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SURVEY OF THE FRESHWATER TURTLES OF INDIA
PART II: THE GENUS *KACHUGA*

EDWARD O. MOILL

(With two colour plates & four text-figures)

[Continued from Vol. 83(3): 552]

SURVEY OF THE FRESHWATER TURTLES OF INDIA

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[Continued from Vol. 83(3): 552]

Subgenus *Pangshura*

Contains four species — *smithii*, *sylhetensis*, *tecta* and *tentoria*. The subgenus is diagnosed by a suite of apomorphic or derived characteristics summarized in Table 1 and Figures 2-6. Members are small to moderate-sized species (< 30 cm CL) with pronounced sexual dimorphism which inhabit a variety of lentic and lotic habitats through much of India. The name is derived from "panshura," a Bengalese word for chelonian.

Kachuga smithii (Gray 1863)

Brown Roofed Terrapin — Plate III, A-C

Identification: A small species (to 23 cm CL) identifiable from other *Pangshura* by a relatively low, vaulted shell ($H/CL < 44\%$) having only a weak, horizontal spine (or none) on the third vertebral scute.

Description: For coloration see descriptions of subspecies. Head moderate in size with short, tapering snout (less than length of orbit) projecting beyond lower jaw; skin at back of head divided into large irregular scales; upper jaw serrate, lacking medial notch or projection; alveolar surface broad, decked by a finely-serrate ridge on each side,

converging but not meeting at midline. Lower jaw serrate with single, projecting tooth anteriorly, alveolar surface concave except for a median symphyseal ridge and a serrate ridge along lingual surface meeting symphyseal ridge at midline; coronoid process prominent. Hyoid moderately developed; ossified portions include a single-element body with a shallow, rounded notch posteriorly and a shallow "V" shaped notch anteriorly, a pair of small, rounded elements attached at either side of anterior notch (ceratohyals?), a narrow, elongate, outwardly-bowed pair of first ceratobranchial horns and a pair of short (2-3 times longer than wide) second ceratobranchial horns.

Shell oval, widest across a plane through seventh marginals; posterior margin of carapace slightly serrate; median keel low; raised areas at posterior of scutes not pronounced, obtuse; Vertebrae 1, 3 and 4 usually longer than wide, 2 and 5 usually wider than long; seam contact formula — $1M\ 4 > 6M\ 8 < 10 >$. Bridge long, exceeding length of either anterior (shorter) or posterior (longer) lobe of plastron; axillary somewhat smaller than inguinal scute; plastron truncate anteriorly; notched posteriorly; plastral formula — $Ab > F > P > A > H > G$.

Distribution: Brown roofed terrapins occur in the Indus, Ganges and Brahmaputra Drainages of Pakistan, Nepal, India, and Bangla-

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desh. Figure 9 map the distribution in India as verified by this survey.

Geographic Variation: Two subspecies (one new) are recognized herein.

***Kachuga smithii pallidipes* subsp. nov.**

Pale-footed Roofed Terrapin — Pl. III, B&C

Holotype: Field Museum Natural History 224177, adult male in alcohol; collected in the Gandak River, Bherihari Wildlife Sanctuary, Bettiah (West Champaran) District, Bihar on 3 June 1983; original number 2827 Edward O. Moll.

Paratypes: USNM 257779, adult female in alcohol; Karnali River, Royal Bardia Wildlife Reserve, 2 km N. Thakurdara, Nepal, 23 April 1985 (obtained by Joseph Mitchell); FMNH 224186, adult female skeleton, Ghagra River, near Kailaspuri at Girija Barage, Bahraich District, Uttar Pradesh, 12 January 1983.

Identification: A subspecies of *Kachuga smithii* differing from the nominate form by the absence of a plastral pattern and a reduction of pigment on head, limbs, feet and penis.

Description of holotype: An adult male measuring 8.6 CL, 6.2 CW, 7.8 PL, 3.1 H and weighing 88 g. Coloration in life — carapace light grayish olive to brownish olive (older scutes) with pale yellow rim around the periphery; single mid-sagittal black stripe with cinnamon-rufous center on Vertebrae 2 and 3, running length of the shell but becoming obscure on V5 and 6; plastron straw yellow, immaculate, having no dark pattern; vague dark blotches present on ventral side of marginals.

Head brownish olive, lightly mottled with smoke gray dorsally; skin creamy white behind eyes; iris pale gray; throat immaculate, colorless; a pair of narrow dark stripes extend anteriorly from eyes converging to meet

at light gray snout; mandibles bright spectrum yellow; neck smoke gray dorsally, colorless ventrally, unstriped.

Limbs — ground color on leading face of front limb smoke gray above elbow and lateral half of foreleg; large triangular scales on lateral border of foreleg, narrow bandlike scales on anterior aspect; toes and webbing yellow; posterior aspect of limb, feet and medial half of foreleg colorless.

Penis colorless lacking the dark pigment characteristic of most members of the order.

Description of Paratypes: USNM 257779, adult female measuring 15.6 CL 11.6 CW 15.5 PL 5.65 H and weighing .453 kg. Coloration of preserved specimen — carapace brownish gray with a black, middorsal stripe; plastron light, largely devoid of pattern but tiny smudges of pigment present near posterior lateral margins of scutes; bridge and ventral side of Marginals 3-9 with heavy concentrations of dark pigment.

Head and neck dark grayish brown dorsally with lighter cinnamon brown band running posteriorly from eye over tympanum; throat light, colorless.

Limbs — anterior face of forelimb and feet generally grayish brown, becoming lighter on medial aspect; lateral border of limb light edged; hind feet immaculate, devoid of pigmentation; skin of leading face of hind leg grayish brown.

FMNH 224186, female measuring 16.2 CL 11.6 CW 15.5 PL 6.0 H and weighing 0.63 kg. Coloration in life — carapace buff with dark brown middorsal stripe; plastron straw yellow, unpatterned.

Head and neck drab dorsally with lighter, cinnamon-colored band running posteriorly from eye over tympanum; tip of snout and iris light grayish blue; mandibles light orange yellow; neck dirty gray above, light cream ventrally.

FRESHWATER TURTLES OF INDIA

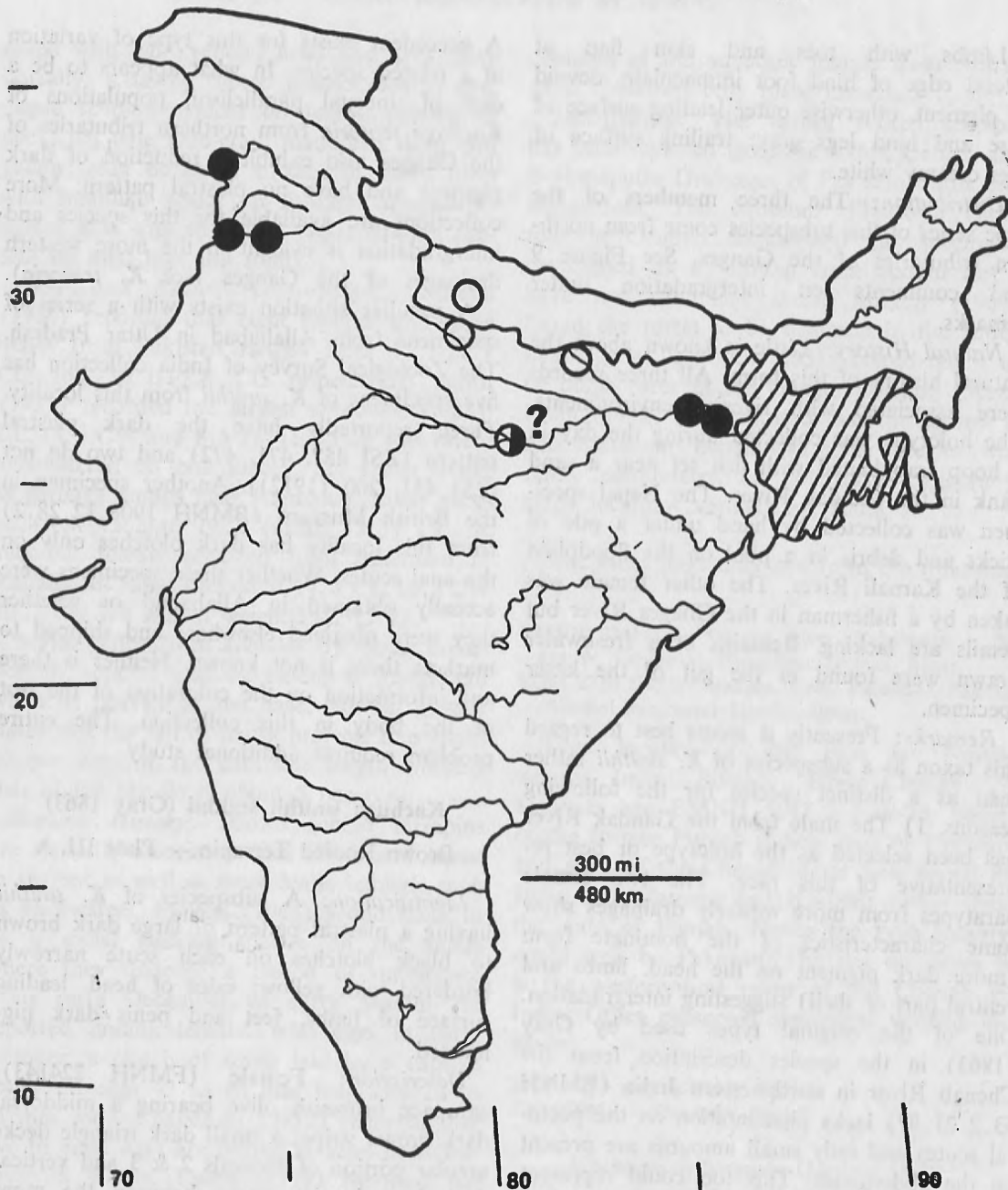


Fig. 9. Distribution map of *Kachuga smithii* in India (see legend of Fig. 7). Solid circles indicate localities of the nominate race, *K. s. smithii*. Open circles indicate localities of *K. s. pallidipes*. The half open circle indicates Allahabad, a possible intergrade site between the two races (see text).

Limbs with toes and skin flap at lateral edge of hind foot immaculate, devoid of pigment, otherwise outer leading surface of fore and hind legs gray; trailing surface of legs creamy white.

Distribution: The three members of the type series of this subspecies come from northern tributaries of the Ganges. See Figure 9 and comments on intergradation under remarks.

Natural History: Little is known about the natural history of this form. All three records were associated with riverine environments. The holotype was collected during the day in a hoop trap baited with fish set near a sand bank in the Gandak River. The Nepal specimen was collected by hand under a pile of sticks and debris in a pool on the floodplain of the Karnali River. The other female was taken by a fisherman in the Ghagra River but details are lacking. Remains of a freshwater prawn were found in the gut of the latter specimen.

Remarks: Presently it seems best to regard this taxon as a subspecies of *K. smithii* rather than as a distinct species for the following reasons. 1) The male from the Gandak River has been selected as the holotype or best representative of this race. The two female paratypes from more westerly drainages show some characteristics of the nominate form (more dark pigment on the head, limbs and ventral part of shell) suggesting intergradation. One of the original types used by Gray (1863) in the species description from the Chenab River in northwestern India (BMNH 63.2.21.87) lacks pigmentation on the pectoral scutes and only small amounts are present on the abdominals. This too could represent intergradation. More collections are needed to confirm whether the observed variation has resulted from intergradation rather than some other factor such as sexual dichromatism. 2)

A precedent exists for this type of variation in a related species. In what appears to be a case of unusual parallelism, populations of *Kachuga tentoria* from northern tributaries of the Ganges also exhibit a reduction of dark pigment and have no plastral pattern. More collections are available for this species and intergradation is evident in the more western drainages of the Ganges (see *K. tentoria*).

A peculiar situation exists with a series of specimens from Allahabad in Uttar Pradesh. The Zoological Survey of India collection has five specimens of *K. smithii* from this locality. Three reportedly have the dark plastral pattern (ZSI 457, 471, 472) and two do not [ZSI 451, 200 (1912)]. Another specimen in the British Museum (BMNH 1908.12.28.2) from this locality has dark blotches only on the anal scutes. Whether these specimens were actually obtained in Allahabad or whether they were obtained elsewhere and shipped to markets there is not known. Neither is there any information on the coloration of the rest of the body in this collection. The entire problem requires additional study.

***Kachuga smithii smithii* (Gray 1863)**

Brown Roofed Terrapin — Plate III, A

Identification: A subspecies of *K. smithii* having a plastral pattern of large dark brown to black blotches on each scute narrowly bordered with yellow; sides of head, leading surface of limbs, feet and penis dark pigmented.

Description: Female (FMNH 224143); carapace brownish olive bearing a middorsal dark brown stripe; a small dark triangle decks areolar portion of Pleurals 2 & 3 and vertical dark bars border seams between the more posterior marginal scutes and the posterior edge of Pleural 4; plastron, bridge and ventral side of marginal chiefly dark but narrowly bor-

dered with light yellow; head and neck olive dorsally; a tawny blotch present behind eye; vague striping evident on lateral portion of neck; iris pale blue-gray; mandibles deep buff yellow; skin on outer surface of limbs olive with bandlike scales on forelegs appreciably lighter than ground color; vague striping present on hind legs and rump.

Size and Sexual Dimorphism: Minton (1966) reported that eight females and three males from Pakistan ranged from 15.3-22.7 CL and 10.1-10.8 CL respectively. Smith (1931) recorded the largest specimen as 23.0 CL 15.5 CW and 8.5 H. This race was rarely encountered on our survey. Six shells found in garbage dumps near Rajmahal, Bihar ranged from 13.2 to 18.3 (mean 15.7) CL. A subadult female obtained from fishermen at Kahalgaon, Bihar measured 14.3 CL 10.3 CW 13.7 PL 5.9 H and weighed 0.315 kg.

Males differ from females by being considerably smaller and by having a longer tail which is heavier at the base. Minton (1966) states that the tail of males projects free about 10 per cent of the carapace length whereas that of the female is about 5 per cent.

Natural History: Brown roofed terrapins are typically associated with rivers and occur in current as well as more lentic habitats such as backwaters. Minton (1966) found them to be a social basking species on the Indus where they undergo a period of quiescence from early December to early March. He reported finding females with eggs in early October; a clutch of seven laid by a captive contained eggs 43 to 45 mm long and 22 to 24 mm wide. Chaudhuri (1912) reported that five to eight eggs are buried in sand nests but gave no season. Ewert (1979) reported the mean size of four hatchlings to be 3.92 CL and 3.67 PL. The species is generally reported to be omnivorous with a carnivorous bias (Das 1985, Minton 1966, Smith 1931). Gut

contents of the subadult female from Kahalgaon contained only plant material.

Distribution: The brown roofed terrapin has been reported from the Indus, Ganges and Brahmaputra Drainages of Pakistan, India and Bangladesh. The Museum d'Histoire Naturelle in Geneve, Switzerland has specimens catalogued as *K. smithii* from Assam but I have not examined these. Minton (1966) found the turtle to be common in the Indus Drainage while Smith (1931) considered it to be much rarer in the Ganges Drainage. Reza Khan (1982) also reported that the species is uncommon in Bangladesh. The species was rarely encountered on our survey. Figure 9 maps localities verified for India.

Specimens were collected from the following sites:

FMNH 224143 — Ganges River, Kahalgaon, c. 50 km W. Sahibganj, Bhagalpur District, Bihar.

EOM 2720-2725 — Ganges River, Rajmahal, Dumka (Santhal Pargana) District, Bihar.

Type locality of this race is "North-western India: Punjab; "River Chenab..." Syntypes are BMNH 1947.3.4.69-70. Much of the former Punjab is now part of Pakistan and most of the Chenab River now found in India is in Jammu and Kashmir rather than the state of Punjab. Hence the type locality could well be Pakistan. The dot on figure 9 is the western-most point of the Chenab in India. Other preserved specimens verified include:

MCZ 3233 — Ludhiana, Punjab.

ZSI 17606 — Firozpur, Punjab.

***Kachuga sylhetensis* (Jerdon 1870)**

Assam Roofed Terrapin

Identification: A small terrapin (20 cm CL) differing from other *Pangshura* by typically having 13 pairs of marginal scutes and

a fifth vertebral scute that is wider in the anterior half than in the posterior.

Description: Head medium-sized with slightly projecting snout; upper jaw slightly hooked with serrations along the tomium being fine or absent; head patterned with a pair of narrow yellow stripes running posteriorly from eye to meet at mid-line on back of head forming a chevron; an additional light stripe runs along underside of the mandible curving upward to meet tympanum; neck with light longitudinal stripes.

Shell steeply peaked as in *K. tecta* and *tentoria* but more serrate posteriorly; oval in shape being widest across plane through sixth marginals; median keel relatively narrow on first through third vertebrals; sharp pointed spines present on the third (largest) and fourth vertebrals; Vertebrals 3 and 4 longer than broad, V2 and 5 broader than long and V1 either as wide or somewhat wider than long; scute contact formula: 1M 4 > 6 > 8M 11 <; coloration of preserved specimens olive-brown with a lighter vertebral keel. Plastron oval with slight notch or no notch between anals; plastral formula F > < Ab > P > H > A > G; inguinal and axillary scutes well developed; pattern a large dark blotch on each plastral scute, bridge, and ventral side of marginals.

Size and Sexual Dimorphism: As typical for the genus, males are much smaller than the females. The largest specimen recorded is a female 19.7 cm CL (Jerdon 1870). Measurements of a typical male and female are: BMNH 1929.11.21.1 M — 8.5 CL 6.8 CW 8.0 PL 4.7 H

BMNH 1947.3.4.22 F — 18.3 CL 14.3 CW 17.8 PL 8.4 H

In addition to being smaller, males have longer tails which are thicker at the base than those of females.

Natural History: Most specimens have come

from hill streams; nothing else seems to be known of the natural history.

Distribution: The Assam roofed terrapin has been reported from the Khasi, Garo and Naga Hill areas of Bangladesh and Assam. As these areas were off limits to our survey, no living specimens of this species were seen or collected. I have examined museum specimens from the following localities:

BMNH 1947.3.4.22 (type) — Khasi Hills, Sylhet District, Bangladesh.

BMNH 1929.11.21.1 — Khasi Hills, Cherrapunji, Meghalaya, India.

ZSI 110 — Cachar District, Assam, India.

ZSI 3923 — Garo Hills, Assam, India.

Kachuga tecta (Gray 1831b)

Indian Roofed Terrapin — Plate III, D-F

Identification: A small *Pangshura* (23 cm CL) with a high vaulted shell (height/length > 45%) most easily distinguished from its closest relative, *K. tentoria*, by its pattern and brighter coloration. Plastral pattern of small dark blotches or streaks (1-4) on most scutes; head with a large red to orange crescent-shaped blotch behind eye; neck with bright yellow stripes and limbs bearing bright yellow spots. Smith (1931) used as a key character that the second vertebral is longer than the third in *tecta* but not in *tentoria*. Although useful, this character is variable being correct in only 76 percent of the 21 *K. tecta* and only 63 percent of the 45 *K. tentoria* examined.

Description: Sexes colored similarly (live female, Lucknow, U.P.); carapace raw umber (brown) with somewhat lighter middorsal stripe (can also be red) bordered in black and a narrow yellow border on marginals; plastron buff-yellow with 2-4 small, round to elongate, black markings on scutes other than gulars and/or anals which may have only one; two dark spots on bridge, one each on inguinal and axillary scutes and on underside of each

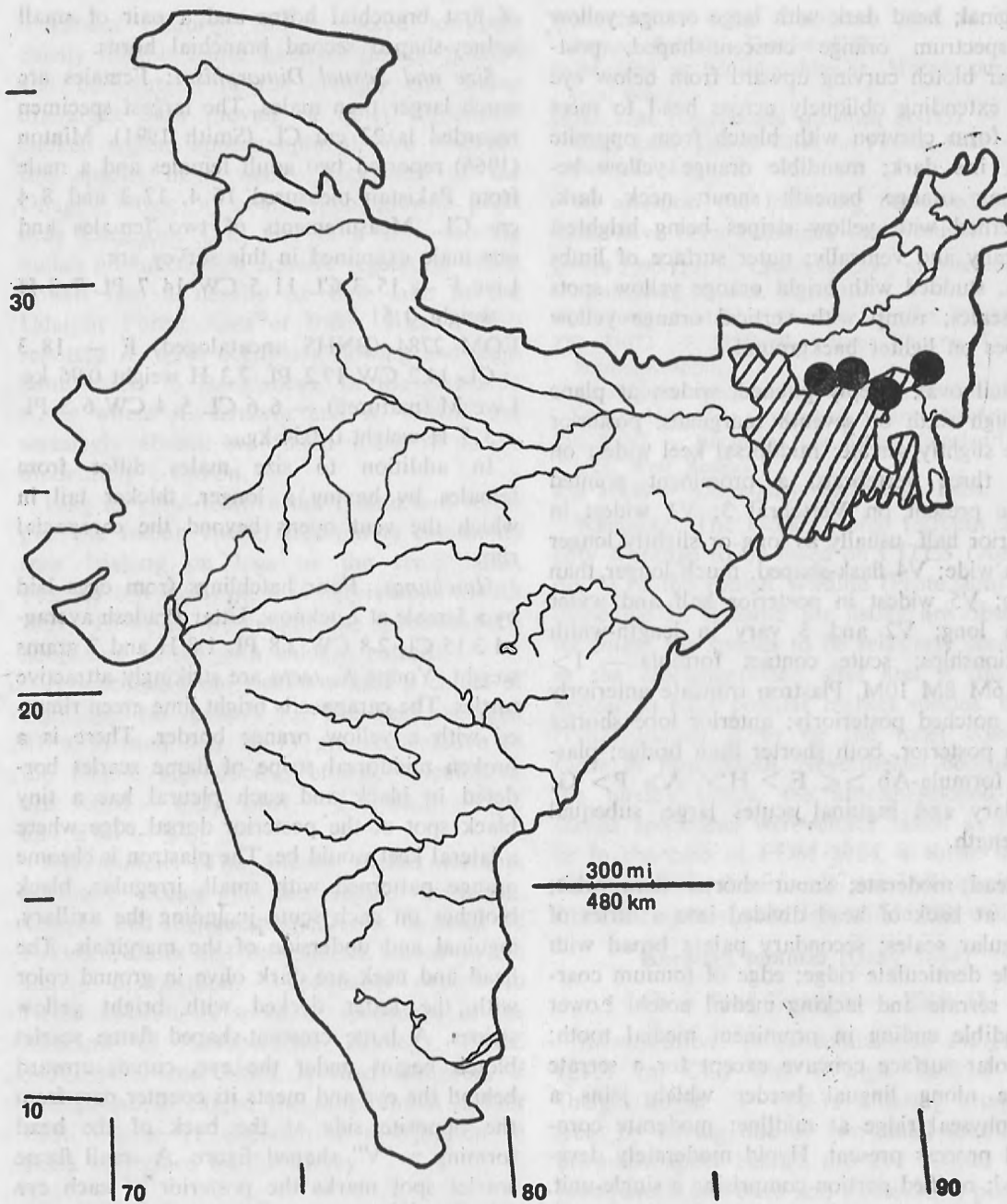


Fig. 10. Distribution of *Kachuga sylhetensis* (see legend of Fig. 7).

marginal; head dark with large orange yellow to spectrum orange crescent-shaped, post-ocular blotch curving upward from below eye and extending obliquely across head to meet and form chevron with blotch from opposite side; iris dark; mandible orange yellow becoming orange beneath snout; neck dark, patterned with yellow stripes being brightest laterally and ventrally; outer surface of limbs dark, studded with bright orange yellow spots on scales; rump with vertical orange yellow stripes on lighter background.

Shell oval, steeply pitched, widest at plane through sixth or seventh marginals, posterior edge slightly serrate; middorsal keel widest on first three vertebrals, a prominent pointed spine present on Vertebral 3; V1 widest in anterior half, usually as long or slightly longer than wide; V4 flask-shaped, much longer than wide; V5 widest in posterior half and wider than long; V2 and 3 vary in length-width relationships; scute contact formula — 1 > 4M 6M 8M 10M. Plastron truncate anteriorly and notched posteriorly; anterior lobe shorter than posterior, both shorter than bridge; plastral formula—Ab > < F > H > A > P > G; axillary and inguinal scutes large, subequal in length.

Head moderate; snout shorter than orbit; skin at back of head divided into a series of irregular scales; secondary palate broad with single denticulate ridge; edge of tomium coarsely serrate and lacking medial notch. Lower mandible ending in prominent medial tooth; alveolar surface concave except for a serrate ridge along lingual border which joins a symphyseal ridge at midline; moderate coronoid process present. Hyoid moderately developed; ossified portion comprising a single-unit, elongated body with a broad shallow notch posteriorly and a deeper, narrower notch anteriorly; a narrow, curving, elongated pair

of first branchial horns and a pair of small kidney-shaped second branchial horns.

Size and Sexual Dimorphism: Females are much larger than males. The largest specimen recorded is 23 cm CL (Smith 1931). Minton (1966) reported two adult females and a male from Pakistan measured 16.4, 17.3 and 8.4 cm CL. Measurements of two females and one male examined in this survey are:

Live F — 15.3 CL 11.5 CW 14.7 PL 7.3 H weight 0.51 kg.

EOM 2784 (BNHS uncataloged) F — 18.3 CL 14.2 CW 17.2 PL 7.3 H weight 0.96 kg.

Live M (mature?) — 6.6 CL 5.4 CW 6.3 PL 3.7 H weight 0.054 kg.

In addition to size males differ from females by having a longer, thicker tail in which the vent opens beyond the carapacial rim.

Hatchlings: Four hatchlings from eggs laid by a female at Lucknow, Uttar Pradesh averaged 3.15 CL 2.8 CW 2.8 PL 1.8 H and 7 grams weight. Young *K. tecta* are strikingly attractive turtles. The carapace is bright lime green rimmed with a yellow orange border. There is a broken middorsal stripe of flame scarlet bordered in black and each pleural has a tiny black spot at the posterior dorsal edge where a lateral keel would be. The plastron is chrome orange patterned with small, irregular, black blotches on each scute including the axillary, inguinal and underside of the marginals. The head and neck are dark olive in ground color with the latter decked with bright yellow stripes. A large crescent-shaped flame scarlet blotch begins under the eye, curves upward behind the eye and meets its counter part from the opposite side at the back of the head forming a "V" shaped figure. A small flame scarlet spot marks the posterior of each eye lid. The scales of the limbs as well as the webbing between the toes are bright yellow on a dark olive background.

Natural History: Indian roofed terrapins chiefly inhabit lentic habitats (tanks, nullahs and backwaters) in the Ganges and Indus drainages. Slow moving or quiet vegetation-choked waters appear optimal. We observed this species in a weedy backwater of the Ghagra River, a small impoundment pond near Lucknow, U.P. and in a slow moving nullah crammed with aquatic vegetation which flowed into a nearby ox bow lake in the Udaipur Forest Area of Bihar. Khan (1982) reported *K. tecta* occupying flowing and stagnant waters in Bangladesh. In the Narmada River where *K. tentoria* and *K. smithii* are seemingly absent, we found *K. tecta* to be moderately common.

Like its close relative the Indian tent terrapin, the Indian roofed terrapin is commonly seen basking on logs or the river bank. Parshad reported that it is herbivorous (Smith 1931). However, we caught one specimen in a hoop trap baited with chicken entrails.

A specimen from Lucknow laid a clutch of eight eggs on January 13. The eggs averaged 37 x 21 mm and 10.75 grams. Relative to the female reproductive efforts, calculations are: RCM — 0.21, EMI — 2.1, ELI — 24.2 and EWI — 14.

Distribution: The Indian roofed terrapin definitely occurs in the Indus, Narmada, Ganges and Brahmaputra River Systems of Pakistan, India and Bangladesh. Based on the Indian distribution, it probably occurs in Nepal as well. A series of specimens in the Museum of Comparative Zoology (MCZ 3459, 3460, and 3462) labelled Rangoon, if verified would extend the range much farther East. Figure 11 depicts the distribution in India as verified by the survey:

Live F — Kukrail, nr. Lucknow, Lucknow District, India.

Live M — Harhi Nala, 15 km W Bettiah, Bettiah Dist., Bihar.

EOM 2658 — 6 km S Katarnia Ghat, nr. Girija Barage, Bahraich District, U.P.

EOM 2868 — Bedaulia, Manika, Muzaffarpur District, Bihar.

EOM 2784 (uncataloged specimen BNHS) — Narmada River, Dhavdi Ghat, nr. Punasa, East Nimar District, M.P.

In addition the following preserved specimens have been examined and verified:

BNHS 1290-1291 — Chandola Lake, nr. Ahmedabad, Ahmedabad District, Gujarat.

ZSI 17609 — Makhu, Firozpur District, Punjab.

ZSI 21672 — Magwall Village, Jammu District, Jammu-Kashmir.

Uncatalogued specimens BNHS — Hindon River, Mohen Nagar, nr. Ghaziabad, Meerut District, U.P.

ZSI 18015 — Baradighi Tea Estate, Jalpaiguri District, West Bengal.

ZSI 19236 — Cherrapunji, Meghalaya, India.

Remarks: The Indian roofed terrapin is the only *Kachuga* to be listed on CITES (Appendix I) or the Indian Wildlife (Protection) Act (Schedule I). Reasons for listing are obscure; we found the species to be relatively common in the aforementioned sites and it did not appear to be a popular market species. Khan (1982) judged it to be the most common turtle in Bangladesh. Nevertheless because of the turtle's status, the aforementioned preserved specimens were either taken as shells or in the case of EOM 2784, a turtle which drowned in a fisherman's net. All specimens from the survey were left within the country.

Kachuga tentoria (Gray 1834)

Indian Tent Terrapin — Plate II

Identification: A moderate-sized *Pangshura* (27.1 cm CL) with a high, vaulted shell (height/length > 45%); differing from *K. tecta* by having one or two small reddish to brownish spots behind the eye instead of a broad crescentic band and by having a plastron with a single large dark blotch per scute or lacking in dark markings.

Description: Shell oval being widest at a

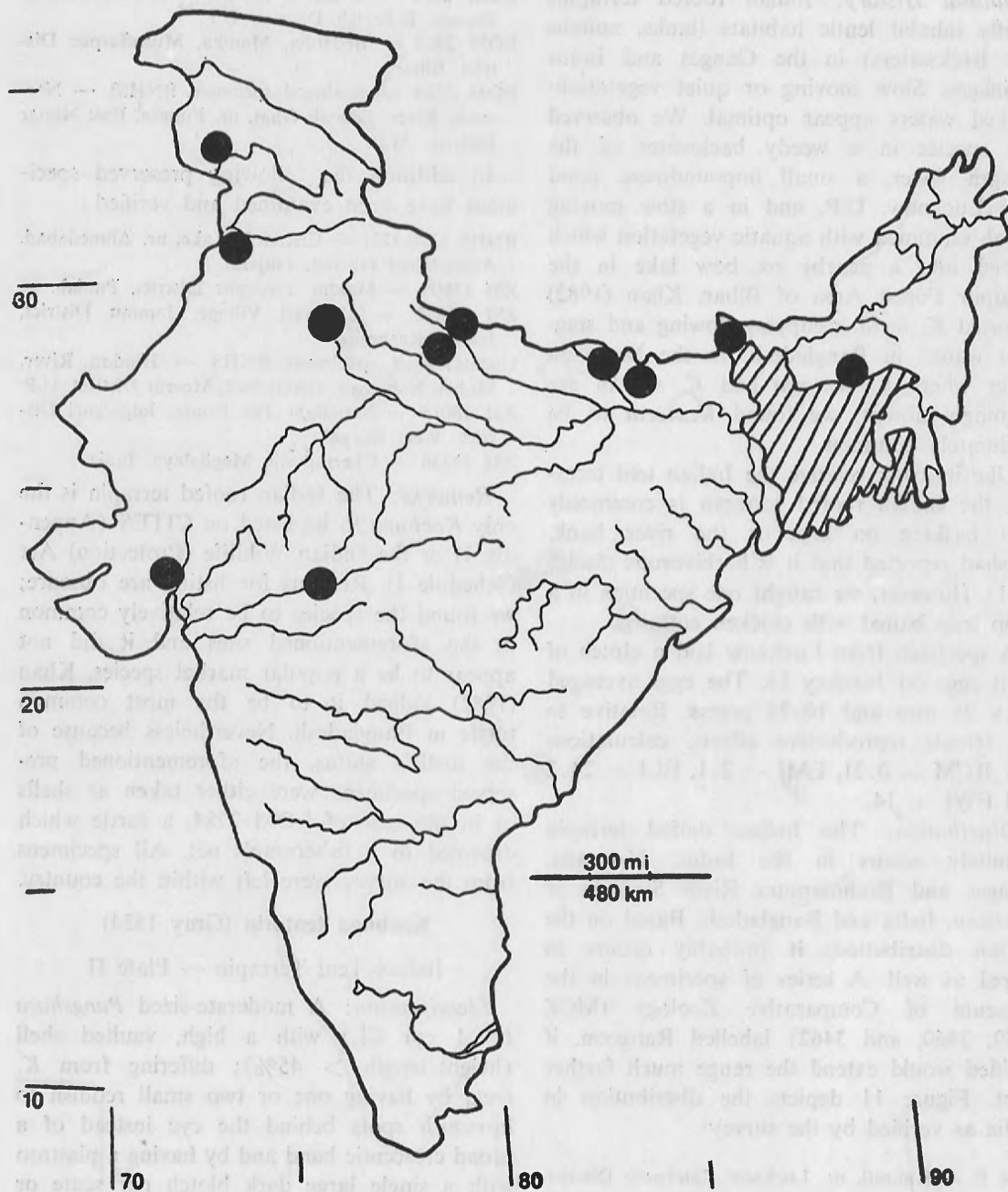


Fig. 11. Distribution of *Kachuga tecta* in India (see legend of Fig. 7).

plane passing through the seventh marginals; a prominent middorsal keel runs the length of the carapace breaking at the end of each vertebral to form a knob or spine, the most pronounced being a sharp upward projecting spine on V3; in adults Vertebrales 3 and 4 typically longer than wide with 5 being wider than long; V1 and 2 variable, with 1 often being hour glass or bell shaped (pinched in the middle) in large individuals; seam contact formula — $1 > 4 > 6M \ 8M \ 10M$. Plastron truncate anteriorly, notched posteriorly; plastral formula — $AB > F > P > H > A > G$; bridge long exceeding lengths of both the shorter fore lobe and longer hind lobe of plastron; axillary somewhat smaller than inguinal scute. Cloacal bursae present with pronounced villous lining.

Head medium-sized with short, pointed, projecting snout; skin at back of head divided to form a series of irregular-shaped scales; upper jaw serrate lacking median notch or prominent projections; alveolar surface broad, bearing single "V" shaped denticulate ridge. Lower jaw similarly serrate with single, prominent, projecting tooth at apex; lower alveolar surface concave bordered by serrate ridge along lingual surface meeting a short symphyseal ridge at midline. Hyoid moderately developed with ossified portions including a single element body having a prominent rounded notch posteriorly and a smaller "V" shaped notch anteriorly, a pair of thin, elongate, outwardly bowed first ceratobranchial horns and a pair of small, rounded second ceratobranchial horns.

Distribution: The Indian tent terrapin is restricted to drainages of rivers flowing into the Bay of Bengal in India, Nepal and Bangladesh. Figure 12 depicts the distribution in India as verified by the survey.

Remarks: Until recently *K. tentoria* has been considered a subspecies of *K. tecta*.

However, as both appear to be sympatric over a broad geographic area including Bangladesh (Khan 1982), Bihar, and Uttar Pradesh (this paper); herein I follow Pritchard (1979) in regarding them as separate species pending additional study. Smith (1931) lists the type locality for *K. tentoria* as Dhond (Krishna River Drainage), Poona District of Maharashtra. See Mertens (1969) for a history of the nomenclature of these two species.

Three subspecies of *K. tentoria* (one resurrected) are recognized herein — *Kachuga t. tentoria* in the rivers of peninsular India; *K. t. circumdata* in the western and central drainage of the Ganges and *K. t. flaviventer* in the eastern Ganges and its northern tributaries.

***Kachuga tentoria tentoria* (Gray 1834)**

Indian Tent Terrapin — Plate II, A+B

Identification: A race with a dark plastral pattern, no pleuro-marginal ring and reddish head markings.

Description: Sexes colored similarly (FMNH 224163 juv., Godavari River); carapace antique brown, unicolor except for hazel to amber stripe along middorsal keel from Vertebrales 1-3; plastron yellow with large dark blotches on each scute, bridge, axillary, inguinal and underside of marginals; ground color of head olive to brownish olive; a poorly defined clay band present behind eye; red markings include a small red postocular spot in clay band, a smaller red mark located at dorsal posterior edge of eye and a thin poorly defined red line in occipital region; iris gray olive; mandibles straw yellow; neck with dull straw yellow stripes on lateral and ventral portions; limbs olive with edges of scutes cream; rump marked with vertical black and cream stripes.

Size and Sexual Dimorphism: Males are much smaller than females. Three males from the Mahanadi River measured 8.1, 9.7 and

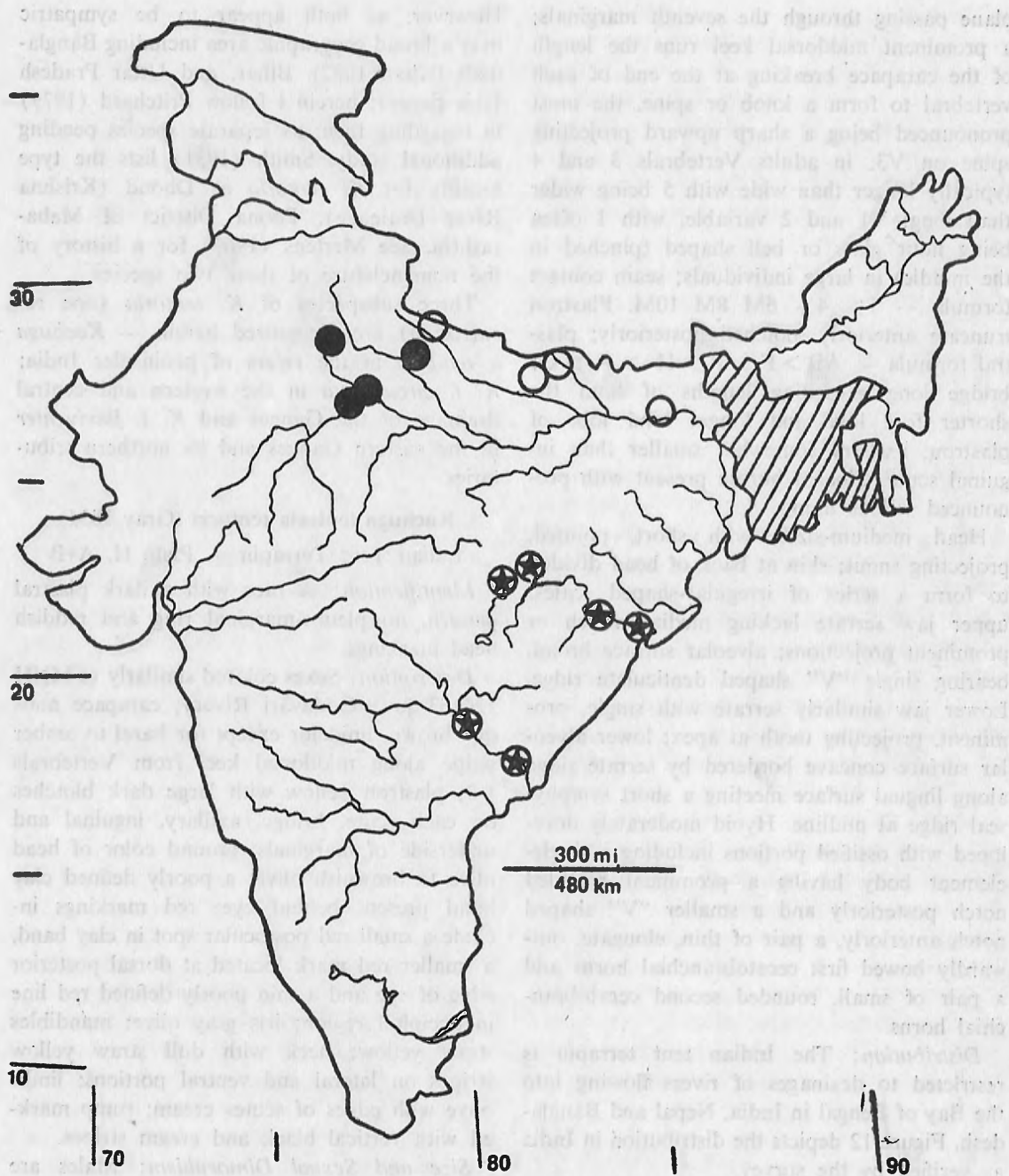


Fig. 12. Distribution of *Kachuga tentoria* in India (see legend of Fig. 7). Starred circles indicate localities of the nominate race, *K. t. tentoria*. Solid circles indicate localities for *K. t. circumdata*. Open circles indicate localities for *K. t. flaviventer*.



A



B



C



D



E



F

(A) *Kachuga tentoria tentoria* — Juvenile (8.1 cm CL) from the Godavari River near Manthani, A.P. (B) *Kachuga t. tentoria* — Ventral view of A. (C) *K. t. flaviventer* — Male (8.3 cm CL) from the Gandak River, Bettiah District, Bihar. (D) *K. t. flaviventer* — Ventral view of C. (E) *K. t. circumdata* — Male (8.5 cm CL) from the Yamuna River nr. Etawah. (F) *K. t. circumdata* — Male (8.1 cm CL) and female (23.5 cm CL) from the Yamuna River near Etawah.



A



B



C



D



E



F

(A) *Kachuga smithi smithi* — Female (14.2 cm CL) from the Ganges near Kahalgaon, Bihar. (B) *K. smithi* subsp. nov. — Male (8.6 cm CL) from the Gandak River, Bettiah District, Bihar. (C) *K. smithi* subsp. nov. — Ventral view of B. (D) *K. tecta* — Immature female (6.4 cm CL) from near Bettiah, Bihar. (E) *K. tecta* — Hatchling (3.0 cm CL) from Lucknow, U.P. (F) *K. tecta* — Ventral view of E.

10.9 cm CL. Another 7.5 cm CL with no sperm in the epididymides was judged subadult. Six females from this locality ranged from 19.2 to 23.0 (mean 20) cm CL. Two other females 18.5 and 18.0 cm CL with no enlarged follicles on their ovary and relatively small oviducts were judged subadult.

Proportions of a typical male and female of this race follow:

BNHS 1329 F — 19.5 CL 14.2 CW 18.9 PL 8.9 H weight 0.86 kg.

FMNH 224141 M — 9.7 CL 7.5 CW 9.2 PL 4.6 H weighing 0.105 kg.

In addition to size, males differ from females by having a longer (preanal > postanal) and thicker preanal portion of the tail with a vent opening beyond the edge of the carapace.

Natural History: Indian tent terrapins occur in small to large rivers of peninsular India. They are frequently seen on logs and rocks basking. Females appear completely herbivorous. They never entered hoop traps baited with chicken entrails or fish and other than a small feather, the guts of four individuals from the Mahanadi River contained only leaves and stems of vascular plants. Males and juveniles appear more omnivorous. They did enter baited hoop traps and the stomach of one male examined contained 75 percent vegetation and a fresh water prawn. Ovaries of two females collected on the Mahanadi River in mid-February appeared post-reproductive having few enlarged follicles and several small, old corpora lutea.

Distribution: *Kachuga t. tentoria* ranges from at least the Mahanadi River drainage southward to the Krishna drainage. The turtle was taken at the following localities on the survey:

FMNH 224163 — Godavari River, Manthani, Karimnagar Dist., A.P.

Live Juvenile — Godavari River, Polavaram, West Godavari Dist., A.P.

FMNH 224141, BNHS 1329 — Mahanadi River, Tikarpura, Dhenkanal, Orissa.

The following additional records have been verified from preserved collections:

ZSI (Type *Kachuga t. intermedia* Blanford 1870) — Hasdo River, Bilaspur Dist., M.P.

ZSI 17775 — Seonath River, Bilaspur, Bilaspur Dist., M.P.

ZSI 16767 & 68 — Mahanadi River, Cuttack, Cuttack Dist., Orissa.

Kachuga tentoria flaviventer (Gunther 1864) Plain-bellied Tent Terrapin — Plate II, C & D

Identification: A small tent terrapin (20.3 cm CL) with reduced pigmentation, an unpatterned plastron and little or no striping on neck and rump.

Description: Sexes colored similarly. Male (FMNH 224178) — carapace brownish olive; light middorsal stripe with pale orange wash on Vertebrae 1 and 2, cream on V3, becoming faint on V4 and 5; pleuro-marginal juncture and border of shell also cream; plastron, bridge and underside of marginals cream and unpatterned; head pale, mottled with brownish olive; a near colorless patch washed with pale salmon extending from behind eye back over mastication musculature to meet patch from opposite side; immediately posterior a dark horizontal line marks juncture of head and neck; neck colorless to pale cream; a small irregular splotch of cinnamon rufous occurs in colorless area immediately behind eye; iris light smoke gray; limbs almost colorless except for a scattering of dark pigment along leading face; webbing and underside of feet creamy.

Female (FMNH 224132) colored as above with the following exceptions: carapace light buff or cinnamon ground color; the central stripe being a darker, tawny coloration with a lighter center; plastron unpatterned but dark blotches present on underside of marginals; head smoke gray dorsally, cream laterally and on mandibles; a light cinnamon-brown spot

behind eye and another at posterior dorsal edge of eye; three additional spots at posterior of head (one medial flanked by two lateral); webbing of feet pale yellow.

Size and Sexual Dimorphism: Sexes widely disparate in size. A female and two shells presumed to be female from Kahalgaon measured 16.5, 16.9 and 18.8 CL. Five males from the Gandak River in northwestern Bihar showing well developed secondary sex characters ranged from 6.6 to 8.8 (mean 8.0) CL. Measurements of two typical specimens are:

FMNH 224132 F — 16.5 CL 12.4 CW 16.1 PL 7.9 H weight 0.64 kg.

FMNH 224178 M — 8.2 CL 6.3 CW 7.7 PL 4.1 H weighing 0.09 kg.

In addition to size males differ from females by having a longer tail (preanal > postanal portion) which is relatively thicker at the base.

Hatchlings: Vijaya (1982e) provided mean measurements for hatchlings from six clutches of the pale-bellied tent terrapin (see comments under geographic variation) laid in nests along the Rapti River near Gorakhpur, U.P. Largest and smallest of these means were: Clutch I — 2.7 CL 1.7 CW 2.3 PL 1.6 H and 6.5 g weight. Clutch V — 3.35 CL 2.7 CW 3.1 PL 1.8 H and 10 g weight. Shell coloration — carapace mottled light and dark olive with a light yellow stripe along the middorsal keel; pleuro-marginal ring light geranium pink at hatching fading in the first few months to a pale olive; plastron buff yellow and unmarked; underside of marginals with a pepper like dusting of dark pigment; head ground color pale olive; two flesh pink spots located posterior to eye and at posterior of eyelid respectively and a narrow, flesh pink bar, broken in the middle, at back of head; vague striping discernible on neck and rump.

Twelve hatchlings obtained from three clutches of eggs collected at the Katarniaghat

Gharial Sanctuary in U.P. had the following mean dimensions: 3.55 CL 3.23 CW 3.2 PL 2.0 H and 9.0 g weight. Their shells were slightly serrate posteriorly with carapacial spines being very small except for a prominent projection on V3. V1 was broadest anteriorly lacking the pinched bell-shape of large adults. None had a plastral pattern but varied as to the presence of dark pigment on the underside of the marginals. Amounts varied from none to having a dark blotch on each scute. Another variable feature was the amount of red in the pattern. Some had an extensive amount including a geranium pink pleuro-marginal ring, middorsal stripe and head pattern. Concerning the latter at one extreme some individuals had both a transverse pink line across the back of the head, two pink spots at the snout and a postocular, pinkish crescent behind the eye. The crescent (similar to that of *K. tecta* but less extensive) was formed by an elongation of the postocular spot to meet the elongated one at the rear of the eyelid (this was evident in other individuals in which the merger was incomplete). At the other extreme were individuals with no pink whatsoever; the pink areas of other individuals were colorless.

Natural History: Like the other races of this species the pale-bellied tent terrapin appears to be chiefly a river turtle. We found this race in Katarniaghat Gharial Sanctuary, an impoundment of the Ghagra River, but otherwise all were seen or collected in areas of flowing water. Many were observed basking near the bank in a sandy area of the Gandak River in May. Gut contents of one male and one female examined contained only leaves and stems of aquatic vegetation. However, five males were taken in traps baited with chicken entrails and fish suggesting that they may be somewhat omnivorous.

Vijaya (1982e) found nests of this turtle

in "soft, clayey river bank soil" along the Rapti River near Gorakhpur from 6-8 December. Nests varied from 15 to 26 cm in depth and were located 3 to 14 metres from the water. Six nests contained from 4 to 8 (mean 6) eggs per nest. She provided mean egg sizes for each nest ranging from 41 x 29 mm and 11.7 g to 45 x 27 mm and 18.5 g. Incubation times (time to emergence from substrate?) in artificial nests ranged from 125 to 134 days at nest temperatures varying between 27° and 28°C.

On this survey we found three clutches comprising 6, 7, and 10 eggs in nests made by this turtle in sand banks along the Ghagra River in the Katarniaghat Gharial Sanctuary on December 5. Mean size of the eggs was 42 x 25 mm and 15.3 g weight. Mean incubation time for 12 hatchlings (to emergence from egg) was 95 days from eggs kept on moist cotton in plastic boxes at ambient temperatures ranging from 24° to 33°C.

Distribution: The pale-bellied tent terrapin inhabits the northern tributaries of the Ganges and possibly the Ganges proper from Bihar eastward. So far I have examined no specimens from West Bengal or Bangladesh. Specimens collected on the survey are from the following localities.

FMNH 224142 — Katarniaghat Gharial Sanctuary, Ghagra River, Bahraich Dist., U.P.

Hatchlings (Vijaya 1982e) — Rapti River, nr. Gorakhpur, Gorakhpur Dist., U.P.

BNHS 1339 & FMNH 224178 — Gandak River, Bherihari Wildlife Sanctuary, Bettiah (West Champaran) Dist., Bihar.

FMNH 224132 — Confluence of Kosi and Ganges River, Khalgaon, c. 50 km W Sahibganj, Bhagalpur Dist., Bihar.

Remarks: Gunther (1864) recognized this taxon as distinct and described it as a new species *Pangshura flaviventer*. The description was based on a single specimen presumed to be from India but lacking in precise locality data. It had been collected by a Mr. Mc-

Clelland who had also sent several other specimens of Bengal species. Subsequent authors (e.g. Boulenger 1889, Smith 1931) considered it a variant of *Kachuga tecta*. Now that more specimens have been found, it is evident that this is a legitimate taxon. However, it appears to be a subspecies of *Kachuga tentoria* rather than a separate species. Evidence for this comes from the aforementioned hatchlings examined from the Rapti and Ghagra Rivers. Characteristics of these specimens particularly those from the Ghagra River appear to be intergrading with those of *K. tentoria circumdata*. The presence of *circumdata* characters (i.e. the pink pleuro-marginal ring and pink head markings) on some but not others of this group is typical of an intergrading population. The subject requires more study but for now I believe a subspecies designation best fits the evidence.

***Kachuga tentoria circumdata* (Mertens 1969)**

Pink-ringed Tent Terrapin — Plate II, E+F

Identification: A moderate-sized tent terrapin (to 27.1 CL) having a single large dark blotch on all plastral scutes, a reddish ring at pleuro-marginal juncture of carapace, and reddish head markings.

Description: Males appear somewhat darker than females otherwise sexes colored similarly (FMNH 224162 M) — carapace olive-green with a geranium pink ring around pleuro-marginal juncture; middorsal stripe comprised of streaks of geranium pink bordered by black; plastron straw yellow with large dark blotch covering over half of each scute; bridge and underside of marginals black bordered in yellow; inguinal with black spot but not axillary; seams of plastral scutes and marginals washed with pink; head olive green with a geranium pink circular spot behind eye and a pair of short, oblique, geranium pink bars at posterior of head; iris smoke gray; mandibles

light straw yellow with orange wash becoming olive near snout; neck olive gray with dull, cream colored stripes on sides and venter; rump and base of tail also striped (stripes more pronounced than in other races).

A female (BNHS 1340) was similar but differed as follows: Carapace antique brown with a cinnamon-rufous rather than pink pleuro-marginal ring; middorsal stripe vague, almost nonexistent; head markings less red and more cinnamon rufous; two irregular spots (instead of bars) present at back of head.

Size and Sexual Dimorphism: Females greatly exceed males in size. A collection of thirteen females from the Chambal River in the Morena District of M.P. ranged from 18.1 to 27.1 (mean 22.1) cm CL. A sample of 11 males from the Yamuna River in the Etawah District of U.P. ranged from 7.7 to 8.8 (mean 8.3) cm CL. Measurements of a typical male and female are:

FMNH 224162 M — 8.4 CL 6.7 CW 7.8 PL 4.6 H and 0.0825 kg.

Live F — 23.3 CL 17.2 CW 22.5 PL 11.2 H and 1.6 kg.

In addition to size males differ from females by having a longer tail with a proportionately thicker base.

Hatchlings: A single hatchling from an egg obtained at Deogarh Ghat, on the Chambal River measured 3.7 CL 3.5 CW 3.4 PL 2.1 H and weighed 11.5 g. Coloration — carapace smoke gray with vague dark mottling on most scutes with a cinnamon-rufous pleuro-marginal ring; anterior portion of middorsal stripe also cinnamon-rufous bordered with black; plastron straw yellow with large, black blotches covering most of the scutes and light cinnamon-rufous along scute seams; head olive with bright geranium pink markings including a spot at posterior edge of upper eyelid and adjacent skin, a larger postocular spot and a

transverse bar across back of head; chin with three additional pink spots along lateral edge of mandible; iris light gray; neck with cream stripes on an olive gray background; limbs gray with cream-colored scutes, webbing and lateral skin flaps; rump with dark and cream stripes. See Moll (1985) for a colored photograph.

Natural History: The pink-ringed tent terrapin is a riverine form which readily basks at any opportunity. We observed hundreds of these turtles basking on logs, islands and along the banks of the Yamuna and Chambal Rivers. In January when the larger *Kachuga* were scarce and presumably dormant, this species was still basking in some number along the Chambal. There is some indication of habitat separation between the sexes and age groups — small males and juveniles were rarely seen in the river proper where females were common. However, in a backwater behind a sandbar projecting out from the shore of the Yamuna River, we once collected 11 males, 6 juveniles and 3 females. Three yearlings were also captured in a small (10' wide) weedy tributary of the Chambal hiding in and around vegetation masses.

Digestive tracts of one male, one female and two immature females were examined. The male contained a beetle and an equivalent amount of aquatic vegetation whereas the female guts were packed with vegetation alone. This supports findings from the other races indicating that females tend to be chiefly herbivorous while males are more omnivorous.

Nesting was occurring along the sandbanks of the Chambal River when we arrived there on 19 January but all nests found had been destroyed by predators. Jackal tracks and occasionally hyena tracks were associated with these nests. Two eggs, one cracked and one entire remained in one of the open nests. The cracked egg measured 47 × 28 mm while the

entire egg was 47×27 mm and weighed 19.5 g.

Rao and Singh (1985) reported that nesting occurs from October through January in the National Chambal River Gharial Sanctuary. They calculated the turtles' average clutch size as 6 (3-12) eggs and thought two clutches to be typical. Mean egg size was 48.6×27.6 mm and 21 g. Using data from eight of their females, I calculated the mean female reproductive effort as: RCM — 0.08, ELI — 22, EWI — 12, and EMI — 1.4.

Distribution: The pink-ringed tent terrapin occurs in the upper and central Ganges and such tributaries as the Hindon, Yamuna, Chambal and Gomati. Mertens (1969) named the type locality for this race as Meerut, Meerut District, U.P. He was not confident about the localities of his paratypes which were listed as Calcutta or vicinity of Calcutta. Based on our observations from this survey, it seems likely that Merten's paratypes were market specimens shipped in from more western states. Because of the heavy market trade in turtles of West Bengal, distribution records from this state are often unreliable. More likely the race of tent turtles which occurs naturally in West Bengal is *K. t. flaviventer* or some as yet undescribed population. Specimens of this race were collected at the following localities on our survey:

FMNH 224105 & 224109 — Hindon River, nr. Ghaziabad, Meerut Dist., U.P.

BNHS 1335 & FMNH 224162 — Yamuna River, 5 km S Etawah, Etawah Dist., U.P.

BNHS 1340 — Chambal River, Deogarh, 30 km NE Morena, Morena Dist., M.P.

FMNH 224185 — Gomati River, nr. Lucknow, Lucknow Dist., U.P.

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