular rugae (e.g. NTM P5337, Fig. 4A) or a fine reticulate ornament of
222   the same type seen on the surface of the bones of the plastron (e.g. NTM P5373, Fig. 4G).

223   **Plastron**
224   Like the carapace the plastron is only known from isolated elements. However, unlike the
225   carapace, enough pieces are known from similar sized individuals to produce a reconstruction
226   (Fig. 5).

227 *Epiplastron*. The epiplastron is represented by the holotype, NTM P5364 (Fig. 1). It is a roughly
228 elliptical plate with a rounded convex anterolateral margin. The margin forms a thin sharp edge
229 that is weakly reflexed ventrally at its posterior end where it forms the anterolateral margin of the
230 humeral scute. The ventral curvature of the margin becomes more strongly developed anteriorly,
231 along the anterolateral margin of the gular scute. Anteriorly the ventral surface is crossed by the
232 seam between the gular and intergular scutes. This seam reaches the median symphyseal line
233 posterior to the anterior margin indicating that the intergular scute was retracted from the anterior
234 margin and the two gular scutes had an anterior midline contact. However this midline contact
235 appears to have been rather short, with a pointed anterior process of the intergular scute intruding
236 deeply between the pair. The posterior end of the epiplastron is damaged but a seam line can be
237 seen clearly curving from the lateral margin of the intergular scute toward the lateral margin of
238 the epiplastron. This seam forms the posterior border of the humeral scute and indicates that the
239 pectoral scute extended onto the posterior surface of the epiplastron. The humeral-pectoral scute
240 seam meets the humeral-intergular scute seam at the medial margin of NTM P5364, but this is
241 clearly a broken edge, not the sutural surface that contacts the entoplastron. Therefore the triple
242 junction of the humeral, pectoral and intergular scute occurs on the epiplastron.

243 *Hyoplastron*. The complete hyoplastron (NTM P5369) is the largest single piece of turtle shell
244 recovered from Alcoota (Fig. 6). It represents a moderately small turtle with a plastron width at
245 the level of the axial notches of about 105 mm. The anterior lobe expands slightly laterally,
246 anterior to the axial notch as in adult *C. (C.) canni* (McCord & Thomson, 2002), though not to
247 the extreme displayed by *C. (C.) longicollis* (e.g. NTM R27168). In lateral view the anterior lobe
248 is slightly upcurved. Its margin is a simple edge that is not ventrally reflexed as in the margin of
249 the epiplastron. A strongly developed seam representing the junction of the abdominal and
250 pectoral scutes extends transversely across the ventral surface, approximately one quater of the
251 length of the bone from its posterior margin. The seam curves posteriorly as it approaches the
252 medial symphyseal suture. There is no seam present near the anteromedial corner of the bone
253 where the medial symphysis meets the suture between the hyoplastron and the entoplastron. This
254 indicates that the posterior end of the intergular scute terminated on the entoplastron and did not
255 extend onto the hyoplastra as it does in *C. (C.) canni* (pers. obs., NTM R16325). Anteriorly the
256 hyolplastron forms a short jagged sutural surface that contacted the epiplastron. Lateral to the
257 triangular notch in this suture, the ventral surface is marked by a seam that extends from the
258 hyoplastron-epiplastron suture to the lateral margin of the hyoplastron. This indicates that the
259 posterolateral corner of the humeral scute extended onto the hyoplastron. Because the humeral-
260 pectoral scute seam intersects the hyoplastron-epiplastron suture rather than extending
261 transversely to the hyoplastron-entoplastron suture, the pectoral scute must have extended onto
262 the epiplastron, as is shown by the epiplastron from Alcoota (NTM P5364). The axial notch
263 extends for slightly less than half the length of the hyoplastron. The bridge region, posterior and
264 lateral to the axial notch is set at a very broad angle to the ventral plate of the hypolastron.
265 Although some crushing may have further flattened the hypolastron it seems likely that the shell
266 was quite dorsoventrally shallow in life. The anterior end of the bridge region curves sharply
267 dorsally and medially to form the anterior bridge strut. No distinct line can be seen on this surface
268 marking the attachment of the dermis. A rounded notch that is 1.7 mm across excavates the

269 anterodorsal margin of the bridge at the point that it curves medially to form the anterior bridge
270 strut (Fig. 7C). This notch would have formed a complete foramen when articulated with the third
271 peripheral. Extant *Chelodina* have a well developed foramen in the same position to allow for the
272 passage of the axillary duct of Rathke's gland (Goode, 1967; Weldon & Gaffney 1998). The
273 sutural surface of the anterior bridge strut that contacted the carapace is tear-drop shaped with a
274 strongly expanded medial end. The medial projection of the anterior bridge strut is great enough
275 to be confident that it would have made broad contact with the ventral surface with the first costal
276 bone when articulated with the carapace.

277 *Hypoplastron*. The hypoplastron is represented by three specimens, all of which are damaged.
278 The main body is a roughly square plate with a laterally protruding bridge process (Figs. 8, 9).
279 The ventral surface of the main body is traversed by a straight transverse seam, dividing the
280 abdominal scute from the femoral scute. The lateral end of the seam terminates at the rounded
281 inguinal notch between the body and the bridge process. Posterior to the inguinal notch the lateral
282 margin of the femoral scute is produced laterally to form a modest semilunate flange. As in the
283 hyoplastron the bridge is set at a very broad angle to the main body, indicating a markedly
284 shallow shell not unlike *C. (C.) steindachneri*.

285 *Xiphiplastron*. The single complete xiphiplastron (NTM P5374) is a flat trapezoidal plate (Fig.
286 10). The ventral surface was largely covered by the anal scute with a narrow band of the femoral
287 scute covering the anterior end of the bone. The lateral margin is damaged in the middle but the
288 posterior and anterior ends of the lateral margin are complete. These show that the lateral margin
289 in the region of the femoral scute was in line with the posterior lateral margin of the anal scute
290 and did not project laterally to form a femoral bulge like some chelodinines such as *Chelodina*
291 (*Chelodina*) *longicollis* and *Birlimarr gaffneyi* (Megirian & Murray, 1999). The posterolateral
292 corner is moderately thickened and upturned. It is not extended posteriorly and the lateral and
293 posterior margins meet to form a right-angled corner. Mirror-imaging (Fig. 10E) indicates that the
294 anal notch was triangular. The dorsal surface bears sutural scars for the ischium and pubis. The
295 pubic scar is centrally located in the anterior half of the xiphiplastron and is roughly oval and
296 oriented with its long axis extending obliquely anteromedial to posterolateral. The ischiadic scar
297 is elongate and tongue-shaped and extends to the midline suture, where it would have met its
298 partner and formed a continuous crescentic scar. The anterior and posterior margins of the scar
299 are parallel and do not diverge laterally. The posterolateral margin is rounded.

Discussion

Phylogenetic relationships

302 The midline contact of the gular scutes anterior to the intergular is a well-known synapomorphy
303 of *Chelodina* (Gaffney, 1977, 1981; Georges & Thomson, 2010). The rounded posterolateral
304 margin of the ischiadic scar on the xiphiplastron is a further synapomorphy of *Chelodina*
305 (Lapparent de Broin & Molnar, 2001). Finally the enlargement of the axillary scent gland

306 foramen would appear to be also a synapomorphy of *Chelodina*. The foramen is large in
307 *Chelodina (Chelodina)* (e.g. diameter of 2.2 mm in *C. (C.) longicollis*; NTM R27168) and
308 *Chelodina (Macrochelodina)* (e.g. *C. (M.) expansa*; Goode, 1967, fig. 134) whereas it is
309 comparatively tiny in members of the short-necked clade (e.g. diameter of 0.9 mm in *Emydura*
310 sp.; NTM unregistered) (Fig. 7A).

311 Lateral widening of the anterior lobe of the plastron is a character that has only been observed
312 among members of the nominal subgenus (e.g. *C. (C.) longicollis* and *C. (C.) canni*) and is
313 probably a synapomorphy of the subgenus that reverses in some members of the *C. (C.)*
314 *novaeguineae* species complex. Further supporting a position within *C. (Chelodina)*, the length of
315 the intergular scute was almost certainly greater than twice the length of the seam between the
316 pectoral scutes. In short-necked chelodinines the ratio of the length of the intergular scute to the
317 length of the shared pectoral seam ranges from 0.55 (*Emydura* sp.) to 1.35 (*Pseudemydura*
318 *umbrina*) a range that overlaps with the range of 1.14 to 1.53 seen in *Chelodina*
319 (*Macrochelodina*) (Table 1). *C. (Macrodiremys) colliei* also falls in this range with a ratio of 1.43.
320 Thus a ratio of less than 2 is clearly primitive for Chelodininae. In contrast all members of *C.*
321 *(Chelodina)* have an intergular scute that is more than twice the length of the shared pectoral
322 seam and can range up to 5.35 times longer in *C. (C.) canni* (Table 1).

323 The state of this character can be determined in *C. (Chelodina) murrayi* despite the fragmentary
324 nature of the material. The length of the junction between the pectoral scutes on the hyoplastron
325 (P5369) is 28 mm. Because the intergular scute extends close to the posterior end of the
326 entoplastron in all *Chelodina*, the total length of the pectoral scute junction in life could not have
327 been more than a few millimetres longer than the length of the seam present on the hyoplastron.
328 The depth of the notch in the anterior margin of the hyoplastron for receiving the entoplastron is
329 27 mm. Thus the midline length of the intergular scute was approximately 27 mm plus an
330 unknown length that protruded anteriorly between the epiplastra. There is 18 mm of intergular
331 scute overlapping the midline suture of the epiplastron. Because the width of this epiplastron
332 from the midline to the lateral edge is a good match for the width of the anterior end of the
333 hyoplastron (Fig. 6A) they must derive from similar sized individuals or possibly even the same
334 individual. Thus we can be confident that the length of the intergular in an individual the size of
335 P5369 or P 5364 was 45mm (18 + 27) plus an unknown length between the anterior end of the
336 hyoplastron and the posterior end of the midline suture between the epiplastra. Thus, even when
337 the unknown segment of the intergular is ignored, the ratio of intergular to the shared pectoral
338 seam exceeds the ratio of 1.5 which lies at the upper end of the range in *Chelodina*
339 *(Macrochelodina)* and *Chelodina (Macrodiremys)*. Indeed the reconstruction suggests that the
340 total length of the intergular was likely to be around 65 mm, which is 2.3 times the length of the
341 shared seam between the pair of pectoral scutes.

342 Finally supporting the subgeneric placement of *C. (C.) murrayi* is the absence of a distinct line
343 demarcating the attachment of the dermis on the anterior surface of the anterior bridge strut. In
344 short-necked chelodinines (fig. 7A) and in *Chelodina (Macrochelodina)* ssp. (pers. obs., NTM
345 R35010, NTM R24813) there is a distinct, sharp line extending anterodorsally from the axillary
346 notch to the peripherals of the carapace that indicates the position that the dermis attached to the

347 shell and divides the ornamented external surface from the smooth inner surface. In *Chelodina*
348 *(Chelodina)* however there is no distinct line and the external surface merges gradually with the
349 internal surface (pers. obs., NTM R16325, R27168; Fig. 7B). The latter condition would appear
350 to be the derived one and is a further synapomorphy of *Chelodina (Chelodina)*.

351 Within *Chelodina (Chelodina)* the large medially inflected and terminally expanded anterior
352 bridge strut of the hyoplastron indicate that its relationships lie with the *C. (C.) novaeguineae*
353 species complex (McCord & Thomson 2002). McCord and Thomson included *C. (C.)*
354 *novaeguineae*, *C. (C.) canni*, *C. (C.) reimanni* and *C. (C.) mccordi* in this complex. I also include
355 *C. (C.) pritchardi* because it has a large anterior bridge strut that contacts the first costal (Rhodin
356 1994a) and is more closely related to other members of the complex than it is to either *C. (C.)*
357 *longicollis* or *C. (C.) steindachneri* (Georges, Adams & McCord, 2002). The condition in basal
358 species of the subgenus, i.e. (*C. (C.) longicollis* and *C. (C.) steindachneri*, is to have reduced
359 anterior bridge struts that do not extend far medially and fail to contact the costal bones
360 (Thomson, 2000). The same condition obtains in *C. (Macrodiremys) colliei* (Thomson, 2000)
361 which is the sister group to *C. (Chelodina)*, indicating that reduced anterior bridge struts are
362 primitive condition for the subgenus. Thus the *C. (C.) novaeguineae* species complex have
363 apparently reversed this condition and have medially extensive anterior bridge struts that broadly
364 contact the costal bones like those of *Chelodina* (*Macrochelodina*) and short-necked chelodinines
365 (Thomson, White & Georges, 1997; McCord & Thomson 2002).

Unity of the hypodigm

367 It is obvious that much of the diagnosis and description of the new taxon is reliant upon the
368 referral of several unassociated specimens to a single taxon. It should be noted that even if there
369 was more than one turtle taxon present at Alcoota, *Chelodina* (*Chelodina*) *murrayi* would still
370 stand as a valid taxon because the holotype epiplastron displays an autapomorphy as well as a
371 synapomorphy of *Chelodina*. Nevertheless the referral of the Alcoota turtle sample to a single
372 species is the most likely hyopothesis based on the following observations.

373 Firstly multiple elements (the epiplastron, hyoplastron and the xiphiplastron) display
374 synapomorphies of *Chelodina*: anteriorly enclosed intergular scute (Fig. 1A), enlarged foramen
375 for Rathke's gland (Fig. 7C), rounded posterlateral margin of ischiadic scar (Fig. 10B, D). The
376 hyoplastron also shows additional synapomorphies of *Chelodina* (*Chelodina*): lateral expansion
377 of anterior lobe of plastron, absence of a distinct line of attachment of the dermis on the anterior
378 bridge strut and a short pectoral-pectoral scute seam.

379 Other elements display plesiomorphies that are only present in *Chelodina* or *Pseudemydura*
380 among Chelodininae. These plesiomorphies include the extension of the pectoral scute onto the
381 posterior end of the epiplastron, a triple junction between the humeral, pectoral and intergular
382 scute located on the epiplastron and a skin-carapace contact on the nuchal bone that lies posterior
383 to the anterior margin of the carapace. None of the preserved elements show any characters of the
384 distinctive *Pseudemydura*, thus these plesiomorphies add further support to the conclusion that
385 most, if not all, of the Alcoota chelid specimens belong to *Chelodina*.

386 None of the preserved elements show any characters that are inconsistent with referral to
387 *Chelodina* (*Chelodina*). These observations strongly suggest that only *Chelodina* (*Chelodina*) is
388 present in the Alcoota assemblage. Extant *Chelodina* (*Chelodina*) species have almost
389 exclusively allopatric ranges (Kennet et al., 1992; Rhodin 1994a&b; McCord & Thomson, 2002;
390 Georges & Thomson, 2010). The Fitzroy-Dawson drainage includes hybrids between *C. (C.)*
391 *canni* and *C. (C.) longicollis* and would appear to represent the sole river system where two
392 species of *Chelodina* (*Chelodina*) overlap (Georges, Adams & McCord, 2002). Thus it is very
393 unlikely that more than one species of *Chelodina* (*Chelodina*) is present in the Alcoota local
394 fauna and the hypodigm of *C. (C.) murrayi* can be safely treated as pertaining to a single species.

395 **Biogeography and Evolution of *Chelodina* (*Chelodina*)**

396 Extant members of the *C. (C.) novaeguineae* complex are restricted to the far north of Australia
397 (*C. (C.) canni*), New Guinea (*C. (C.) novaeguineae*, *C. (C.) reimanni* and *C. (C.) pritchardi*) and
398 Indonesia (*C. (C.) mccordi*). The presence of *C. (C.) murrayi* at Alcoota indicates that this clade
399 extended further south in the past. At present it is not possible to determine if *C. (C.) murrayi* is
400 an unusual southerly extension of an otherwise tropical clade, or whether the species group
401 originated south of its present range and only later radiated in the tropics to the north of
402 continental Australia.

403 The presence of a member of the *C. (C.) novaeguineae* species complex in the late Miocene
404 indicates that stem members of *C. (C.) steindachneri* and *C. (C.) longicollis* were in existence at
405 this time and their divergence was not related to climatic fluctuations of the Pleistocene as has
406 been suggested (Kennet et al., 1992).

407 **Palaeobiology**

408 Among chelodinines it is the members of *Chelodina* (*Chelodina*) that are best able to cope with
409 unpredictable drying events. C. (*C.*) *steindachneri* occupies some of the most arid habitats of any
410 chelodinine, where surface water is ephemeral and infrequent (Cann, 1998). *C. (C.) longicollis*
411 and C. (*C.*) *canni* are reported to travel many kilometres over land (Stott, 1987; Covacevich,
412 1990) and are capable of prolonged aestivation (Bill Cook, reported in Kennet et al., 1992; Roe &
413 Georges, 2007).

414 It is therefore unsurprising to find that the Alcoota chelid belongs to *Chelodina* (*Chelodina*)
415 because palaeoenvironmental indicators suggest that surface water in the Waite Basin, during the
416 late Miocene, was prone to episodic drying events. It is notable that the Alcoota assemblage does
417 not contain any fish. While a preservational bias may account for the lack of smaller fish bones it
418 does not explain the absence of robust lungfish toothplates which are generally abundant in
419 freshwater deposits throughout central and eastern Australia from the late Oligocene through to
420 the Pleistocene (Kemp, 1991, 1993). The lack of lungfish toothplates therefore indicates that
421 surface water at the Alcoota site was not permanent. Other aquatic taxa are scarce. *Chelodina*
422 (*Chelodina*) *murrayi* itself requires a minimum of just two individuals to account for its known
423 remains. Crocodiles are present, but these are massive, altirostral, semiziphodont mekosuchins of
424 the genus *Baru* (pers. obs.) with clear indications that they specialised on large vertebrate prey

425 (Willis, Murray & Megirian, 1990) and thus may not have been as strongly tied to deep
426 permanent water as extant crocodylids are.

Conclusions

428 The chelid material from the late Miocene Alcoota Local Fauna of central Australia can be
429 referred to a single species that is here named *Chelodina (Chelodina) murrayi*. Within the
430 subgenus, the affinities of the new species lie with the *C. (C.) novaeguineae* species complex
431 which now occurs in tropical habitats to the north of Alcoota (mostly outside continental
432 Australia). Thus both the subgenus, and the *C. (C.) novaeguineae* species complex were more
433 widespread in the past and diversification of the extant species began prior to the late Miocene.

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436 field program for over two decades by P. Murray and D. Megirian. Many people have
437 participated in these excavations over the years but J. Archibald stands out as the collector of the
438 holotype and several other important pieces of *Chelodina (Chelodina) murrayi*. Access to
439 comparative specimens was facilitated by G. Dally and S. Horner.

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532   Figure 1. Holotype of *Chelodina (Chelodina) murrayi* sp. nov., right epiplastron, NTM P5364. **A**,
533   ventral view; **B**, dorsal view; **C**, anterior view; **D**, posterolateral view; **E**, interpretive drawing of
534   A; **F**, interpretive drawing of B. Arrow indicates ventrally curved marginal flange. Abbreviations:
535   da, line of dermal attachment; g, gular scute; h, humeral scute; ig, intergular scute; p, pectoral
536   scute; sys, symphyseal surface. Hatched areas represent broken bone surfaces, grey areas
537   represent adherent matrix. Scale bar = 20 mm.

538   Figure 2. *Chelodina (Chelodina) murrayi* sp. nov., nuchal bone, NTM P5370. **A**, dorsal view; **B**,
539   ventral view; **C**, interpretive drawing of A; **D**, interpretive drawing of B. Abbreviations: ce,
540   cervical scute; da, line of the dermal attachment; m1, first marginal scute; ssc1, sutural surface for
541   first costal bone; ssp1, sutural surface for first peripheral bone; v1, first vertebral scute. Hatched
542   areas represent broken bone surfaces. Scale bar = 20 mm.

543   Figure 3. *Chelodina (Chelodina) murrayi* sp. nov., costal bones. **A-D**, proximal end of right
544   costal 7, (NTM P5377). A, dorsal view; B, ventral view; CD; **E**, distal end of right costal 2 (NTM
545   P5409) in dorsal view; **F-I**, interpretive drawings of A-D, respectively; **J**, Interpretive drawing of
546   E. Abbreviations: ia, iliac articulation surface; P1, P2, P4, first, second and fourth pleural scutes;
547   r, medial end of rib; rg, rib gomphosis; ss, symphyseal surface; ssc6, sutural surface for sixth
548   costal bone; sssp, sutural surface for suprapygal bone; V4, fourth vertebral scute; vps, vertebral-
549   pleural scute seam. Hatched areas represent broken bone surfaces, grey areas represent adherent
550   matrix. Scale bar = 20 mm.

551   Figure 4 *Chelodina (Chelodina) murrayi* sp. nov., peripheral bones. **A-F**, left second peripheral,
552   (NTM P5337). A, dorsal view; B, ventral view; C, posterior view; D, interpretive drawing of A;
553   E, interpretive drawing of B; F, interpretive drawing of C; **G-L**, left tenth peripheral, (NTM
554   P5373). G, dorsal view; H, ventral view; I, anterior view; J, interpretive drawing of G; K,
555   interpretive drawing of H; L, interpretive drawing of I. Abbreviations: da, line of the dermal
556   attachment; M2, M3, M10, M11, second, third, tenth and eleventh marginal scutes; P1, P4, first
557   and fourth pleural scutes; ssc1, ssc8, sutural surfaces for first and eighth costal bones; sspe3,
558   sspe9, sspe11, sutural surfaces for third, ninth and eleventh peripheral bones. Scale bar = 20 mm.

559   Figure 5. *Chelodina (Chelodina) murrayi* sp. nov., reconstruction of plastron in ventral view.
560   Abbreviations: AB, abdominal scute; AN, anal scute; ent, entoplastron; epip, epiplastron; FE,
561   femoral scute; GU, gular scute; hyo, hyoplastron; hypo, hypoplastron; HU, humeral scute; IN,
562   intergular scute; PE, pectoral scute; xip,xiphiplastron. Grey areas represent areas of missing bone
563   that have been reconstructed. Scale bar = 50 mm

564   Figure 6. *Chelodina (Chelodina) murrayi* sp. nov., left hyoplastron, NTM P5369. **A**, dorsal view;
565   **B**, ventral view; **C**, anterior view; **D**, lateral view; **E**, interpretive drawing of A; **F**, interpretive
566   drawing of B; **G**, interpretive drawing of C; **H**, interpretive drawing of D. Abbreviations: AB,
567   abdominal scute; abs, anterior bridge strut; HU, humeral scute; PE, pectoral scute; ssca, sutural
568   surface for articulation with the carapace; ssen, sutural surface of the entoplastron; ssep, sutural
569   surface of the epiplastron; sshy, sutural surface of the hypoplastron; sys, symphyseal surface.
570   Scale bar = 20 mm.

571   Figure 7. Anterior bridge struts of various chelodinines in oblique, anterior-ventral-lateral view.
572   Top row: whole specimens with area of enlargement indicated by a box. Bottow row:
573   enlargement of anterior bridge strut area. **A**, *Emydura* sp., NTM unregistered comparative
574   collection; **B**, *Chelodina (Chelodina) longicollis*; **C**, *Chelodina (Chelodina) murrayi*. Dotted line
575   indicates likely extent of foramen for the axillary duct of Rathke's gland. Note that sediment
576   partly infills this notch. Abbreviations: da, line of dermal attachment; rgf, foramen for the axillary
577   duct of Rathke's gland.

578   Figure 8. *Chelodina (Chelodina) murrayi* sp. nov., left hypoplastron, NTM P5375. **A**, dorsal
579   (internal) view; **B**, ventral (external) view; **C**, Interpretive drawing of A; **D**, Interpretive drawing
580   of B. Abbreviations: AB, abdominal scute; b, bridge; FE, femoral scute; ssh, sutural surface for
581   the hyoplastron; ssx, sutural surface for the xiphiplastron; sys, symphyseal surface. Hatched areas
582   represent broken bone surfaces. Scale bar = 20 mm.

583   Figure 9. *Chelodina (Chelodina) murrayi* sp. nov., left hypoplastron, NTM P9810. **A**, dorsal
584   (internal) view; **B**, ventral (external) view; **C**, Interpretive drawing of A; **D**, Interpretive drawing
585   of B. Abbreviations: AB, abdominal scute; b, bridge; FE, femoral scute; ssh, sutural surface for
586   the hyoplastron; ssx, sutural surface for the xiphiplastron; sys, medial symphyseal surface.
587   Hatched areas represent broken bone surfaces, grey areas represent patches of adherent matrix.
588   Scale bar = 20 mm.

589   Figure 10. *Chelodina (Chelodina) murrayi* sp. nov., right xiphiplastron, NTM P5374. **A**, ventral
590   view; **B**, dorsal view; **C**, interpretive drawing of A; **D**, interpretive drawing of B; **E**,
591   reconstruction of articulated xiphiplastron pair in dorsal view. Abbreviations: AN, anal scute; FE,
592   femoral scute; sshy, sutural surface for hypoplastron; ssi, sutural surface for ischium; ssp, sutural
593   surface for pubis; sys, symphyseal surface; tm, possible tooth mark. Hatched areas represent
594   broken bone surfaces, grey areas represent areas of adherent matrix. Scale bar = 20 mm

Figure 1

Figure 1. Holotype of *Chelodina (Chelodina) murrayi* sp. nov., right epiplastron, NTM P5364.

A , ventral view; **B**, dorsal view; **C**, anterior view; **D**, posterolateral view; **E**, interpretive drawing of A; **F**, interpretive drawing of B. Arrow indicates ventrally curved marginal flange. Abbreviations: da, line of dermal attachment; g, gular scute; h, humeral scute; ig, intergular scute; p, pectoral scute; sys, symphyseal surface. Hatched areas represent broken bone surfaces, grey areas represent adherent matrix. Scale bar = 20 mm.
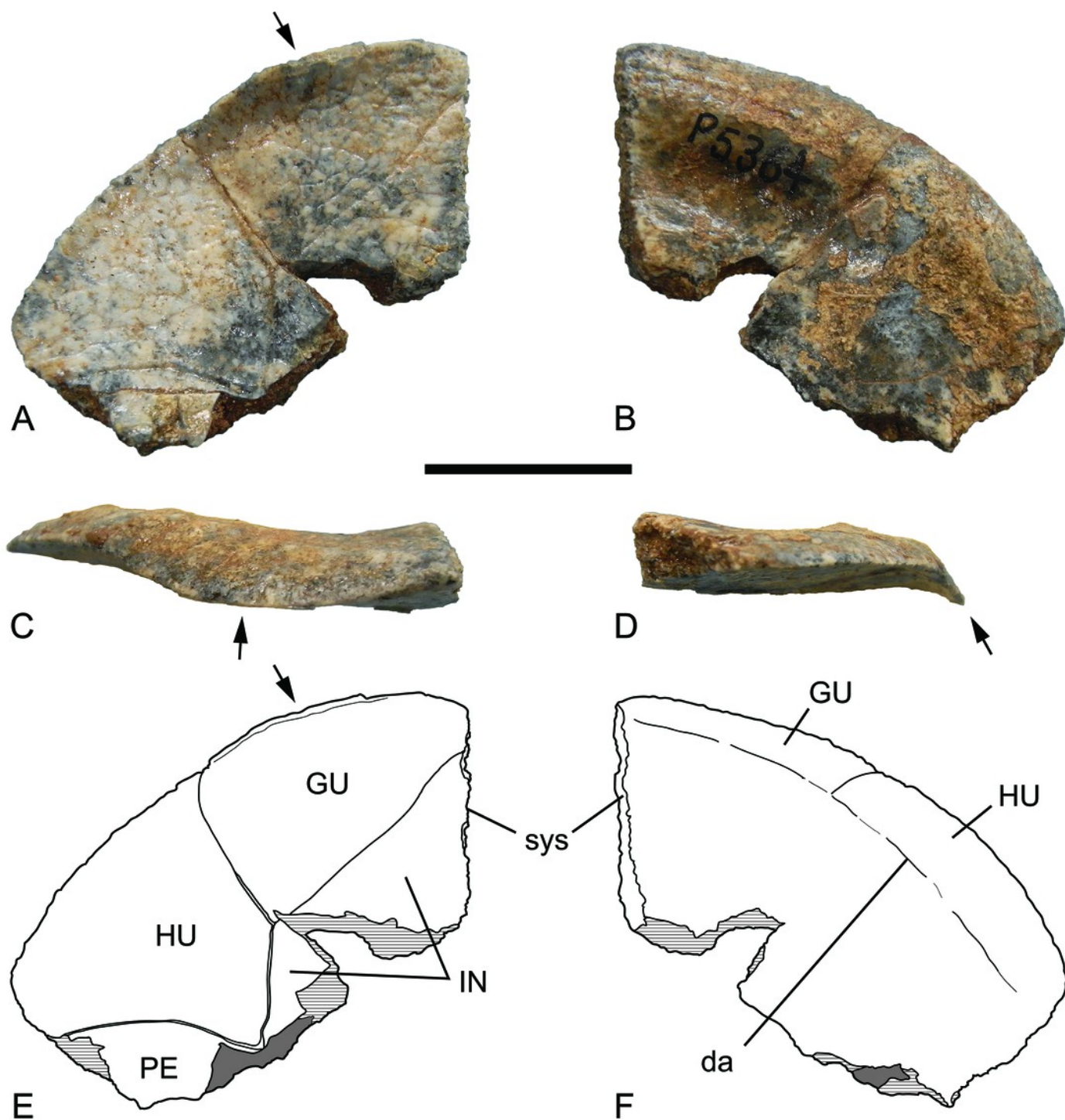
Figure 2

Figure 2. *Chelodina (Chelodina) murrayi* sp. nov., nuchal bone, NTM P5370.

A , dorsal view; **B**, ventral view; **C**, interpretive drawing of A; **D**, interpretive drawing of B. Abbreviations: ce, cervical scute; da, line of the dermal attachment; m1, first marginal scute; ssc1, sutural surface for first costal bone; ssp1, sutural surface for first peripheral bone; v1, first vertebral scute. Hatched areas represent broken bone surfaces. Scale bar = 20 mm.
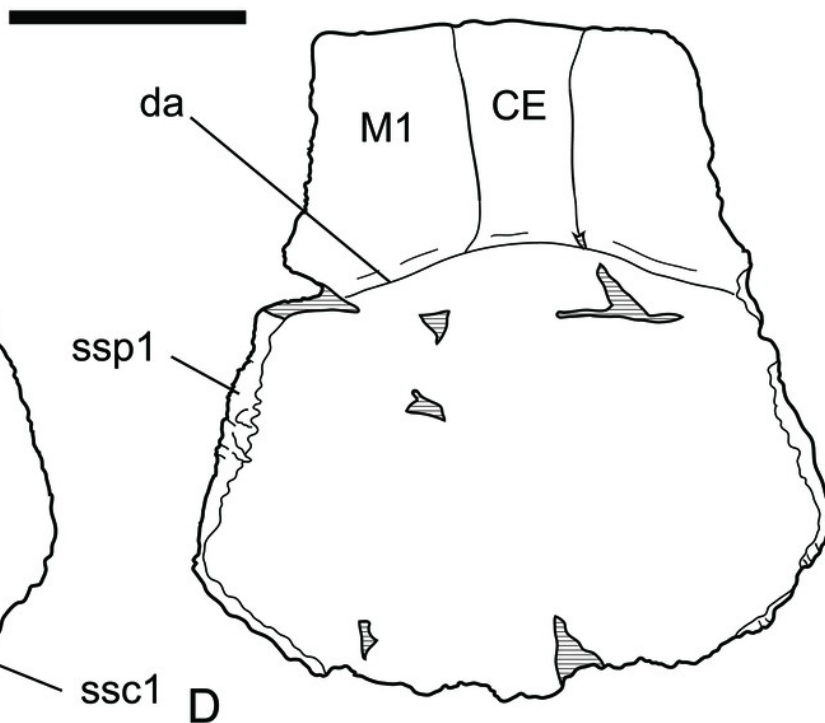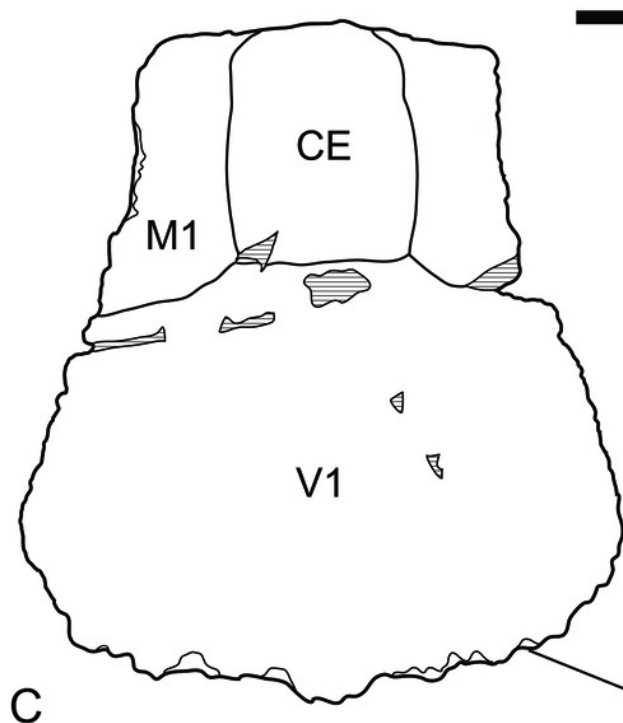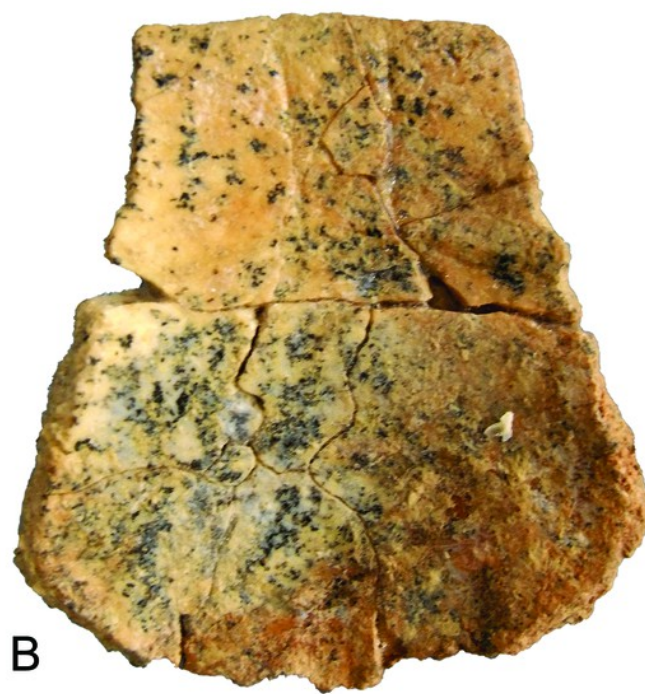
Figure 3

Figure 3. *Chelodina (Chelodina) murrayi* sp. nov., costal bones.

A -**D**, proximal end of right costal 7, (NTM P5377). A, dorsal view; B, ventral view; CD; **E**, distal end of right costal 2 (NTM P5409) in dorsal view; **F-I**, interpretive drawings of A-D, respectively; **J**, Interpretive drawing of E. Abbreviations: ia, iliac articulation surface; P1, P2, P4, first, second and fourth pleural scutes; r, medial end of rib; rg, rib gomphosis; ss, symphyseal surface; ssc6, sutural surface for sixth costal bone; sssp, sutural surface for suprapygal bone; V4, fourth vertebral scute; vps, vertebral-pleural scute seam. Hatched areas represent broken bone surfaces, grey areas represent adherent matrix. Scale bar = 20 mm.
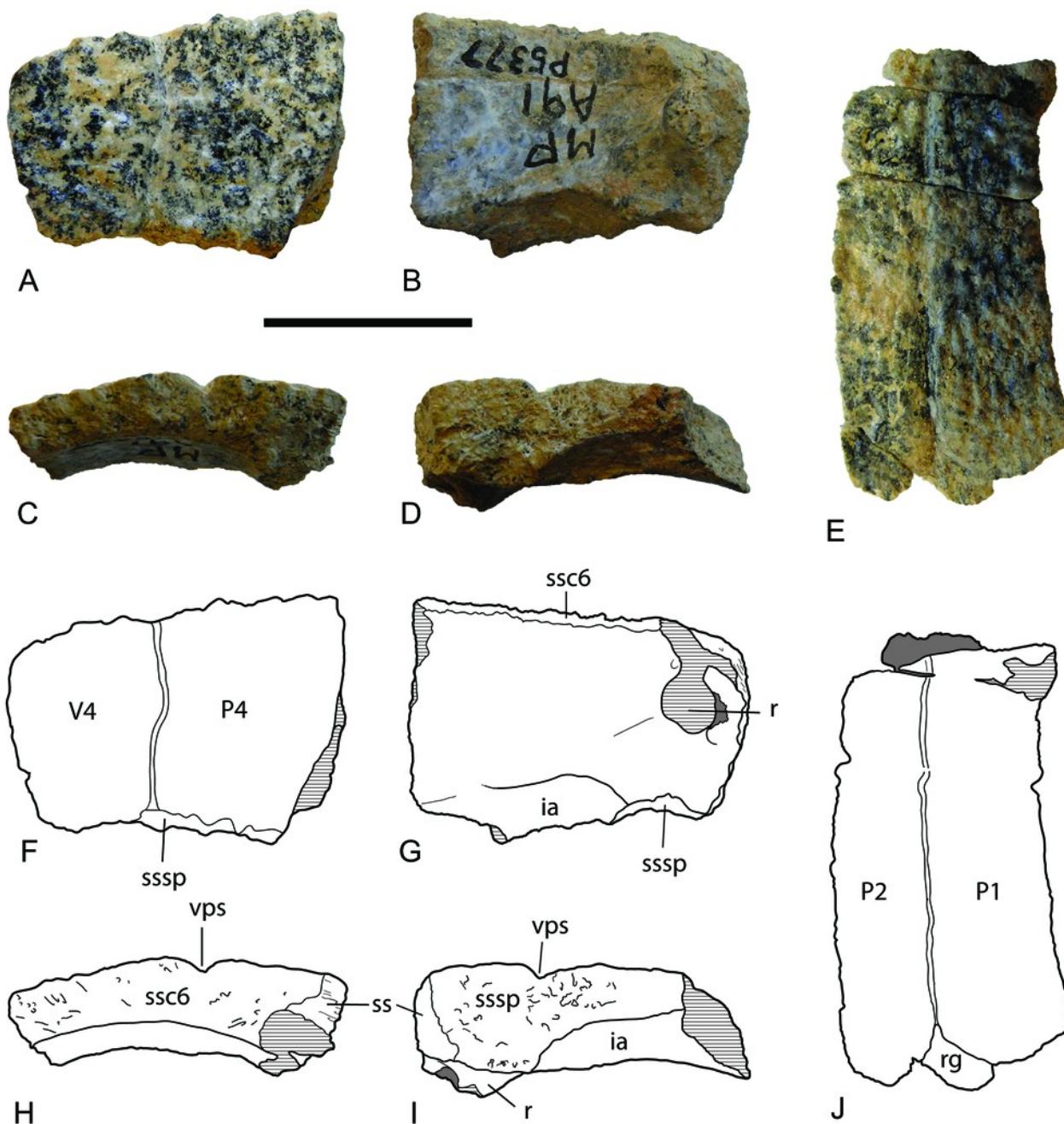
Figure 4

Figure 4 *Chelodina (Chelodina) murrayi* sp. nov., peripheral bones.

A-F , left second peripheral, (NTM P5337). A, dorsal view; B, ventral view; C, posterior view; D, interpretive drawing of A; E, interpretive drawing of B; F, interpretive drawing of C; **G-L**, left tenth peripheral, (NTM P5373). G, dorsal view; H, ventral view; I, anterior view; J, interpretive drawing of G; K, interpretive drawing of H; L, interpretive drawing of I. Abbreviations: da, line of the dermal attachment; M2, M3, M10, M11, second, third, tenth and eleventh marginal scutes; P1, P4, first and fourth pleural scutes; ssc1, ssc8, sutural surfaces for first and eighth costal bones; sspe3, sspe9, sspe11, sutural surfaces for third, ninth and eleventh peripheral bones. Scale bar = 20 mm.
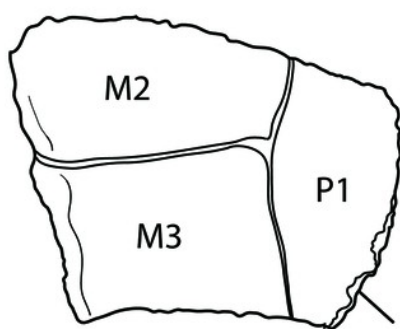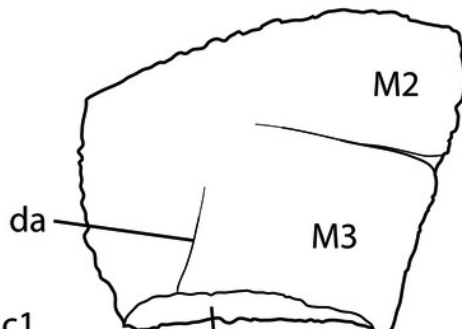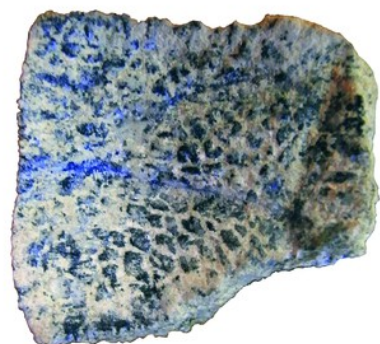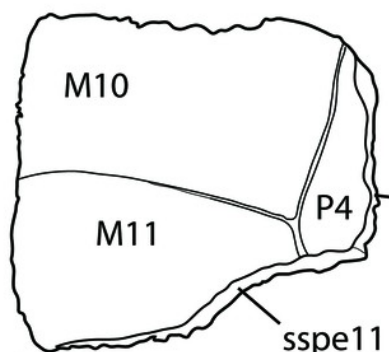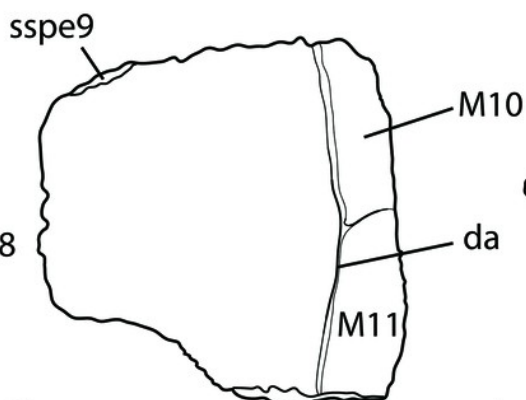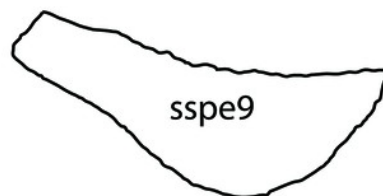
Figure 5

Figure 5. *Chelodina (Chelodina) murrayi* sp. nov., reconstruction of plastron in ventral view.

Abbreviations: AB, abdominal scute; AN, anal scute; ent, entoplastron; epip, epiplastron; FE, femoral scute; GU, gular scute; hyo, hyoplastron; hypo, hypoplastron; HU, humeral scute; IN, intergular scute; PE, pectoral scute; xip,xiphiplastron. Grey areas represent areas of missing bone that have been reconstructed. Scale bar = 50 mm
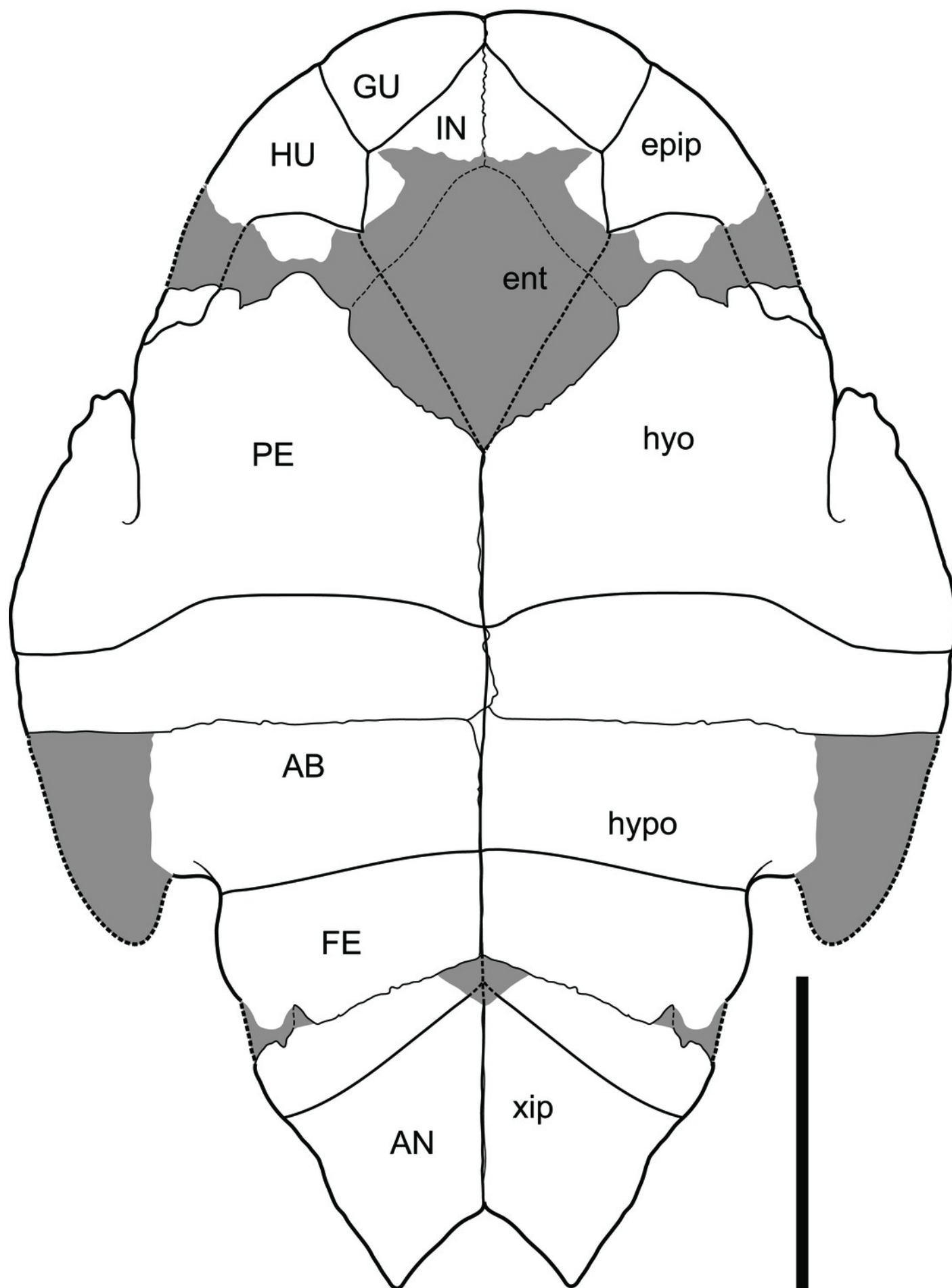
Figure 6

Figure 6. *Chelodina (Chelodina) murrayi* sp. nov., left hyoplastron, NTM P5369.

A , dorsal view; **B**, ventral view; **C**, anterior view; **D**, lateral view; **E**, interpretive drawing of A;

F, interpretive drawing of B; **G**, interpretive drawing of C; **H**, interpretive drawing of D.

Abbreviations: AB, abdominal scute; abs, anterior bridge strut; HU, humeral scute; PE,

pectoral scute; ssca, sutural surface for articulation with the carapace; ssen, sutural surface

of the entoplastron; ssep, sutural surface of the epiplastron; sshy, sutural surface of the

hypoplastron; sys, symphyseal surface. Scale bar = 20 mm.
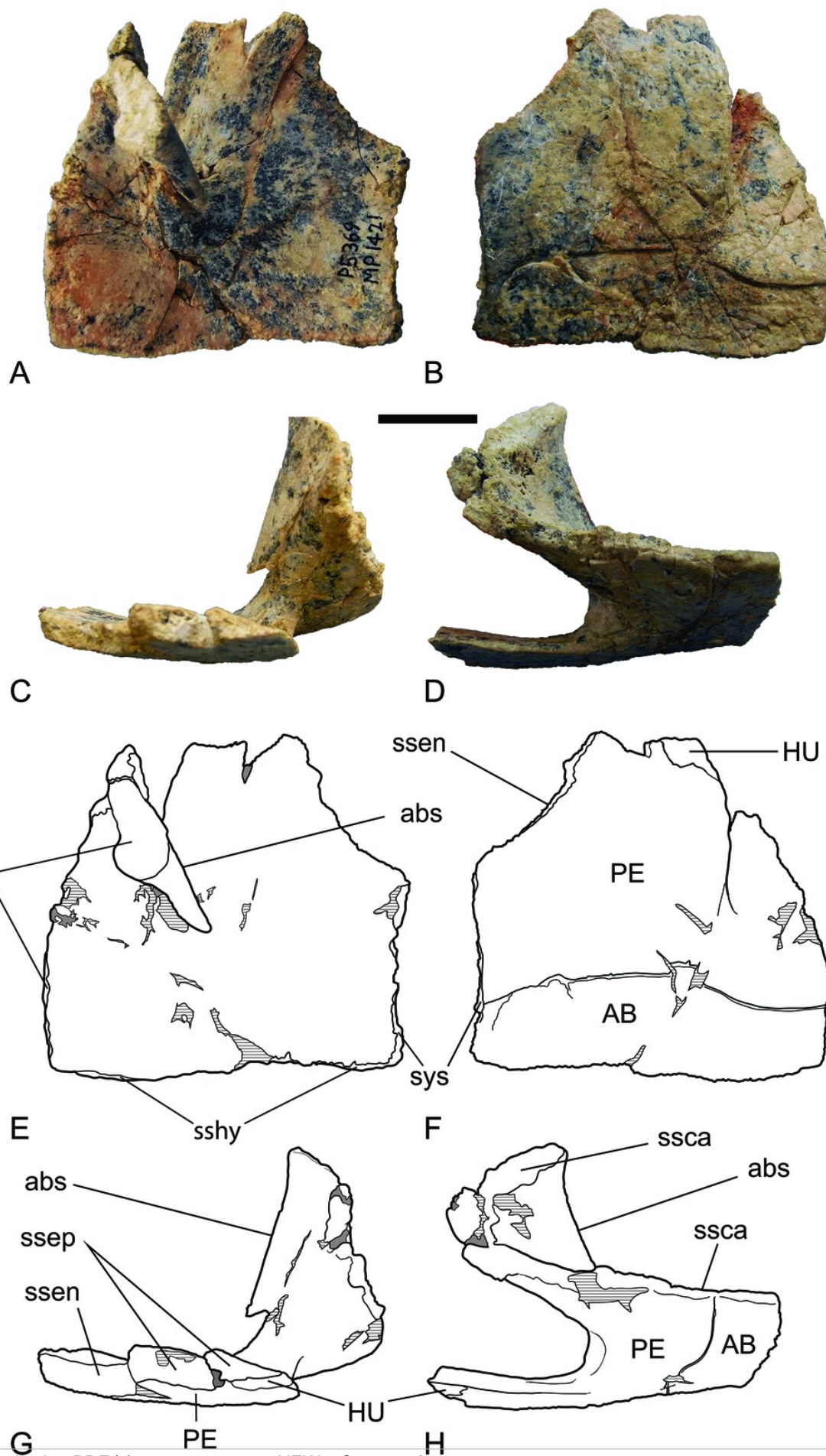
Figure 7

Figure 7. Anterior bridge struts of various chelodinines in oblique, anterior-ventral-lateral view.

Top row: whole specimens with area of enlargement indicated by a box. Bottow row: enlargement of anterior bridge strut area. **A**, *Emydura* sp., NTM unregistered comparative collection; **B**, *Chelodina (Chelodina) longicollis*; **C**, *Chelodina (Chelodina) murrayi*. Dotted line indicates likely extent of foramen for the axillary duct of Rathke's gland. Note that sediment partly infills this notch. Abbreviations: da, line of dermal attachment; rgf, foramen for the axillary duct of Rathke's gland.
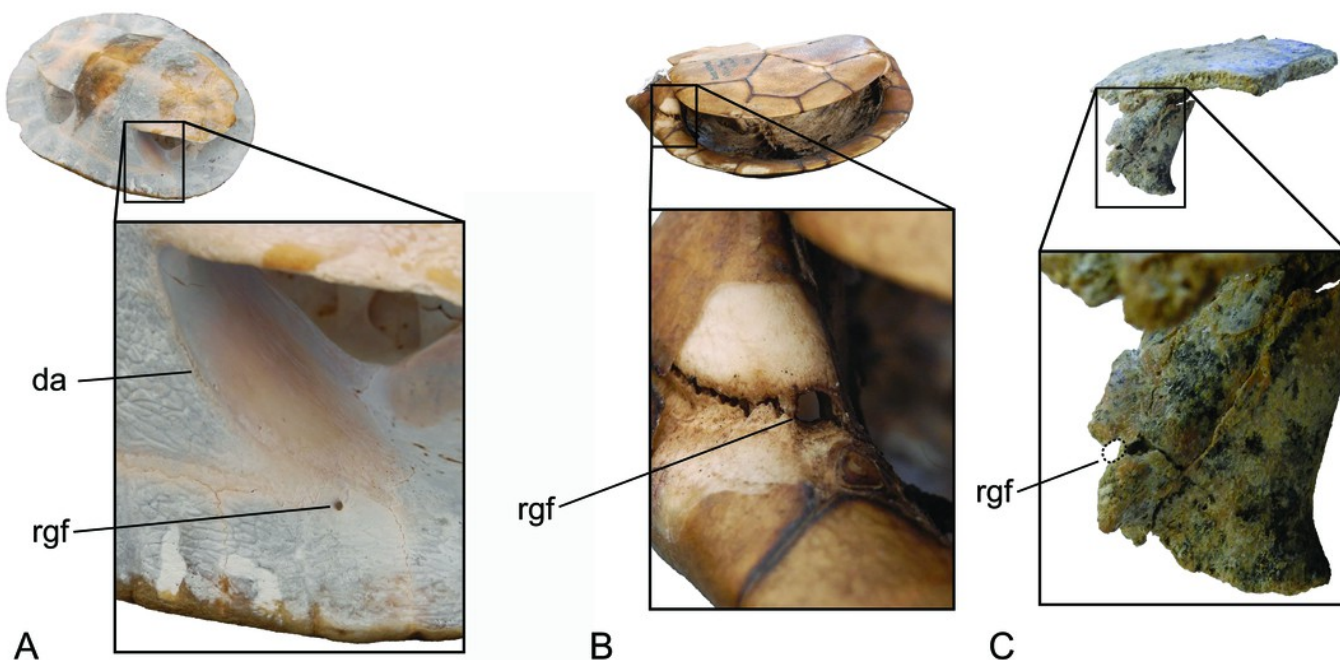
Figure 8

Figure 8. *Chelodina (Chelodina) murrayi* sp. nov., left hypoplastron, NTM P5375.

A , dorsal (internal) view; **B**, ventral (external) view; **C**, Interpretive drawing of A; **D**, Interpretive drawing of B. Abbreviations: AB, abdominal scute; b, bridge; FE, femoral scute; ssh, sutural surface for the hyoplastron; ssx, sutural surface for the xiphiplastron; sys, symphyseal surface. Hatched areas represent broken bone surfaces. Scale bar = 20 mm.
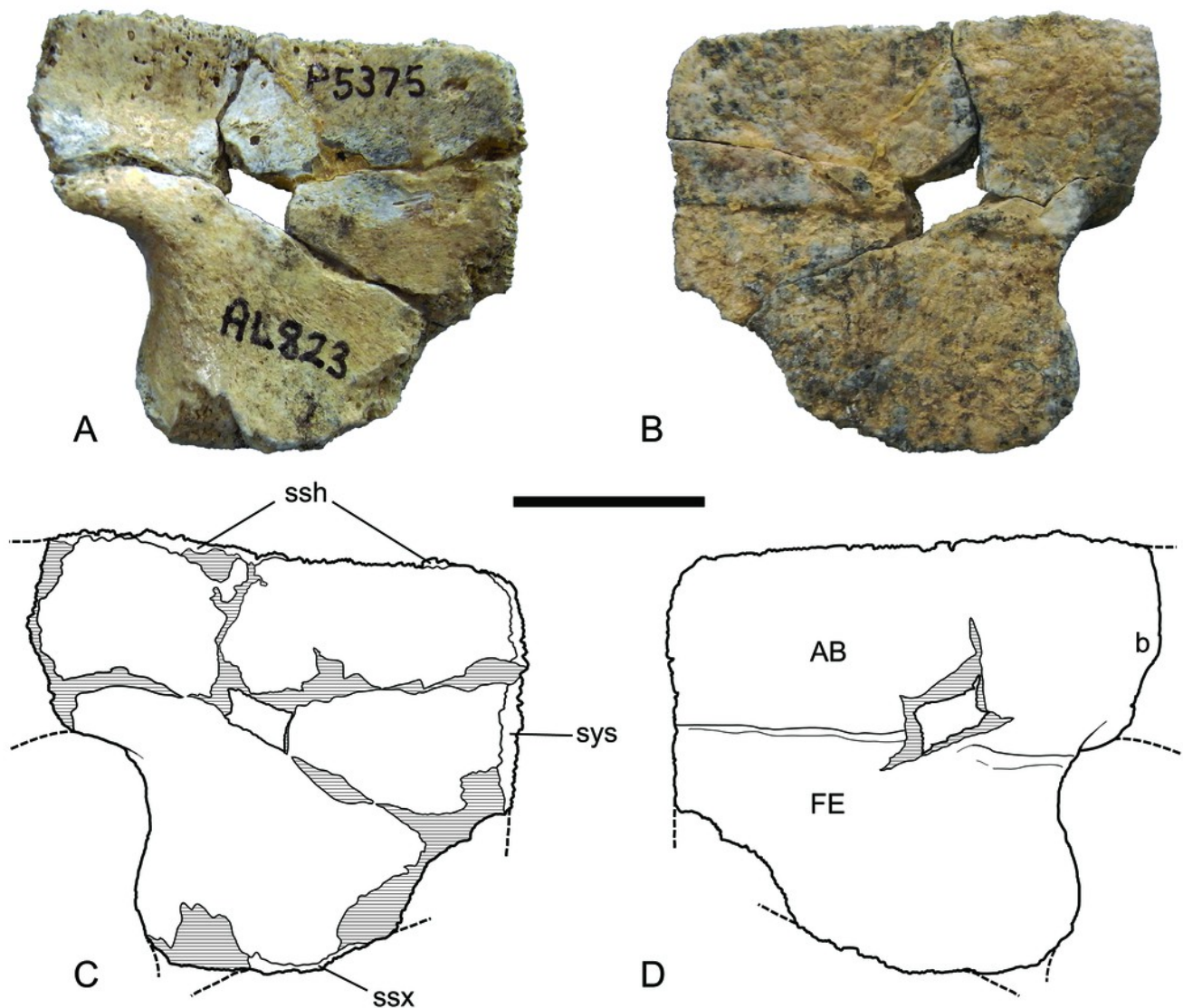
Figure 9

Figure 9. *Chelodina (Chelodina) murrayi* sp. nov., left hypoplastron, NTM P9810.

A , dorsal (internal) view; **B**, ventral (external) view; **C**, Interpretive drawing of A; **D**, Interpretive drawing of B. Abbreviations: AB, abdominal scute; b, bridge; FE, femoral scute; ssh, sutural surface for the hyoplastron; ssx, sutural surface for the xiphiplastron; sys, medial symphyseal surface. Hatched areas represent broken bone surfaces, grey areas represent patches of adherent matrix. Scale bar = 20 mm.
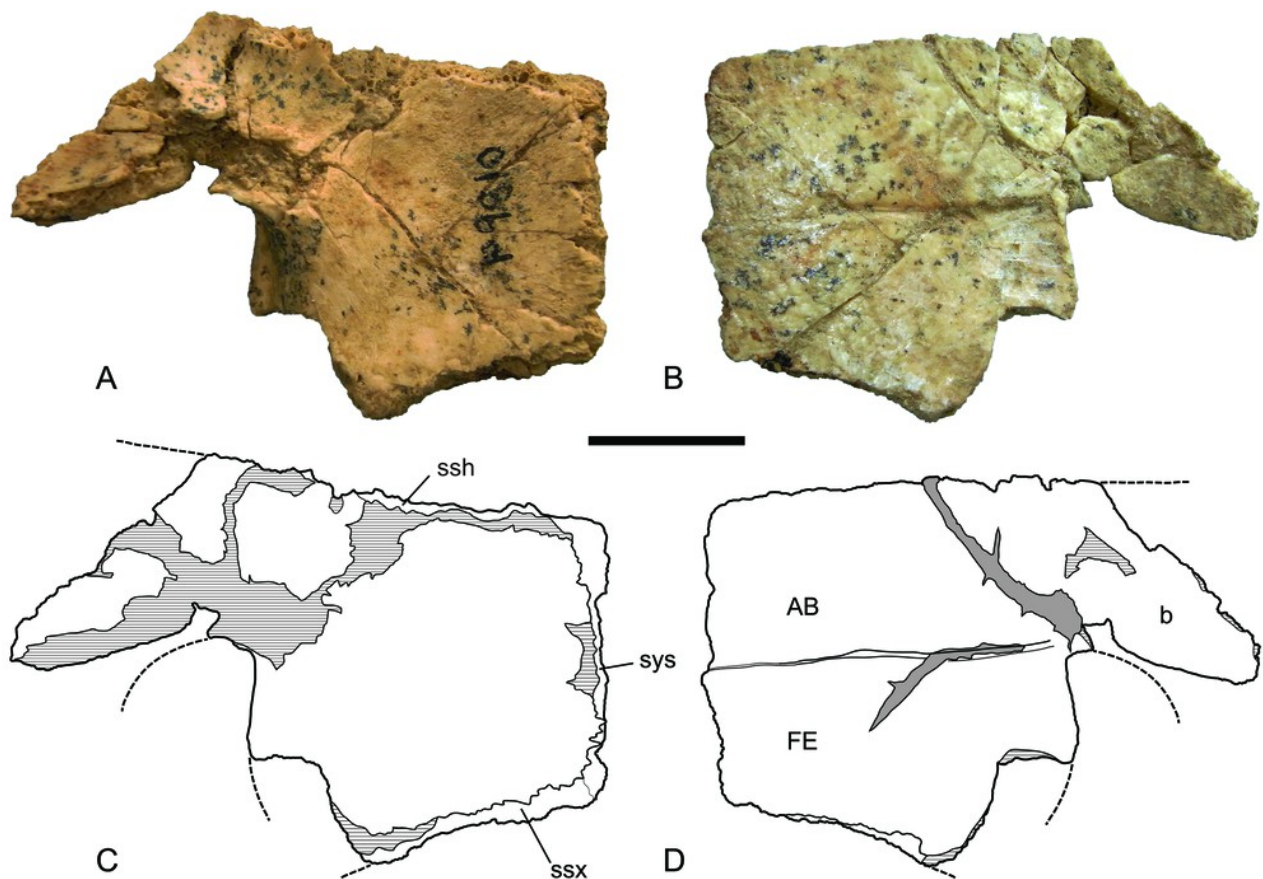
Figure 10

Figure 10. *Chelodina (Chelodina) murrayi* sp. nov., right xiphiplastron, NTM P5374.

A , ventral view; **B**, dorsal view; **C**, interpretive drawing of A; **D**, interpretive drawing of B; **E**, reconstruction of articulated xiphiplastron pair in dorsal view. Abbreviations: AN, anal scute; FE, femoral scute; sshy, sutural surface for hypoplastron; ssi, sutural surface for ischium; ssp, sutural surface for pubis; sys, symphyseal surface; tm, tooth mark. Hatched areas represent broken bone surfaces, grey areas represent areas of adherent matrix. Scale bar = 20 mm
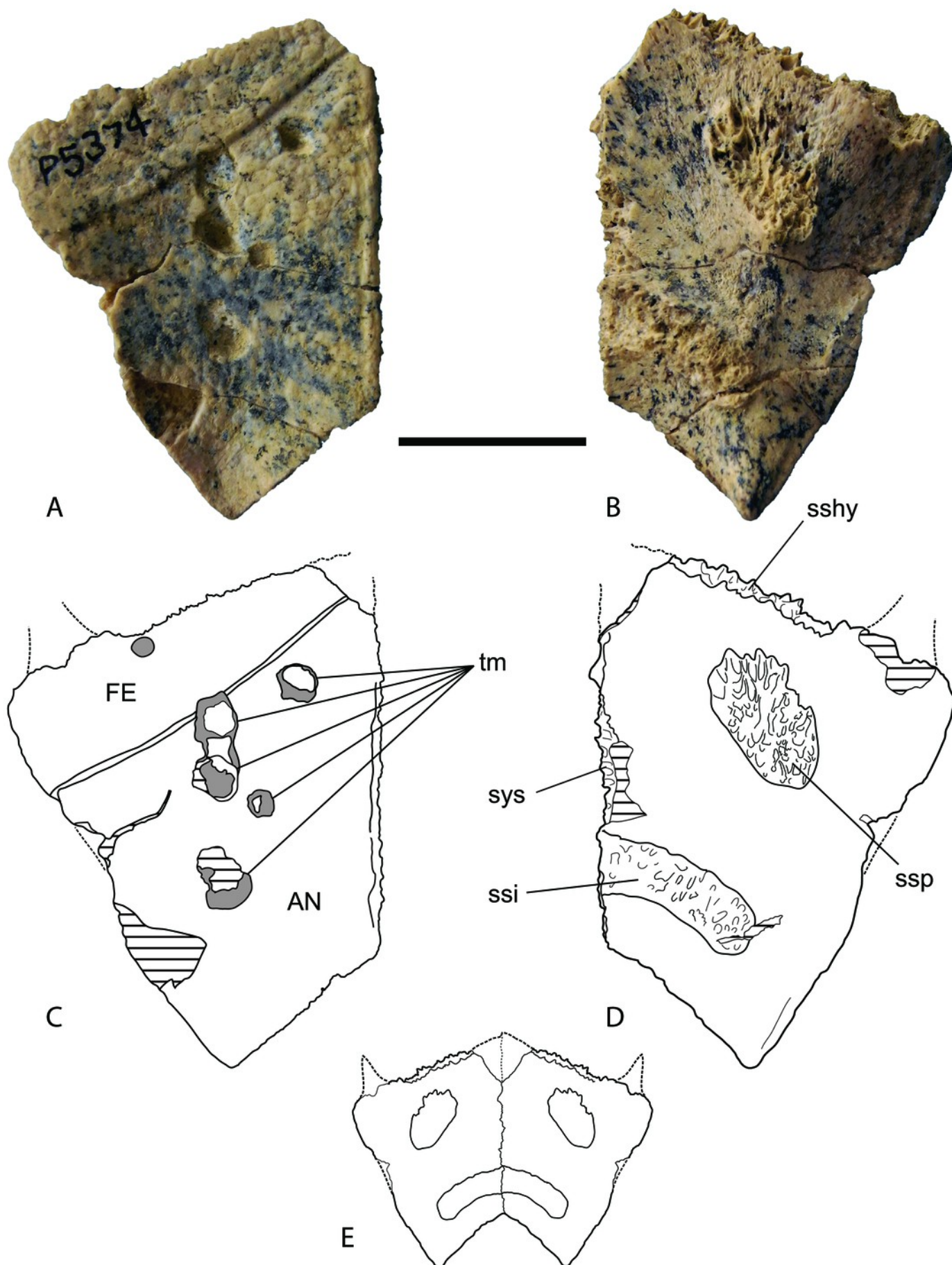
Table 1_(on next page)

Table 1. Ratio of intergular scute length to length of the shared seam between pectoral scutes in various chelodinines.

Species	Ratio	Source
Pseudemydura umbrina	1.35	Burbidge et al. 1974, fig. 1
Emydura sp.	0.55	NTM (MCA unregistered)
Chelodina (Macrodiremys) collei	1.43	Burbidge et al. 1974, fig. 2
Chelodina (Macrochelodina) rugosa	1.53	NTM R24814
Chelodina (Macrochelodina) rugosa	1.40	Thomson et al. 2000, fig. 6b
Chelodina (Macrochelodina) burrungandjii	1.23	NTM R35010
Chelodina (Macrochelodina) burrungandjii	1.14	Thomson et al. 2000, fig. 6a
Chelodina (Macrochelodina) parkeri	1.18	Rhodin & Mittermeier 1976, fig. 15
Chelodina (Chelodina) longicollis	3.25	NTM R27168
Chelodina (Chelodina) canni	5.35	NTM R16325
Chelodina (Chelodina) novaeguineae	3.20	McCord & Thompson 2002, fig. 3f
Chelodina (Chelodina) novaeguineae	2.79	Rhodin 1994a, fig. 7
Chelodina (Chelodina) pritchardi	3.13	Rhodin 1994a, fig. 1
Chelodina (Chelodina) reimanni	2.37	Philippen & Grossmann 1990, fig. 2