Review of the Pelomedusid Turtle Specimens in the Division of Vertebrate Zoology, Yale Peabody Museum: Species Identifications and Distribution Records

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ABSTRACT. – The Pleurodiran turtle family Pelomedusidae includes only two extant but speciose genera, *Pelusios* and *Pelomedusa*, both of which also succeed fossil record taxa with moderate representation. The Division of Vertebrate Zoology, Yale Peabody Museum, located in New Haven, Connecticut, United States of America, currently houses 68 specimens of recent pelomedusid turtle. Here we review and describe the specimens comprising this collection and correct several species identifications under the light of modern taxonomy, with each illustrated where possible. Based on morphology and specific collection locality data we can confirm the distribution records of some species through these vouchered specimens where their presence was previously only assumed.

Keywords: *Pelusios*; *Pelomedusa*; Pelomedusidae; Testudines; *Erymnochelys*; Africa; reidentifications.

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Figure 1. *Pelusios niger,* a West African species with well-preserved specimens in the YPM. Live adult female, P. Vander Schouw collection.

INTRODUCTION

Pelomedusidae is one of three extant freshwater turtle families belonging to the subordinal Testudines lineage Pleurodira, the other two being Chelidae and Podocnemididae. The fossil record preserves explosively diverse representatives of all three families as well as those of an additional four families which are now entirely extinct. Pelomedusidae is an endemic African lineage, and a relatively recent evolutionary novelty with origins still masked beyond the late Miocene. Only two extant genera are currently known, *Pelomedusa* and *Pelusios*, but both are speciose, with much of the marked species biodiversity only being recognized within the last five decades. The family is naturally confined to the southern Saharan belt and sub-Saharan Africa, including numerous offshore islands as well as the islands of Madagascar, Seychelles and the Mascarenes, though the latter two may have human-introduced agency.

In preparation for our upcoming review and revision of the taxonomy and morphology of Pelomedusidae, the senior author was generously hosted by Gregory Watkins-Colwell, Division of Vertebrate Zoology, Yale Peabody Museum, New Haven, Connecticut in the United States of America as a guest researcher and had an opportunity to personally examine the collection of freshwater pleurodiran turtle specimens housed by YPM. The museum register includes 67 pelomedusid specimens (18 *Pelomedusa*, 43 *Pelusios*). Here we offer our concurrency or prospective revised species identification of these specimens as currently catalogued and illustrate each where possible. As vouchered specimens with definitive locality collection data, we are also able to confirm distributional records where previously considered assumed or only identified through sight records. A dry semi-skeletal specimen previously attributed to the Podocnemidid genus *Erymnochelys* (YPM HERR 010884) is reidentified here as the West African species *Pelusios niger* and can be added now as an additional pelomedusid specimen to the registry. This reidentification leaves YPM HERR 018118, a yearling, as the sole *Erymnochelys* registered specimen in the collections.

METHODOLOGY

The senior author personally examined and imaged each of the existing wet and dry preserved pelomedusid turtle specimens over the course of multiple visits to the Yale Peabody Museum as part of his guest research project hosted by the Yale Peabody Museum Division of Vertebrate Paleontology through the sponsored id program. Notes on the integrity of the specimens and observations on morphology, osteology, scalation, scutation and coloration were recorded. The project is part of a larger effort endeavoring to progress knowledge of extant and fossil species biodiversity within the pleurodiran family Pelomedusidae.

Supporting authors provided access to their extensive private collections of living species and assisted with the determination of museum preserved species identifications based on their personal experience with extant animals and knowledge of distributions in Africa and surrounding territories.

All pertinent literature was also consulted in species determinations and distributions. Final species identification and other conclusions were conveyed to Collections Manager G. Watkins-Colwell prior to publication.

CATALOGUED SPECIMENS

Order: Testudines Batsch, 1788
Suborder: Pleurodira Cope, 1864
Family: Pelomedusidae Cope, 1868
Genus: *Pelomedusa* Wagler, 1830

■ *Pelomedusa subrufa* (Bonnaterre, 1789)

Southern Helmeted Turtle

Specimen: YPM HERR 002992, collected by Walter Hoesch, 1956 from Okahandja, Damaraland, Namibia.

Notes: This specimen is a formalin preserved yearling-juvenile, whole and undamaged (Figure 2). This locality was considered to harbor a distinct subspecies, *P. s. damarensis*, but this taxon has continued to be placed into the synonymy of the nominate subspecies (Fritz *et al.* 2014).

■ *Pelomedusa variabilis* Petzold, Vargas-Ramírez, Kehlmaier, Vamberger, Branch, Du Preez, Hofmeyr, Meyer, Schleicher, Široký & Fritz, 2014

Variable Helmeted Turtle

Specimens: YPM HERR 008199; 008200; 008201; 008202; 008203; 008204; 008206; collected by Charles D. Miller, July 20, 1968 from 'Akpannou', Republic of Benin [= Agbanou, southern Benin].

Notes: These specimens (Figure 2) represent a formalin preserved series of near hatchlings to older juvenile and as such illustrate some of the ontogenetic morphological and color changes in this species. They can be morphologically identified as *P. variabilis* by coloration, head scalation, carapace and plastral sulci and by overall locality, and thereby offer additional confirmation of records in the southern Republic of Benin where some specimens were considered presumably this species (as opposed to specifically genotyped; TTWG, 2021). Images of live adult specimens are presented in Figure 5.

■ *Pelomedusa* sp.

Wet specimens

Specimens: YPM HERR 0009502; 017347; 017350; 017445; all lacking collection data.

Notes: YPM HERR 0009502: This is a large adult female (Figure 2), formalin preserved, whole and undamaged. Locality and collection data are completely lacking, unfortunately, as the specimen is marked with distinct color and pattern on the head and plastron. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp. It is possible that with further morphological investigation that this specimen can be eventually identified to species.

YPM HERR 017347 & 017350: These specimens were previously destroyed for a specific project and are no longer in existence; as such we cannot offer any observations of the original specimens nor confirm identification. They are currently catalogued as '*Pelomedusa subrufa*' but are better considered as *Pelomedusa* sp.

YPM HERR 017445: This is a formalin preserved large adult specimen (Figure 4), that is complete and intact, missing only portions of the 1st vertebral scute but showing extensive damage to the neck skin. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp. It is possible that with further morphological investigation that this specimen can be eventually identified to species.

Figure 2. Dorsal and ventral views of A) *Pelomedusa subrufa* YPM HERR 002992; B) *Pelomedusa variabilis* YPM HERR 008202 and D) clockwise from bottom left, YPM HERR 008203, 008199, 008201, 008204, 008206, 008200 (final specimen, YPM HERR 008205 has been reidentified this current study as *Pelusios castaneus*); and C) *Pelomedusa* sp. YPM HERR 9502. All *Pelomedusa* in B, C, D reidentified from formerly *P. subrufa*, this current study. Scale bar above each figure letter indicates 1 cm.

■***Pelomedusa*** sp.
Dry specimens

Specimens: YPM HERR 011159; 012812; 017348; 017349; 017444; all lacking collection data.

Notes: YPM HERR 011159: This is an adult semi-skeletal shell (Figure 3), fully articulated, whole and undamaged except for the majority of missing or separated epidermal scutes. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp.

YPM HERR 012812: This is a skeletal, small juvenile specimen (Figure 4), that is entirely disarticulated in bones and scutes, with intact cranium present. It is currently catalogued as '*Pelomedusa subrufa nigra*' but is better considered as *Pelomedusa* sp.

YPM HERR 017348: This is a young adult semi-skeletal specimen (Figure 3) represented by an intact carapace disarticulated from an intact plastron, with scutes present. Cranium and post-cranial elements are present but separated/isolated; organs in formalin; tissue sample preserved. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp.

YPM HERR 017349: This is a young adult semi-skeletal specimen (Figure 3) that is entirely disarticulated in bones and scutes. Intact cranium and post-cranial elements are present but disarticulated; organs in formalin; tissue sample preserved. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp.

YPM HERR 017444: This is a semi-skeletal complete shell (Figure 4), that has been cut at the bridges to separate the carapace and plastron. Scute covering is complete; cranium and post-cranial elements are isolated/separated but present. It is currently catalogued as '*Pelomedusa subrufa*' but is better considered as *Pelomedusa* sp.

■***Pelomedusa*** sp.
Dried eggshells

Specimen: YPM HERR 017994; no collection data.

Notes: This specimen consists of eight dried eggshells (Figure 4) attributed to '*Pelomedusa subrufa*'. We are unable to confirm this specific identification; as such the identification is better considered as *Pelomedusa* sp.

Genus: *Pelusios* Wagler, 1830

■***Pelusios castaneus* (Schweigger, 1812)**
West African Chestnut Mud Turtle

Specimen: YPM HERR 008205, collected by Charles D. Miller; July 20, 1968, from 'Akpannou' Republic of Benin [= Agbanou, southern Benin].

Notes: This hatchling specimen (Figure 6) is formalin preserved, whole and undamaged and was misidentified formerly as *Pelomedusa subrufa* (current nomen = *Pelomedusa variabilis*) with which it was sympatrically field collected amongst numerous specimens. It can be referred to *Pelusios castaneus* based on the presence of a hinge, the plastral configuration and the constriction of the 1st vertebral scute, as well as color and pattern characters.

Specimens: YPM HERR 008207; 008208; 008209; 008210; 008211; 008212; 008213; 008214; 008215; 008216; 008217; 008218; 008219; 008220; 008222; 008223; 008224; 008225; 008226; 008227; 008228; 008229; 008230; 008231; 008232; 008234; 008235; 008236; 008237; all collected by Charles D. Miller, July 13, 1968, from Bodji, Republic of Benin.

Notes: These specimens represent a large series of age classes ranging from hatchling and yearling to older juveniles; as such they offer valuable information on ontogenetic changes in morphology and coloration (Figures 6, 7, 8).

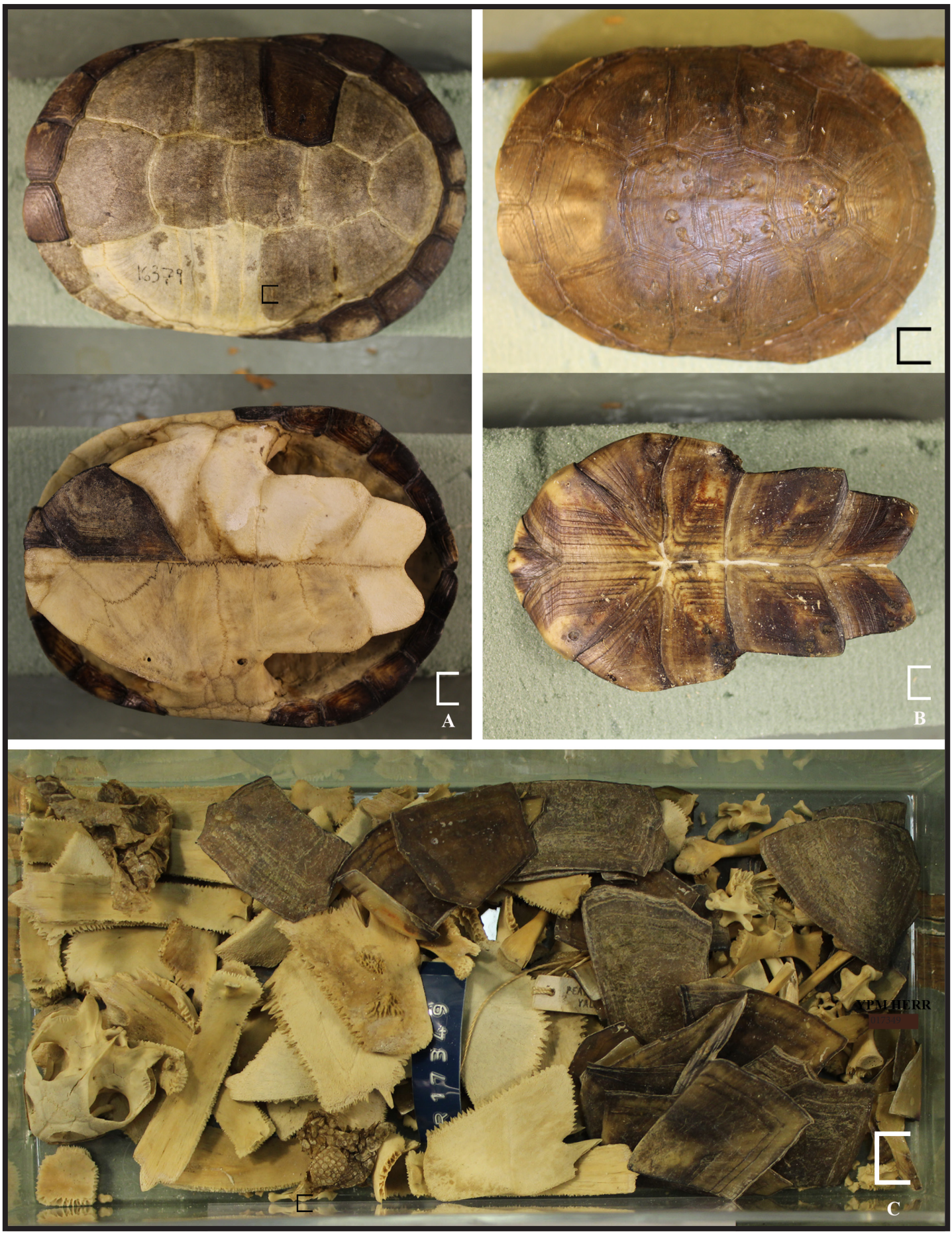

Figure 3. Dorsal and ventral views of *Pelomedusa* sp. A) YPM HERR 011159; B) YPM HERR 017348 and C) YPM HERR 017349. All three specimens reidentified from formerly *P. subrufa*, this current study. Scale bar above each figure letter indicates 1 cm.

Figure 4. Dorsal and ventral views of *Pelomedusa* sp. A) YPM HERR 017445; B) YPM HERR 017444 and C) YPM HERR 012812. Eggs attributed to *Pelomedusa* sp. YPM HERR 017994 shown in D). Last two specimens, image credit © Andis, A. Z., online catalog). Specimens in A, B, D reidentified from formerly *P. subrufa*, this current study, and from (C) as formerly *P. subrufa nigra*. Scale bar above each figure letter indicates 1 cm.

Figure 5. Male A) and female B) live *Pelomedusa variabilis* from Lake Volta, Ghana.

Figure 6. Dorsal and ventral views of *Pelusios castaneus*, Republic of Benin. A) YPM HERR 008207 and 008224; B) YPM HERR 008208 and 008209 and C) YPM HERR 008210 and 008234; and D) YPM HERR 008205. Scale bar above each figure letter indicates 1 cm.

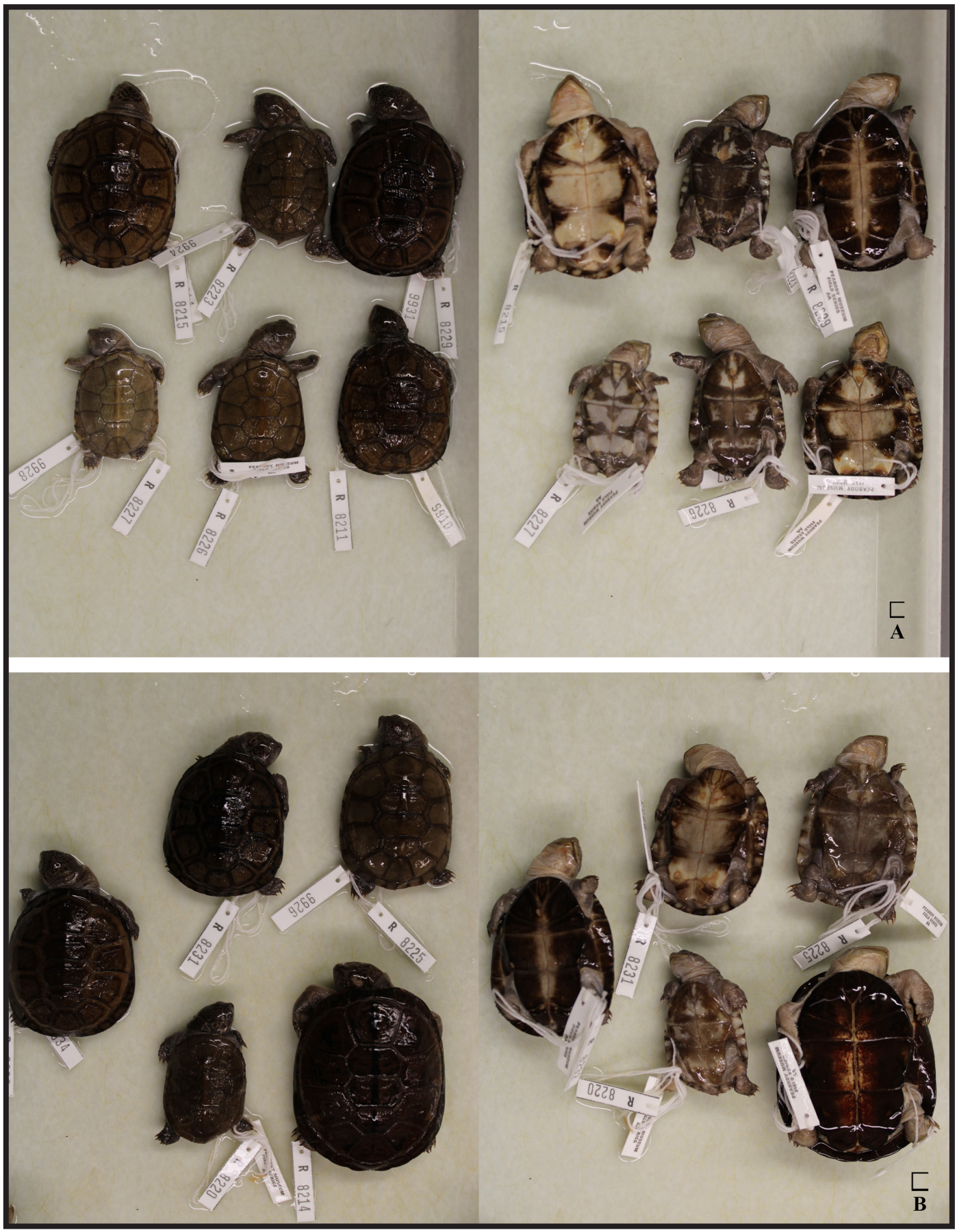

Figure 7. Dorsal and ventral views of *Pelusios castaneus*, Republic of Benin. A) left to right, top to bottom, YPM HERR 008215, 008223, 008229, 008227, 008226, 008211; B) YPM HERR 008232, 008231, 008225, 008220, 008214. Scale bar above each figure letter indicates 1 cm.

■**'*Pelusios castaneus*' (Schweigger, 1812)**
West African Chestnut Mud Turtle
Dried Eggshells

Specimen: YPM HERR 018002, no collection data.

Notes: This registration consists of 29 dried eggshells (Figure 9, letter A; image credit © Andis, A. Z., online catalog) attributed to '*Pelusios castaneus*'. We are unable to confirm this specific identification; as such it may be better considered at *Pelusios* sp.

■***Pelusios gabonensis* (Duméril, 1856)**
Gabon Mud Turtle

Specimens: YPM HERR 008221; 008233, collected by Charles D. Miller, July 13, 1968 from Bodji, Republic of Benin.

Notes: These two specimens are currently 'out on loan' to a European institution for further study; no images are available and therefore we are unfortunately unable to make any observations of them nor confirm their identity. Currently this species is not known from Benin; confirmation of these specimens' identification as *P. gabonensis* would hence constitute an important range extension through field collected voucher. Records currently attributed to *P. gabonensis* west of Cameroon are currently considered 'uncertain, trade, or misidentified' (TTWG 2021). Alternatively, the YPM specimens may refer to *Pelusios cupulatta*, a relatively recently described species (Bour & Maran, 2003) that is superficially similar to *P. gabonensis* (*pers. obs.*)

■***Pelusios niger* (Duméril and Bibron, 1835)**
West African Black Mud Turtle
Wet Specimens

Specimens: YPM HERR 008868, collected by Charles D. Miller, February 16, 1972 from Banga Bakundu, Cameroon; YPM HERR 008869; 008871, collected by Charles D. Miller, April 4, 1972 from Bombe, Cameroon; YPM HERR 008870, collected by Charles D. Miller, February 16, 1972 from Mbonge, Cameroon.

Notes: These specimens (Figure 9, letters B-E) are all yearling to juvenile specimens which are formalin preserved, whole and undamaged and preserve bright coloration and pattern.

■***Pelusios niger* (Duméril and Bibron, 1835)**
West African Black Mud Turtle
Dry Specimens

Specimens: YPM HERR 010765; YPM HERR 010884; YPM HERR 010914; no collection data.

Notes: YPM HERR 010765 (Figure 10): This is a complete skull specimen (cranium and mandible), fully prepared, presenting intact and discernible suturation. This specimen potentially belongs to shell only specimen YPM HERR 010914 below but this is uncertain. Some post-cranial elements are present from the limbs but separated.

YPM HERR 010884 (Figure 11): This specimen is a dry, semi-skeletal carapace and plastron (most scutes still attached) that was originally misidentified in the collections as an *Erymnochelys madagascariensis* from Madagascar. The plastron has been cut at the bridges and the axillary processes are missing. The dorsal vertebrae are intact and in situ with the iliac blades of the pelvis still sutured to the interior carapace. It can be positively reidentified here as a *Pelusios* specimen by the presence of the anterior plastral (hyo-mesoplastral) hinge, the iliac suture scars on the visceral carapace, the pubic and ischial suture scars on the visceral plastron and the complete lack of axillary bridge strut suture scars on the thoracic surface of the 1st costals (these latter present and robustly defined in *Erymnochelys*; see Joyce for schematic representation). It can further be identified to the species *Pelusios niger* by the specific details of the suture scars, coloration, vertebral, pleural and plastral sulci. This reidentification leaves specimen YPM HERR 018118 (Figure 13) as the only confirmed *Erymnochelys* specimen in the collections.

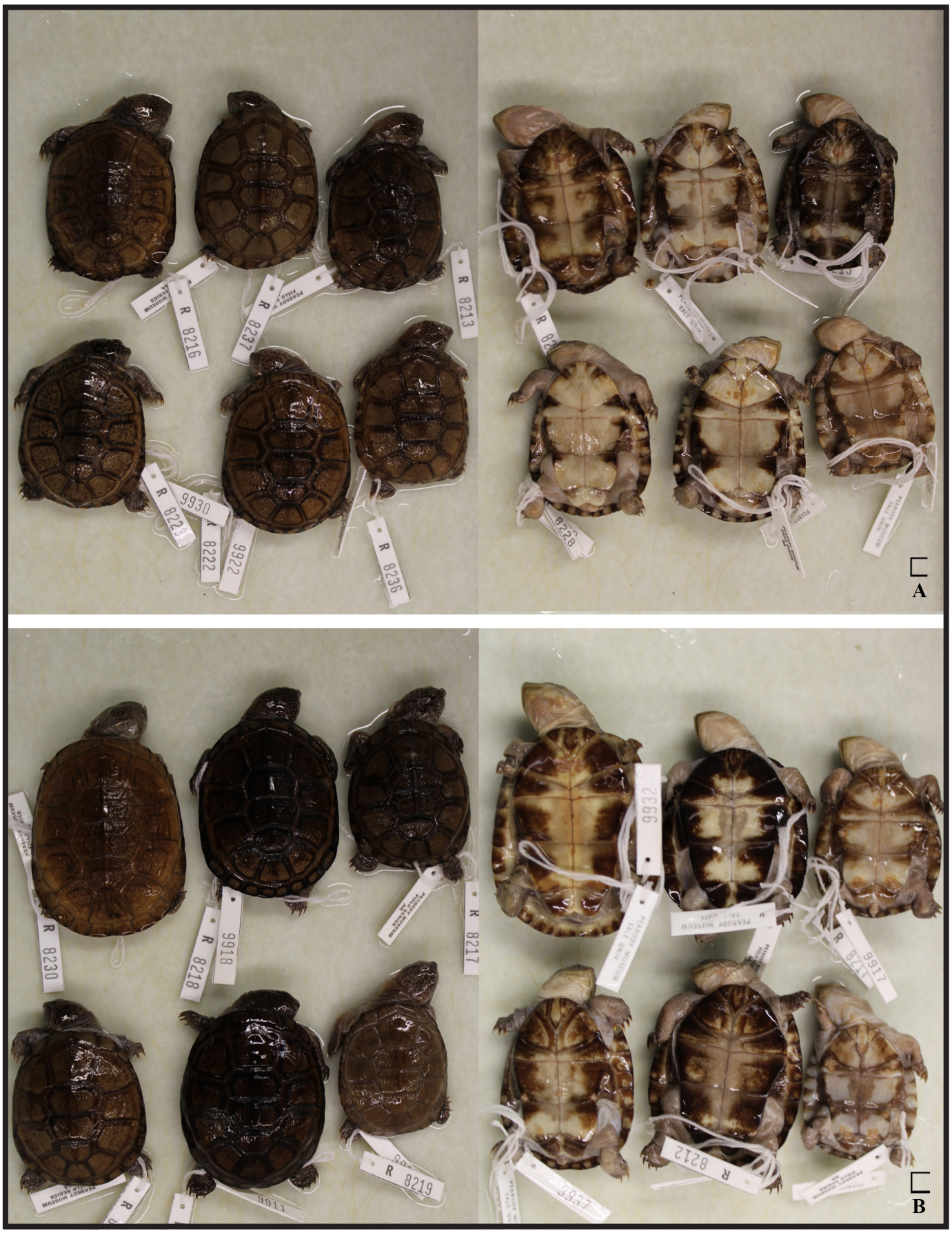

Figure 8. Dorsal and ventral views of *Pelusios castaneus*, Republic of Benin. A) left to right, top to bottom, YPM HERR 008216, 008237, 008213, 008228, 008222, 008236; B) YPM HERR 008230, 008218, 008217, 008235, 008212, 008219. Scale bar above each figure letter indicates 1 cm.

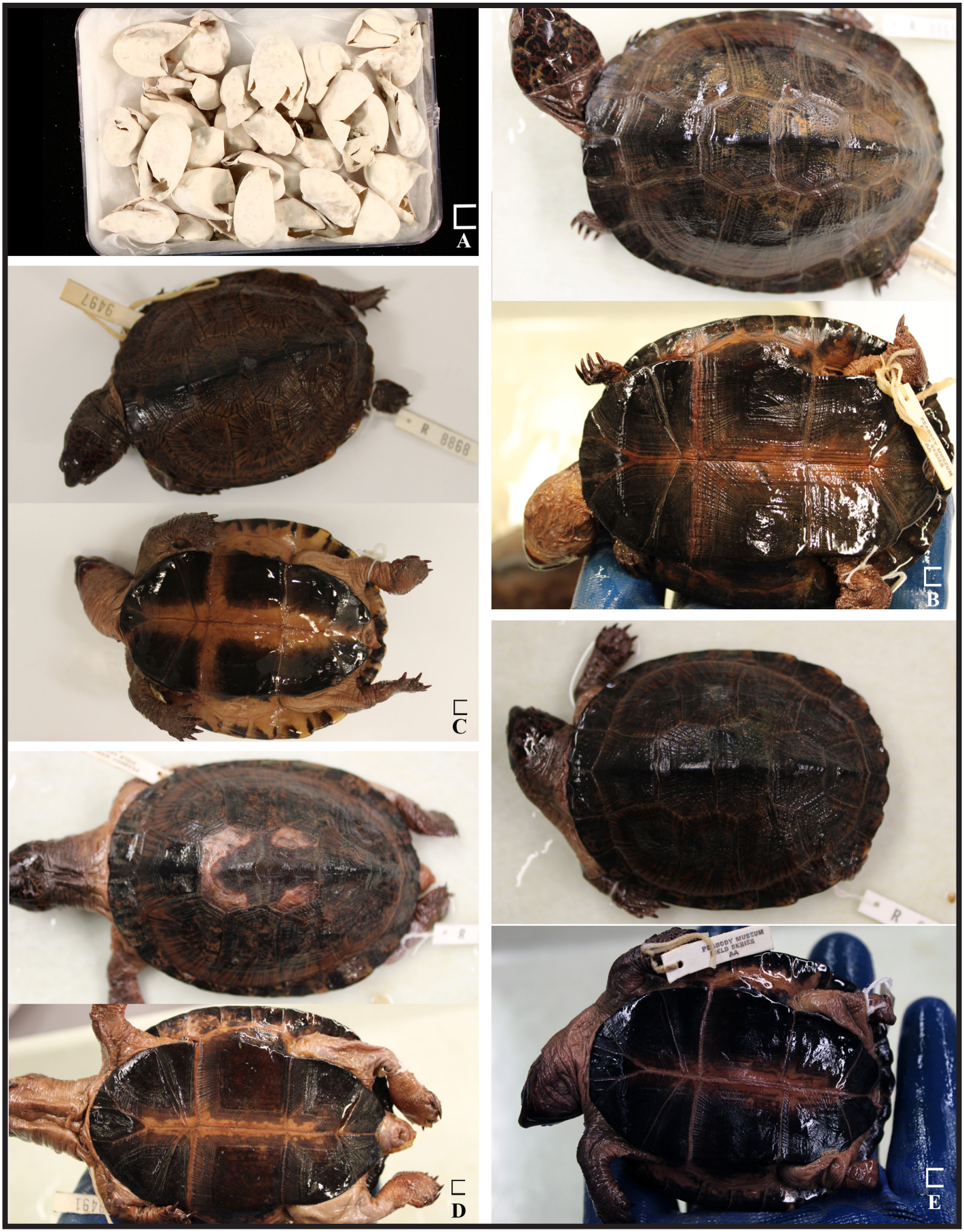

Figure 9. A) Dried egg shells attributed to '*Pelusios castaneus*', YPM HERR 018002; yearling and young juvenile specimens of *Pelusios niger* B) YPM HERR 008869; C) YPM HERR 008868; D) YPM HERR 008870; E) YPM HERR 008871. Scale bar above each figure letter indicates 1 cm.

Figure 10. Dorsal and ventral exterior and interior views of skull specimen *Pelusios niger* YPM HERR 010765, and of the carapace and plastron of the same species (potentially same specimen) YPM HERR 010914 in B). Scale bar above each figure letter indicates 1 cm.

YPM HERR 010914 (Figure 10, letter B): This specimen is a dry, semi-skeletal carapace and plastron (most scutes still attached, missing most prominently on the exterior carapace). The central and posterior neural series are fully exposed. The plastron has been cut at the bridges and the axillary processes are missing. The dorsal vertebrae are intact and in situ, but the pelvis is separated. There is large perforate damage to the 1st right costal and adjacent peripherals.

'*Pelusios seychellensis*' (Siebenrock, 1906)

Seychelles Mud Turtle

Specimen: YPM HERR 006114, collected by William D. Hartman, January 30, 1958 from Grand Anse, Praslin Island, Seychelles.

Notes: This specimen is currently 'out on loan' to a European institution for further study; no images are available and therefore we are unfortunately unable to make any observations of it nor confirm its identity. It was presumably collected at the same exact site as YPM HERR 006113, *P. subniger parietalis*. The identification as *P. seychellensis* is intriguing as that taxon is known in the literature from only three specimens in European museums. *P. seychellensis* was the center of a decades long enigma as to the unique status and potential extinction of a Seychelles endemic, but has now been considered a synonym of *Pelusios castaneus*, and hence bearing erroneous collection data for the original series, following a genetics investigation (Stuckas *et al.*, 2013).

Pelusios sinuatus bottegi (Boulenger, 1895)

East African Serrated Mud Turtle

Specimen: YPM HERR 014503, collected by Thomas E. Lovejoy, July 24, 1964, from Kathangacini, Thangatha River, Meru District, Kenya.

Notes: This subspecies was recently resurrected from the synonymy of *Pelusios sinuatus* by Vamberger *et al.* (2019) to accommodate the populations of eastern Africa following a genetic study. The specimen (Figure 12) is a formalin preserved juvenile, whole and undamaged. The *P. sinuatus* complex includes additional subspecific taxa, both extant and fossil, which are currently under study by us, but it is not expected to affect the subspecific identification of this specimen.

Pelusios subniger parietalis Bour, 1983

Madagascar Black Mud Turtle

Specimen: YPM HERR 006113 collected by William D. Hartman, January 30, 1958 from Grand Anse, Praslin Island, Seychelles.

Notes: This specimen (Figure 12) is a large adult female, formalin preserved, whole and undamaged. Considered a character diagnostic of this subspecies, the parietal scales in this specimen do reach and make direct contact with the supraocular scales on both sides of the dorsal head; however, the ventral sulcus of the anterior most parietal scale on the left side is unformed/ incomplete.

Figure 11. Dorsal and ventral exterior and interior views of *Pelusios niger* YPM HERR 010884, in A) and B), reidentified from original designation as *Erymnochelys madagascariensis* (original label, C). Note the absence of the axillary bridge strut suture scar on the thoracic surface of the 1st costal D) and the separation of the gular scutes by the intergular scute and presence of the hyo-mesoplastral hinge E). Scale bar above each figure letter indicates 1 cm.

Figure 12. Dorsal and ventral views of *Pelusios sinuatus bottegi* A) YPM HERR 014503; and *Pelusios subniger parietalis* B) YPM HERR 006113 with focus on the parietal scalation in C, D. Scale bar above each figure letter indicates 1 cm.

SUMMARY

The Divison of Vertebrate Zoology, Yale Peabody Museum located in New Haven, Connecticut, United States contains a relatively diverse registration of *Pelusios* and *Pelomedusa* specimens that are important additions to our knowledge of the speciose family Pelomedusidae. Under the management of Gregory Watkins-Colwell, the senior author was generously given access to personally examine and image the pelomedusid collection. The wet (formalin-preserved) specimens of *Pelusios* contain the two West African species *P. castaneus* and *P. niger*, and these are significant in that multiple specimens document color, pattern and ontogenetic changes among various age classes up to older juveniles. A single adult *Pelusios subniger parietalis* subspecies is also preserved, whole and undamaged and notably presents the diagnostic extension of the parietal scales fully separating the post ocular scales from contacting the frontal scale. A juvenile specimen attributable to the recently resurrected taxon *Pelusios sinuatus bottegi* is present with definitive field collection data. Lastly, two specimens of *Pelusios* attributed to *P. gabonensis* are of interest in that they record definitive field collection data from the Republic of Benin, a country in which the species is currently unknown to occur. Unfortunately, these latter are out on loan to a European institution, and we were unable to gain access to any imagery or data to confirm the species identification. Alternatively, the specimens may prove to be referable to *Pelusios cupulatta*, a relatively recently described species that is superficially similar to *P. gabonensis*.

The dry specimens of *Pelusios* consist only of *P. niger*, but these are significant in that they are largely prepared semi-skeletal specimens that mostly preserve the visceral suture scars of the pelvis, other post cranial elements, and a cranium and mandible, all of which have useful diagnostic characters. A large adult semi-skeletal specimen, formerly considered to represent an *Erymnochelys madagascariensis* from Madagascar proved to be identifiable as *Pelusios niger*.

The *Pelomedusa* dry specimens likewise preserve these elements but unfortunately lack specific locality data and it is difficult at this stage to offer confident identifications to species level, at least until the diagnostic morphology of the numerous species can be comfortably assessed. These dry specimens of *Pelomedusa* unfortunately all lack collection data and can only be referred at this stage to *Pelomedusa* sp.

The wet specimens of *Pelomedusa* contain a single juvenile Damaraland *Pelomedusa subrufa subrufa*, additional specimens that cannot yet be attributed to species level which lack locality data as well as a series of young juvenile and young adult *Pelomedusa variabilis* from Benin. These latter ones represent a documentable range confirmation for the species in the Republic of Benin, and added confirmation of a second *Pelomedusa* for that country, the other being *P. olivacea* from the northern region. This determination is based on morphological characterization assessed in the specimens as well as through the support of examination of living specimens from confirmed localities.

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Figure 13. Dorsal and ventral views of A) YPM HERR 018118, a yearling *Erymnochelys madagascariensis*, formerly captive specimen; and B) live yearlings for comparison.