

A NEW SPECIES OF *STERNOTHERUS* WITH A DISCUSSION
OF THE *STERNOTHERUS CARINATUS* COMPLEX

(CHELONIA, KINOSTERNIDAE)

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Tulane University field crews under the supervision of Dr. Fred R. Cagle and supported by a grant from the National Science Foundation have done much to clarify the status of turtle populations in the rivers of the north Gulf coast (Cagle, 1952, 1953, 1954).

The collecting techniques developed, such as that described by Chaney and Smith (1950), made possible the procurement of samples of *Sternotherus* from the major rivers along the Gulf coastal plain. These samples revealed the presence of an undescribed species in the upper reaches of the Black Warrior river above the Fall Line in Alabama which is defined and named herewith.

The authors are indebted to Dr. Cagle for the opportunity provided of serving with the field crews; to Dr. Hobart M. Smith of the University of Illinois for examining selected specimens; to Dr. William B. Davis of Texas A. & M. College for making available the holotype of *Sternotherus peltifer* and other material; to Dr. Wilfred T. Neill of the Ross Allen Reptile Institute, Dr. Albert Schwartz of the Charleston Museum and Dr. Ralph L. Chermock of the University of Alabama for the loan of material; and to Mrs. Roger Conant and Mrs. Fred R. Cagle for photographs. We are grateful, also, to the many students who worked with us in the field for their contribution of time and ideas. The name for the new species was suggested by Dr. E. S. Hathaway, emeritus professor of Zoology at Tulane University.

Sizes referred to in the text are plastra lengths measured along the median longitudinal suture to the nearest tenth of a millimeter with a Vernier caliper. Sex in all Tulane (TU) specimens was determined by dissection.

STERNOTHERUS DEPRESSUS, sp. nov.

Holotype.—Tulane University number 16171, immature male, taken in the Mulberry Fork of the Black Warrior river, 9 miles east of Jasper, Walker County, Alabama, near the bridge crossing of U.S. highway 78, August 11-12, 1953, by Robert G. Webb and Donald W. Tinkle.

Paratypes.—Tulane University numbers 15902 (12) and 16062 (10) and Museum of Comparative Zoology number 54023, 18 females and five males collected at the type locality in June and August, 1953; University of Alabama 52-1065, 8 miles south of Carbon Hill, Walker County, Alabama, June 14, 1952, by H. Boschung and L. Cooper.

This latter paratype is the only adult specimen of the new species known to us. Twenty-five types and seven topotypes comprise the hypodigm.

Type locality.—A sluggish tributary of the Black Warrior river. All specimens taken at night, except one, by trapping or hand collecting from crevices in submerged stumps and in detritus along the shore.

Diagnosis and definition.—A species possessing a round, low carapace with flared marginals; obtuse vertebral angle; and a reticulated pattern of lines on the dorsum of the head. Adult with flat carapace, arched at the sides. Related to *Sternotherus carinatus* in having imbricate carapace shields, by absence of light stripes on the head and neck, absence of barbels on the neck, and lack of lateral keels in juveniles. These characters distinguish *S. carinatus* and *S. depressus* from *S. odoratus*. Differing from *S. c. carinatus* by lacking a high vertebral keel, absence of spots on the head, and presence of a gular scute. Differing from *S. c. peltifer* by lacking dark stripes on the sides of the head and neck, by having a flatter carapace with a larger ratio between vertebral angle and carapace height. Differing from *S. c. minor* by absence of lateral ridge, by a low carapace in adults which is flat on top, and by the presence of a reticulated pattern on the head.

Description of holotype.—Male; plastron length, 36.8 mm; maximum carapace length (straight line), 59.9 mm; carapace height from abdominals to juncture of second and third vertebrae, 18.5 mm; carapace width at juncture of sixth and seventh marginals, 52 mm; maximum head width, 12.6 mm; length of abdominal from axillary to inguinal periphery, 8.0 mm; interhumeral suture, 5.8 mm; interpectoral suture, 4.4 mm; interabdominal suture, 7.9 mm; interfemoral suture, 4.0 mm; interanal suture, 11.3 mm; length of mandibular symphysis, 6.0 mm; angle of keel at juncture of second and third vertebrae, 133° . Eleven marginals, the last two higher than any of the first nine. All vertebrae except first wider than long. Each carapace shield with dark streaks on a gray-green background. Center of each marginal with a radial light line distinct against the cloudy ground color. Plastron immaculate; gular scute single and small. Neck with seven broken, irregular thin lines on the dorsal and dorsolateral surfaces. Head pattern of fine, reticulated, and dark lines on a yellow-green ground color. The anterior surfaces of forelegs and posterior surfaces of hind legs with similar reticulate pattern. Tail with eight irregular dark lines converging distally. Horny beak of upper jaw with numerous, tangentially arranged, dark markings. Two chin barbels; no neck barbels.

Description of paratypes.—Measurements of the smallest and largest of the topotypes are: plastron length, 18.7 and 36.4 mm; maximum carapace length, 33.4 and 53.4 mm; carapace height, 9.5 and 16.8 mm; carapace width 31.3 and 50.0 mm; head width, 7.3 and 11.8 mm; abdominal length, 3.3 and 8.2 mm. Measurements other than plastron lengths do not necessarily reflect the maximum in these topotypes.

The elevation of the tenth and eleventh marginals above the preceding ones is more distinct in larger individuals. The dark markings on the carapace may be radiating lines, spots or small blotches. The markings are reduced in some turtles, but never absent. The plastra are usually covered with a brown deposit of environmental origin which must be removed to reveal the immaculate scutes. The gular is variable in size and unpaired.

Dark lines on the neck vary from five to 18, depending partially upon which are considered lines and which rows of tiny, sometimes united spots. The reticulated arrangement of dark lines on a light background gives the head a dendritic pattern, which is also present on the limbs. Dark tangential marks are universal on the beaks of both jaws. Dark lines present on the tail.

The vertebral angle was measured with aluminum wire (1.2 mm diameter) which was bent around the keel of the carapace at the juncture of the second and third vertebrae. The angle formed was traced on paper and measured with a protractor. This method is a slight modification of that reported by Mosimann (1955). The variation in this angle was 113° to 132° . The size of the angle is generally directly correlated with the size of the turtle. The inherent error for measurements of *S. c. carinatus* and *S. depressus*, the forms representing the extremes of size of the angle, was two to four (mean 2.44 degrees) for the former and four to six (mean 4.75 degrees) for the latter. The error for the other forms presumably lies between these extremes.

The adult paratype must be given special consideration. Its color pattern is identical with that of the holotype. The carapace is low, but flat and is arched at the sides, unlike any of the topotypes. Its combination of characters sets this turtle apart from adults of any other form in the *Sternotherus carinatus* complex. Measurements are as follows: plastron length, 55.8 mm; carapace length, 89.4 mm; carapace height, 26.7 mm; carapace width, 60.4 mm; interhumeral suture, 6.2 mm; interpectoral suture, 10.6 mm; interabdominal suture, 16.1 mm; interfemoral suture, 6.8 mm; interanal suture, 14.2 mm.

Little variation of the differentiating characters exists in the paratype series. All are similar to the holotype in general appearance, pattern and proportions.

Range.—This species has been taken only from a two mile length of the Mulberry Fork of the Black Warrior river in the vicinity of the type locality, and from a stream in the Black Warrior drainage, eight miles south of Carbon Hill. Both localities are in Walker County, Alabama, above the fall line. *Sternotherus depressus* is undoubtedly more widespread, and should be expected in Tennessee, particularly in the drainage of the Tennessee River. Its known distribution presents a geographic puzzle. Collections made in the Black Warrior river in Greene and Tuscaloosa counties, Alabama, contain only *S. c. peltifer* which has not been found in the Black Warrior above the fall line where *S. depressus* occurs. In the Coosa river of

TABLE 1.
COMPARISON OF THE FORMS IN THE *Sternotherus carinatus* COMPLEX.

Character	<i>depressus</i>	<i>peltifer</i>	<i>minor</i>	<i>carinatus</i>
Gular scute	present	present	present	absent
Stripes on head and neck	If present, narrow	wide and distinct	absent in most	never present
Carapace angle	Wide in all; always greater than 100°	narrow in juveniles; increasing with age. Less than 100° in juveniles	as in <i>peltifer</i>	Narrow in all; less than 100° in all, less than 45 mm carapace height
Angle/height ratio	Mean about 9.5 in juv.	Mean about 5.0 for those with keel	as in <i>peltifer</i>	Mean about 4.0 for those with keel
Carapace shape and arching	Circular in outline; adult with arched sides but flat top	Less circular. Sides arched, but not flat on top	as in <i>peltifer</i>	Less circular; some arching in old individuals, but high keeled usually retained
Keels	None sharp; mid-dorsal present and blunt	1 distinct in juveniles, none in adult	3 in juv., none in adult	1 distinct in all
Pattern on dorsum of head	Reticulated pattern of fine lines	Usually spotted; a few reticulated posteriorly	Usually spotted; in some, spots coalesced into blotches	always small spots
Range	Northern Alabama and probably Tennessee	Alabama, Miss., and W. Florida	Fla. and Ga., possibly E. Alabama	East central Texas to eastern Miss.

eastern Alabama, *S. c. peltifer* occurs above the fall line and *S. depressus* is absent.

Comparisons (Table 1).—*Sternotherus depressus* is an unusual turtle. The low carapace with flaring marginals gives the turtle the appearance of being dorsoventrally flattened, whence the specific name (fig. 1-4). The characteristic depression of the carapace has been placed on a quantitative basis by calculation of the ratio of carapace angle to carapace height. *Sternotherus depressus*, at least the juveniles, are strikingly different in this character from other members of the *Sternotherus carinatus* complex (fig. 7).

Another distinctive feature of young *S. depressus* is the shape of the carapace in outline as seen from dorsal aspect. The shape more closely approaches the form of a circle than does that of any other members of the genus. A ratio of carapace-length/carapace-width expresses this characteristic and demonstrates the differences in this character between the members of the *Sternotherus carinatus* complex (fig. 8).

The general shape of the carapace in cross section is important in distinguishing among juveniles in the *S. carinatus* complex (fig. 9). Though distinct in some features, *Sternotherus depressus* is most closely allied to *S. c. peltifer* in general appearance and totality of characters.

Discussion.—Allopatric populations with some resemblances are usually considered to be subspecifically related. However, in this instance, the striking differences of *S. depressus* and the lack of evidence of intergradation make the elevation of this form to specific rank a more conservative procedure. *Sternotherus depressus* is almost as different in its peculiar characteristics from *S. carinatus* and *S. odoratus* as the latter two are from one another. Further knowledge

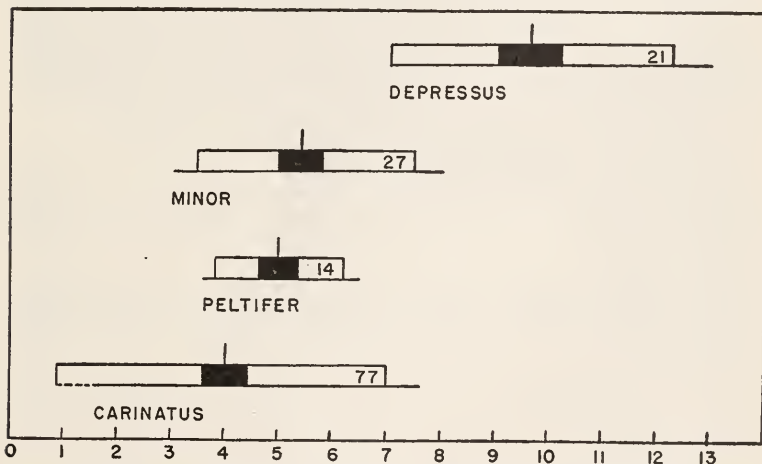


Figure 7. Comparison of carapace-angle/carapace-height ratios. Block diagram shows mean, two standard errors and two standard deviations.

of distribution and variation of *S. depressus*, as well as other members of the complex, may alter this tentative conclusion.

The turtles referred to as *Sternotherus carinatus peltifer* fit the description of that form given by Smith and Glass (1947). We have compared our specimens with the holotype in the Texas Cooperative Wildlife Collection of Texas A. & M. College. This form was described as *Sternotherus peltifer*. Carr (1952) referred it to conspecificity with *S. carinatus*.

Because *S. c. peltifer* is most closely related to *S. depressus* a re-description of the former is needed in order to evaluate its status and understand its relationships within the *Sternotherus carinatus* complex. We have available 24 specimens from which the following description was made.

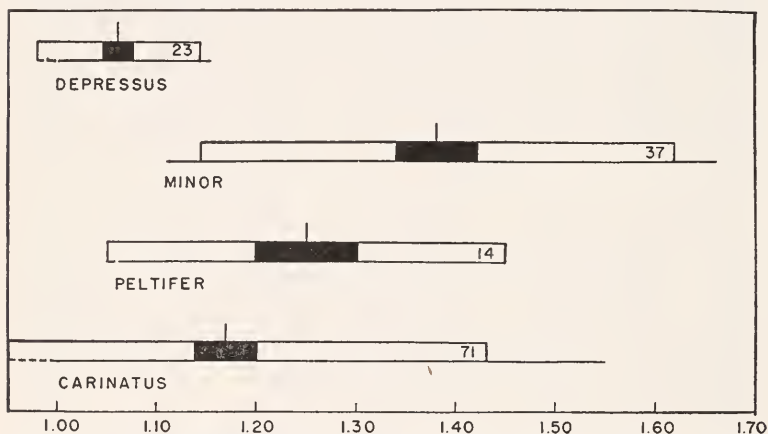


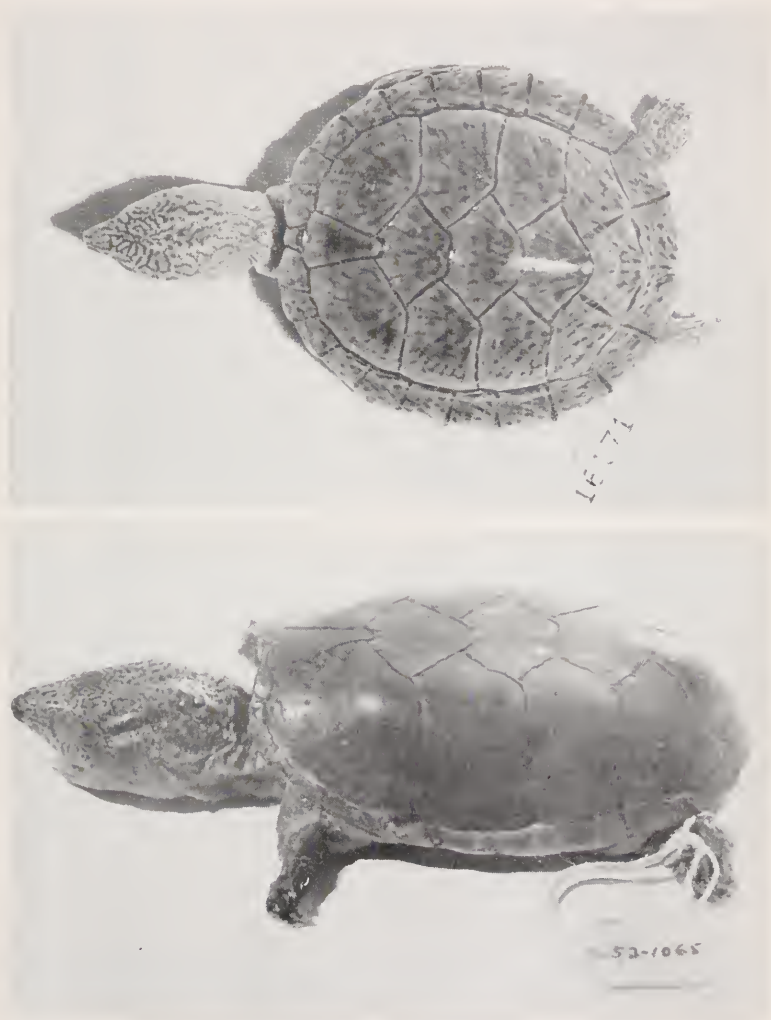
Figure 8. Comparison of carapace-length/carapace-width ratios. Block diagram shows means, two standard errors and two standard deviations.

STATUS OF *Sternotherus c. peltifer* SMITH AND GLASS

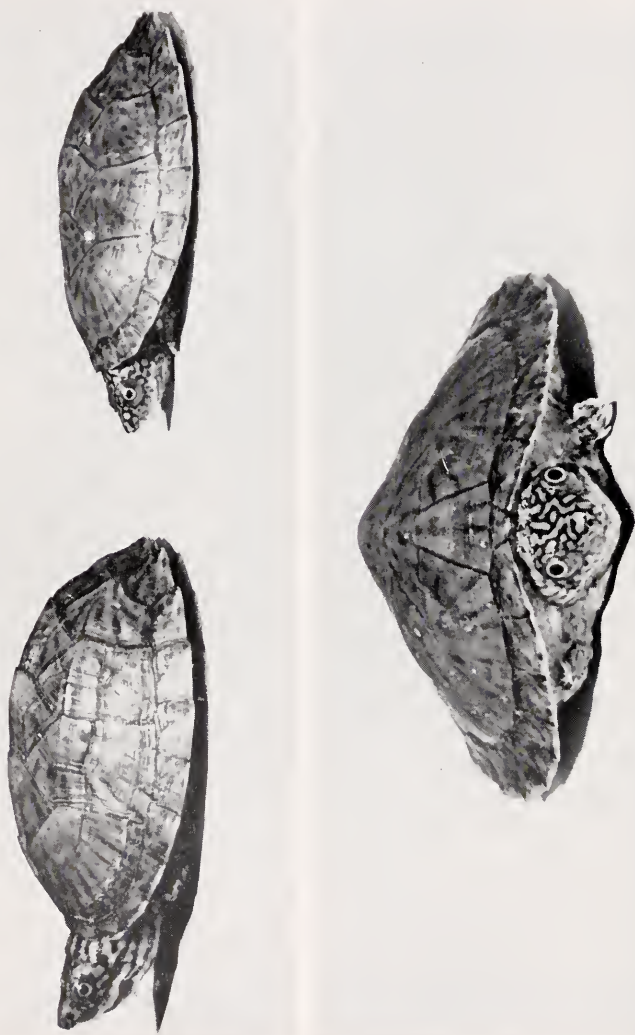
The holotype is similar in every detail to our specimens. Four of the latter are from the Coosa River above the fall line in Alabama, and the remainder from the Alabama and Black Warrior rivers below the Fall Line.

The character of size of the axillary and inguinal scutes used by Smith and Glass (1947) holds for all specimens, *i.e.*, in each these scutes are small and longer than broad. This character is of no value in differentiating *S. c. peltifer* and *S. depressus*. The striping on the sides of the head and neck is the best character for distinguishing *S. c. peltifer* from the majority of individuals of other forms in the complex (fig. 5-6). This striping occurs in occasional specimens of *S. c. minor*, but not to the extent characteristic of *S. c. peltifer*.

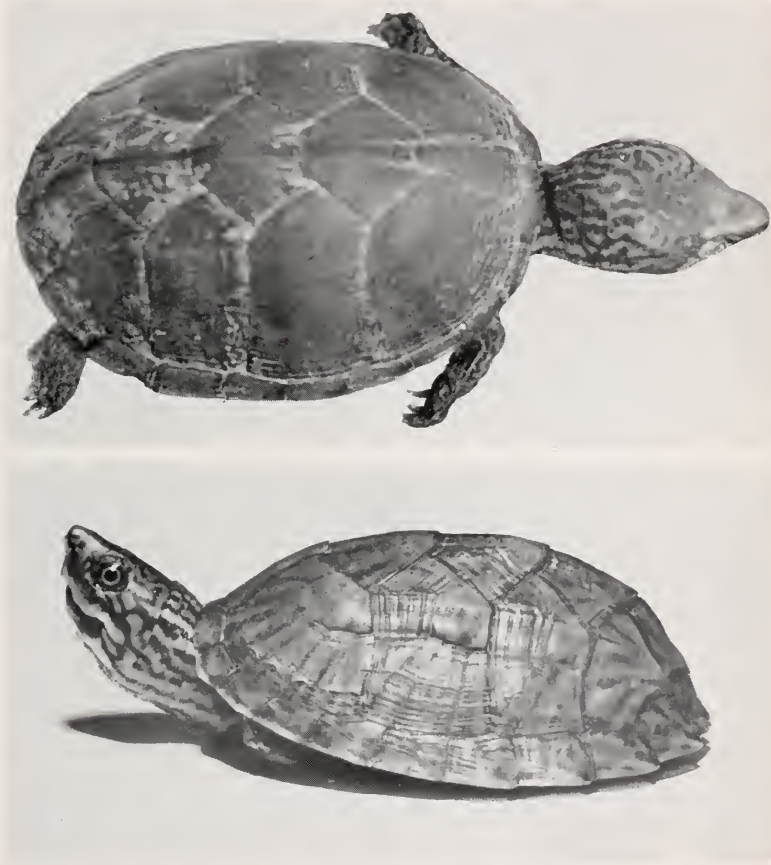
The second, third and fourth vertebrae are broader than long in all individuals. This is true generally also of *S. depressus*. The length



Figures 1-2. 1. (top) Holotype of *Sternotherus depressus* 2. (bottom) Adult paratype of *Sternotherus depressus* (Photographs by Mrs. Fred R. Cagle).



Figures 3-4. 3. (top) *Sternotherus carinatus peltifer* and *S. depressus*. Juveniles of approximately same size 4. (bottom) Front view of *S. depressus* showing flared marginals (Photographs by Isabelle Hunt Conant).



Figures 5-6. 5. (top) Holotype of *Sternotherus carinatus peltifer* (Photograph by R. G. Webb) 6. (bottom) Juvenile *S. c. peltifer* from Black Warrior River, Tuscaloosa County, Alabama (Photograph by Isabelle Hunt Conant).

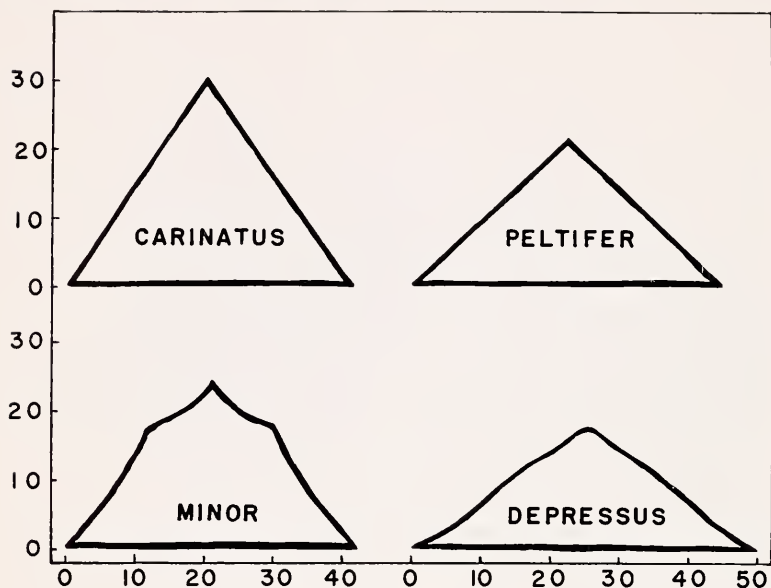


Figure 9. Relative carapace shapes of juvenile representatives of each member of the *Sternotherus carinatus* complex. Height is shown on ordinate and width on abscissa. All specimens are of the same plastron length.

of the median humeral suture is too variable to be of any diagnostic value. In general appearance, *S. c. peltifer* is most similar to *S. c. carinatus* because of the prominent median dorsal keel. This keel is never as high nor sharp as in the latter, and is completely lost in older individuals of *S. c. peltifer* which developed the arched carapace characteristic of *S. c. minor*. Lateral keels are absent, but in small individuals faint ridges are present on some of the costal shields. The carapace pattern is of dark lines on each shield radiating from the postero-dorsal corner. The plastra are immaculate.

The dorsal surface of the head in all individuals below the Black Belt (Chermock, 1952) is marked with small dark spots which are sparse or absent in the nasal region. These spots predominate also in individuals above the Black Belt, but fusion of the spots and development of a partially reticulated pattern (like *S. depressus*) occurs in a few individuals.

The gular is unpaired in all except one individual which lacks this scute. Two chin barbels are present; no barbels present on the neck. The ventral surface of the neck is well marked, but the pattern is variable from distinct longitudinal stripes to a reticulate or diffuse pattern of spots.

In summary, *S. c. peltifer* is a musk turtle with a distinct middorsal keel which becomes reduced with increasing age; with no lateral keels;

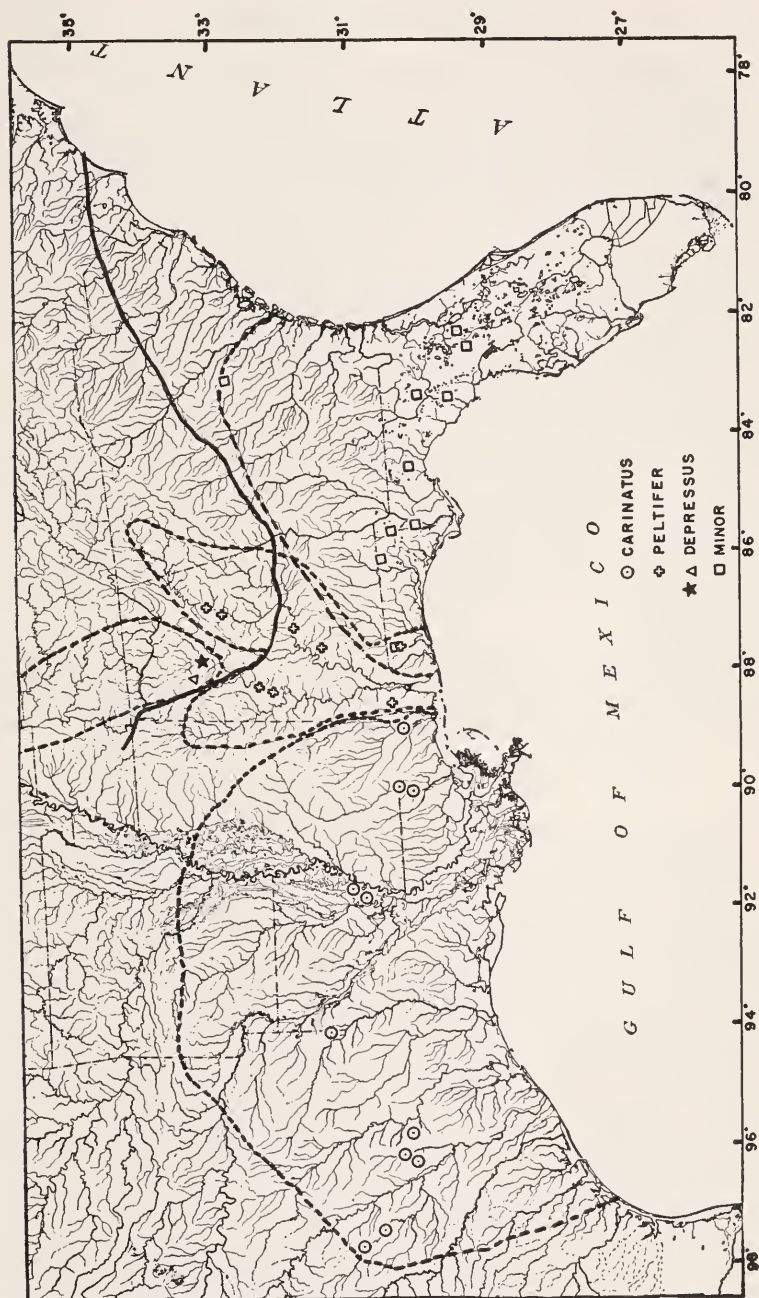


Figure 10. Distribution of members of the *Sternotherus carinatus* complex. The symbols show actual localities from which material has been examined (star symbol is type locality of *S. depressus*). Dotted line shows hypothetical distributions and solid line approximates the geographic position of the Fall Line.

with unpaired gular; and with dark stripes on the sides of the head and neck.

The range of this form cannot be definitely delimited on the basis of existing records. The holotype was taken in the Pascagoula River drainage of central Mississippi. Two trips to the type locality failed to reveal the presence of *S. c. peltifer* in the area, but numerous *S. odoratus* were collected there. Intensive work on the Pascagoula river and seining in other rivers, streams and ponds in Mississippi has not produced additional specimens. Only *S. c. carinatus* is represented in turtle samples taken from the Pascagoula river. Assuming the validity of the type locality, *S. c. carinatus* may be sympatric with *S. c. peltifer*, or the inferred distribution may reflect an interdigitation of the ranges. The probable distribution of *S. c. peltifer* is Mississippi to western Florida. The northward distribution cannot be surmised but it definitely reaches into northern Alabama. Smith and Glass (1947) allocated a specimen from Tennessee mentioned by Stejneger (1923) to this form, but did not examine it. The specimens referred to by Neill (1948) from "near the fall line" in Georgia are *Sternotherus odoratus*. Neill reached and informed us of this conclusion in recent conversation, and showed us material similar to that described in his paper.

Further collections from critical areas and examination of additional museum material must serve as a basis for defining the ranges of the various forms under consideration. A map showing the probable distribution of the *Sternotherus carinatus* complex is given in figure 10.

INDICATED TAXONOMIC ARRANGEMENT OF *Sternotherus carinatus* COMPLEX

Sternotherus c. carinatus is distinctive by having a pronounced, acutely keeled carapace. This keel persists in old individuals, though somewhat blunted by slight arching of the carapace. The gular scute is absent. This turtle may be sympatric in part of its range with *S. c. peltifer*. These differences are of specific value and *Sternotherus carinatus* should be recognized as a distinct species. This arrangement leaves *S. c. minor* and *S. c. peltifer* in another group which would be *Sternotherus minor minor* and *Sternotherus minor peltifer* as previously suggested by Smith and Glass (1947). This is reasonable because both of these forms: (1) have the same growth progression, *i.e.*, toward development of a low, unkeeled and arched carapace in adults; (2) are allopatric; and (3) the most important differentiating characteristic of *S. m. peltifer* (the head and neck striping) is present in some individuals of *S. m. minor*. More conclusive is the existence of a population of turtles in the Escambia river which is apparently an intergrading one between these two races.

Therefore, the genus *Sternotherus* consists of two well-marked species, *S. carinatus* and *S. odoratus* with another complex of less certain relationships made up of *S. depressus* and the two races of *S. minor*. This latter group of three forms is more closely related to

S. carinatus than to *S. odoratus* and together with the former has been referred to as the *Sternotherus carinatus* complex. The senior author is continuing with a further study of the relationships in these species.

A tentative key for the identification of the majority of individuals in the various forms of *Sternotherus* follows. Although *S. odoratus* has not been considered in detail in this paper, it has been included in the key for the sake of completeness.

KEY TO MEMBERS OF THE GENUS STERNOTHERUS

1. Two distinct light stripes present on sides of head (if absent, head almost black); throat and chin barbels present; three dorsal keels (juveniles) or none; shields of carapace not overlapping; ground color of head usually dark. *S. odoratus*
 Light stripes usually absent; if present they alternate with dark stripes; barbels on chin only; number of keels variable; shields of carapace overlap; ground color of head light. 2
2. Gular absent; head with dark spots on a light background; carapace with a high, sharp median keel, sloping abruptly to marginals. *S. carinatus*
 Gular present; head with dark spots on a light background, or with dark stripes, or with a reticulated pattern; number of keels variable, but middorsal not as high nor as sharp as in *S. carinatus*; adult specimens with distinctly arched carapace without a sharp median keel. 3
3. Sides of head with alternating dark and light stripes or with dark stripes on a light background; middorsal keel in juveniles is distinct and moderately high; never more than one keel. *S. m. peltifer*
 Sides of head without dark and light stripes (rarely present and, if so, animal usually with three keels. 4
4. Head with dark spots on a light background; carapace relatively high, the ratio of carapace angle to carapace height less than six in individuals greater than 20 mm in height; juveniles with three keels; adults with at least a partially rounded carapace in cross section, not perfectly flat dorsally. *S. m. minor*
 Head with a reticulate pattern of dark lines on a light background; carapace low, the ratio of carapace angle to carapace height greater than six in individuals greater than 20 mm in height; no sharp middorsal keel;

juveniles never with lateral keels;
carapace of juveniles nearly circular
in dorsal view; adults with a low
carapace, arched at sides, but not
rounded in cross section; carapace
flat dorsally. ----- *S. depressus*

Material examined.—Numbers in parentheses indicate the total number of specimens in the series. Institutions from which material was utilized are abbreviated as follows: AU = University of Alabama; CM = Charleston Museum, Charleston, S. C.; TCWC = Texas Co-operative Wildlife Collection of Texas A. & M. College; TU = Tulane University; RARI = Ross Allen Reptile Institute.

Sternotherus depressus: TU 15902 (12), TU 16062 (11), TU 16631 (5), Mulberry Fork of the Black Warrior River, 9 mi. e. Jasper, Walker Co., Ala.; AU 52-1065, 8 mi. s. Carbon Hill, Walker Co., Ala.

Sternotherus carinatus peltifer: TU 1504, 1513, 1515, 5859-62, Navco, Mobile Co., Ala.; TU 14668 (2), 14732, 16064, 16167, Black Warrior River, 17 mi. ssw. Tuscaloosa, Tuscaloosa Co., Ala.; TU 15634, 3.4 mi. sw. Camden, Wilcox Co., Ala.; TU 16168, Coosa River at Childersburg, Shelby Co., Ala.; TU 16608, Alabama River, 4 mi. n. Whitehall, Lowndes Co., Ala.; TU 16623 (3), Black Warrior River, 3 mi. e. Eutaw, Greene Co., Ala.; TU 16634 (4), Coosa River, 6 mi. e. Pell City, Talladega Co., Ala.

Sternotherus carinatus carinatus: TU 1373, 1379-80, 1385, 1395, 1408-09, 1412, 1426, 1433, 1437, 1439, 1452-54, 1456, 1460, 1470, 1472-75, 1478-79, 1482, Jonesville, Catahoula Par., La.; TU 11303, 14010, Pearl River near Angie, Washington Par., La.; TU 11647-48, 11661 (5), 12011-12, 12038-41, 12058 (23), Pearl River, 7 mi. e. Varnado, Washington Par., La.; TU 14349, tributary of Sabine River, 9 mi. nw. Joaquin, Shelby Co., Texas; TU 14816 (10), 14925, 16545 (4), Pascagoula River, 13 mi. sw. Lucedale, George Co., Miss.; TU 16047 (2), Tensas River at Clayton, Concordia Par., La.; TCWC 511-13, Twin Lakes, Madison Co., Tex.; TCWC 521, 684, Wickson Lake, Brazos Co., Tex.; TCWC 4647, Navasota River, 6 mi. w. Normangee, Brazos Co., Tex.; TCWC 4689-90, Black Lake, 17 mi. nne. Bryan, Brazos Co., Tex.; TCWC 7236, Gatesville, Coryell Co., Tex.; TCWC 8978-79, Leon River, 5 mi. n. Hamilton, Hamilton Co., Tex.

Sternotherus carinatus minor: CM 57-87-2 (2), RARI 769-79, McKinneys' Pond near Midville, Emanuel Co., Ga.; CM 54-144-12 (23), RARI 700-719; 721-731, Ichucknee Spring run between Suwannee and Columbia Cos., Fla.; RARI 732-33, 736, 743-45, 765-68, 787, 788-90, 797-99, 804, Silver Springs, Marion Co., Fla.; RARI 734-35, 742, Silver Glen Springs, Marion Co., Fla.; RARI 737, small stream near Eureka, Marion Co., Fla.; RARI 739-41, 746-53, 754-64, 780-85, 803, 786, 793-96, Chipola River, 4 mi. n. Scott's Ferry, Calhoun Co., Fla.; RARI 791-92, Oklawaha River near its junction with Fla. hwy. 40, Marion Co., Fla.; TU 13313, 13342-43, 13353, 13356, 13359,

13368-69, 13411, 13422, 13574 (2), 15244, Chipola River, 4 mi. s. Marianna, Jackson Co., Fla.; TU 15629, 6.5 mi. nw. jct. hwy. 79 and 177, Holmes Co., Fla.; TU 15829 (5), 16565 (16), Escambia River, 1.2 mi. e. Century, Escambia and Santa Rosa Cos., Fla.; TU 15848 (5), Wacissa River, 1 mi. s. Wacissa, Jefferson Co., Fla.; TU 15915 (18), Suwannee River at Fannin Springs, Gilchrist Co., Fla.

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