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A NEW TURTLE (GENUS *KINOSTERNON*) FROM NORTHWESTERN MEXICO¹

By James F. Berry ^{2,3} and John M. Legler³

ABSTRACT: The Alamos Mud Turtle, *Kinosternon alamosae*, new species, is described from southern Sonora and northern Sinaloa, Mexico. The species is a member of the *Kinosternon scorpioides* complex (males lacking clasping organs) and differs from other *Kinosternon* in its rounded, noncarinate carapace, widely separated axillary and inguinal scutes, narrow first central scute, and reduced chin barbels. *Kinosternon alamosae* is known to occur in the Pacific coastal region from Guaymas, Sonora, southward at least to Guasave, Sinaloa, at elevations from sea level to 1,000 m. It is at least partly sympatric with *K. integrum*. *Kinosternon alamosae* seems to inhabit temporary aquatic situations; all existing specimens were taken in the wet season (July to September). Follicular development and oviposition coincide with the wet season. A dichotomous key is presented for the identification of the adults of *Kinosternon* species occurring in Sonora, Sinaloa, and Chihuahua, Mexico (*K. alamosae*, *K. flavescens*, *K. hirtipes*, *K. integrum*, and *K. sonoriense*).

Three species of *Kinosternon* are currently recognized from Sonora, Mexico. These are *K. flavescens* (Agassiz) 1857, *K. sonoriense* LeConte 1854, and *K. integrum* LeConte 1854 (Bogert and Oliver 1945; Langebartel and Smith 1954; Zweifel and Norris 1955; Conant and Berry 1978; Iverson 1978, 1979). *Kinosternon hirtipes* Wagler 1830 is not presently known from Sonora but may occur there considering its known distribution in the Río Papigochic (Río Yaqui drainage) of extreme western Chihuahua (Legler and Webb 1970; Van Devender and Lowe 1977; Iverson 1978). Of these four species, only *K. integrum* was thought to occupy the Pacific slopes of the Sierra Madre Occidental and the coastal plain from Guaymas southward (Conant and Berry 1978; Iverson 1978, 1979).

Heringhi (1969) reported both *K. integrum* and *K. hirtipes* from the vicinity of Alamos, Sonora. We examined his and other specimens from that region and found that most specimens of *K. integrum* have been correctly identified but that most specimens of "*K. hirtipes*" (total of 32) represent a previously undescribed species. In the course of preparing this paper and in preparing much more extensive analyses of *Kinosternon*, we have seen no specimens of *K. hirtipes* from southeastern Sonora.

METHODS AND MATERIALS

Shells were measured using the method outlined by Carr (1952) and described in detail by Berry (1978). Plastral scute lengths are interlaminal (i.e., average length of right and left scutes, as measured along their common midventral seam). Condylbasilar length was measured in a straight line from the posteriormost point of the occipital condyle to the anteriormost point of the premaxillary region.

The contact of nuchal and first neural bones is easy to observe on any whole preserved specimen by gently loosening the tapered posterior edge of the first central scute with a blunt blade and curling it forward. If the condition of the first neural is not immediately evident, a gentle scraping of the soft tissue over the bone will usually reveal it. In most cases, the reflected scute can be laid back in place without any damage to the specimen.

Tinkle (1962) demonstrated the utility of expressing the points at which the five lateral seams of the carapace intersect the marginal scutes. Our terminology is as follows: P, contact on posterior half of marginal; M, contact at midpoint; A, contact on anterior half; or, e.g., 9-10, on the seam between M9 and M10. This terminology is a simplification of that used by Tinkle.

Materials examined are in the collections of the American Museum of Natural History (AMNH), Arizona State University (ASU), John B. Iverson, Earlham College, Richmond, Ind. (JBI), University of Kansas (KU), Natural History Museum of Los Angeles County (LACM), Museum of Vertebrate Zoology, University of California, Berkeley (MVZ), University of Arizona (UAZ), University of Colorado Museum (UC), University of Illinois Museum of Natural History (UIMNH),

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Table 1. Comparisons of scute and shell proportions for adults of the three species of *Kinosternon* of the *scorpioides* group in Mexico. The specimens of *K. integrum* are from Sonora and Chihuahua and those of *K. scorpioides* are all from Tehuantepec, Oaxaca, and represent the subspecies *K. scorpioides cruentatum*. Values are means and extremes.

	<i>K. alamosae</i>		<i>K. integrum</i>		<i>K. scorpioides</i>	
	Males (N = 15)	Females (N = 16)	Males (N = 24)	Females (N = 36)	Males (N = 22)	Females (N = 46)
Carapace length (CL; mm)	118 90-135	113 89-126	150 110-183	140 109-161	123 109-133	124 105-138
Shell height ÷ carapace width	0.562 0.496-0.653	0.604 0.523-0.644	0.579 0.516-0.613	0.584 0.521-0.633	0.633 0.557-0.727	0.667 0.615-0.717
Length of ant. plastral lobe ÷ CL	0.290 0.273-0.313	0.298 0.282-0.318	0.316 0.296-0.351	0.326 0.287-0.353	0.319 0.274-0.339	0.317 0.295-0.362
Length of gular scute ÷ length of ant. plastral lobe	0.557 0.468-0.643	0.564 0.482-0.592	0.489 0.400-0.556	0.488 0.435-0.634	0.465 0.395-0.512	0.495 0.400-0.615
Length of pectoral scute ÷ length of post. plastral lobe	0.109 0.028-0.180	0.106 0.057-0.156	0.235 0.100-0.364	0.201 0.105-0.366	0.074 0.000-0.167	0.065 0.000-0.167
Length of anal scute ÷ length of post. plastral lobe	0.726 0.623-0.838	0.746 0.686-0.815	0.741 0.682-0.800	0.800 0.731-0.878	0.835 0.738-0.905	0.897 0.795-0.976
First central scute, width ÷ length	0.880 0.726-1.119	0.969 0.751-1.255	0.991 0.903-1.161	0.987 0.833-1.167	1.020 0.857-1.167	1.077 0.923-1.360
CW ÷ CL	0.633 0.562-0.673	0.676 0.614-0.766	0.630 0.592-0.700	0.658 0.619-0.702	0.688 0.634-0.721	0.731 0.684-0.772
Bridge ÷ CL	0.270 0.255-0.290	0.301 0.276-0.327	0.243 0.221-0.273	0.256 0.212-0.279	0.299 0.271-0.315	0.321 0.283-0.346

University of Michigan Museum of Zoology (UMMZ), University of New Mexico (UNM), National Museum of Natural History (USNM), and University of Utah (UU).

SYSTEMATICS

Kinosternon alamosae NEW SPECIES

Figures 1 through 3

VERNACULAR NAME. Alamos Mud Turtle.

HOLOTYPE. LACM 127639, adult female, preserved whole; obtained at Rancho Carrizal, 7.2 km north and 11.5 km west of Alamos, Sonora, Mexico [27°05'N, 109°03'W] on 9 July 1966 by Harold L. Heringhi. Formerly ASU 6383 and bearing a small tag with that number.

ALLOTYPE. LACM 127640, adult male, preserved whole; same date and locality as holotype. Formerly ASU 6390 and bearing a small tag with that number.

PARATOPOTYPES (total of 6). UU 14280♀; UU14281♀ skeleton; ASU 6385♂, 6386♀, 6387♂, 6389♀.

OTHER PARATYPES (total of 17 from Sonora). MVZ 50907♀, 50908♀, 50909♀ im, 50910♂; AMNH 64163♀, 64164♂, 64165-68♀♀; ASU 6781♀; Alamos [27°01'N, 108°56'W]. UU 14279♂: 0.5 mi. W Alamos. LACM 105403♂, 105404♀: La Esmeralda Ranch, 1.2 mi. N Alamos. ASU 6547♂: 8 mi. S Alamos. UU 11853♂ skeleton: La Casa de la

Huerta, Sierras de Alamos [26°59'N, 109°00'W]. UAZ 39891♂: 4.5 mi. W Minas Nuevas (by road).

DIAGNOSIS. *Kinosternon alamosae* is a medium-sized species (males to 135 mm, carapace length; females to 126 mm). It is a member of the *K. scorpioides* complex (with *K. scorpioides* and *K. integrum*) in which adult males lack clasping organs (*sensu* Legler 1965) on the posterior thigh and leg. *Kinosternon alamosae* is most similar to *K. integrum* but differs from it and all other *Kinosternon* by the following unique combination of characteristics in adults: (1) carapace of both sexes broadly rounded or flat-topped in cross section; noncarinate; (2) movable plastral lobes extensive in area, closing or nearly closing anterior and posterior orifices of shell (almost completely concealing head, limbs, and tail); (3) anal notch small or lacking; (4) bridge relatively long, 26 to 33 percent of carapace length (Table 1); (5) axillary and inguinal scutes widely separated, the inguinal narrowly in contact with sixth marginal (M6) but never in contact with M5; (6) rear margin of carapace straight or evenly curved in profile, never recurved or flared outward; (7) first central scute usually not in contact with M2; (8) clasping organs lacking in both sexes; (9) adult tail terminating in horny spine in both sexes.

GENERAL DESCRIPTION OF SPECIES (based on hypodigm). Carapace relatively narrow (Table 1), oval in dorsal aspect, evenly rounded or flat-topped in cross section (large adult females may have slight concavity in middorsal region); no evidence of carapacial keeling. Growth zones evident on all plastral

and carapacial scutes in most medium-sized individuals and on some of largest adults. Scutes imbricate. First central scute narrow, not in contact with second marginal scute (M2) or just reaching the M1-M2 interlaminal seam. Modal formula for carapacial scute contacts: 1P, 5M, 7M, 9A, 10P. Marginal scutes 1 through 9 of approximately same height, their dorsal margins forming an even line; M10 abruptly higher than M9 but only slightly higher than M11. Carapace slightly flared laterally (viewed in cross section) in region of M8-10, but extreme posterior edge (the pygal region viewed in profile) straight, often vertical, not flared, not recurved; suprapygial region abruptly rounded where horizontal dorsal edge of profile meets posterior vertical edge.

Plastral lobes extensive, nearly closing orifices of shell, almost completely concealing soft parts when closed in live animals. Plastral lobes evenly rounded; anal notch small or absent. Plastron deeply concave in males, flat or slightly convex in females; posterior plastral lobe of females extending nearly to extreme posterior edge of carapace (shorter in males; Fig. 1). Plastral scutes ranked from longest to shortest: abdominal, anal, gular, humeral, femoral, pectoral.

Rostrum short and broad in dorsal aspect; rostral pores well developed. Premaxillary hook of upper jaw weakly to moderately developed, occasionally lacking. Keratinized head shield extensive, covering entire area underlain by frontal and prefrontal bones, abutting upon superiormost part of maxillary sheath and upon soft skin of snout; posterior edge of head shield straight, bulged posteriorly, or with blunt extensions onto postorbital arches and onto parietal region, creating a trilobate configuration; posterior edge of head shield never concave or V-shaped.

One pair of small chin barbels, occasionally pointed (Fig. 2) but more often low, flat, tubercular or wartlike, almost never longer than basal width. Two rows of low, weak, indistinct papillae on each side of neck. Anterior part of tongue papillose.

Hands and feet small and fully webbed; digital claws well developed. Clasp organs lacking on posterior thigh and opposed leg in both sexes. Spadelike falciform scales on antebrachium and heel typically kinosternine, variably keratinized. A horny spine at tip of tail, that of male broader and more massive than that of female; tail of male elongate and prehensile, longer than one-half the length of posterior plastral lobe; tail of female much shorter than one-half the length of posterior lobe.

COLORATION OF PRESERVED SPECIMENS. Ground color of carapace neutral tan, pale brown, or pale brownish olive with interlaminal seams distinctly darkened. Plastral ground color yellowish, golden, or yellowish brown, unmarked except for distinctly darkened interlaminal seams. Interosseous sutures often visible beneath translucent carapacial scutes.

Skin of soft parts medium to pale slatey gray or brown, darker dorsally than ventrally, lacking a distinct pattern. Skin of head and neck grayish to cream below, pale neutral brownish above, pale and dark fields blending gradually on side of head and neck without sharp contrast. Dark ground color of head unmarked (most preserved specimens) or with a pattern of pale vermiculations. Individual pale marks fused to form vague longitudinal temporal stripes in some specimens. Pale vermiculations coalesce into what is a pale field marked with remnants (dots) of the original darker ground color in largest specimens. Jaw sheaths bearing vertical dark streaks in males, uniformly

straw colored in females. Head pattern never as bright, bold, or contrasting as in *K. integrum*.

COLORATION OF LIVE SPECIMENS. The following descriptions are based on observation of two live adults of *K. alamosae* (JBI 858♂, Fig. 2, and JBI 859♀) made available through the courtesy of John B. Iverson. All observations were made in aquaria with clear water under white fluorescent illumination. The shells of these specimens were free of dirt and epizoic algae.

Coloration of shell and skin not greatly different from that of preserved specimens. Carapace in both sexes olive to brown with dark brown to black interlaminal seams; paler at margin. Plastron yellowish with dark brown seams; growth rings containing melanin and distinctly visible.

Skin of head pale gray above with numerous dark spots; sides of head mottled pale gray and yellowish cream with fewer dark spots. An indistinct pale stripe extending from posteroventral edge of orbit, above maxillary sheath to jaw articulation. Horny jaw sheaths yellowish cream to pale gray, male with numerous faint brown vertical streaks. Dorsal surface of neck pale gray grading into immaculate yellowish cream of ventral surface of head and neck. Skin of limbs overall pale gray, slightly darker above.

Iris of female dark orange with four evenly spaced concentrations of darker pigment immediately peripheral to the pupil, forming a stellate figure. Iris of male darker orange than that of female but bearing the same stellate arrangement of dark pigment.

OSTEOLOGY. The following description is based on two complete adult skeletons of *Kinosternon alamosae* (UU 11853♂ and UU 14281♀). Comparisons are with *K. integrum* and are based on 13 complete skeletons (UU 7680, 7696, 7827, 7850-51, 11678♂♂; UU 7737, 7750, 7833, 7872, 7875, 11855♀♀; AMNH 64161♀♀). When the skeletal characters of *K. integrum* are judged to differ significantly from those of *K. alamosae*, those of *K. integrum* appear in brackets. See Table 2 for a comparison of skull proportions in *K. alamosae* and *K. integrum*.

The appendicular skeleton of *K. alamosae* is typically kinosternine and does not differ significantly from that of *K. integrum*. The phalangeal formula is 2-3-3-3-3 on hands and feet.

Skull (Fig. 3) in general relatively broad, low, robust, and compactly built. Dorsal and ventral aspects: skull tapers abruptly from posterior edge of orbit to snout [a gradual tapering from anterior edge of tympanum to snout]; temporal bars nearly parallel or bowed outward [temporal bars angled forward towards snout, not bowed outward]; snout short, broad, and prominent [relatively longer and narrower]. Lateral aspect: dorsal edge of profile at least slightly convex from rostrum to parietal-supraoccipital suture [slightly concave]; supraoccipital spine relatively short and low, its dorsal edge concave posterior to parietal-supraoccipital suture [spine longer and higher, dorsal edge highest just posterior to suture then angling posteroventrad as a straight or slightly convex blade of bone]; orbit relatively large; posterior edge of postorbital bar lies anterior to posterior edge of *foramen interorbitale* (Gaffney 1972; the descending process of the parietal and the ascending process of the palatine), permitting one to see through a properly oriented skull [postorbital bar posterior to *foramen interorbitale*—no such view possible]; jugal contributing extensively to dorsal free

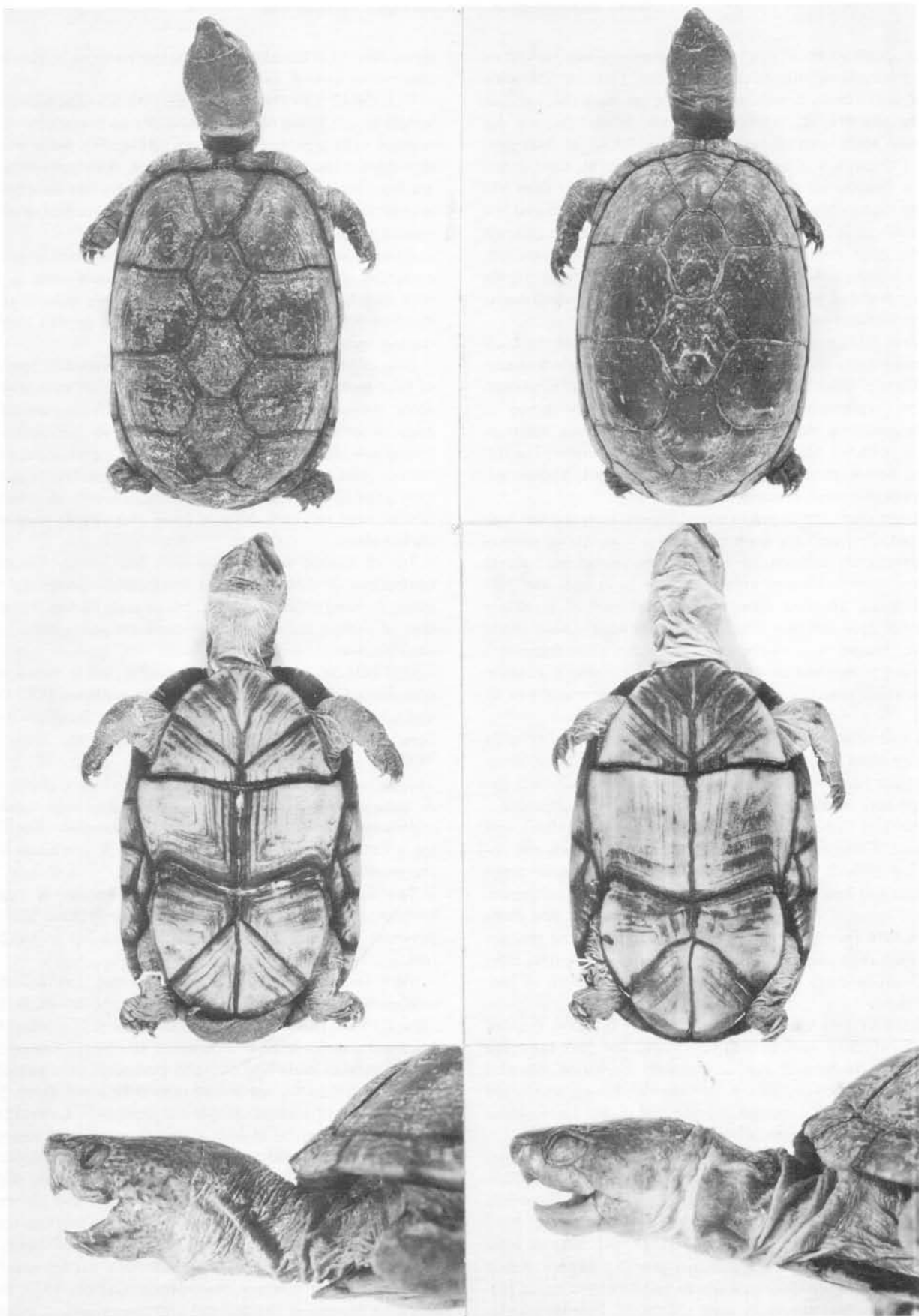


Figure 1. Dorsal, ventral, and lateral head views of *Kinosternon alamosae*, new species. Left column—UU 14279♂ paratype, 0.8 km W of Alamos, Sonora, Mexico; CL, 126 mm. Right column—LACM 127639♀ holotype; Rancho Carrizal, 7.2 km N and 11.5 km W of Alamos, Sonora, Mexico; CL 122 mm.

edge of temporal arch where it is joined by postorbital arch [excluded from free edge or making a small contribution]; posterior tips of squamosals do not project posterior to occipital condyle [project far posterior to condyle].

Surangular bone high and with straight-sided dorsal edge, concealing prearticular in lateral view [emarginate above, prearticular exposed in lateral view]. Dentary crushing surface well developed, equal to or wider than ventral part of mandibular ramus or mandibular symphysis [not as well developed, narrower than ventral part of ramus or symphysis]. Mandibular hook well developed but blunt [sharper]. Maxillary crushing surfaces broad and well developed. Premaxillary beak moderately to strongly developed.

Caudal vertebrae 18 (male) to 20 (female), terminal vertebrae (2 in female, 4 in male) fused to form skeleton of terminal spine. Second cervical vertebra opisthocelous, third biconvex, all others procoelous; sixth and seventh doubled posteriorly, seventh and eighth doubled anteriorly.

Male with six hexagonal neural bones, posteriormost round and lying between sixth costals; female having five hexagonal neurals, the hindmost narrowly contacting sixth costals. First neural separated from nuchal by suture between first costals, the suture greater than one-half the length of first neural. All hexagonal neurals long-sided and tapered anteriorly. Pygal bone nearly square, slightly notched posteriorly. Suprapygals five-sided, partially fused to eighth costals in female. Eight pairs of costals; pairs 1, 6, 7, and 8 in middorsal contact, pairs 2 through 5 separated by neurals. First peripherals in narrow contact with first costals, narrowly separating nuchal from second peripherals.

DISCUSSION

RELATIONSHIPS. The absence of clasping organs on the hind limbs of males of *Kinosternon alamosae* seems clearly to ally it with members of the *K. scorpioides* complex. In Mexico, the other members of the complex are *K. integrum* and *K. scorpioides* (Figs. 4 and 5). The relationships among all members of the *K. scorpioides* complex have been considered in a separate report (Berry 1978). *Kinosternon alamosae* bears a superficial resemblance (general coloration and shell shape) to *K. flavescens*, but we ascribe this to convergent adaptation to temporary aquatic habitats. Tables 1 and 3 summarize the differences and similarities of the three species of the *K. scorpioides* complex in Mexico (see also the taxonomic key). We regard the significant morphological differences between *K. integrum* and *K. alamosae* and the sympatric occurrence of these populations to be sufficient evidence for their distinction as species.

Berry (1978) used multivariate techniques in the analysis of relationships within the *K. scorpioides* species complex and demonstrated that *K. alamosae* is phenetically more similar to *K. integrum* than to any other member of the complex but that the two species are nonetheless phenetically distinct. Berry hypothesized that *K. integrum* had reached the Mexican Plateau via the Río Balsas drainage and had then descended the Río Grande de Santiago drainage and spread northward along the northern Pacific coast of Mexico. It is not clear which species first colonized the region of Alamos or how *K. alamosae* may have gotten there. The two best possibilities are the route suggested by Berry for *K. integrum*, or downstream dispersal from

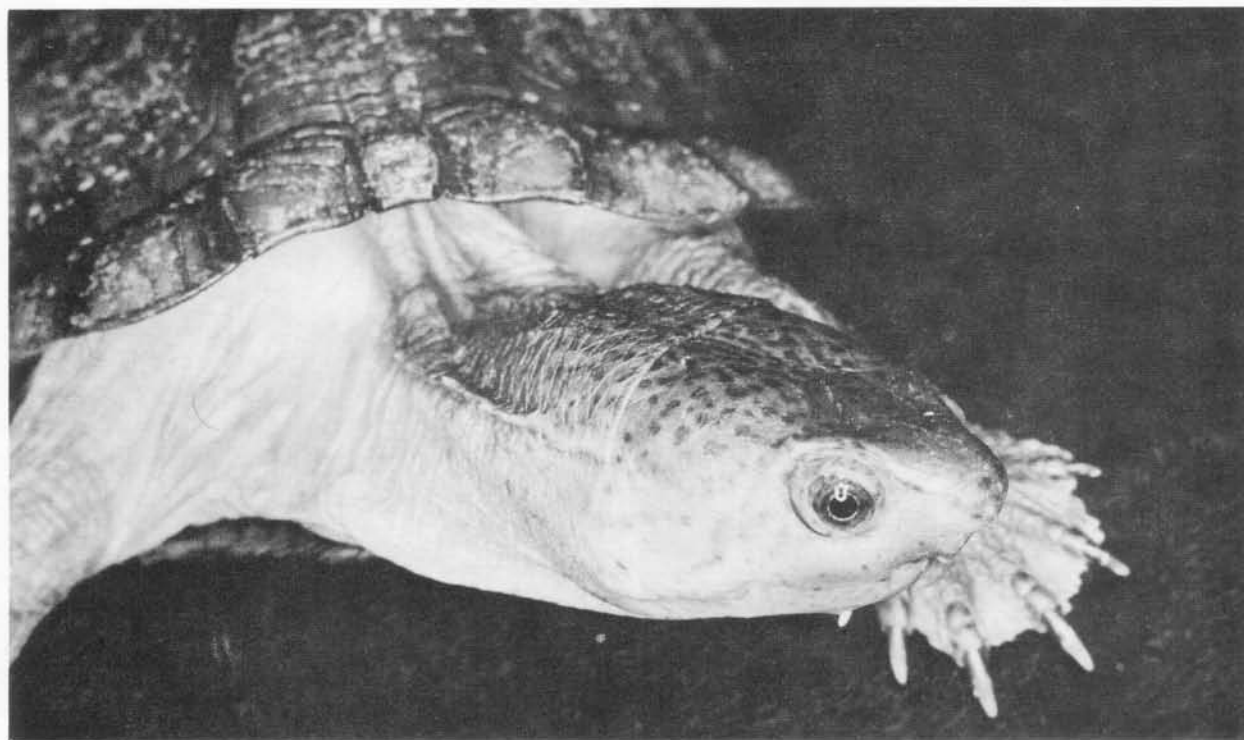


Figure 2. *Kinosternon alamosae*, new species, live adult male; JBI 858, 14.8 mi. W, 1.8 mi. S Alamos, Sonora, Mexico. Width of head 21 mm.

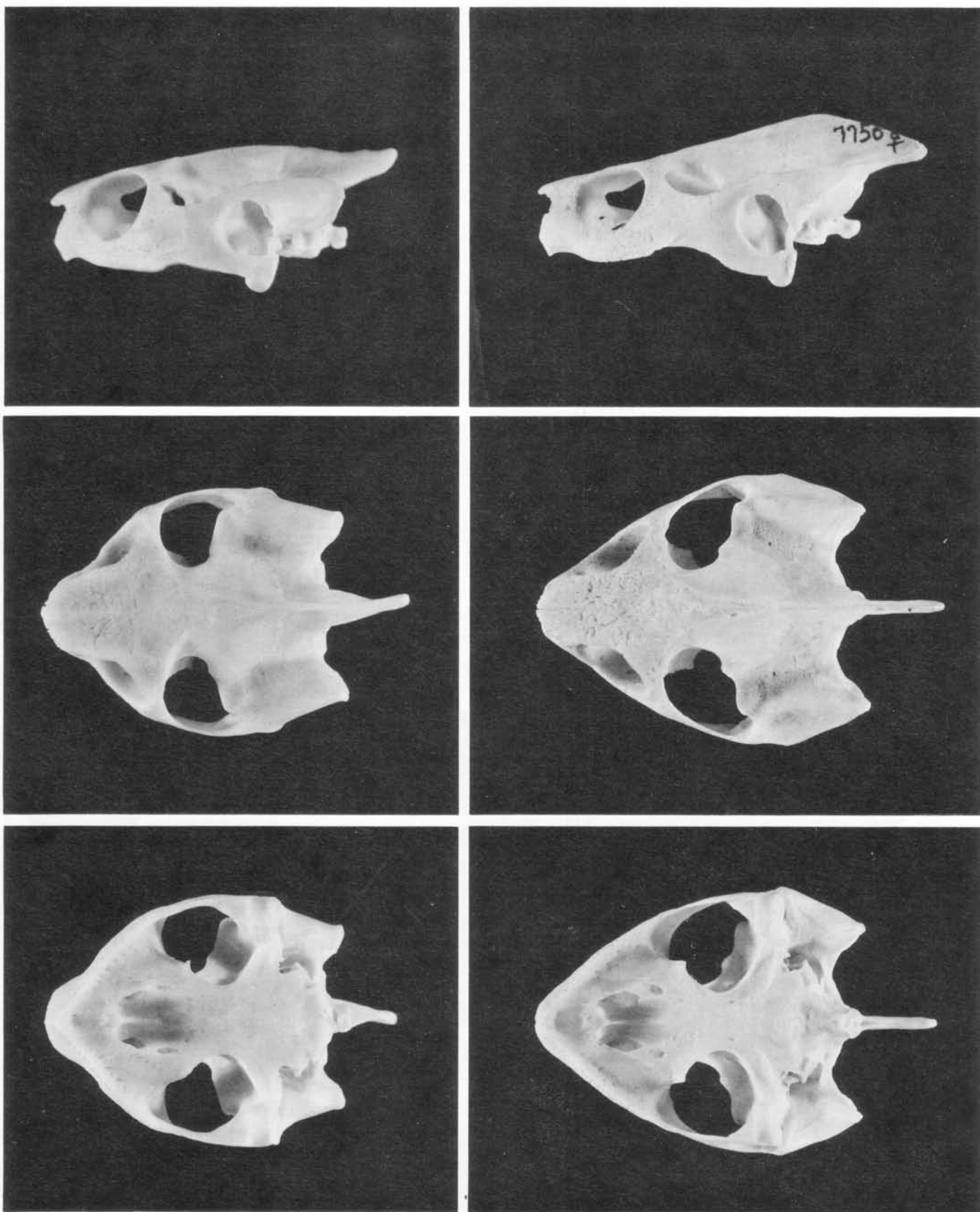


Figure 3. Lateral, dorsal, and ventral views of *Kinosternon* skulls: Left column—*K. alamosae*, new species, UU 14281♀ paratopotype; condylobasilar length 26.2 mm. Right column—*K. integrum* UU 7750♀, Laguna Río Viejo, 2 km N of Eldorado, Sinaloa, Mexico; condylobasilar length 35.3 mm.

Table 2. Skull proportions in *Kinosternon alamosae* (two specimens) and *K. integrum* (ten specimens from Sinaloa and Guerrero). Selected measurements are expressed (means and extremes) as proportions of condylobasilar length (see Figure 3).

	<i>K. integrum</i>		<i>K. alamosae</i>	
	Males (N = 5)	Females (N = 5)	Males (N = 1)	Females (N = 1)
Greatest width	0.80 0.77-0.83	0.80 0.77-0.83	0.78	0.82
Width, maxillary crushing surface	0.15 0.15-0.16	0.15 0.14-0.17	0.17	0.16
Vertical diameter of orbit	0.19 0.19-0.20	0.20 0.19-0.23	0.21	0.23
Width of rostrum	0.25 0.23-0.25	0.24 0.21-0.27	0.27	0.28
Greatest height	0.53 0.50-0.56	0.51 0.47-0.54	0.49	0.50

the headwaters of the Río Yaqui, Río Mayo, or Río Fuerte as suggested for fishes (Meek 1904) and for other freshwater turtles (Legler and Webb 1970). Since no member of the *K. scorpioides* complex presently occurs in the Río Yaqui, Río Mayo, or Río Fuerte on the Mexican Plateau, the former explanation seems more plausible.

We regard *K. alamosae* as a population that has been isolated in the Alamos region for a long period. Wider (undetected) geographic distribution of *K. alamosae* is unlikely since Berry has examined most existing specimens of *Kinosternon* from within the range of *K. integrum*.

TYPE LOCALITY. Data associated with the holotype and paratopotypes are "México, Sonora, Rancho Carrizal, 7 mi. [11.3 km] W Alamos, 9 July 1966, Heringhi." Heringhi (1969) states the following concerning Rancho Carrizal: "27°05'N, 109°13'W, 360 m. A ranch 6 mi. [9.7 km] W Alamos on the Alamos-Navajoa Road; Shorttree Forest." The longitude and latitude stated by Heringhi would place the locality more nearly 29 to 32 km NNW of Alamos. We conclude therefore that Heringhi's coordinates were in error and that he used odometer distances. The NIS Gazetteer for Mexico (1956) lists a village ("popl.") named Carrizal at 27°05'N, 109°03'W, and we regard this as the type locality as it lies approximately 11 km NNW of Alamos by road. The locality is just north of the point where an intermittent tributary of the Río Mayo crosses the main Alamos-Navajoa road ("Agua Marin" *fide* Heringhi 1969). Our statement of the type locality in metric distance from Alamos (7.2 km N and 11.5 km W) is based on all of the above information.

GEOGRAPHIC DISTRIBUTION. *Kinosternon alamosae* is now known from seasonal aquatic habitats on the Pacific Coastal Lowlands of Mexico from the vicinity of Guaymas, Sonora, southward at least to Guasave, Sinaloa (Fig. 6; possibly as far south as Culiacán—see "Other Specimens Examined") at elevations of sea level to slightly higher than 1000 m (in the Sierras de Alamos). The northern limit of the range of *K. alamosae* corresponds to the limit of thorn scrub forest and

to the northern limit of many tropical vertebrates (Stuart 1964).

ECOLOGY. *Kinosternon alamosae* occurs partly within the northern part of the known range of *K. integrum*. The two species are known from the same localities in some cases (e.g., "Alamos," and 8 mi. S of Alamos, Heringhi 1969). It is not known whether the two species ever occur microsympatrically. Legler has worked near Alamos on three occasions. On 21–24 January 1959 and 15–19 June 1961, baited traps set in the Río Cuchujaqui (10 km SE of Alamos, 26°57'N, 108°53'W) caught many specimens of *K. integrum* but no *K. alamosae*. On 19–26 May 1978, conditions were extremely dry near Alamos. The Río Cuchujaqui was barely flowing, and the water was clear enough (visibility 1 to 2 m) for diving. No turtles of any kind were seen at the aforementioned locality nor at a locality farther downstream (26°58'N, 108°51'W). During the 1978 visit, we did locate large concentrations (up to two individuals per square meter of surface area) of *K. integrum* near Alamos in a small (10 by 10 m) spring-fed impoundment in thorn forest, and in a large-mouthed deep well on a ranch. No *K. alamosae* were present in the approximately 100 specimens we examined from these two localities (we were aware of *K. alamosae* at that time and were seeking it). Exploration of the deep mud bottoms (with hands, feet, and seine) of two drying cattle reservoirs produced no turtles.

Heringhi (1969) stated that the two species of *Kinosternon* he collected near Alamos (his "*K. hirtipes*" = *K. alamosae*) "do not separate geographically" but was otherwise vague on the ecological differences (if any) of the two species. In one instance, he obtained *Kinosternon* from the bottom mud of a drying odorous cattle reservoir containing decaying vegetation. Wiewandt et al. (1972) show a photograph of a temporary, wet season pool in thorn forest near Alamos in which "*Kinosternon sonoriense*" were seen mating in July 1969 (there is no other evidence that *K. sonoriense* occurs in that region—the turtles could have been *K. alamosae*).

July, August, and September are the wettest months of the year in the coastal region from Guaymas to Culiacán. All of the specimens of *K. alamosae* known to us were obtained during these months. From these data and from our field observations, it seems likely that *K. alamosae* is active only or mainly in the wet season, occurs chiefly in temporary aquatic habitats, and probably occurs in microsympatry with *K. integrum* only where the latter enters temporary aquatic situations in the wet season.

REPRODUCTION. A female paratype (AMNH 64168) collected "27 Aug.–2 Sept. 1942" contained five oviducal eggs; dimensions of two of these were 25.7 by 16.5 and 27.6 by 16.4 mm. The ovaries bore fresh (but no old) corpora lutea plus five follicles 6 to 11 mm in diameter (mean, 9.4 mm) that were regarded as potentially ovulatory in the same season. The ovaries of another female (UU 14281, paratopotype) collected 9 July 1966 bore five follicles 12 to 13 mm in diameter (mean, 12.2), five follicles 8 mm in diameter, and an additional three follicles of 5 mm diameter. No corpora lutea were visible.

The eggs of *K. alamosae* would rank among the smaller *Kinosternon* eggs listed by Moll and Legler (1971). We hypothesize that follicular development begins when the turtles become active in the early wet season, that at least some females lay more than one clutch per season, and that laying is probably completed by the end of the wet season (Oct to Nov). This

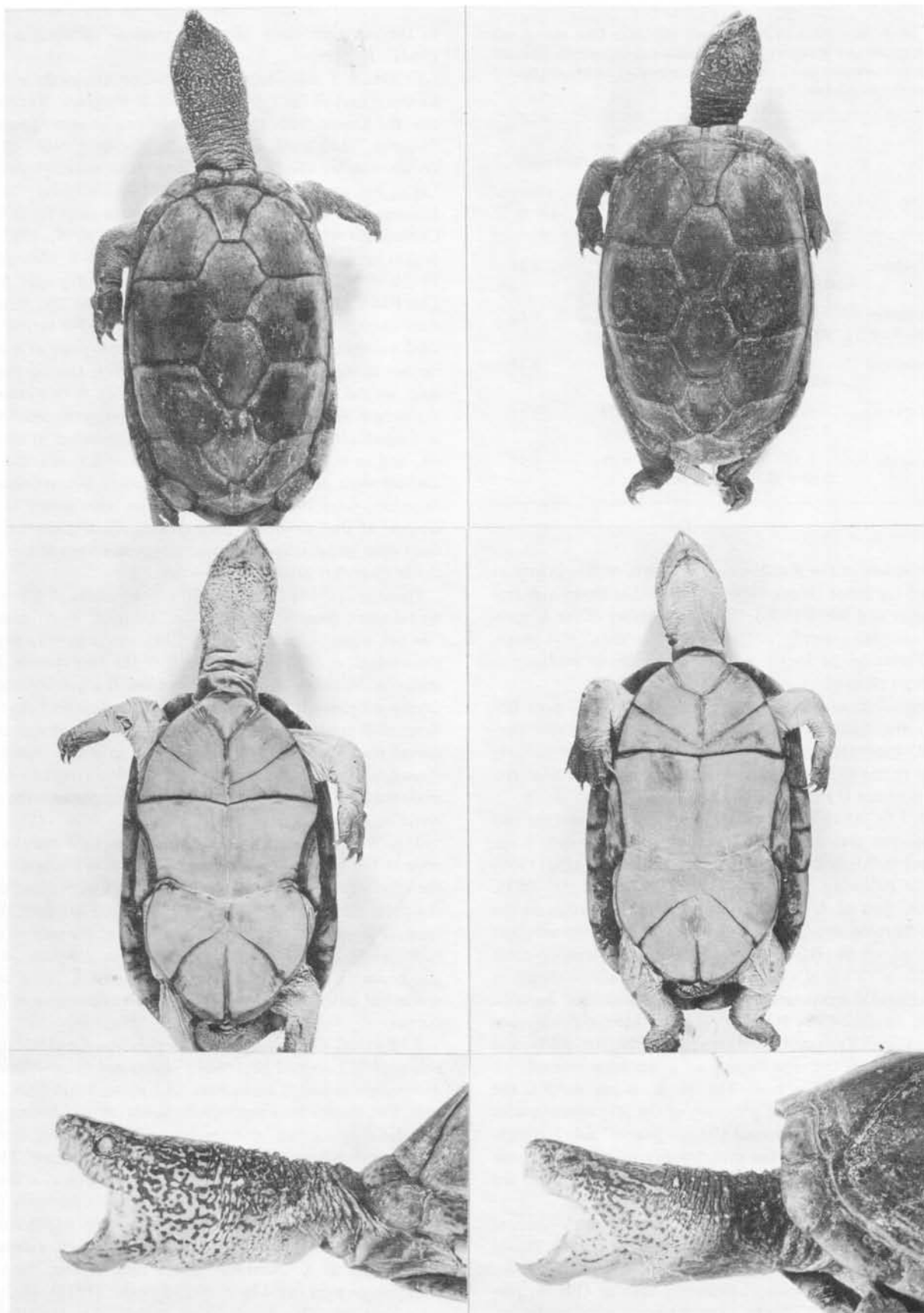


Figure 4. Dorsal, ventral, and lateral head views of *Kinosternon integrum* from Rio San Lorenzo, 17 mi. km ENE of Eldorado, Sinaloa, Mexico. Left column—UU 7778♂, CL 176 mm. Right column—UU 7783♀, CL 163 mm.

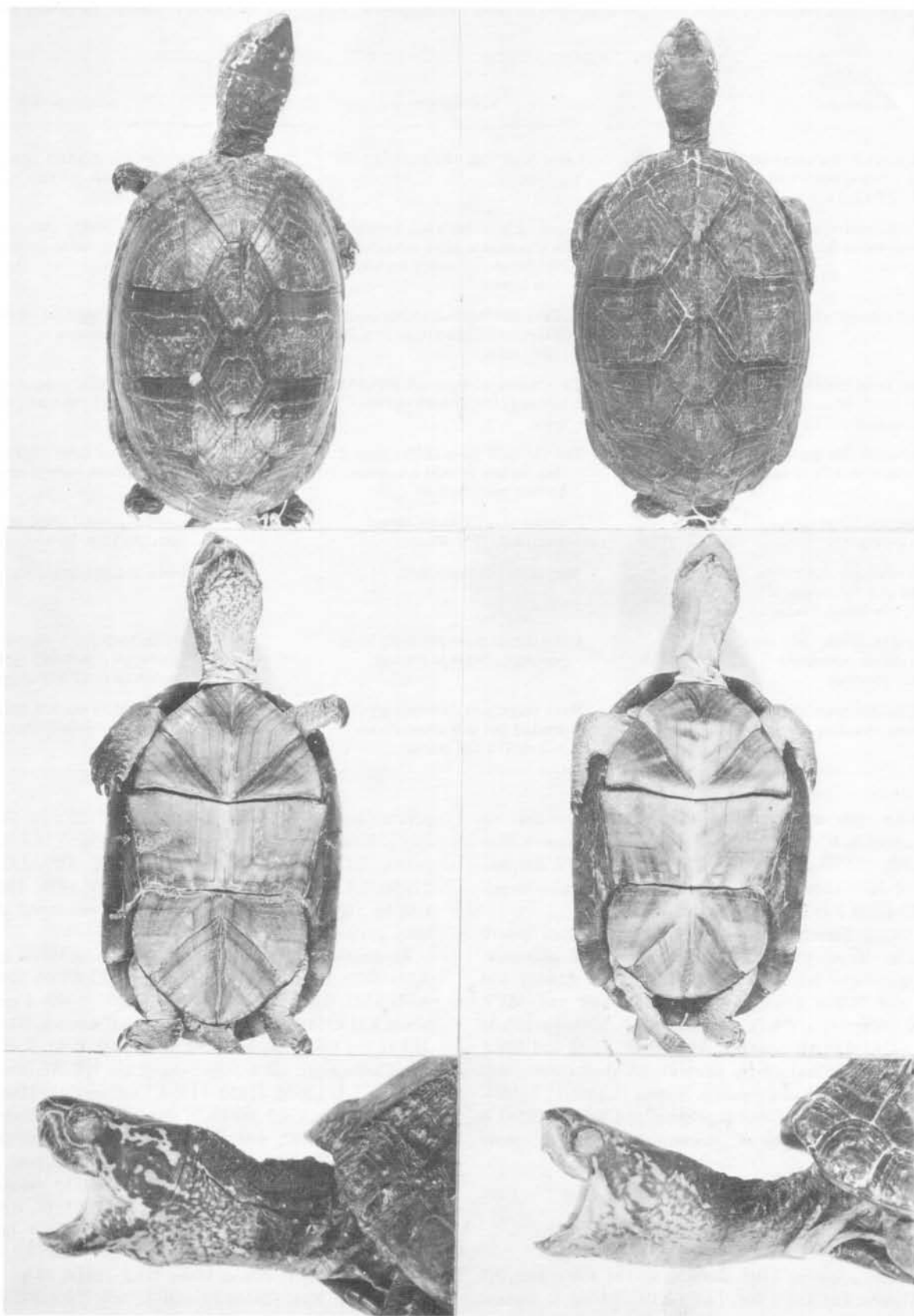


Figure 5. Dorsal, ventral, and lateral head views of *Kinosternon scorpioides cruentatum* from vicinity of Tonalá, Chiapas, Mexico. Left column—UU 7631♂; CL 116 mm. Right column—UU 7633♀; CL 103 mm.

Table 3. Comparison of selected characters in *Kinosternon alamosae*, *K. integrum*, and *K. scorpioides cruentatum*. Values in parentheses are percentages of total specimens examined with the given character. See also Table 1 for proportions, and "Other Specimens Examined" for further information on samples.

<i>K. alamosae</i>	<i>K. integrum</i>	<i>K. scorpioides</i>
Intermediate adult size; carapace length to 135 mm in ♂♂ and 126 mm in ♀♀ (Table 1).	Large adult size, 183 mm ♂♂, 164 mm ♀♀.	Intermediate adult size; 151 mm ♂♂ and 133 mm ♀♀.
Carapace noncarinate, broad, and evenly rounded or flat-topped in cross section.	Carapace tricarinate but keels may be obscured in older individuals. Not broad and evenly rounded in cross section.	Carapace strongly tricarinate, not evenly rounded in cross section.
Axillary and inguinal scutes never in contact.	Axillary and inguinal scutes usually in contact on one (16%) or both (50%) sides.	Axillary and inguinal scutes rarely (2.5%) in contact.
First central scute excluded from (80%) or barely in contact with second marginal (20%).	C1 in substantial contact with M2 on one (11%) or both (66%) sides.	C1 in substantial contact with M2 on one (25%) or both (45%) sides.
One pair of small chin barbels; barbels absent in 13% of sample.	Two (35%) or three (60%) pairs of chin barbels in most specimens; barbels never lacking.	Two (30%) or three (70%) pairs of chin barbels; barbels never lacking.
Posterior plastral hinge curved posteriorly (Fig. 1).	Posterior plastral hinge curved posteriorly (Fig. 4).	Posterior plastral hinge nearly straight (Fig. 5).
Anal scute relatively short when expressed as a percentage of posterior lobe length (Table 1).	Anal scute relatively long.	Anal scute relatively long.
Interpectoral seam relatively short; humerals never completely separating pectorals.	Interpectoral seam relatively long; pectorals always in contact.	Interpectoral seam relatively short; humerals completely separating pectorals in 21% of sample.
Head dull, neither contrastingly marked nor including red and orange.	Head bright and contrastingly marked but pale colors do not include red and orange.	Head brightly marked, pale colors are usually yellow, orange or red.

reproductive cycle does not differ substantially from that we have observed in a few *K. integrum* (UU 7808, Guasave, Sinaloa, 20 July 1965—gravid; ASU 6077 and UU 7677, Alamos, Sonora, 16 June 1966 and 17 June 1961, respectively—developing follicles in 5 to 10 mm class).

REMARKS. Several collections of *Kinosternon* from Sonora identified as "*K. integrum*" include specimens of *K. alamosae*. Of the specimens listed by Bogert and Oliver (1945) and Zweifel and Norris (1955), AMNH 64163-68 and MVZ 50907-10 (Alamos) are here identified as *K. alamosae*, while AMNH 64161-62 (Alamos) and AMNH 63755-58 and MVZ 50889-902 (Guirocoba) are *K. integrum*. A shell lacking soft parts from 23.7 km S of Empalme, Sonora (UIMNH 24456), identified as *K. integrum* by Langebartel and Smith (1954) is tentatively identified as *K. alamosae* based on scute proportions.

OTHER SPECIMENS EXAMINED

Kinosternon alamosae (10). SONORA: JBI 859♀ live, 3.5 mi. W Alamos; JBI 858♂ live, 14.8 mi. W, 1.8 mi. S Alamos [JBI 858-9 will ultimately be deposited in the Florida State Museum, Gainesville]; UAZ 31741♂, ca. 23 mi. E (by road) Navojoa; UAZ 39889♂, 7.6 mi. NE (by road to Tezapaco) Es-

peranza (ca. 27°40'N, 109°55'W); UC 35122♂ im, San Carlos Bay [27°56'N, 111°04'W]; UIMNH 24456♂, 14.7 mi. S Empalme; UC 16145♂, 28 mi. S Navojoa. SINALOA: UAZ 27956, 7.4 mi. S Guasave (by road) [25°34'N, 108°27'W]; LACM 105396-97, "Culiacán" (locality incorrect *vide* R.L. Bezy, personal communication).

Kinosternon integrum (292). SONORA: AMNH 64161-62, ASU 6075, UU 7677, 11855, Alamos [27°01'N, 108°56'W]; ASU 6545, 0.8 mi. S Alamos; ASU 6077, 6107, 4 mi. SE Alamos; KU 47589-90, 47592-94, 9 mi. SE Alamos, Río Alamos; JBI 862, 1 km E Alamos; LACM 105406, 8 mi. SSE Alamos, Río Cuchujaqui; UAZ 39892, ca. 2 mi. NE Alamos Church, Alamos; UU 11678, 11852, 11854, La Casa de la Huerta, Sierras de Alamos; UAZ 36480, N slope Sierras de Alamos; MVZ 28937, 50889-902, AMNH 63755-57, Guirocoba [26°53'N, 108°41'W]; LACM 75350, Barranca del Cobre, 2 km E Guirocoba; LACM 105402, UAZ 38189-90, La Aduana; UAZ 38705-6, mine, ¼ mi. NW La Aduana [27°03'N, 109°01'W]; UNM 5787, UAZ 28015, 28019, 28022-23, ½ mi. N La Aduana; UNM 14492, abandoned mine nr. La Aduana; UMMZ 79514, nr. Pilares Mine; UAZ 38864, 20 mi. by rd. to Yécora, NE Nuri [28°02'N, 109°22'W]; UAZ 39890, 12 mi. (by rd.) SW Santa Ana de Yécora; UAZ 28008-9, 10.5 mi. W (by rd.) Rosario [27°59'N, 109°20'W]. SINALOA: KU 63637-46, 3 mi. NE San Miguel [25°56'N, 109°03'W], Río

del Fuerte; KU 80772-73, 13 km NNE Vaca; AMNH 82142, Guasave, Río Sinaloa; UU 7786-7818, 12 mi. NE Guasave, trib. Río Sinaloa; UMMZ 122242, trib. Río Bacaburito, Río Sinaloa ca. 13 mi. NE Palmar; LACM 75351, La Huerta, Río Mocorito; UMMZ 122235-39, 0.9 mi. N San Benito, trib. Río Mocorito; UAZ 36511, Rancho los Pocitos, 14.2 mi. WNW Pericos Jct.; AMNH 82143, LACM 105394-95, Culiacán [24°48'N, 107°24'W]; LACM 105393, 5.5 mi. N Culiacán; UMMZ 121922, 7.6 mi. N Culiacán; UU 3799-3800, 11 mi. NW Culiacán; KU 45398, Eldorado [24°17'N, 107°21'W]; UU 7678-7774, 13007-8, 2 km N Eldorado, Laguna Río Viejo; UU 7775-85, 17 mi. ENE Eldorado, Río San Lorenzo; KU 63633-36, 1 mi. SE Camino. CHIHUAHUA: UAZ 28238, Milpillas [27°13'N, 108°38'W]; UAZ 28141-74, vic. Milpillas; UAZ 39893-94, 1.5 mi. (by rd. to San Antonio) SW Milpillas.

Kinosternon scorpioides cruentatum (78). OAXACA: UMMZ 118633-34, USNM 109106-23, Tehuantepec [16°20'N, 95°14'W]; UMMZ 82226-35, vic. Tehuantepec; UMMZ 82183-224, Tehuantepec, Tehuantepec R.; UMMZ 82225, 12 km NW Tehuantepec; UMMZ 82238, Nisa Pipi, 8 km NW Tehuantepec; UMMZ 82236-37, "5 leagues" [ca. 20 km] S Tehuantepec, Rancheria Lamanga; USNM 113278, San Mateo del Mar [16°12'N, 95°00'W]; UU 7950, 12 mi. NE Juchitan [16°26'N, 95°01'W].

KEY TO THE SPECIES OF *KINOSTERNON* OF SONORA, SINALOA, AND CHIHUAHUA, MEXICO

The following key is applicable only to adults or individuals longer than 90 mm.

1. Marginal scute 9 distinctly higher than M8, about same height as M10, forming a distinct peak where it meets seam between laterals 3 and 4; head shield consisting of crescent over each orbit, joined or not joined to shield on rostrum

. *K. flavescens*

Marginal scute 9 approximately same height as M8, much lower than M10, not distinctly peaked where it meets seam between laterals 3 and 4; head shield V-shaped, rhomboidal, or with trilobate posterior margin; all parts of head shield interconnected 2

2. Adult males with discrete clasping organs on posterior thigh and leg (opposed patches of horny scales); bridge relatively short in both sexes (less than 25 percent of carapace length in 93 percent of sample); known distribution at higher elevations east of continental divide or north of Guaymas on coastal plain. 3

Adult males lacking discrete clasping organs on posterior leg and thigh; bridge relatively long in both sexes (greater than 25 percent of carapace length in 96 percent of sample); known distribution at lower elevations west of continental divide from Guaymas southward 4

3. Head shield deeply notched posteriorly (V-shaped); usually three pairs of relatively short chin barbels (longest barbel less than one-half the vertical diameter of orbit); male plastron relatively narrow (midfemoral width less than 60 percent of carapace width at same level, anterior hinge width less than 65 percent of carapace width at same level); first neural not in

contact with nuchal (96 percent of sample, see "Methods and Materials") *K. hirtipes*

Head shield triangular or rhomboidal, straight-sided or with a single lobe posteriorly; usually 3 to 4 pairs of relatively long chin barbels (length of at least one pair greater than one-half the vertical diameter of orbit); male plastron relatively extensive (midfemoral width greater than 60 percent of carapace width at same level, anterior hinge width greater than 65 percent of carapace width at same level); first neural usually in contact with nuchal (73 percent of sample, see "Methods and Materials") *K. sonoriense*

4. Inguinal and axillary scutes in contact on at least one side (66 percent of sample); inguinals extending anteriorly beyond seam between marginals 5 and 6; first central scute wide, in contact with marginal 2 on one or both sides (80 percent of sample); at least two pairs of well-developed chin barbels

. *K. integrum*

Inguinal and axillary scutes never in contact; inguinals not extending anteriorly beyond seam between marginals 5 and 6; first central scute narrow, never in contact with marginal 2 (in contact with seam between M1 and M2 in 20 percent of sample); barbels lacking or wartlike and inconspicuous

. *K. alamosae*

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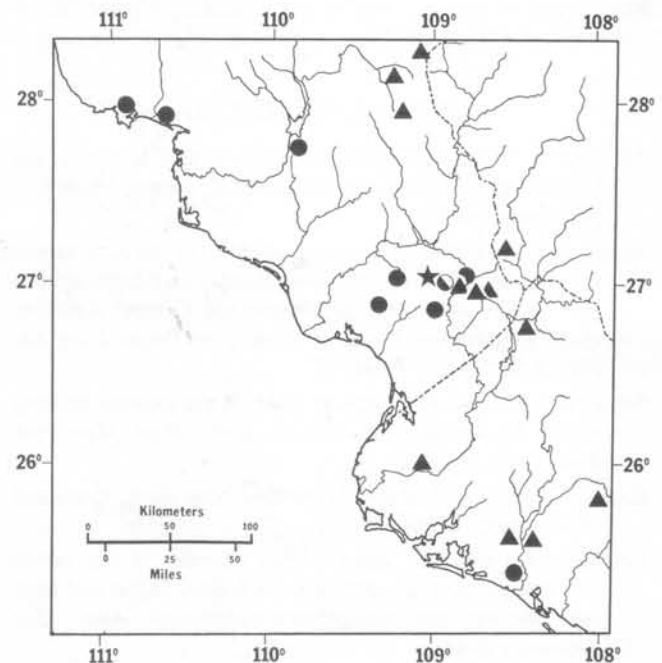


Figure 6. Geographic ranges of *Kinosternon alamosae* (dots) and *K. integrum* (triangles) in northwestern Mexico. Star is type locality of *K. alamosae*; half circle is locality at which sympatry occurs.

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RESUMEN

Una especie nueva de casquito, *Kinosternon alamosae*, es descrita del sur de Sonora y del norte de Sinaloa, México. La especie es miembro del complejo *K. scorpioides* (machos faltando órganos abrazadores) y es en parte simpátrica con otros *Kinosternon* la cual se diferencia por su carapacho redondo, axila y escudos inguinal anchamente separados, primera escuda central angosta, y barbilla reducida. *Kinosternon alamosae* se conoce en la región pacífica costal de Guaymas, Sonora hacia el sur por lo menos hasta Guasave, Sinaloa, de elevaciones de nivel de mar hasta 1000 metros. La especie parece ocurrir en hábitats acuáticos temporales; todos los ejemplares existentes fueron obtenidos durante la temporada de lluvia en los meses de julio, agosto, y septiembre. Desarrollo folicular y puesta de huevos coincide con la temporada de lluvia. Una llave dicotómica se presenta para la identificación de adultos de *Kinosternon* en Sonora, Sinaloa, y Chihuahua, México (*K. alamosae*, *K. flavescens*, *K. hirtipes*, *K. integrum*, y *K. sonoriense*).

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