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A NEW EMYDID TURTLE FROM CHINA

PETER C. H. PRITCHARD[1] AND WILLIAM P. MCCORD[2]

[1]*Florida Audubon Society, 1101 Audubon Way, Maitland, FL 32751,*
[2]*East Fishkill Animal Hospital, Route 82, Box 285, Hopewell Junction, NY 12533, USA*

ABSTRACT: A new species of batagurine emydid turtle, *Mauremys iversoni*, based upon a series of 29 specimens from the Provinces of Fujian and Guizhou, People's Republic of China, is described. This species is most similar to *Mauremys mutica*, from which it differs in several morphological features and in coloration and pattern. *Mauremys mutica* and *M. iversoni* are reported to be sympatric near Nanping, Fujian.

Key words: Turtle; Batagurine; *Mauremys iversoni* sp. nov.; China

THE batagurine genus *Mauremys* is characterized by a combination of the contact between the quadratojugal and squamosal bones, and the narrow, keyhole-shaped fissura ethmoidalis (Hirayama, 1985). The generic name came into common use when McDowell (1964) demonstrated that the various pond turtles of the genus *Clemmys*, widely distributed from Japan through southeastern and western Asia and southern Europe to eastern and western North America, were in fact referable to several genera in two subfamilies. True *Clemmys* are now considered to be restricted to North America, while the eastern Asiatic species *C. bealei* is clearly divergent at the generic level from the other Eurasian taxa, which were allocated to *Mauremys*. The original *Clemmys* assemblage had been defined by Boulenger (1889), in part, as having the hexagonal neural bones with their short sides adjacent to their anterior face, as opposed to adjacent to the posterior face, as is typical of the genera *Cuora*, *Cyclemys*, *Rhinoclemmys*, *Geoemyda*, *Melanochelys*, *Heosemys*, and their allies. However, McDowell (1964) demonstrated that the species *Mauremys mutica* has such variable neural configurations as to reduce the usefulness of this distinction.

As currently understood, the genus *Mauremys* includes the taxa *M. leprosa* (Spain and North Africa), *Mauremys caspica* (eastern Mediterranean to Iran), *Mauremys japonica* (Japan), and *Mauremys mutica* (China to Vietnam). *Mauremys caspica* includes two subspecies, the western *M. c. rivulata* and the eastern *M. c. caspica*. Some authorities also consider *M. leprosa* to be a subspecies of *M. caspica*. *Mauremys mutica* is a morphologically variable taxon (Nakamura, 1934), not only as regards the configuration of the neural bones, but also in position of the humero-pectoral seam relative to the entoplastron

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FIG. 1.—(Top) Plastral views of four living specimens of *Mauremys iversoni*. (Middle) Head and neck of living *M. iversoni*. (Bottom) Living adult female *M. iversoni*.

(Mao, 1971; Nakamura, 1934) and in color. Our examination of a large series of living specimens from Shanghai south to Vietnam suggests, among other things, a progressive increase in extent of black pigmentation of the plastron, and intensity of dark carapace pigmentation, from north to south. "*Emys nigricans*" Gray, 1834, has often been considered to be a senior synonym of "*Emys muticus*" Gray, 1844 (e.g., Wermuth and Mertens, 1961), but Iverson and McCord (1989) have now demonstrated that the former is in fact a senior synonym of *Chinemys kwangtungensis* Pope, 1934. The form *Annamemys annamensis* (Siebenrock, 1903) may or may not be identical to *M. mutica*; the external resemblance is striking, although Savage (1953) considered *Annamemys* to be distinct in having more extensive plastral buttressing. Iverson and McCord (1989) further commented that they considered the taxa *Testudo anyangensis* Ping, 1930, *Annamemys grochovskiae* Tien, 1957, and *Clemmys schmackeri* Boettger, 1894 to be "potentially" referable to *Mauremys mutica*.

We here describe a new species of *Mauremys*, superficially more similar to *Mauremys mutica* than to any other taxon, but differing markedly in plastral shape and midline scute ratios, carapacial carination, and in skin markings. Oscar Shiu, the collector, has provided a series of 21 live specimens (six adult females, 10 adult males, and five juveniles) from Fujian, and an adult male, three adult females, and four large juveniles from Guizhou. The specimens from the latter province differ slightly from the specimens from Fujian, although not sufficiently for us to suggest the naming of subspecies at this time.

Mauremys ***iversoni*** sp. nov.

Holotype.—Florida State Museum 71865, young adult male, in alcohol. People's Republic of China: Fujian Province: vicinity of Nanping (26°38′ N, 118°10′ E). Collected by Oscar Shiu, July 1986.

Paratype.—UF 71866, skeleton, adult female. Same locality as holotype.

Other material examined.—Nine live males, five live females, and five live juveniles, from Fujian (Nanping and Kaenyang); one live male, three live females, and four live juveniles from near Kweiying, Guizhou Province, currently in W. P. McCord's live collection. These will be deposited later in institutional collections.

Diagnosis.—A batagurine turtle of the genus *Mauremys*, most closely related to *M. mutica*, but differing from that species in the following characteristics. The posterior plastral lobe is relatively broader than in *M. mutica*, the plastral concavity is much less developed in adult males, and the plastral figure often includes a dark "horseshoe" formed by coalescing blotches on the pectoral to anal scutes. Sometimes the lateral rami of this figure are interrupted on the anterior part of each scute (Fig. 1 top). In *M. mutica*, the plastron, although most often with a black blotch on each scute, ranges from immaculate (in some specimens from Guangzhou) to pure black (in some Vietnamese specimens), but the "horseshoe" marking is absent. The gular region is rounded in *M. iversoni*, contrasting with the angular anterior plastral projection in *M. mutica*, and the intergular seam is relatively longer [at least 13.1% of plastral length in *M. iversoni*; 7.4–10.8% of plastral length in Taiwan specimens of *M. mutica*, according to data in Nakamura (1934) and Mao (1971)]. The interanal seam is also relatively longer in *M. iversoni*, at least 12.5% of plastral length, compared with 8.8–11.5% for *M. mutica* from Taiwan. Other differences from *M. mutica* include the more defined lateral keels of *M. iversoni*, the lighter carapace and skin, the latter with a distinct orange tinge (absent in *M. mutica*), and the head coloration (dorsally uniform light olive, compared to the gray of *M. mutica*), and the postorbital stripe is narrowly black-edged (Fig. 1 middle). *Mauremys iversoni* contrasts with most *M. mutica* in lacking the dorsomedial head stripe and the median notch in the upper rhamphotheca. The head pattern is completely different from that of *M. caspica*, *M. leprosa*, and *M. japonica*, so detailed comparisons with these forms are unnecessary.

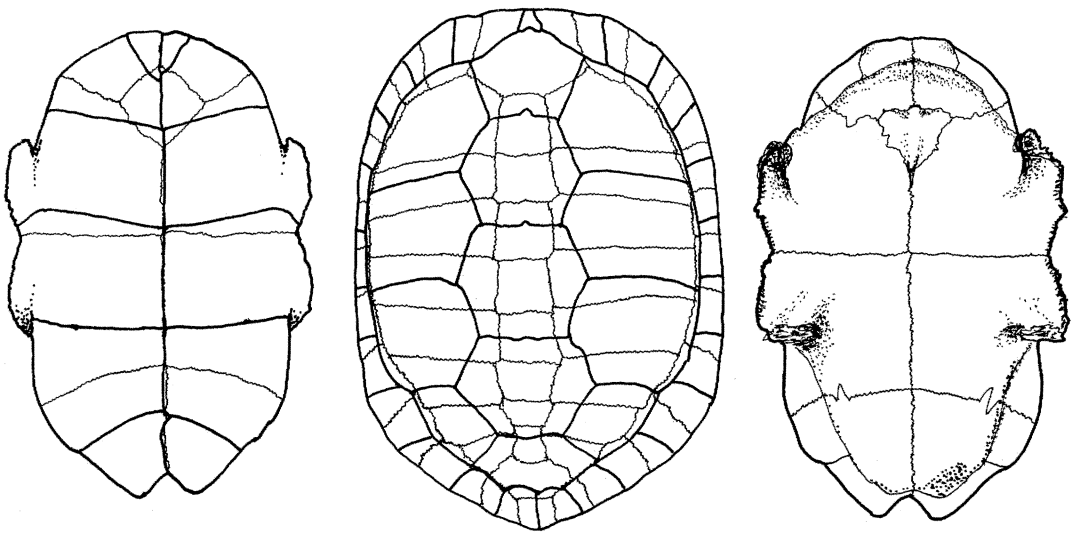

FIG. 2.—Shell bones of adult female *Mauremys iversoni* (UF 71866). (A) External view of plastron. (B) External view of carapace. (C) Visceral view of plastron.

Description.—Carapace: The carapace is moderately elevated (Fig. 1 bottom) with a strong median keel extending from the nuchal to the supracaudals. In females, the shell is somewhat parallel-sided (Fig. 2), in males it may be more oval or posteriorly expanded. The rim of the carapace is smooth (unserrate) or nearly so. The small nuchal scute has posteriorly diverging sides and a median posterior indentation; in ventral aspect, the nuchal is parallel-sided or slightly divergent posteriorly. Of the five vertebral scutes, the first is the narrowest and the fifth is the widest. There are 11 pairs of marginals and a pair of supracaudals. Minor imbrication is present on the scutes of the carapace, and growth annuli are usually apparent. Maximum height of shell is at the second vertebral. Marginals 1–5 are of moderate height; the posterior marginals are higher, but irregular. In color, the carapace is a rich brown, uniform or with a modest degree of dark speckling or radiating markings.

Plastron: The plastron is large, although shorter than the carapace, completely rigid, and with a strong anal notch. The anterior lobe is always narrower and shorter than the posterior lobe. The longest scutes along the midline of the plastron are the pectorals and the abdominals; the interpectoral seam may be slightly longer than the interabdominal seam, or the reverse, with about equal frequency. The intergular seam is relatively long (13.1–17.6% of plastral length), and the interanal seam is also relatively long (12.1–19.1% of plastral length). The axillary scutes are small and undivided, mainly abutting the fourth marginal but narrowly contacting marginal 3 and the pectoral scute. The inguinals are usually elongate, lying along the inside border of marginal 7, but sometimes touching marginals 6 and 8. The anterior plastral lobe is smoothly rounded in ventral view, the posterior lobe slightly bowed laterally.

The ground color of the plastron is yellow, the ventral aspect of the marginals being light orange-buff with heavy black pigment on the bridge forming either a continuous or broken stripe. There is a wedge-shaped black mark along the posterior margin of the ventral aspect of each marginal, but the underside of the nuchal is usually immaculate. Random black spots

may also be present on the undersides of the marginals. There is a black blotch on the anterior portion of each gular scute, with linear medial blotches on each of the other plastral scutes, sometimes failing to reach the anterior margin of some of the scutes (Fig. 1 top); typically the blotches on the pectorals to the anals coalesce to form a horseshoe-like figure united across the anal scutes, the rami being separated by a constant light yellow band extending medially from the gulars to the femorals. The plastral pigmentation is very variable in intensity, and the blotches may be either smooth-edged or may extend outwards with short radiations.

Head: The head is rather narrow, the snout extending beyond the upper jaw, with terminal nostrils. The jaws are smooth-edged, not hooked, notched, or serrated. The top of the head is covered with smooth, unscaled skin.

Dorsally the head is uniform light olive. A light olive, black-bordered stripe extends posteriorly along the neck, broadening to cover the tympanum. The eye is light olive also, with a horizontal black bar. The sides of the neck are gray-black with light olive stripes. The exposed surfaces of the rhamphothecae are immaculate, and almost white. The unmarked chin and throat are light to bright lemon-yellow. There is an elongate light olive marking above the tympanum and below the lateral edge of the light area on top of the head. The lateral neck stripes become pinkish-orange posteriorly.

Skin and limbs: The forelimbs are strong and broad, with webbed digits, and 9–12 rows of scales on the anterior face; some of the individual scales are very wide (the largest extending across about half the breadth of the limb). The forelimb scales are granular and imbricate, and become very small along the digits. The humeral section of the forelimb is covered with granular skin. Folds of skin stretch vertically on each side of the retracted head, from the posterior margin of the nuchal to the inner posterior margin of the gular scutes. The hind limbs are moderately strong, with webbed digits, and have fine, granular, imbricate scales becoming larger along the posterior margin and along the upper surface of each digit. Each hind foot bears four claws. The forelimbs are orange, darker on the dorsal surfaces. The hind limbs are light orange on the soles of the feet, dark gray-pink dorsally and posteriorly. The skin of the rump is light orange in color, immaculate or nearly so, and bears tiny soft tubercles. The tail is rather long, dorsally dark gray-pink, and ventrally light orange.

Sexual dimorphism: Not marked. There is a slight plastral concavity in adult males (extending from the pectorals to the femorals), and the tail is thicker and with a more posteriorly-located vent.

Osteology.—The bones of the shell, the skull, and the cervical vertebrae were examined only in the paratype, an adult female (UF 71866). See Fig. 2.

Carapace: the seven neural bones are large and almost square, with the interneural sutures nearly continuous with the interpleural sutures. Neural 1 is tetragonal, with slightly divergent sides; neurals 2–4 are hexagonal, with short sides posteriorly; neural 5 is pentagonal, with a posterior short side on the right only; neural 6 is pentagonal, with an anterior short side on the left; neural 7 is hexagonal, with short sides anteriorly. The upper suprapygal is elongate, narrow, and almost rectangular; the lower suprapygal is very broad and hexagonal. The pygal is single, small, and nearly square. The upper margin of the supracaudal scutes traverses the lower edge of the lower suprapygal bone.

There are eight pairs of pleural bones. Pleural 1 is by far the widest, with little alternation in width within the pleural series, although the lower edge of pleural 3 is narrower than that of pleural 2 or 4. There are 11 pairs of peripheral bones, with the pleuro-peripheral suture line dorsal to the costo-marginal sulcus, except for encroachment of the supracaudals upon the lower suprapygal.

Plastron: The entoplastron is large, rhomboid in external aspect, and roughly triangular in visceral view, and has a strong median posterior spike. The entoplastron

is crossed by both the gular-humeral and the humero-pectoral sulci. The suture between the hyoplastra and hypoplastra is just posterior to the pectoro-abdominal sulcus, both closely approximated at the midline. The suture between the hypoplastra and xiphiplastra bisects the interfemoral sulcus.

The plastral buttresses are moderate, with the axillary smaller than the inguinal buttress; the former impinge upon peripheral 3 and pleural 1, extending about 20% along the inner surface of the latter. The inguinal buttresses impinge upon peripheral 7 and extend about 40% along the inner surface of pleural 5.

Cervical vertebrae: Ginglymoidy and orientation of centra are as follows. Joints 2/3 and 3/4 are single and procoelous; joints 4/5 and 5/6 are single and opisthocoelous; joint 6/7 is doubled and opisthocoelous; joint 7/8 is doubled and procoelous. This cervical configuration is a common one among batagurines (Williams, 1950).

Skull: the following skull characteristics were noted: (i) quadratojugal present. (ii) Premaxillae completely separating maxillae. (iii) Pterygoid extending posteriorly to contact basioccipital, well posterior to jaw articulation, excluding basisphenoid from border of ear region. (iv) Foramen caroticopharyngeale absent. (v) Frontal reaches margin of orbit (narrowly). (vi) Anterior border of inferior process of parietal thickened and ventrally showing two attachments to the pterygoid, with the anterior end of the Vidian Canal passing between them. (vii) Epipterygoid anteriorly shortened, ending posterior to the thickened lower end of the inferior process of the parietal. (viii) Fissura ethmoidalis keyhole-shaped, very narrow in the ventral part, upper open part diamond-shaped. (ix) Jaw surfaces with simple cutting edge, no tomial ridges, no expanded crushing surfaces.

The last two characters are important diagnostic ones for *Mauremys*. Many of the others are primitive for batagurines in general.

Measurements.—Females attain a straight carapace length of at least 19.3 cm, and males at least 18.9 cm. Detailed measurements of our series from Fujian and Guizhou are given in Tables 1 and 2.

John Iverson has kindly made available some preliminary morphometric comparisons of certain plastral aspects of four female and five male specimens of *M. iversoni* from Fujian with sexually-matched series of five populations of *M. mutica* from different localities, and also single series for each of *M. japonica*, *M. leprosa*, both subspecies of *M. caspica*, and with four specimens (just one male) of *Annamemys annamensis* (Figs. 3, 4). They demonstrate clearly the morphological distinctness of *M. iversoni*.

Comparisons.—See Diagnosis for comparisons with *Mauremys mutica*. The head coloration of *M. iversoni* is remarkably similar to that of *Cuora trifasciata*, although that taxon is easily distinguished from *M. iversoni* by the absence of the bar through the eye, the greater extent and brightness of the orange coloration of the soft parts, the plastral hinge, and the dark lines along the keels of the carapace. In *C. trifasciata*, the postorbital marking is wider than that of *M. iversoni*, and of a darker (puce) color.

Geographic variation.—The shells of *M. iversoni* from Guizhou were relatively broader than those from Fujian, and they did not become relatively narrower with maturity (mean CW/CL for four Guizhou juveniles: 78.12%; for four adults: 78.75%. Mean CW/CL for five Fujian juveniles: 76.44%; for 15 adults: 72.57%). The turtles from Guizhou also had less carapacial speckling, none at all in some cases, and tended to have a darker postorbital marking.

Distribution and habitat.—The specimens were collected from two general areas: near the towns of Nanping and Kaenyang, Fujian Province, and in the central part of Guizhou Province near Kweiying. The species may presumably be expected in the intervening provinces of Hunan and Jiangsi. The Fujian habitat is reported by the collector to consist of the slow-moving sections and backwaters of fast streams

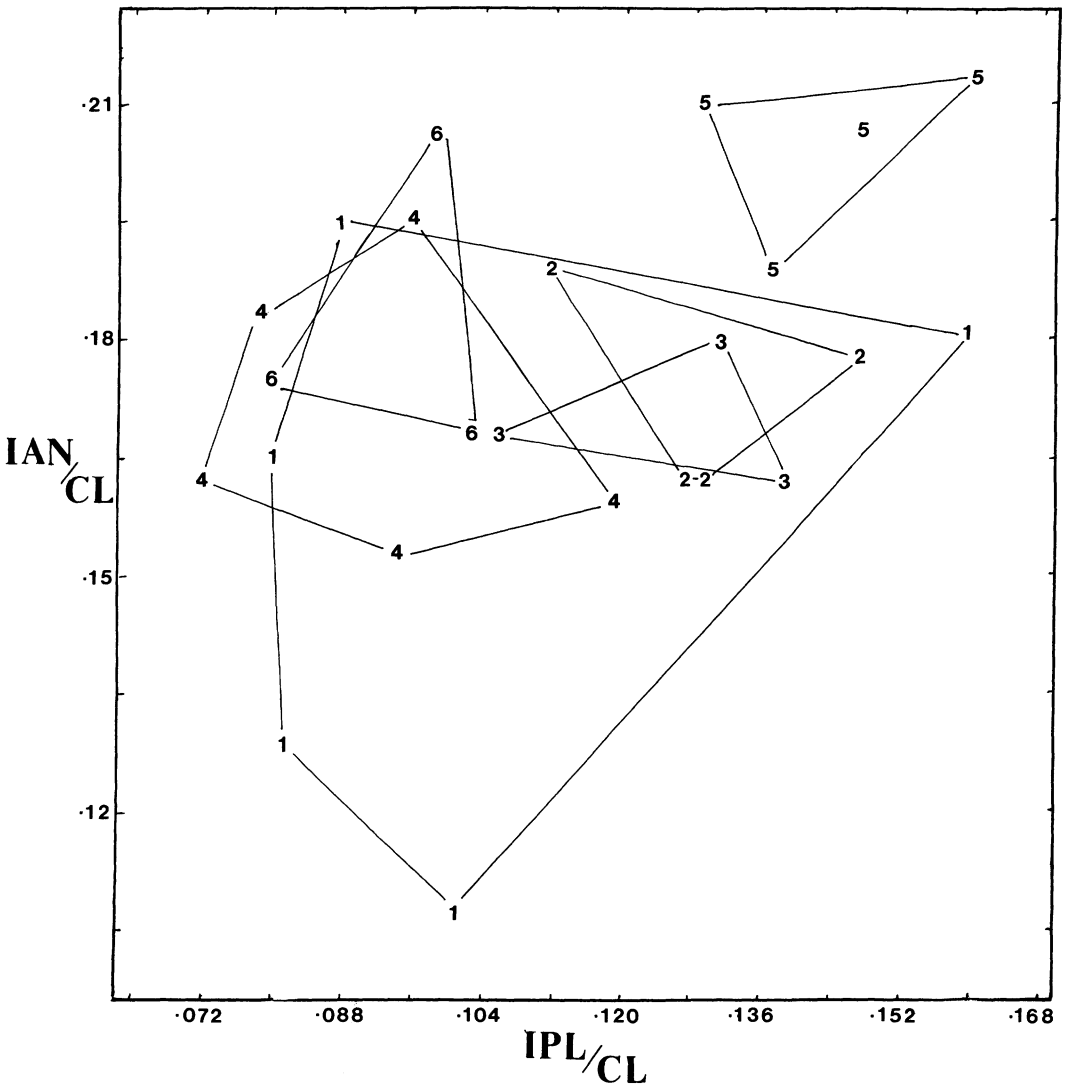

FIG. 3.—Bivariate plot of ratio of interanal seam length/carapace length (IAN/CL) versus ratio for specimens of each recognized species of *Mauremys*. Adult females only. Polygons enclose range of variation of each species (individual specimens plotted for *M. iversoni*). Symbols: 1 = *mutica* (n = 35); 2 = *japonica* (n = 4); 3 = *leprosa* (n = 8); 4 = *caspica* (n = 12); 5 = *iversoni* (n = 4); 6 = three specimens of *Annamemys annamensis*.

running close to mountains, at about 500 m elevation.

Oscar Shiu reports that *M. iversoni* is syntopic with *M. mutica* and is grossly sympatric with *Cistoclemmys flavomarginata*; however, *M. mutica* occurs frequently in rice fields, whereas *M. iversoni* rarely, if ever, occurs in such habitats.

Zoogeographically, the apparent distribution is curious indeed. Virtually all new species of turtles that have come to light in recent decades had been overlooked previously, in part because of their very limited geographic distribution; yet *M. iversoni* appears to range over at least 1000 km between the Fujian and Guizhou localities, although it remains to be demonstrated whether this distribution is discontinuous, and if so to what degree. If we had not seen the specimens from Guizhou,

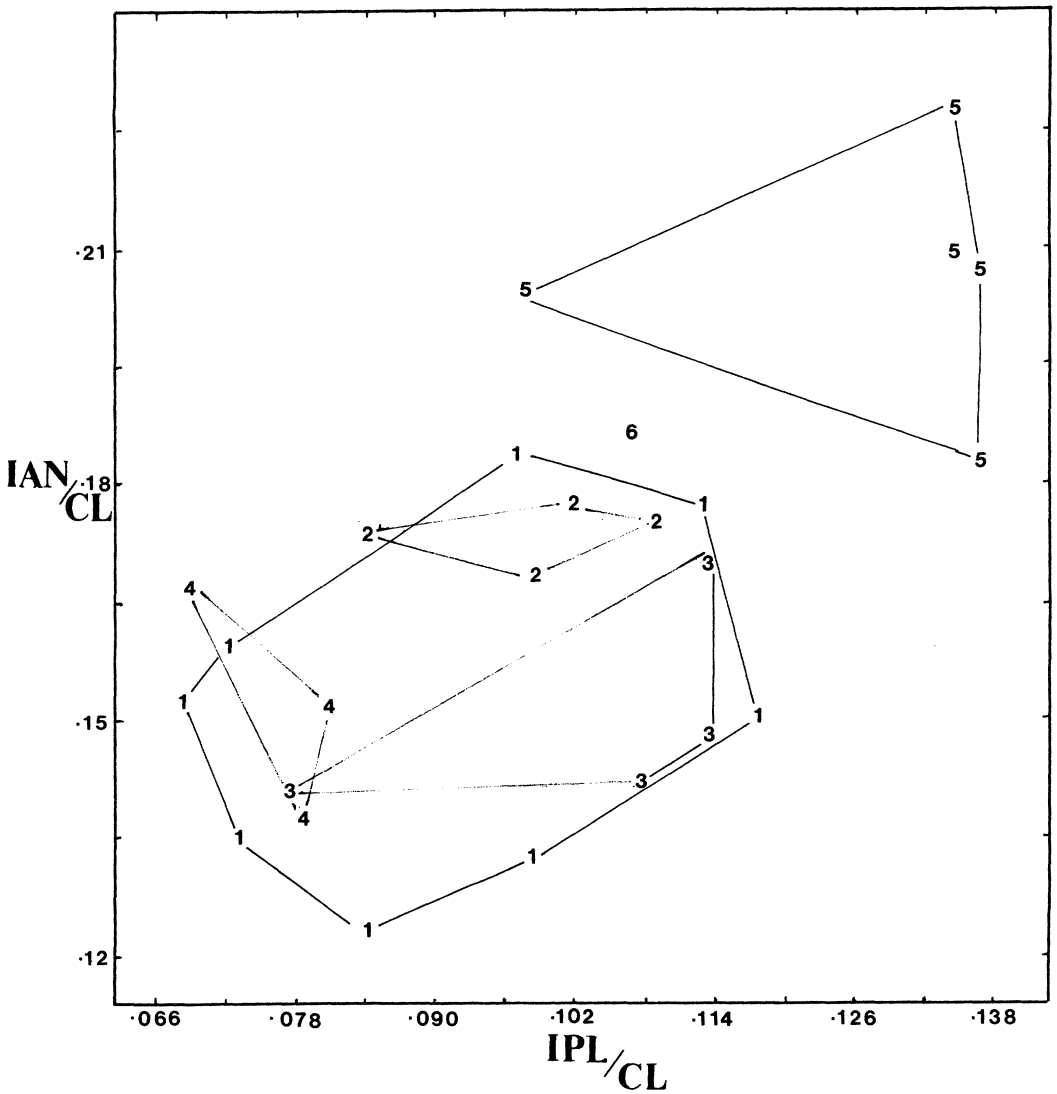

FIG. 4.—Bivariate plot of IAN/CL and IPL/CL (see Fig. 3) for adult males of each recognized species of *Mauremys*. Symbols: 1 = *mutica* (n = 37); 2 = *japonica* (n = 5); 3 = *leprosa* (n = 8); 4 = *caspica* (n = 3); 5 = *iversoni* (n = 5); 6 = only specimen of *Annamemys annamensis*.

we would have been tempted to postulate that *M. iversoni* had evolved in isolation in short river drainages in coastal Fujian, essentially surrounded by populations of the pond-dwelling *M. mutica* (to the north, northeast, west, and southwest). This speculation would suggest that the reported origin of the "Guizhou" specimens might have been in error. Nevertheless, the latter specimens do differ in several ways, albeit subtle ones, from those from Fujian. We have presented these queries to Oscar Shiu and, while he does not offer zoogeographic interpretations, he has assured us that there is no doubt about the areas of origin of the specimens. Some Chinese turtles (especially *Chinemys reevesi*) have been relocated and released extensively as a manifestation of Buddhist ritual, and conceivably such displacements may have occurred with *M. iversoni* also.

Etymology.—We name this species in honor of our colleague Dr. John B. Iverson, one of the most productive and knowl-

TABLE 1.—Dimensions (cm) of specimens of *Mauremys iversoni* from Fujian, China. Abbreviations: CL = carapace length, CW = carapace width, PL = plastral length, WHL = width of hind lobe, GUL = gular length, HUM = humeral length, PECT = pectoral length, ABD = abdominal length, FEM = femoral length, AN = anal length.

CL	CW	PL	WHL	GUL	HUM	PECT	ABD	FEM	AN	CW/CL	GUL/PL	AN/PL
Adult females												
17.5	12.5	15.7	8.5	2.6	1.3	3.9	3.35	2.0	2.9	71.4%	16.7%	18.5%
14.05	10.1	12.5	6.4	1.75	1.5	2.5	3.05	2.05	1.85	71.8%	14.0%	14.8%
17.8	12.9	16.45	8.9	2.45	1.7	3.95	3.7	2.5	2.5	72.5%	14.9%	15.2%
14.2	10.4	12.8	7.0	1.9	0.95	2.9	2.6	1.8	2.45	73.2%	14.8%	19.1%
19.3	14.55	17.2	9.6	(plastron deformed—highly convex, scutes very asymmetrical)								
17.0	12.35	15.05	8.8	2.15	1.7	3.25	3.4	2.5	2.55	72.6%	14.3%	16.9%
$\bar{x}$ = 16.64	12.13	14.95								73.83%	14.94%	16.86%
Adult males												
17.6	12.9	15.2	8.3	2.35	1.2	3.65	3.55	2.5	1.9	73.3%	15.5%	12.5%
16.3	12.2	14.1	8.2	2.15	1.25	3.05	2.85	2.3	2.5	74.8%	15.2%	17.7%
14.1	10.0	12.4	6.6	1.95	1.0	2.9	2.45	2.2	2.0	70.9%	15.7%	16.1%
14.05	9.7	12.6	6.65	1.65	1.1	3.1	2.9	1.75	2.0	69.0%	13.1%	15.8%
16.1	12.0	13.9	7.95	2.1	1.25	3.0	3.2	2.0	2.5	74.5%	15.1%	18.0%
18.9	13.6	16.1	9.35	2.3	1.5	3.5	3.5	2.45	2.8	71.9%	14.2%	17.4%
14.8	10.6	12.6	6.7	1.8	0.9	3.05	2.5	2.1	2.0	71.6%	14.3%	15.8%
15.05	10.7	12.9	6.95	1.7	1.15	2.9	3.2	2.15	1.8	71.1%	13.2%	13.9%
16.75	12.5	14.9	7.7	2.15	1.35	3.8	2.85	2.5	2.25	74.6%	14.4%	15.1%
13.0	9.8	11.25	5.95	1.28	1.57	2.40L 2.90R	2.90L 2.25R	1.90	1.30	75.3%	11.4%	11.6%
$\bar{x}$ = 15.67	11.40	13.60								72.7%	14.21%	15.39%
Juveniles												
11.6	8.45	10.0	5.5	1.4	0.95	2.45	2.25	1.25	1.8	72.8%	14.0%	18.0%
9.55	7.15	8.4	4.25	1.1	0.9	1.9	2.1	1.25	1.25	74.8%	13.1%	14.9%
10.5	7.8	9.15	4.85	1.3	1.1	2.1	2.1	1.15	1.5	74.2%	14.2%	16.4%
9.8	7.7	8.9	4.55	1.4	0.95	1.85	2.1	1.45	1.2	78.6%	15.7%	13.5%
8.25	6.75	7.35	3.9	1.0	0.85	1.55	1.65	1.15	1.0	81.8%	13.6%	13.6%
$\bar{x}$ = 9.94	7.64	8.76								76.44%	14.12%	15.28%

TABLE 2.—Dimensions (cm) of *Mauremys iversoni* from Guizhou, China. Abbreviations as in Table 1.

CL	CW	PL	WHL	GUL	HUM	PECT	ABD	FEM	AN	CW/CL	GUL/PL	AN/PL
Adult male												
13.4	10.4	11.5	6.4	1.75	0.9	2.75	2.65	1.8	1.7	77.6%	15.2%	14.8%
Adult females												
15.2	12.5	13.5	7.8	2.25	1.4	2.8	3.0	2.4	2.05	82.2%	16.7%	15.2%
17.55	13.9	15.65	8.65	2.25	1.65	4.0	3.8	2.45	2.25	79.2%	14.4%	14.4%
17.85	13.55	15.8	8.8	2.4	1.1	3.8	3.5	2.75	2.6	76.0%	15.2%	16.5%
$\bar{x}$ = 16.86	13.32	14.98								79.13%	15.43%	13.37%
Juveniles												
12.9	10.2	11.4	6.65	2.0	0.75	2.25	3.0	1.85	2.1	79.1%	17.5%	18.4%
11.0	8.75	10.2	5.3	1.8	0.65	2.25	2.3	1.5	1.8	79.5%	17.6%	17.6%
10.85	8.45	9.5	5.1	1.65	0.8	2.0	2.1	1.5	1.3	77.8%	17.3%	13.7%
12.35	9.4	10.9	5.85	1.75	0.7	2.65	2.4	1.75	1.45	76.1%	16.1%	13.3%
$\bar{x}$ = 11.77	9.2	10.5								78.1%	17.1%	15.75%

edgeable of the current generation of cheloniologists, and one who has always helped us unstintingly with our own endeavors in matters relating to turtles.

Acknowledgments and notes.—We are most grateful to John Iverson for making various unpublished manuscripts available to us and for conducting the morphometric comparisons. We thank Oscar Shiu for collecting the specimens and making them available to us. And we thank two anonymous reviewers for their helpful comments.

Primary orthography of Chinese geographic names follows the Pinyin convention approved by the government of the People's Republic of China. Measurements of shells and scutes (all straight-line) were made with dividers and a millimeter ruler, with interpolation to the nearest 0.5 mm. Carapace and plastral lengths are midline, not maximum; carapace width is maximum.

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