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DORSUM OF *CAIMAN CROCODILUS* NEEDS WORK

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It is argued that some of the new data in a peer-reviewed journal is wrong. The need for a repeat study is obvious. An example of how Dr. Gregory Mayer and I counted some *Caiman yacare* is given. Parts 1 and 2 cover southern South America without big surprises; but, part 3 raises some serious questions about northern South America and Central American *Caiman.*

Part 1: Harvard versus Herpetologica: a minor correction to Ross & Mayer (1983) about neck scales in *Caiman*, and an all-out attack on the dorsal armor data in Busack & Pandya (2001).

Postulating that the transverse rows of contiguous dorsal armor on the bodies and tails of all crocodilians are related directly to individual bony vertebrae essentially underneath them (Ross & Mayer 1983, utilized x-rays and dissections to prove it, and describe the off-set and one-to-one relation in detail), it becomes possible to divide the continuous series of dorsal rows into two parts. One, a caudal series ("C"); and, two: a pre-caudal ("PC") series. In their paper, Ross & Mayer did that, and then counted anteriorly away from the sacro-caudal juncture and found that the maximum number of contiguous-rows on the long-axis midline, in a continuous and unbroken series towards the head, is to PC-24; and, it occurs (infrequently and often asymmetrically) in the caymans group only.

The most common and normal condition is 23 Pre-Caudal (PC) rows in the caymans and gators and crocodiles including *Osteolaemus* and *Mecistops cataphractus*; but, *Tomistoma schlegelii* can exhibit 23 or 22; and, *Gavialis* has 22 only. This is an over-simplification based on comparisons of many individual and taxonomic variations; and, it includes some assumptions about how many missing scale-rows have to be counted to get to PC-23 in *Crocodylus acutus*, for example.

In all of their sample of *Caiman latirostris*, and also in some *Caiman crocodilus* including *yacare* as a subspecies, the authors Ross & Mayer (1983: table 1, etc.) found rows which had been completely dissolved in the PC-18 (anterior thoracic) to

PC-20 (posterior cervical) region. Their data showed that common caymans can sometimes have zero contiguous elements in the central part of PC-18; but, common caymans (*Caiman crocodilus* including *yacare* as a subspecies) can also have as many as six scutes across in the row; and, the mean numerical value in a sample of 23 individuals was 2 scutes crossing the midline in PC-18.

Ross & Mayer (1983: table 1) also said that in *Caiman latirostris* and *Melanosuchus niger*, and also in both species of the genus *Paleosuchus*, there are always two or more contiguous scales in row PC-18; but, note that one specimen of *Paleosuchus trigonatus* exhibited a zero in PC-17, so who knows what else could occur in the smooth-fronted caymans. Ross & Mayer (1983: 320-321 text) said that in *Caiman crocodilus* including *yacare* as a subspecies, PC-18 or PC-19 can be missing and thus "the thoracic and cervical armors are sometimes not truly continuous, though they appear so with only narrow strips of skin where PC 18 or PC 19 are lost." About other taxa, they said *Caiman latirostris* is normally missing PC-19, and possibly PC-20 as well. Further, *Melanosuchus niger* always has 23 to 24 continuous PC-rows, and *Paleosuchus* is tricky. It is taxonomically significant that PC-24 can be in contact with the neck shield in all of the cayman genera; yet, it is rare or unknown outside the caymans. As a plus-or-minus character, remnants of PC-24 do not distinguish *Melanosuchus* from *Paleosuchus*, nor does the presence of part of PC-24 distinguish either of the other cayman genera from *Caiman*, including *yacare* as a species or subspecies.

With some serious reservations (discussed below), I think that transverse row "nuchal 1" of Busack & Pandya (2001) is PC-24. Thus, their "nuchal 2" is PC-23, which Ross & Mayer (1983) though might possibly be a compound with PC-22 especially in *Caiman latirostris* (the nuchal cluster in *latirostris* looks a lot like the neck-shield in *Crocodylus*); but, in hindsight I now think that PC-23 and PC-22 are always simple normal rows in the caymans as a group. Further, there is no doubt in my mind that PC-23 and PC-22 are present on the vast majority of specimens of every cayman genus and species, with at least two contiguous scutes crossing the midline in each row in *Paleosuchus*; and, at least four scales in PC-23 and also PC-22 in *Melanosuchus niger*. Having 4 scutes, and rarely 3 or 2, in PC-23 is the norm in *Caiman*.

It follows that "nuchal 3" of Busack & Pandya is PC-22; and, that "nuchal 4" is PC-21; and "nuchal 5" is PC-20. This leaves PC-19 counted as one of Busack & Pandya's "dorsals", while Ross & Mayer considered PC-19 to be the posterior end of the neck. The important thing is that PC-19 is a variable in *Caiman crocodilus* including *yacare* as a subspecies (Ross & Mayer, 1983). It is possible that *yacare* and *crocodilus* or one of its subspecies shows a significant trend toward loosing PC-18 and never PC-19; or, towards loosing PC-19 and never PC-18; or, not loosing either. Back in the 1980's the samples available to Mayer and Ross were too small to answer these questions.

With their huge sample, Busack & Pandya (2001: table 2) claimed that the number of "dorsals" includes counts of 17 and 20 scale-rows in *Caiman crocodilus* and *Caiman yacare* lumped together. Their number 20 must mean that PC-19 and PC-18 were present and that they additionally counted the first caudal row as a "dorsal" meaning body. For them to have found 17 out of the 19 expected (PC-1 to PC-19) is possible; but, only if they ended their counting at PC-1. However, if they counted C-1 as a dorsal consistently, then 17 dorsals is three rows short of the condition in *Melanosuchus*; meaning, it is more like *Caiman latirostris*. When PC-19 is counted as a "dorsal" (body or trunk), it becomes predicted that *Caiman crocodilus* and

Caiman yacare will have 18 or 19 rows in the series to PC-1; and, 19 to 20 "dorsals" to and including C-1 (the first caudal row).

In general, I find the dorsal armor data in Busack & Pandya (2001) extremely confusing. For example, they don't ever say if "nuchal 1" is the most anterior of their nuchal series; or, if it is the most posterior of the series. The same data which leads me to think that "nuchal 1" is PC-24 also contradicts the hypothesis (most of the numbers look plausible; but, some must be fiction). What bothers me is the second column from the left, presumably "nuchal 2" which has a 0 in it, and also two cases of the number 1 in it, so it can't be PC-23 which should have 4 almost invariably; and, if it has less, it will be 3 or 2 across, not 1 or 0. However, back to the column at the far left of table-1 in Busack & Pandya (2001), it has zero in far more than half of the sample, which is what Ross & Mayer (1983) said is characteristic of PC-24 in the caymans (above and below).

In my opinion, table 1 ("nuchals") and the part of table 2 ("nuchal" & "dorsals" data) based on it in Busack & Pandya (2001) can not be translated into Ross & Mayer (1983) numbers. It is a shame that neither Busack and Pandya, nor their reviewers and editors, noticed this conflict between Herpetologica magazine and the Museum of Comparative Zoology at Harvard. Personally, I trust the Ross & Mayer (1983) data, and I recommend trashing the conclusions of Busack & Pandya (2001) because their dorsal armor numbers (part of the data on which their conclusions were based) doesn't add-up correctly.

Part 2: Don't cry for me, said *yacare*, I might be a full species anyway; just count my scales right and then, only then, do statistics.

By showing that the dorsal armor data which Busack & Pandya (2001) used for their elevation of *yacare* to full species status is faulty, I'm afraid that I've put all the old questions about the common caymans of Latin America back on the table. Yes, the *yacare* race has special recognizable spots on its jaws (but remember that many other caymans including *chiapasius* also have spots); and, it is real as a species or as a subspecies. No, I don't think that Busack & Pandya (2001) proved that the northern subspecies of *Caiman crocodilus* aren't real. Without going into detail, most of the taxa in question are supposed to be distinguishable when adult skulls are examined in ways that Busack & Pandya didn't use. It may be difficult; but, it may also be possible to distinguish the races of *crocodilus* and to further distinguish between *crocodilus* and *yacare* by dorsal scalation as well. It has not been tried yet with the Ross & Mayer (1983) technique.

Several years after publishing Ross & Mayer (1983), Greg and I in 1987 examined six specimens of *yacare* and counted their scales. The first 4 were hatchlings in alcohol; and, we could locate PC-1 with absolute certainty, because the bones of the pelvis and hind limbs were completely accessible for criteria 1 and 2 of the three ways that Ross & Mayer (1983) recommend for locating PC-1. The remaining two specimens were stuffed young, so we had to rely solely on criterion 3 of the Ross & Mayer method. We decided what we thought looked like PC-1 by means of scale-row width (on the stuffed ones); and, then we compared the situation to the four others (whole in alcohol), finding satisfactory coincidence (see below). Criterion 3 worked.

Here is what Ross & Mayer (1983: 308) said. "Short of dissection or X-ray, the following criteria have been found useful in the identification of PC 1. First, PC 1 lies

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between the posterior blades of the ilia. The posterior edge of the iliac blades are overlain by PC 1 or the anterior portion of the first caudal row (C 1). The location of the blades can be determined by palpation." So, we felt for the pelvis and found the back ends of the prominent dorsal blades and drew an imaginary line at that level to find PC-1 or C-1, depending. Sometimes its obvious, sometimes a second technique is needed, especially since the instructions are valid for all living crocodilians.

We used the back legs too, following our wording. "Secondly, when held perpendicular to the body, the long axis of the femurs passes through PC 2 or the border between PC 2 and PC 1." By a combination of both the pelvic blades and the bones in the proximal half of the hind limbs, we found PC-1 on the 4 in alcohol. When we faced the stuffed and dry pair, what we did is as follows. "Third, in many species, PC 1 is the first transverse row to become broader after monotonically decreasing in breadth from midbody towards the sacrum." Indeed, the midbody rows were the widest, and the lumbar rows got much narrower and the two sacral rows were peculiar. PC-2 is narrower than PC-1; and, on both specimens PC-2 has 4 scutes across, while PC-1 has six. We compared this result with the four other *yacare* (wet) and they showed almost exactly the same pattern except that one had 5 scales in PC-1 (all the rows widened the same).

Thus, in our sample of six, five of them had PC-1 with six scales, and all had PC-2 with 4 scutes and narrower than either of its adjacent rows. PC-3 was four scales across in 5 cases, and six scutes across in 1 case. PC-4 was six across in the whole sample. PC-5 was six or seven across. PC-6 ranged from seven to nine scales in contact. PC-7 and PC-8 had eight scales to eleven, with PC-9 and PC-10 and PC-11 much the same. PC-12 in one case narrowed to eight scales in contiguity, but the others had more. PC-13 and PC-14 and PC-15 stayed in the ten to eight range; but, PC-16 narrowed to seven or six across, starting a significant decrease in dorsal armor breadth as the carapace approaches the shoulders.

In the 1987 *yacare* examination, the whole sample of 6 animals had six scutes in PC 17; and, PC-18 varied from six to four (see appendix). We were then very anxious to see if all of the rows PC-19 to PC-23 were present; and, they were in all cases. Thus, we knew that all of the thoracic armor was complete. If there had been only 22 transverse rows to the anterior end of the cervical shield, we would have worried about the presence or absence of PC-18; but, with 23 continuous PC-rows and with PC-24 identified on all specimens, we were then properly prepared to count the neck rows.

At the base of the neck, PC-19 was highly variable; and, we got counts ranging from two to four, and often asymmetrical. It was evident that PC-19 was degraded in its integrity, but still present. PC-20, however, always exhibited a solid-pair across the midline; and, in one or two cases could have be counted as four, with very reduced lateral elements. PC-21 was similarly two to four scutes across; but, PC-22 was four in the whole sample, as was PC-23 also. As mentioned above, Greg and I carefully examined the PC-24 to PC-26 region of the neck and located PC-24 on all six *yacare*. On one in particular, four scutes were enlarged and in contiguity and in contact with PC-23 to look at first sight like a part of the neck shield. We could see from their relationship to the scales around them that this was an extreme of individual variation in PC-24, because some of the other specimens showed the same scales much smaller, and in various stages of loosing contiguity. The vestigial PC-24 also looses or decreases its continuity with PC-23 in the rest of the sample. Since Ross & Mayer (1983) defined PC-23 as the anterior end of the neck shield,

everything looked okay. The remarkable development of PC-24 was understood as a row of "nape" scales masquerading as "nuchals" in only one out of six individuals, as had been predicted for the taxon. Some of the others had some contiguity in PC-24; but, not continuity with PC-23. Some scales in PC-24 had some continuity with PC-23 on the vertebral axis; but, not contiguity between themselves laterally. The Ross & Mayer (1983) method demands contiguity and continuity; so, we did not count PC-24, and instead drew some pictures. However, this is an example of where it can be said that *yacare* can exhibit 24 continuous rows in some cases.

As mentioned above, we have also seen a *Paleosuchus* with a functional PC-24 of two scutes; and, in *Melanosuchus* there are individuals where PC-24 could be said to be four, five, or six scales across; but, always smaller than their corresponding elements in PC-23; and, always with decreased contiguity amongst them, especially on the dorsal midline.

On the tails of the four wet (Chicago = FMNH 9064, 9083, 9497-98) specimens of *yacare*, there were 14 to 15 Double-Crested Caudals ("DCC"), and 21 to 22 Single-Crest Caudals ("SCC"). On the tails of the two dry (BMNH 1947-3-6-40 & 1947-3-6-41) specimens there were 13 and 15 DCC and both had only 12 of the SCC series present, because their tails were broken. The four Chicago specimens were identified as *yacare* by K.P. Schmidt. The #40 British Museum specimen is the holotype of *Jacare ocellata* Gray; and, #41 is the holotype of *Jacare longiscutata* Gray, both currently considered junior synonyms of *yacare* Daudin.

After examining the BM(NH) pair of holotypes, it was clear that Gray's two species were remarkably similar to each other, and also resembled the four Chicago *yacare* in dorsal scalations, except for the PC-23 and PC-24 region on *ocellata*, where PC-24 is extraordinarily big and PC-23 is slightly reduced in scale length to accommodate it. When Gray compared the two, *longiscutata* had a longer PC-23 because PC-24 (the first nape row) is extremely reduced and vestigial in *J. longiscutata* compared with *J. ocellata*. Both specimens have approximately the same neck protection; and, we now know that variation in PC-24 is a fact of life in the caymans; and, thus G.C. Mayer and F.D. Ross in 1987 agreed with consensus, that the difference between *ocellata* and *longiscutata* was not taxonomically significant.

Part 3: Is Chiapas independent, or really a part of the Amazon?

In 1987, Greg and I called the six borrowed specimens *Caiman crocodilus yacare* as a subspecies; but, in King & Burke (1989) Mayer and Ross both independently reviewed the *Caiman yacare* section, where we recognized Daudin's *yacare* as a full species (it has special large spots on its jaws). In the final analysis, I'm not certain about the species or subspecies status of Daudin's *yacare*; and, it should be noted that even if I did have dorsal-armor data that showed *yacare* as a recognizable taxon, it still wouldn't say at what level.

In King & Burke (1989), G.C. Mayer and F.D. Ross reviewed *Caiman crocodilus* as a species including four distinct subspecies (in alphabetical order: *apaporiensis*, *chiapasius*, *crocodilus*, and *fuscus*). While Busack & Pandya (2001) did not alter *Caiman yacare* as a full species, their 2001 paper in Herpetologica did directly challenge the recognition of Bocourt's *Caiman crocodilus chiapasius*; and, Cope's *Caiman crocodilus fuscus*; and, also Medem's *Caiman crocodilus apaporiensis*, leaving us only with *Caiman crocodilus* based on *Lacerta crocodilus* of Linnaeus

(King & Burke, 1989). What Busack & Pandya (2001) propose is that all of the *Caiman* that are not *C. latirostris* must be either *Caiman yacare* or *Caiman crocodilus*; and, they mock the "science-oriented lay press" for suggesting that *Caiman fuscus* is possible.

I suggest testing the hypothesis in Busack & Pandya (2001) that *Caiman* from Central America including Mexico is not distinguishable from *Caiman* in the Amazon drainage at a level deserving taxonomic recognition. Further, I urge utilization of cranial measurements which K.P. Schmidt used. It is also time to apply the Ross & Mayer (1983) technique to substantial samples of *Caiman crocodilus* from throughout its whole range. Forget about *Caiman yacare* or *Caiman crocodilus yacare* for the moment; because, either way, Daudin's *yacare* is safe. It is *chiapasius* and *fuscus* and *apaporiensis* that I fear have been hurt unfairly. Proper skull work and better dorsal armor data is needed before the conclusions of Busack & Pandya (2001) deserve consideration. Until then, I urge the IUCN-SSC to follow King & Burke (1989).

While Busack & Pandya (2001) used only hatchlings in alcohol, and were proud of themselves for excluding stuffed specimens and flat skins from their sample, I remind you that "criterion 3" of Ross & Mayer (1983) worked on the six *yacare* examined in 1987, above. That means stuffed caymans are fair game; and, the Ross & Mayer (1983: 308) text continues. "Finally, the posterior edge of PC 1 is often at the posterior edge of the hind limb (the traditional point of demarcation between dorsals and caudals), but this is not always the case." It is suggested that criteria 1-3 and the hind legs all be used; and, further, that dissection and x-rays be consulted when available. "Skins and stuffed specimens present special problems. Determination of the relationship of the transverse rows to the variously granulated scales around the base of the hind limb in intact specimens and criterion 3 above are the best guides to the identification of PC 1 in such specimens." speaking of flat skins, with the advice that "comparison with intact specimens is helpful" (Ross & Mayer, 1983), which it is.

See Appendix 1-2, for raw data on the six *yacare* examined in 1987. "1/1 = 2" means two scutes are in proper contact across the midline. "1+1/1+1" means there are two central scales in contiguity, with detached but substantial lateral elements floating in flexible skin. When counting, remember that "contiguous" means touching laterally between scales within a single transverse row; and, "continuous" refers to scale-rows overlapping or abutting snugly in a series on the long vertebral-axis of the animal.

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