

## *Mauremys pritchardi*, a New Batagurid Turtle from Myanmar and Yunnan, China

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**ABSTRACT.** — A new batagurid turtle species, *Mauremys pritchardi*, is described from northern Myanmar and adjacent Yunnan, China. It is related to *Mauremys mutica*, and is the westernmost member of the *M. mutica* complex, which includes *M. annamensis* as well as several morphologically differentiated populations of *M. mutica*. The species is distinguished from *M. mutica* by the smaller size, especially of adult males; the relatively shorter plastron; relatively longer abdominal scutes; presence of two stripes on each side of the head (the lower one often interrupted or broken), sexual size dimorphism favoring females (sexes of similar size in some populations of *M. mutica*, dimorphism favoring males in Ryukyu populations); absence of plastral concavity in adult males, and more clearly defined dorsal keels.

**KEY WORDS.** — Reptilia; Testudines; Bataguridae; *Mauremys*; turtle; systematics; taxonomy; distribution; morphology; osteology; China; Myanmar; Burma

The chelonian fauna of Myanmar (formerly Burma) remains one of the least-known in Asia. Important but mostly descriptive early studies on several of the species were reported by Theobald (1868) and Anderson (1878). Maxwell (1911) gave some statistics on marine and estuarine turtles in the lower Ayeyarwady (Irrawaddy), and Smith (1931) included the Burmese species in his monograph on the Fauna of British India. But, as van Dijk (1993) observed, hardly any new information has been collected this century, an amazing negligence in view of widespread recent scientific and herpetocultural interest in turtles in general, and the great variety of chelonians found within Myanmar, whose fauna includes 5 sea turtle species, 4 or 5 tortoises, 11–19 aquatic hardshells, and 6 or 7 trionychids. Six of these turtle species are thought to be endemic (van Dijk, 1993).

Nonetheless, in recent years a few herpetologists have succeeded in making observations on turtles in Myanmar and in adjacent parts of Yunnan, forming small collections of mostly salvaged or local market material (Frazier, 1987; van Dijk, 1993, 1994; Kuchling, 1995). Furthermore, my colleague Oscar Shiu, who has been instrumental in the discovery of numerous new chelonian species from eastern Asia in recent years (Ernst and McCord, 1987; Ernst, 1988; McCord and Iverson, 1991, 1992, 1994; Pritchard and McCord, 1991; Iverson and McCord, 1992), has had several opportunities for travel within Myanmar and adjacent Yunnan in recent years, and has now obtained a series of a new species of turtle referable to the genus *Mauremys* (family Bataguridae), described and named below.

### *Mauremys pritchardi*, sp. nov. (Figs. 2–6)

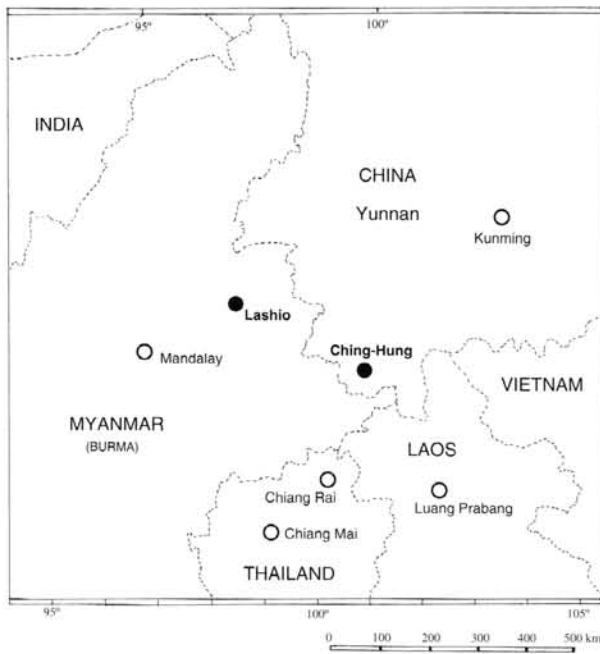
**Holotype.** — UF 105422 (University of Florida, Florida State Museum) (formerly PCHP 3251), adult female, in alcohol, carapace length (CL) 165 mm, locality: Lashio, Myanmar (97°14'E, 22°56'N), coll. Oscar Shiu, 1991.

**Paratypes.** — UF 105423 (formerly PCHP 3255), sub-adult, in alcohol, CL 105 mm, same data; UF 105424 (formerly PCHP 4400), adult male, skeleton, CL 135 mm, locality: Ching-Hung (= Jinghong), Yunnan, China (100°49'E, 21°59'N), coll. Oscar Shiu, 1994.

**Referred Specimens.** — In addition to the 3 type specimens, 17 supplementary reference specimens were also obtained from local markets in the same two communities. This permitted the assembly of a large series upon which to establish the new species, but the market origin of the specimens could raise the question as to whether they were indeed locally caught. Shiu's enquiries at the time of purchase, and lines of argument presented by Kuchling (1995) after obtaining turtles from the Ruili market about 130 km north of Lashio, have convinced me that the animals were all collected within a minimal radius of the actual points of sale, and certainly within the same biogeographic zone and drainage basins in which the markets themselves were located.

The specimens were kept alive after purchase, and were conveyed to Hopewell Junction, New York. They arrived in several batches over about three years. Early and generally smaller specimens were obtained at the Lashio (Myanmar) market, and later ones from Ching-Hung (Yunnan, China). These localities are 343 km apart (Fig. 1), and the international (Myanmar/China) border passes about half way between them. The live animals were not tagged or marked, and partial mixing of specimens occurred subsequently in captivity. Consequently, apart from the three type specimens, for which origins were recorded, I am obliged to give less precise collection data for the other Lashio and Ching-Hung turtles measured.

Detailed measurements were initially taken of the 20 live specimens; they are given in Table 1. As mortalities occurred in captivity, the dead specimens were conveyed to the Peter C.H. Pritchard collection (PCHP) in Oviedo, Florida, where they were preserved or skeletonized and catalogued. In that several years typically elapsed before death, growth and ontogenetic changes occurred during this interval, and it is no



**Figure 1.** Map of northeastern Myanmar and adjacent areas of Yunnan, China, showing collecting localities for *Mauremys pritchardi* (solid dots).

longer possible to establish the precise correspondence between the 20 live specimens measured originally and the 11 skeletal and preserved specimens that eventually accumulated in the PCHP collection. Consequently, in order to avoid biasing the morphometrics by presenting data taken on a single specimen at two stages of life as if it were two separate specimens, I restrict the morphometric data to the live animals, and utilize the skeletal specimens only for elucidation of osteological features, including skull morphology, neural bone configurations, articulations of the cervical vertebrae, and relationships of plastral scutes to plastral bones.

The following 11 specimens are in the PCHP collection: 3252, ad. female, CL 135 mm, alc., Lashio, Myanmar, or Ching-Hung (= Jinghong), Yunnan, China, coll. O. Shiu, W.P. McCord don.; 3435, ad. female, CL 142 mm, skel., same data; 3436, ad. male, CL 139 mm, skel., same data; 3437, ad. male, CL 136 mm, skel., same data; 3438, ad. male, CL 132 mm, skel., same data; 3439, ad. male, CL 119 mm, skel., same data; 3440, ad. male, CL 120 mm, skel., same data; 3441, ad. male, CL 130 mm, skel., same data; 4088, ad. female, CL 164 mm, alc., Burma/Yunnan border area, O. Shiu, coll., W. McCord don.; 4106, ad. female, CL 160 mm, alc., same data; 4214, ad. female, CL 152 mm, skel., same data.

There are also 9 specimens of *M. pritchardi* in the Staatliches Museum für Tierkunde, Dresden, Germany, all lacking collecting data, and these are listed below only for completeness. They were not examined or included in any of the morphometric analyses (these specimens were identified by U. Fritz, *pers. comm.* to P. Pritchard). They are: 28692, "China" (ex Hong Kong import), alc.; 29013, no data, juv., M. Reimann don., alc.; 33301, "China," ad. male, purchased from M. Reimann, alc.; 33302, ad. male, same data; 35685, "China," ad. female (ex Hong Kong import, M. Reimann don.); 36586, juv., same data;

36737, juv., same data; 38646, "China," ad. male, M. Reimann don., alc.; 39507, ad. male, no data, M. Reimann, don., alc.

**Distribution.** — All the specimens examined were obtained by Oscar Shiu from local people at two localities: Lashio, Myanmar, and Ching-Hung (= Jinghong), Yunnan, China (Fig. 1). They had reportedly been collected locally, but precise localities of actual collection are unavailable. Smith (1931) and Kuchling (1995) discussed the zoogeographic uniformity of southwestern Yunnan and upper Myanmar — and indeed of Assam, Laos, Cambodia, and northern Vietnam also — but at present it would be speculative to discuss the potential range limits of *M. pritchardi*.

**Diagnosis.** — A small pond turtle, distinguished from its congeners by the combination of a relatively narrow carapace; plastron with relatively short interhumeral and long interpectoral and interabdominal seams; sexual dimorphism manifested by adult females being significantly larger than adult males; the males with little if any plastral concavity; and the presence of two light facial stripes on each side, the lower one often interrupted or broken. Superficial similarity exists between juveniles of *M. pritchardi* and *Chinemys reevesi*, whereas adults are closer in appearance to their congener *Mauremys mutica*.

**Etymology.** — The species is named for Peter C.H. Pritchard of Oviedo, Florida. His lifelong scholarly study of the turtles of the world, as well as his popular writings and conservation efforts on behalf of chelonians have been an inspiration to many.

## DESCRIPTION

**Carapace.** — The carapace is moderately elevated, less so in adults, with a strong median keel extending from the nuchal to the supracaudals. Paired lateral keels are prominent in juveniles and reduced but present in adults. The nuchal scute is small but relatively broad, with posteriorly divergent sides in dorsal aspect and notched posteriorly. In ventral aspect the nuchal scute has convex and slightly divergent sides. Vertebral scutes 1 to 3 are of subequal width; vertebral 4 is wider. Eleven pairs of marginal scutes and a single pair of supracaudals are present. The shell margin is smooth and unserrated except for a slight notch between the supracaudals. In dorsal aspect the carapace is oval or posteriorly slightly flared, the greatest width being at or near marginal 8. Marginal 1 is the longest, marginal 2 the second longest. The upper edge of the marginal series is nearly even except for slight elevations below the intercostal seams. Growth annuli are evident but are not deeply incised. The carapace is usually dark to light brown or olive in color (Fig. 2), with the median keel usually darker (sometimes interruptedly). The dorsal scutes are non-imbriate and may be dark-edged, especially with age, and in some individuals, probably mostly old ones, the carapace is entirely black (Fig. 3). In lateral aspect the vertebral profile is slightly sinuous, with the highest point at the peak of vertebral 3.

**Plastron.** — The plastron is broad, relatively short, and unhinged, or with slight posterior kinesis in adult females, and with a strong anal notch (Figs. 4, 5). The anterior and posterior



**Figure 2 (top left).** Juvenile *Mauremys pritchardi*, apparently two years of age. **Figure 3 (top right).** Old adult male *Mauremys pritchardi* showing unusually dark carapace. **Figure 4 (bottom left).** Plastron of subadult *Mauremys pritchardi*. **Figure 5 (bottom right).** Plastron of old adult male *Mauremys pritchardi*.

lobes are of subequal width. The abdominal scutes are the longest in the plastron, with the femorals either slightly longer or slightly shorter than the pectorals. The humeral scutes are relatively short. The axillary scute may be elongate or short, and contacts marginals 3 and 4 and the pectoral scute. The anterior lobe has a sinuous periphery, slightly constricted at the gular/humeral seam, anteriorly truncated, or slightly notched. The posterior lobe is widest at the inguinal notch, slightly constricted at the femoral-anal seam. The inguinal scutes are four-sided, elongate, and abut marginal 7, and sometimes marginal 6.

The ground color of the plastron and ventral marginals is light yellow, with a single black blotch on each scute except for the pectorals and abdominals, each of which has two blotches. The blotches are often small and well-separated but may enlarge and coalesce longitudinally; lateral coalescence may occur between the paired blotches on the pectorals and abdominals (Figs. 4, 5). The blotches may be merely nondescript dark areas or may shade into coarse anteromedial radiations. The ventral marginal scutes are usually lightly pigmented, but dark pigment, if present, is usually heaviest adjacent to the bridge. Ventral intermarginal seams may be black. Although usually patterned as described, the plastron of some individuals may be either uniformly light yellow or completely dark.

**Head.** — The head is small and rather narrow, with a slightly overhanging snout and terminal nostrils. The dorsal surface of the head is smooth, unmarked, and light to dark

olive-green in color. Usually two black-bordered light yellow-green postorbital stripes are present on each side; quite often, one of these stripes (usually the lower) may be broken or incomplete (Fig. 6). There may be a very fine light line along the upper edge of the maxillary rhamphotheca. A downwardly oblique light bar extends posteriorly from the corner of the mouth, ending at the antero-ventral border of the tympanum. The chin is elaborately marbled with light or bright yellow and gray-green. The neck is gray, with inconspicuous light lateral stripes. The eye is light yellow-green, with a horizontal dark bar.



**Figure 6.** Head and neck of a subadult *Mauremys pritchardi*.

*Limbs and Tail.* — The forelimbs are broad and robust, with about four rows of enlarged lamellae on the anterior face. Five claws are present on each of the four limbs. The hindlimbs are well webbed, and rather heavily scaled. The tail is moderately long. The forelimbs are gray with light yellow marbling and the skin between the lower neck and forelimbs is usually light yellow. The hindlimbs are gray with small yellow papillae arranged in vertical rows on the ischial tuberosities. The tail is dorsally gray, ventrally yellow.

*Skeleton.* — Eight neural bones were present in each of the 9 specimens examined. The neural configuration was constant (in contrast to the wide variation found in *M. mutica*; McDowell, 1964), with neural 1 rectangular, and the remainder of the series hexagonal, generally with the anterolateral sides extremely short, although in neural 8 the anterolateral and posterolateral sides are subequal. Except for neural 1, all are wider than long, with neurals 1, 3, and 4 the longest, neural 2 slightly shorter than 1 and 3, and neurals 5 to 8 progressively shorter. Suprapyrgals are usually two, sometimes three. Pleurals show some alternation in width at the lower end, 1 being very wide, 2, 4, and 6–8 also quite wide, and 3 and 5 narrowed. The axillary buttress makes contact with pleural 1, and the inguinal buttress contacts the suture between pleurals 5 and 6.

In the plastron, the anal notch is variable in depth and angular or sinuous in shape, without obvious correlation with sex. The hyo-hypoplastral suture is transverse and straight, usually bisecting the distance between the axillary and inguinal notches. The posterior lobe is relatively narrow and has only slightly convex sides, and incomplete sutural closure between the hypoplastron and the adjacent pleural and peripheral bones suggests some degree of posterior lobe kinesis. The

entoplastron is longer than wide and is always traversed by the gular-humeral and humeral-pectoral sulci. A relatively large musk duct opening perforates peripheral 7 close to the inguinal buttress, and a much smaller opening penetrates peripheral 3 close to the axillary buttress.

*Skull and Vertebrae.* — The skull was examined in 7 specimens. In no cases were notable differences from skulls of *M. mutica*, as described by McDowell (1964), observed. In the palatal view, several characters diagnostic for the genus *Mauremys* and identified by McDowell (1964) were confirmed, including the absence of the foramen caroticopharyngeale, the backward extensions of the pterygoids contacting the basioccipital, and the presence of a "batagurid process" extending laterally from each side of the basioccipital, forming the floor of the recessus scalae tympanae. The fissura ethmoidalis is keyhole-shaped, contrasting with the broadly triangular form of this orifice in *Sacalia*.

The cervical vertebrae were examined in 9 specimens. In all cases, cervicals 2 and 3 were opisthocelous, 4 and 8 were biconvex, 5 and 6 were procoelous, and 7 was amphicoelous. Ginglymoids were present only in the articulations between cervicals 6 and 7 and between 7 and 8. The absence of ginglymoids between cervicals 5 and 6 is a feature that differentiates *Mauremys* from its nearctic ecological replacement *Clemmys*, once considered congeneric but now placed in the family Emydidae.

In a single adult male specimen, 18 postsacral vertebrae were present.

*Size and Sexual Dimorphism.* — This is a small species; the largest live, freshly-caught individual examined had a straight CL of 157.5 mm. After several years of captive

**Table 1.** Dimensions (mm) and ratios (expressed as percentages) of shell parameters for a series of 20 live wild-caught *Mauremys pritchardi*. CL = maximum straight-line carapace length, CW = maximum straight-line carapace width, PL = maximum plastral length, PWC = maximum width of hind lobe of plastron, GL = length of gular scutes along plastron midline, IH = length of humeral scutes, IP = length of pectoral scutes, IAB = length of abdominal scutes, IF = length of femoral scutes, IAN = length of anal scutes.

Dimensions in mm										Ratios as Percentages of CL								
CL	CW	PL	PWC	GL	IH	IP	IAB	IF	IAN	CW	PL	PWC	GL	IH	IP	IAB	IF	IAN
Females																		
157.5	110.5	141.5	69.0	20.0	12.5	28.0	33.5	31.0	15.0	70.2	89.8	43.8	12.7	7.9	17.8	21.3	19.7	11.7
156.0	112.0	140.0	68.0	23.0	16.5	21.0	35.5	27.0	16.5	71.8	89.7	43.6	14.7	10.6	13.5	22.7	17.3	10.6
153.5	110.5	134.0	69.0	20.0	14.5	27.0	32.5	24.0	16.0	72.0	87.3	44.9	13.0	9.4	17.6	21.2	15.6	10.4
152.0	107.0	135.0	69.5	20.0	15.0	25.0	32.0	25.5	16.5	70.4	88.8	45.7	13.2	9.9	16.4	21.1	16.8	10.9
147.5	104.5	127.5	64.5	20.0	17.0	23.5	30.0	22.0	16.5	70.8	86.4	43.7	13.6	11.5	15.9	20.3	14.9	11.2
141.0	103.0	125.5	64.5	18.5	13.5	22.5	33.0	23.0	16.0	73.0	89.0	45.7	13.1	9.6	15.9	23.4	16.3	11.3
136.0	95.5	120.0	59.5	15.0	17.0	21.5	31.0	21.0	15.0	70.2	88.2	43.7	11.0	12.5	15.8	22.8	15.4	11.0
127.5	94.5	113.5	56.0	17.5	13.0	21.5	28.0	21.0	12.5	74.1	89.0	43.9	13.7	10.2	16.9	22.0	16.5	9.8
113.5	85.5	100.0	50.5	15.5	11.0	20.0	21.5	21.0	11.5	75.3	88.1	44.5	13.7	9.7	17.6	18.9	18.5	10.1
113.0	80.0	96.0	46.0	14.0	12.0	16.5	22.0	20.0	10.0	70.8	85.0	40.7	12.4	10.6	14.6	19.5	17.7	8.85
Males																		
128.0	90.0	108.0	52.0	17.0	9.5	20.0	23.0	23.0	13.0	70.3	84.4	40.6	13.3	7.4	15.6	17.9	17.9	10.2
122.5	86.0	107.5	53.5	18.0	11.0	20.0	25.0	22.0	11.5	70.2	87.7	43.7	14.7	9.0	16.3	20.4	17.9	9.4
115.0	82.0	99.0	45.5	13.5	12.0	15.0	23.0	20.0	13.5	71.3	86.1	39.6	11.7	10.4	13.0	20.0	17.4	11.7
115.0	80.0	99.5	47.5	13.5	12.5	22.0	22.5	20.0	9.0	69.6	86.5	41.3	11.7	10.9	19.1	19.6	17.4	7.8
111.5	79.0	91.5	45.0	11.5	12.0	18.0	20.0	20.0	8.5	70.8	82.1	40.4	10.3	10.8	16.1	17.9	17.9	7.6
108.0	74.0	89.0	44.0	12.5	10.0	17.5	21.0	17.5	12.0	68.5	82.4	40.7	11.6	9.3	16.2	19.4	16.2	11.1
Juveniles																		
115.0	83.5	100.5	52.5	16.5	7.5	21.5	25.0	18.0	11.5	72.6	87.4	45.6	14.3	6.5	18.7	21.7	15.7	10.0
102.0	74.0	87.5	42.5	12.0	12.0	16.0	19.0	16.5	11.0	72.5	85.8	41.7	11.7	11.7	15.8	18.6	16.2	10.8
97.0	69.0	83.0	39.0	12.0	7.0	15.0	18.5	17.5	9.0	71.1	85.6	40.2	12.4	7.2	15.4	19.1	18.0	9.3
86.5	64.5	78.5	37.5	12.0	11.5	14.0	19.5	15.0	8.5	74.6	90.7	43.3	13.9	13.3	16.2	22.5	17.3	9.8

**Table 2.** Selected ratios of shell parameters for eastern Asiatic species of *Mauremys*. Ratios are mean values expressed as percentages. Abbreviations: CL: carapace length (mean and maximum in mm); CW: carapace width; PL: plastral length; PWC: anterior width of plastral hindlobe; GL: gular length; IH: interhumeral seam length; IP: interpectoral seam length; IAB: interabdominal seam length; IF: interfemoral seam length; IAN: interanal seam length. Data for all species except *M. pritchardi* from Iverson and McCord (1994).

Species	Sex	n	CL		Ratios Expressed as Percentages of CL								
			mean	max	CW	PL	PWC	GL	IH	IP	IAB	IF	IAN
<i>M. pritchardi</i>	M	6	116.7	128.0	70.1	84.9	41.1	12.2	9.6	16.1	19.2	17.5	9.6
	F	10	139.7	157.5	71.9	88.1	44.0	13.1	10.2	16.2	21.3	16.9	10.6
<i>M. iversoni</i>	M	5	160.9	194.0	66.5	91.4	44.9	13.7	7.4	20.6	19.2	14.1	12.8
	F	5	174.4	193.0	74.8	93.5	48.7	14.1	7.9	21.2	19.8	13.8	14.0
<i>M. japonica</i>	M	11	123.1	174.0	69.1	91.5	43.3	12.6	7.5	16.4	22.7	16.6	9.4
	F	4	153.6	184.0	68.9	96.9	51.7	10.8	10.4	17.3	23.4	15.0	12.9
<i>M. annamensis</i>	M	4	168.7	188.0	78.1	88.9	46.9	13.0	8.9	16.5	18.0	18.2	8.7
	F	6	191.1	285.0	76.2	91.5	46.3	13.9	8.3	18.7	18.5	17.3	9.7
<i>M. mutica</i> (Mainland)	M	28	141.6	187.0	70.3	89.7	42.5	11.1	13.1	15.2	18.2	17.8	9.3
	F	25	143.9	187.0	70.8	91.8	44.9	11.4	12.8	15.9	18.8	17.8	9.4
<i>M. mutica</i> (Ryukyus)	M	4	156.0	179.0	69.0	87.2	42.6	12.5	10.1	14.0	18.9	17.5	9.3
	F	7	130.3	149.0	74.4	92.4	48.0	12.3	11.8	14.4	19.8	18.1	10.3

growth that may or may not have followed typical growth patterns, the largest specimen (PCHP 4088) had reached a CL of 164 mm. Mean CL of 6 wild-caught adult males was 116.7 mm (range 111.5–128 mm). Mean CL of 10 wild-caught adult females was 139.7 mm (range 113–157.5 mm).

In addition to their smaller mean size, adult males are noticeably narrower (mean CW/CL 70.1%;  $n = 6$ ; range 68.5–71.3%) than females (mean CW/CL 71.9%;  $n = 10$ ; range 70.2–75.3%) and subadults (mean CW/CL 72.7%;  $n = 4$ ; range 71.1–74.6%). Adult males also have a much thicker tail base than females. However, unlike *M. mutica* and *M. annamensis*, the plastron shows little if any concavity in adult males, and plastral dimorphism is manifested primarily by the relatively shorter plastron of males, and the relatively longer abdominal scutes of females.

Morphometrics of 20 *M. pritchardi* are given in Table 1 and are also reduced to ratios (expressed as percentages of maximum straight-line CL). The mean values are compared in Table 2 with those for other East Asian species of *Mauremys* given by Iverson and McCord (1994).

Figures 7–8 show bivariate plots of certain plastral scute ratios of *M. pritchardi*, with comparisons with those of other mainland southeast Asian *Mauremys* species. The clustering of the points corresponding to the four taxa plotted have relatively little overlap, with *M. pritchardi* being noteworthy for the relatively high value of the abdominal/plastral length (Ab/PL) ratio and the lower value of the humeral/pectoral (H/P) ratio.

## COMPARISONS

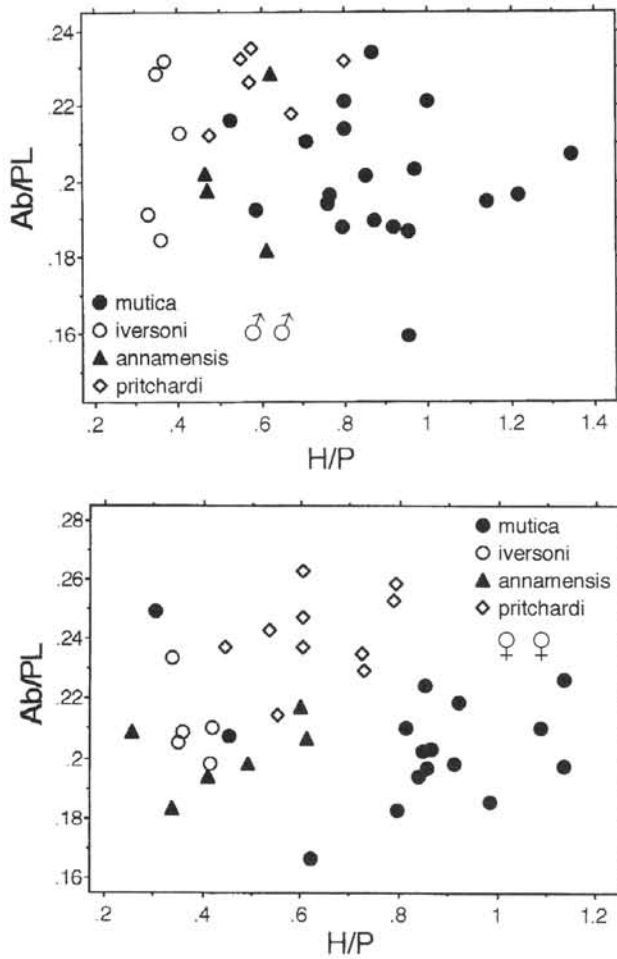
The following extant taxa are currently included within the genus *Mauremys* Gray, 1869:

- Mauremys leprosa* (Schweigger, 1812)
- Mauremys leprosa leprosa* (Schweigger, 1812)
- Mauremys leprosa atlantica* Schleich, 1996
- Mauremys leprosa erhardi* Schleich, 1996

- Mauremys leprosa wernerkaestlei* Schleich, 1996
- Mauremys leprosa marokkensis* Schleich, 1996
- Mauremys leprosa saharica* Schleich, 1996
- Mauremys leprosa zizi* Schleich, 1996
- Mauremys caspica* (Gmelin, 1774)
- Mauremys caspica caspica* (Gmelin, 1774)
- Mauremys caspica rivulata* (Valenciennes, 1833)
- Mauremys caspicaventrimaculata* Wischuf and Fritz, 1996
- Mauremys iversoni* Pritchard and McCord, 1991
- Mauremys japonica* (Temminck and Schlegel, 1835)
- Mauremys mutica* (Cantor, 1842)
- Mauremys mutica mutica* (Cantor, 1842)
- Mauremys mutica kami* Yasukawa, Ota, and Iverson, 1996
- Mauremys annamensis* (Siebenrock, 1903).

Definitive subgeneric groupings within the genus *Mauremys* have not been established, although Mlynarski (1976) presented a proposed breakdown, based largely upon fossil forms, into a “sarmatica–caspica” group and an “ukoi” group. However, zoogeographic, morphological, and chromatic considerations do suggest some level of breakdown of the extant taxa into an eastern group (*mutica*, *annamensis*, *japonica*, and *iversoni*) and a western one (*leprosa*, *caspica*), and on these grounds I shall emphasize comparisons of the new taxon with members of the eastern complex, especially the widespread *M. mutica*.

McDowell (1964) found *M. mutica* to be a perplexing taxon in that certain characters widely used for key characters within the Bataguridae showed major intraspecific variation in this species. Such characters included the inconstant relationship of the entoplastron to the humeropectoral sulcus, a feature that shows clinal change from north to south (Nakamura, 1934), and the extraordinary variability of the neural bones even within a series from Hainan Island alone, with the frequent inclusion of an octagonal element at position 2, 3, or 4. I did not find significant variation in these characters within the series of *M. pritchardi*.



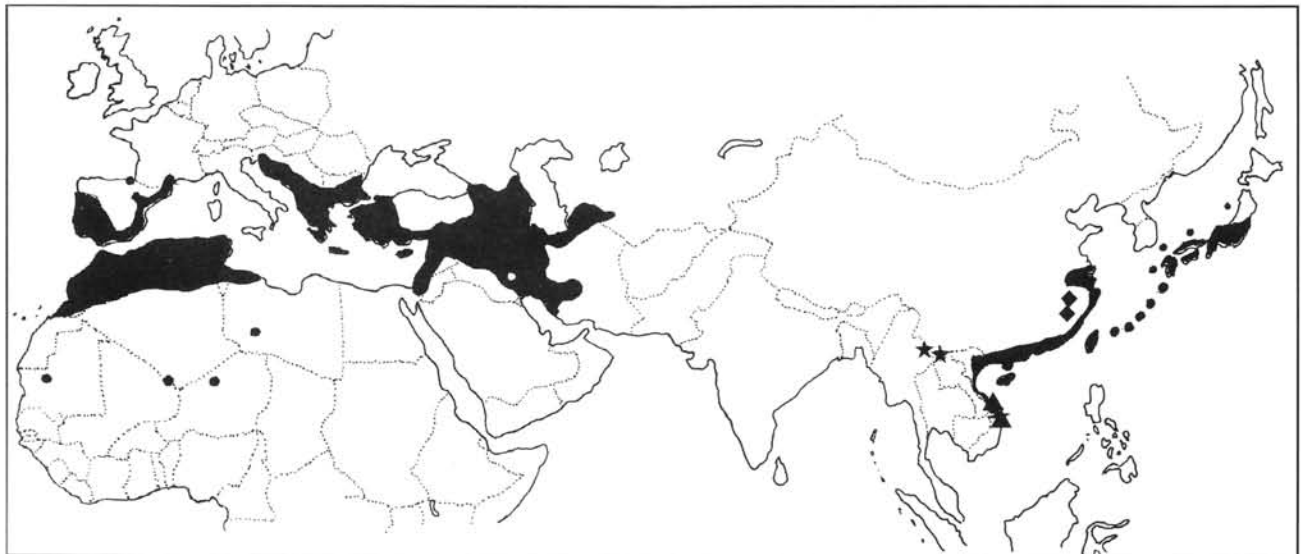
**Figure 7 (top).** Comparison of male plastral scute ratios for the species of *Mauremys* inhabiting mainland southeast Asia. Abbreviations are plastron length (PL), interhumeral seam length (H), interpectoral seam length (P), and interabdominal seam length (Ab). **Figure 8 (bottom).** Comparison of female plastral scute ratios for the species of *Mauremys* inhabiting mainland southeast Asia. Abbreviations as in Fig. 7.

*Mauremys mutica* has a wide distribution in eastern Asia, although its inland penetration appears to be modest (Figs. 9, 10). It occurs from central and northern Vietnam north along the coastal plain of China to the vicinity of Shanghai, with records also from Hainan, Taiwan, and many of the Ryukyu Islands (Yaeyama, Miyako, Okinawa, and Tokara groups). *Mauremys annamensis*, from central Vietnam, differs from *M. mutica* in being larger, with more differentiated sexual size dimorphism (favoring females), boldly striped head and neck, moderately tricarinate carapace, wider carapace, longer bridge, narrow and longer gular scutes, and shorter interhumeral and longer interpectoral seams (Iverson and McCord, 1994). It is clearly a member of the *M. mutica* group, but has differentiated sufficiently to be recognized as a separate species. Nonetheless, the major difference in degree of buttress development in this form described by Savage (1953) has not been substantiated. Petzold (1963, 1965) offered a photograph of a specimen of *M. mutica* (clearly not *M. annamensis*) from a hilly section of western Ha Tinh Province, Vietnam, only about 200 km from the nearest *M. annamensis* locality (Vinh Linh), raising the possibility of sympatry without intergradation between these forms.

*Mauremys iversoni* is described as sympatric with *M. mutica* (Pritchard and McCord, 1991), and this observation, together with its trenchant morphological differences (Iverson and McCord, 1994), tends to confirm the species-level distinctness of this taxon.

Yasukawa et al. (1996) undertook an intensive study of variation among populations of *M. mutica*, and concluded that the southern Ryukyu populations were sufficiently distinctive to merit recognition as a new subspecies (*M. m. kami*). In addition, the Honshu and Taiwan populations were also considered to be morphologically distinctive, although not to the degree of meriting subspecific recognition.

Thus, the documented overall range of the genus *Mauremys* is vast, extending from Spain and northwestern Africa to Japan, but it has numerous profound discontinuities.



**Figure 9.** Overall distribution of the genus *Mauremys*; ★ = locality points for *M. pritchardi*; ▲ = *M. annamensis*; ◆ = *M. iversoni*.

These include the obvious archipelagic disjunctures between the main islands of Japan, and also between these islands and the numerous small, offshore Japanese islands, as well as the chain of the Ryukyu Islands, and Taiwan and Hainan. Mainland populations of *M. mutica* appear to be reasonably contiguous although more data are clearly needed. It would be interesting to know if the minor (200 km) hiatus between southernmost *mutica* and *annamensis* in central Vietnam (Iverson and McCord, 1994) is real.

But the greatest range hiatus is between northwestern Iran, where *M. caspica* is widespread in Kurdistan and the Zagros Mountains (Pritchard, 1966), and the isolated record of *M. mutica* in northwestern Vietnam indicated by Iverson (1992), Iverson and McCord (1994), and Yasukawa et al. (1996). Much of this discontinuity is real, composed either of extremely arid habitat in central and western Iran and Afghanistan, or, in moister environments, by the presence of what may be an ecological replacement — the genus *Melanochelys* — in the Indian subcontinent.

The new species of the *M. mutica* complex described herein, *M. pritchardi*, extends the eastern Asian distribution of the species complex several hundred km to the west, to the border areas between northern Myanmar and adjacent Yunnan, China (see Figs. 1, 9, and 10), and into new drainage basins (the Salween – Irrawaddy). It also extends the generic range, hitherto known from the West Asian and Southeast Asian faunal zones, into the South Asian zone.

Relationships between *M. mutica* and its congeners in southeast Asia are not completely clear, and it would be premature to hypothesize a phylogeny. Within the continent, the pattern appears to be one of a widespread species (*M. mutica* itself) with a number of differentiated, localized “satellite” forms. Two of these (*M. iversoni* and *M. annamensis*) have possible or good evidence of sympatry with *M. mutica*, and the best current hypothesis is that they are valid species, presumably evolved from demes of a *mutica*-like common ancestor during a period of natural isolation.



Figure 10. Vouchered localities for *Mauremys mutica* (Iverson, 1992).

The apparent hiatus between the distributions of *M. mutica* and *M. pritchardi* is considerable, although the possibility that it is narrower than has been documented should not be rejected. In such situations, the criteria for designation of the taxa in question as species or subspecies are less than absolute, and my decision to accord binomial status to *pritchardi* is based upon the following considerations.

1) The morphological and chromatic differences are generally at least as developed as those that have been recognized binomially by other workers describing new chelonian taxa.

2) Current protocols (eloquently argued by Carr and Crenshaw, 1957) suggest that isolated and distinguishable populations should be given species status (the “binomial-of-reserved-judgement” rather than the “trinomial-of-complacency”) unless there is persuasive evidence to the contrary.

3) Among the most trenchant differences between *M. mutica* and *M. pritchardi* are those pertaining to sexual size dimorphism and to presence or absence of a plastral concavity in males. Such features are intimately involved in courtship mechanisms (Berry and Shine, 1980) as well as in the mechanics of copulation, and the differences may well correspond to reproductive isolation that evolved at a time when the taxa were sympatric.

The differences between *M. pritchardi* and its congeners within the “eastern group” of *Mauremys* may be summarized as follows.

*Mauremys mutica*. — This species differs from *M. pritchardi* in reaching a larger adult size (to 187 mm in both sexes), sexual size dimorphism that is either absent or favors males, depending upon the population; erratic variation in neural bone configuration and location of the anterior plastral seams relative to the entoplastron; deep plastral concavity in adult males; a single light stripe on the side of the head; relatively longer plastron in both sexes (PL/CL 0.872 in males, 0.744 in females, vs. 0.849 and 0.881 in *M. pritchardi*); and relatively shorter interhumeral and interabdominal seams (see Table 2).

*Mauremys annamensis*. — This species differs from *M. pritchardi* in its much greater adult size (females to 285 mm, males to 188 mm), considerably broader carapace in both sexes (CW/CL 0.762 in females, 0.781 in males) with almost horizontal development of the mid-marginals, relatively longer plastron in both sexes, and much more contrasting pigmentation of the soft parts that includes three pairs of pale yellow stripes extending posteriorly from the top of the nose, with a fourth beginning along the inner border of the lower jaw, passing along the jugular region to the neck.

*Mauremys japonica*. — This form, with a wholly insular distribution, differs from *M. pritchardi* in having a completely black ventral surface of the shell, and by the relatively light olive-brown “textured” carapacial pigmentation, with black pigment generally concentrated along the midline. Morphometrically, the plastron is relatively longer and wider than that of *M. pritchardi* in both sexes (see Table 2), and the interabdominal seam is longer relative to the carapace length.

*Mauremys iversoni*. — This species differs from *M. pritchardi* in having head pigmentation that includes light olive-yellow sides grading into a light tan dorsum, and with a posteriorly widening black postorbital stripe passing above the tympanum and along the neck, and another extending posteriorly from the posteroventral part of the orbit, partially defining the anterior side of the tympanum. The soft skin at the base of the extremities is orange. *Mauremys iversoni* also differs from *M. pritchardi* in having more strongly convex sides to the posterior plastral lobe; a broader plastron; an octagonal neural 2 in most individuals; less prominent carapacial keels (especially the lateral ones); greater adult size; and larger black blotches on the plastral scutes, often coalescing into a black, anteriorly open U-shaped figure.

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