JOURNAL OF HERPETOLOGY

Volume 14 | 31 October 1980 | Number 4

A New Species of Mud Turtle, Genus *Kinosternon*, from Oaxaca, Mexico

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ABSTRACT—The relationships between *Kinosternon scorpioides* and *K. integrum* are discussed. A new allopatric species, *Kinosternon oaxacae,* is described from coastal Oaxaca, Mexico. *K. oaxacae* is a member of the *scorpioides* species complex (with *integrum*), but differs from these two species in its reduced plastron, narrower carapace, and axillary and inguinal scutes in broad contact. A dichotomous key for the identification of the adult *Kinosternon* of Oaxaca is presented.

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INTRODUCTION

Systematic relationships within the mud turtles (genus *Kinosternon*) of Mexico are notoriously confused. Several recent contributions (Berry and Legler 1980; Conant and Berry 1978; Iverson 1978, 1979; and Iverson and Berry 1979) have clarified many of the taxonomic problems associated with the genus in northern Mexico, but relationships among the taxa in southern Mexico remain in disorder.

Particular disagreement surrounds the systematic relationships between *Kinosternon integrum* Leconte and *K. scorpioides* Linnaeus (*K. cruentatum* Dumeril and Bibron *in* Dumeril and Dumeril 1851 has been relegated to a subspecies of *K. scorpioides* by Legler 1965 and Iverson 1976). Siebenrock (1906, 1907) was first to consider *integrum* a subspecies of *K. scorpioides,* an arrangement followed subsequently by Ahl (1934), Wermuth and Mertens (1961, 1977), Casas Andreu (1967), and Morafka (1977). Most other authors (*e.g.* Smith and Taylor 1950; Duellman 1961; Casas Andreu 1965; Hardy and McDiarmid 1969; Pritchard 1979; and Smith and Smith 1980) have considered *integrum* a species distinct from *scorpioides.* Pritchard (1967) referred to *integrum* as a subspecies of *scorpioides* in his text (p. 40), but as a distinct species in his index (p. 285).

We have examined the relationships between *Kinosternon integrum* and *K. scorpioides* in detail. The two taxa are known to occupy the same river basins only in the Río Pánuco and Río Papaloapan basins in eastern Mexico. Although they are nowhere known to occur at the same locality, we find the lack of evidence of intermediacy (intergradation) and the presence of numerous morphological differences between the taxa to be ample evidence that *Kinosternon integrum* is a

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species closely related to but specifically distinct from *K. scorpioides*. We cannot agree with Morafka's (1977) suggestion that *integrum* is a "Mexican high plateau race of *scorpioides*" since it occupies lowland habitats virtually to sea level along much of the Pacific Coast of western Mexico (albeit it is restricted to the Mexican Plateau in eastern Mexico; on this, *cf.* Iverson and Berry 1979). The relationships among all members of the *Kinosternon scorpioides* complex (including *integrum*) are discussed by Berry (1978).

In examining the distributions of *K. scorpioides cruentatum* and *K. integrum* in southern Oaxaca, Mexico where their geographic ranges are adjacent, we discovered the existence of a third, undescribed, allopatric species of *Kinosternon*.

Kinosternon oaxacae, sp. nov.
Oaxaca Mud Turtle
Figs. 1 and 2

Holotype.—UC 48857, whole, preserved, adult male; collected 11.6 km N. of Pochutla (San Pedro Pochutla), along Mexican Hwy. 175 (*ca.* 235 m), Oaxaca, Mexico (15°46′ N, 96°28′ W) on 13 July 1971 by T. Paul Maslin and the UC Summer expedition to Oaxaca. Also bearing a tag "UIMNH Field 15892".

Allotype.—AMNH 88884, whole, preserved, adult female; collected 11.3 km N. of Pochutla, Oaxaca, Mexico on 12 August 1962 by Roger Conant.

Paratypes.—A total of six, whole preserved specimens from Oaxaca, Mexico: UIMNH 9975, adult male, Pochutla; KU 137680, adult male, 4.8 km S. of Candelaria; KU 87296, adult female, 1 km NNW of San Gabriel Mixtepec (800 m); KU 38209-10, juveniles, and KU 38211, subadult female, Chacalapa (between Puerto Ángel and Miahuatlán).

Diagnosis.—*Kinosternon oaxacae* is a large species (largest specimen a male 159 mm in carapace length, CL) belonging to the *scorpioides* species complex (with *integrum* and *scorpioides*). It is most similar to *K. integrum,* but is distinguishable from all other *Kinosternon* by the following combination of characteristics in adults (*cf.* Table 1): (1) a depressed, strongly tricarinate carapace; (2) a relatively small plastron (smaller in males than in females) which does not completely close the ventral opening of the shell (maximal width of plastral hindlobe 57–63% of maximal carapace width, CW); (3) anterior and posterior plastral lobes both freely moveable; (4) posterior plastral lobe with a distinct anal notch which is more emarginate in males than in females (Figs. 1 and 2); (5) fixed portion of plastron long, interabdominal seam 24–27% of CL; (6) bridge of moderate length (22–25% of CL), not grooved posteriorly; (7) axillary and inguinal scutes in contact, inguinal in contact with marginal scute M5; (8) first vertebral scute, V1, contacts M2; (9) opposed patches of horny scales on the posterior thigh and crus (clasping organs) lacking in males and females; and (10) tail of males and females terminating in a horny spine.

Description of species (based on adults of the type series): Carapace relatively depressed and wide (CW and carapace height 58–66% and 32–37% of CL respectively), with three prominent, parallel, longitudinal keels. Ground color of carapace brown to black, or mottled brown and black; seams darker in lighter colored specimens. Carapacial scutes imbricate; vertebral scutes variable in size (V2–V4 may be longest, V1 or V3–V5 may be widest, and V1 or V4–V5 may be shortest). Nuchal scute small, longer than broad both dorsally and ventrally. V1 usually (83%) contacting M2. Dorsal margins of M1–M9 aligned; M10 higher, sloping upward from its contact with M9 to seam between V5 and fourth pleural, then abruptly downward to contact M11; M11 not significantly higher than M9.

Plastron relatively small, smaller in males than in females (plastron width at anterior hinge 65–67% of CW in both sexes, but maximal width of plastral hindlobe 57–59% and 62–63% of CW in males and females respectively). Plastron concave in males, more nearly flat in females. Plastral ground color yellow to brown with darker seams, sometimes with dark brown stains, particularly on the bridge and ventral surfaces of the marginals. Plastron with two freely kinetic hinges; anterior

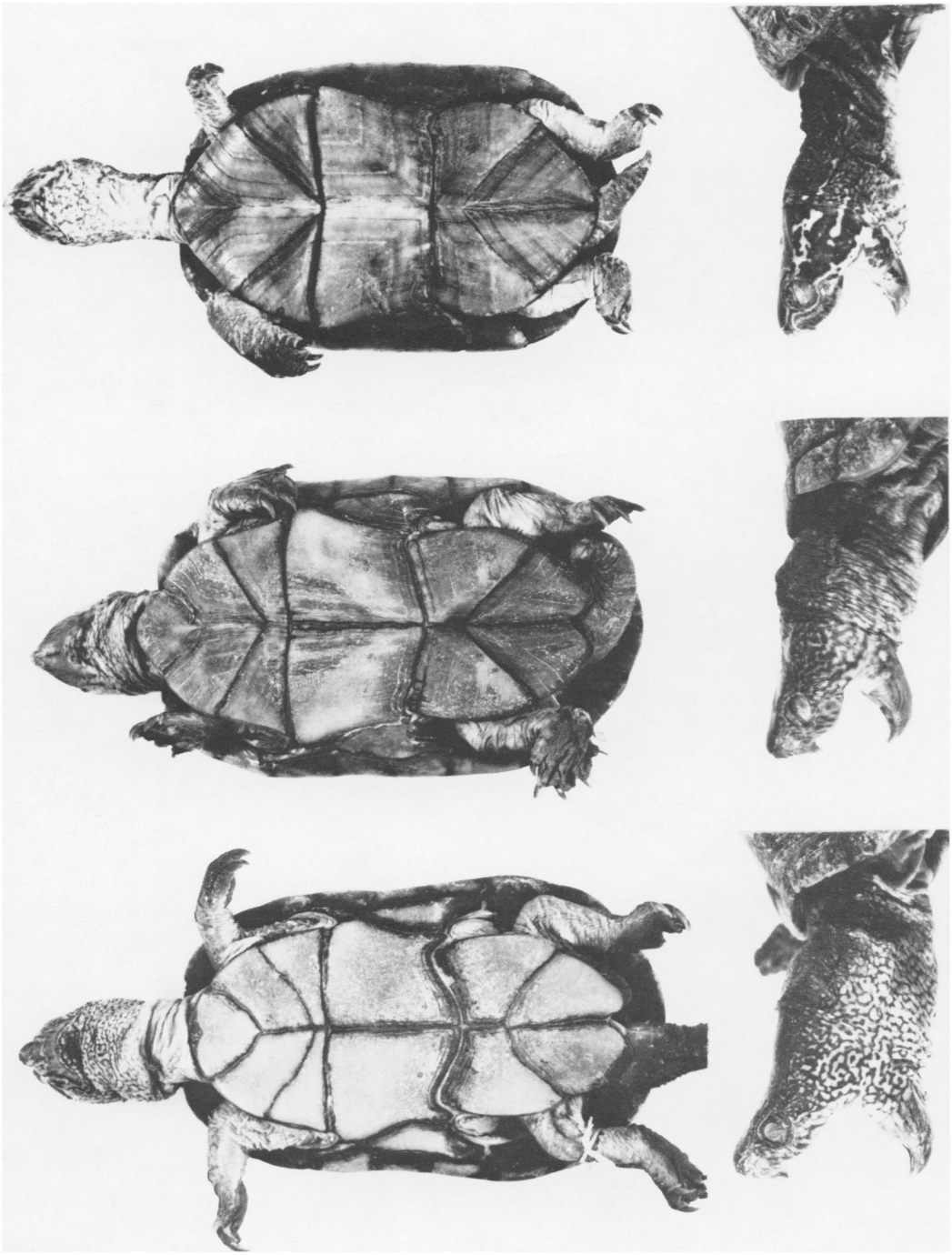

FIGURE 1. Photographs of the plastron and head of males of *Kinosternon oaxacae* (UC 48857, holotype, left), *K. integrum* (UU 7849, center), and *K. scorpioides cruentatum* (UU 7631, right).

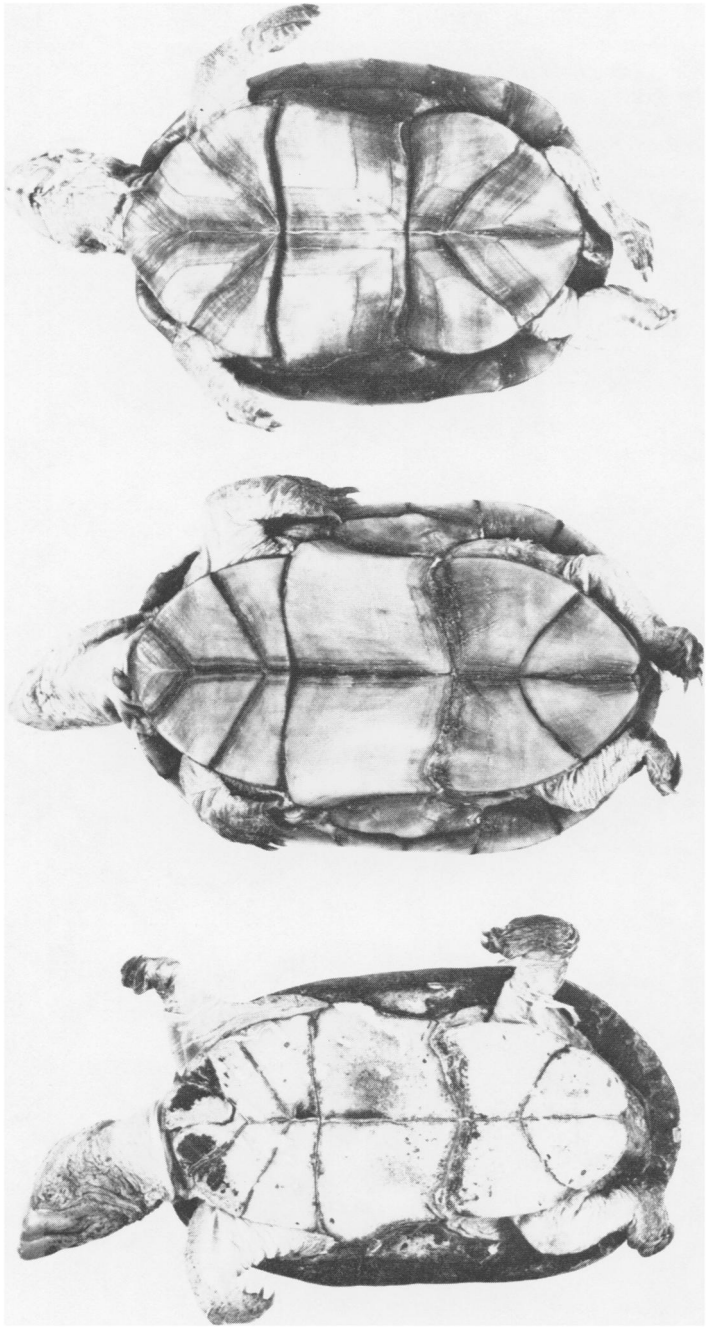

FIGURE 2. Photographs of the plastron of females of *Kinosternon oaxacae* (AMNH 88884, allotype, left), *K. integrum* (UU 7877, center), and *K. scorpioides cruentatum* (UU 5150, right).

TABLE 1. Character ratios useful in distinguishing *Kinosternon oaxacae, K. integrum,* and *K. scorpioides cruentatum.* For each ratio (expressed as percent) there is a mean with the range beneath. Character abbreviations not included in the text are: PWant = width of anterior plastral lobe at hinge; PWpost = maximal width of posterior plastral lobe; Ab = interabdominal seam length; Br = bridge length; Ht = maximal carapace height; F = interfemoral seam length; Post. Lobe = maximal length of posterior plastral lobe; P = interpectoral seam length; and Ant. Lobe = length of anterior plastral lobe.

		CL (mm.)	PWant / CW	PWpost / CW	Ab / CL	Br / CW	Ht / CL	F / Post Lobe	P / Ant. Lobe
MALES									
K. oaxacae	(3)	153	65.0	58.4	25.7	35.0	34.1	27.7	13.2
		150–159	64.6–65.5	57.2–59.4	24.4–27.3	33.7–36.0	32.1–35.6	23.3–32.3	9.4–17.7
K. integrum									
Rio Coyuca-	(18)	154	68.7	62.4	25.7	35.0	34.8	27.8	15.5
Rio Papagayo		110–118	62.5–76.9	56.8–69.4	22.7–27.5	29.5–38.0	31.5–37.4	22.9–36.4	7.4–26.8
Upper Rio	(9)	151	75.3	68.3	26.1	35.7	36.4	25.9	13.4
Balsas		113–183	71.3–78.8	64.4–70.5	25.0–27.7	30.8–39.8	34.5–39.7	20.0–32.8	5.6–19.6
Rio Verde	(6)	150	73.5	65.6	26.3	36.2	36.2	27.8	17.3
		133–177	63.7–88.4	63.0–70.8	24.1–28.2	33.0–39.2	33.7–41.8	24.2–31.0	14.0–23.2
K. scorpioides									
Rio Tehuantepec	(24)	122	73.1	69.5	24.9	43.4	42.9	7.4	16.4
		219–133	67.5–80.5	63.8–75.0	20.5–27.2	40.4–47.5	34.2–47.6	0.0–16.7	9.5–26.7
FEMALES									
K. oaxacae	(2)	128	65.8	61.9	26.3	36.8	36.4	32.5	14.0
		126–130	64.9–66.7	61.7–62.0	26.2–26.4	35.2–38.3	35.8–36.9	32.4–32.5	10.0–17.9
K. integrum									
Rio Covuca-	(39)	142	69.4	65.0	28.6	37.6	39.9	29.1	13.4
Rio Papagayo		126–174	63.2–76.7	60.0–71.1	24.6–33.3	32.2–42.3	34.4–44.4	18.2–36.8	4.4–27.1
Upper Rio	(23)	140	73.0	70.1	27.8	37.8	38.9	21.1	13.8
Balsas		123–157	66.7–76.0	64.4–73.3	26.0–31.0	32.0–41.3	32.8–43.8	13.6–26.9	5.0–21.4
Rio Verde	(10)	131	71.4	65.5	28.3	37.5	41.4	25.5	12.6
		107–154	68.0–75.6	62.7–70.2	26.3–30.9	34.5–39.6	37.8–45.8	15.4–32.6	6.5–19.4
K. scorpioides									
Rio Tehuantepec	(49)	124	71.3	68.4	27.1	44.0	48.6	6.1	10.6
		105–138	65.9–75.9	63.9–72.9	24.8–29.9	40.0–48.5	42.9–53.2	0.0–15.8	2.4–23.8

hinge straight (at right angles to midline), posterior hinge curved (Figs. 1 and 2); posterior lobe slightly constricted at hinge; anal notch distinct, more emarginate in males than in females. Axillary and inguinal scutes in contact; axillaries extending from mid-M4 to posterior M5 or anterior M6, inguinals from posterior M5 or anterior M6 to anterior or mid-M8 (posterior portion of inguinal tending to be replaced by skin in older, larger individuals). Plastral scutes in order of decreasing length at the midline: abdominal—anal—gular—humeral—femoral—pectoral (33%), or abdominal—anal—gular—femoral—humeral—pectoral (67%).

Rostral shield "V"-shaped or bell-shaped. Maxillary sheath strongly hooked in larger specimens, weakly hooked in smaller specimens. Head mottled dark brown to black and cream dorsally, cream to yellow with few, faint spots ventrally (more nearly immaculate in females than males); laterally, those patterns integrated in a reticulated network (Fig. 1). Dark pigment coalesced in some to form indistinct light or dark head stripes, but no well-defined head stripes present. Jaw sheaths cream to yellow, heavily streaked with dark brown to black in males, faintly streaked or immaculate in females. Skin of limbs dark brown or gray with darker spots dorsally, immaculate cream to pale gray ventrally; tail in both sexes uniformly brown or gray dorsally and ventrally. Three to four pairs of barbels on chin between mandibular symphysis and throat at level of mid-tympanum; anterior pair longest, remaining pairs of subequal length. Four to six poorly defined rows of papillae on lateral and dorsal surfaces of the neck.

Hands and feet small, fully webbed, with well developed claws. Discrete, opposed patches of horny, tuberculate scales (clasping organs) on posterior thigh and crus lacking in both sexes. Tail of males elongate and prehensile, greater than half length of posterior plastral lobe; tail of females short, less than half length of posterior plastral lobe. Tail in both sexes with four rows of dorsal and lateral papillae, and terminal horny spines.

Ontogenetic variation.—The three immature paratypes of *Kinosternon oaxacae* (KU 38209–11, with CL = 55, 84, and 100 mm) differ from the adult type specimens in having: (1) a proportionately wider, more evenly rounded carapace (CW = 73–79% of CL); (2) medial carapacial keel more prominent than lateral keels; (3) ground color of carapace olive to brown with darker seams (carapacial scutes of KU 38210 much darker near their posteromedial borders, gradually lighter anterolaterally); (4) V1 contacting M2 in KU 38210 only; (5) M10 more nearly the same height as the other marginals in smaller specimens; (6) plastron proportionately smaller than in adults (plastron width at anterior hinge and mid-hind lobe 55–62% and 52–57% of CL respectively); (7) plastron of the smallest specimen (KU 38209) with a faint, gray, foliate plattern; and (8) head with a distinct, lateral, cream-colored stripe extending from posteroventral edge of orbit to angle of jaws.

Distribution.—*Kinosternon oaxacae* is known only from the basins of the Ríos Colotepec and Tonameca in coastal Oaxaca between 100 and 800 m elevation (Fig. 3).

KEY TO THE ADULT (CL > 90 mm) *KINOSTERNON* OF OAXACA, MEXICO

1. Interabdominal seam length < 22% of CL, < 80% of plastral forelobe length; gular length < 52% of plastral forelobe length; maximal dorsal width of gular scute > maximal ventral width; head brown or gray, with two broad, cream or yellow postorbital stripes, sometimes broken into a series of blotches or mottles ..... *K. leucostomum* (Atlantic drainages of the Ríos Papaloapan and Coatzacoalcos and their tributaries, northwestward and eastward)

   Interabdominal seam length > 21% of CL, > 80% of plastral forelobe length; gular scute length > 50% of plastral forelobe length in 94% of individuals; maximal dorsal width of gular scute ≤ maximal ventral width; head not colored as above 2
2. Interfemoral seam length < 20% of maximal length of plastral hindlobe; plastral hindlobe not notched or only very slightly notched posteriorly (Figs. 1 and 2); bridge length > 40% of maximal CW 3

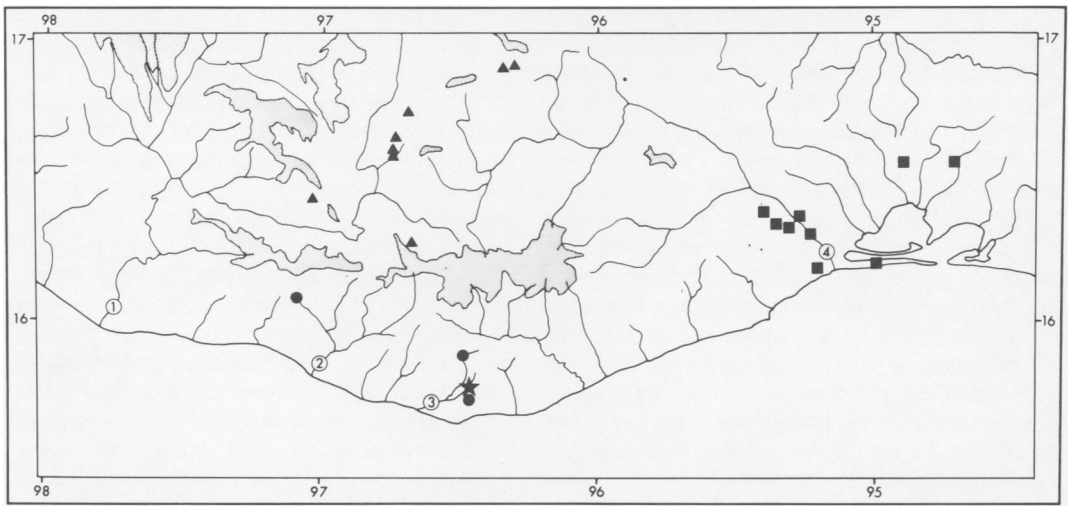

FIGURE 3. Ranges of *Kinosternon* in southern Oaxaca, Mexico. Triangles, *K. integrum;* dots, *K. oaxacae* (star, type locality); squares, *K. scorpioides cruentatum*. Principal rivers are numbered: Verde (1), Colotepec (2), Tonameca (3), and Tehuantepec (4). Elevations above 2400 m are shaded.

Interfemoral seam length > 19% of maximal length of plastral hindlobe; plastral hindlobe with a distinct posterior notch (Figs. 1 and 2); bridge length < 40% of maximal CW 4

3. Carapace with a single, longitudinal, medial keel, or lateral keels considerably less prominent than medial keel; anterior width of plastral hindlobe < 45% of CL; fourth costal scute usually (73%) contacting 11th marginals; maximal shell height < 41% of CL; anterior border of plastral hindlobe slightly curved ..... *K. acutum*
   (Atlantic drainages of the Ríos Papaloapan and Coatzacoalcos and their tributaries, northwestward and eastward)

   Carapace with three longitudinal, parallel keels of subequal prominence; anterior width of plastral hindlobe > 42% of CL; fourth costal scutes usually not (83%) contacting 11th marginals; maximal shell height > 38% of CL; anterior border of plastral hindlobe a straight line (Figs. 1 and 2) ..... *K. scorpioides cruentatum*
   (Pacific drainages of the Río Tehuantepec eastward; Atlantic drainages of the Río Papaloapan northwestward)

4. Width of plastral forelobe at anterior hinge > 67% of CW (88% of individuals); maximal width of plastral hindlobe > 59.5% of CW in males (91%) and > 62% of CW in females (93%); interfemoral seam length < 46% of bridge length, and < 12% of maximal plastron length .. .. *K. integrum*
   (Pacific drainages of the Río Verde north and westward)

   Width of plastral forelobe < 67% of CW; maximal width of plastral hindlobe < 59.5% of CW in males, < 62% of CW in females; interfemoral seam length > 38% of bridge length, and > 9% of maximal plastron length ..... *K. oaxacae*
   (Pacific drainages of the Ríos Colotepec and Tonameca)

SPECIMENS EXAMINED

Standard museum acronyms (Duellman, Fritts, and Leviton 1978) are used throughout this paper.

Kinosternon oaxacae—
UC 48857; UIMNH 9975; AMNH 88884; KU 87296, 38209-11, 137680.

Kinosternon integrum—
Río Coyuca—Río Papagayo: USNM 46275, 108729-30, 108732; FMNH 116514, 116523-24, 116540; KU 87292-94; UMMZ 80964; UU 7839-40, 7842-44, 7847-84, 7919-20.
Upper Río Balsas (Ríos Mixteco, Acatlán, Atoyác): USNM 108590, 108593, 108609-10, 108614-15, 108617, 108624, 108626, 108628-29, 108631; KU 40135-38, 62527; UMMZ 102173-76, 102183, 119496, 125364-65; FSM 20647; UU 7951, 12086-87, 12095; MVZ 76528; CAS 87218.
Río Verde: LACM 64498-99; UMMZ 119407; KU 87297; UIMNH 9966, 9968, 9971-74, 61002, 61004-05; UC 48853-54; EAL 858.

Kinosternon scorpioides—Río Tehuantepec: USNM 109105-23, 113278; UMMZ 82183-85, 82187-213, 82215-22, 82224-26, 82228, 82230-33, 82235-38, 118633-34; UU 7950.

Kinosternon leucostomum—
Río Papaloapan—Río Jamapa: USNM 109189-92, 109194-96, 109198, 109202, 109205-11; UMMZ 89388, 89390, 89392-93, 118290-93; KU 40129-30, 47375-76, 51449; UU 8555-88, 10258-61, 11875; FSM 32628-29.
Río Coatzacoalcos: AMNH 97997; KU 24447; UU 7953-55.

Kinosternon acutum—(see list in Iverson 1976).

RESUMEN

Las relaciones entre *Kinosternon scorpioides* y *K. integrum* se discuten brevemente. Una nueva especie alopatrica, *Kinosternon oaxacae,* se describe de la costa de México. *K. oaxacae* es miembro del complejo de especies de *scorpioides* (con *integrum*), pero se difiere de estas dos especies en el plastrón reducido, el carapacho mas estrecho, y escudos axillares y inguinales en contacto extenso. Una llave dicótoma para los *Kinosternon* adultos de Oaxaca se presenta.

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Accepted 13 May 1980