

ANDERSON, JAMES D. 1967. *Ambystoma opacum*.
Catalogue of American Amphibians and Reptiles, p. 46.

Ambystoma opacum (Gravenhorst)
Marbled salamander

Salamandra opaca Gravenhorst, 1807: 431. Type locality, New York. Type not known to exist, collector unknown.

Ambystoma opaca: Baird, 1849: 283. Transfer of *opaca* to genus *Ambystoma*.

Amblystoma opacum: Cope, 1867: 173. Emendation of generic and specific names.

Salamandra fasciata Green, 1818: 350. Type locality, "New Jersey," probably the vicinity of Princeton, Mercer County. Syntypes Acad. Nat. Sci. Philadelphia 1420-23, collected by "Dr. Bache."

Amblystoma fasciatum: Duméril, Bibron, and Duméril, 1854: 106. Transfer of *fasciata* to genus *Amblystoma*.

• CONTENT. No subspecies are recognized.

• DEFINITION. A short, stocky species of *Ambystoma* with a short tail (about 40 percent of the total length) and short heavy limbs. Adults average about 100 mm in total length but may reach 120 mm. The ground color is a lustrous black, almost deep purple in some individuals. The white, greyish-white or bluish-white dorsal markings are variable but basically form crossbands that often coalesce laterally to enclose black spots middorsally. Most patterns are variations of banding but in some individuals the crossbands are incomplete or absent. The pattern in such individuals consists of dorsolateral stripes, usually continuous but sometimes interrupted. The light markings are brighter and more distinct in males, especially during the breeding season. The venter is uniformly black.

Recently transformed juveniles are variable. Immediately after emergence they are brownish but gradually darken to dark brown or black marked by a variable number of light flecks that, after several weeks, increase in density to form the adult pattern. In the flecked stage *A. opacum* resembles a stocky *Plethodon glutinosus*.

Larvae are of the pond type (as defined by Valentine and Dennis, 1964) although the dorsal fin is not as deep as in many species of *Ambystoma*. The color is generally brown to black, with light spots or a light mottling dorsally and laterally. The spotting is variable and becomes more apparent as larvae approach transformation. A characteristic feature is a ventrolateral series of light spots that form a line just below the level of the limb insertions. This series of spots persists for a week or more after metamorphosis and may aid in the identification of juveniles with transitional patterns.

Neoteny is unknown and is not expected in this species with its terrestrial courtship and egg-laying habits.

• DESCRIPTIONS. Spermatophores and spermatozoa were described by Lantz (1930) and by Noble and Brady (1933); eggs and egg capsules by Bishop (1924, 1941), Lantz (1930), Noble and Brady (1933), and Salthe (1963); larvae by Viosca (1924), Noble and Brady (1933), King (1935), Bishop (1941), and Brandon (1961); metamorphic stages by Grant (1931); adults by Bishop (1941, 1947), Conant (1958), and Smith (1961). Many other regional guides and keys include brief descriptions of adults and sometimes other stages. Numerous authors have provided short descriptions of the nests and brooding behavior of females, but the most complete and significant observations are given by Noble and Brady (1933), King (1935), and Bishop (1941). cursory anatomical descriptions are scattered in the literature; the following are most complete and provide additional references: Hoheisel (1931, general features of skull), Stokely and Holle (1953, vertebral column; 1954, appendicular skeleton), Tihen (1958, osteology and phylogeny), and Baker and Taylor (1964, male urogenital system). The opercular apparatus was described by Monath (1966).

• ILLUSTRATIONS. Although this species has been frequently photographed, the most useful recent illustrations of adults are in works by Bishop (1941, 1947), Conant (1958), and Smith (1961). A color plate is provided by Cochran (1961). Noble and Brady (1933) provided drawings of the major variations in color pattern and also illustrated the major features of courtship behavior. For photographs of nests and brooding females, see works by Bishop (1941, 1947), Noble and Brady

(1933), and King (1935). The spermatophore and spermatozoa were illustrated by Lantz (1930) and by Noble and Brady (1933); eggs and egg capsules by Bishop (1941) and by Salthe (1963); early embryonic development by Barth (1953); larvae by Noble and Brady (1933), King (1935), Bishop (1941, 1947), and Brandon (1961). Bishop (1941, 1947) included a photograph of a recently transformed individual showing the juvenile coloration. Illustrations of anatomical features are included in the following works: Duméril, Bibron and Duméril (1854, dentition), Cope (1889, skull, carpus, tarsus, and visceral anatomy), Hoheisel (1931, skull), Stokely and Holle (1954, scapula and pelvis), Tihen (1958, premaxilla, prevomer, parasphenoid, and vertebra), Baker and Taylor (1964, male urogenital tract), and Monath (1966, opercular apparatus).

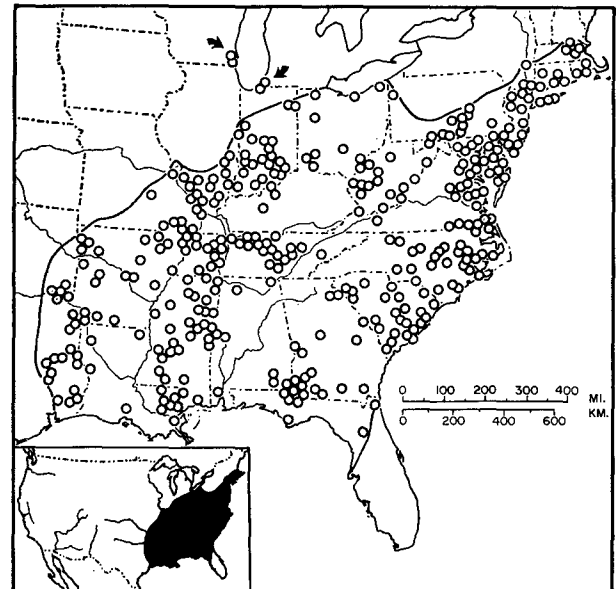
• DISTRIBUTION. This species occurs from New Hampshire and central Massachusetts southward to northern Florida, westward through southeastern New York to the region of Lake Michigan and southward through the Mississippi basin to eastern Oklahoma and eastern Texas.

Specific locality records were given by Babbitt (1937, Connecticut), Bishop (1941, New York), Bragg and Hudson (1951, Oklahoma), Brown (1950, Texas), Cook (1959, Mississippi), Dunn (1918, Massachusetts), Green (1956, West Virginia), Hoffman (1947, Virginia), Mohr (1930, Pennsylvania), Peters (1946, Missouri), Smith (1961, Illinois), Smith and Minton (1957, Illinois and Indiana), Siebert and Brandon (1960, Ohio), and Thompson (1955, Ohio).

The northern limit of the range is poorly known. Populations along the southern edge of Lake Michigan in Michigan (Walley and Smith, 1951), Indiana (Smith and Minton, 1957) and Wisconsin (Dickinson, 1965) may be disjunct from the main range of the species. The scarcity of locality records in the Appalachians suggests that *A. opacum* may be rare or absent in mountainous regions.

• FOSSIL RECORD. Unknown.

• PERTINENT LITERATURE. Many notes and short papers have been written on the unusual life history of *A. opacum*. The summary of the life history provided by Bishop (1941) is the best available. Courtship, nesting, delayed hatching and other special features of the life history of this species were discussed by Noble and Brady (1933); King (1935) provided additional information on nesting and requirements of the eggs. Stewart (1956) discussed the effect of temperature and food on larval development. Salthe (1963) compared the terrestrial egg with that of other members of the genus. Relationships and phylogeny based on osteology were discussed by Tihen (1958). Czapok



MAP. Distribution of *Ambystoma opacum*. Symbols indicate locality records. The type-locality, given only as "New York," is not indicated. Arrows point to populations presumed to be disjunct.

(1962) described the capillary networks of the mouth, skin and lungs, and discussed the relative importance of these respiratory surfaces. Whitford and Hutchison (1966) studied cutaneous and pulmonary gas exchange and (1967) the relationship between body size and metabolic rate. Thermal acclimation and critical thermal maximum were discussed by Hutchison (1961), and Moore (1939) discussed the developmental rate of the eggs. Nocturnal activity of larvae was discussed by Anderson and Graham (1967).

• REMARKS. Adults are fully terrestrial and do not enter the water. This is the only species in the family known to deposit the eggs on the land in nests that are attended by females.

In volume 9 of their *Erpétologie générale*, Duméril, Bibron, and Duméril referred to this species both as *Salamandra opaca* and as *Ambystoma fasciatum*. The latter is given the common name *Ambystoma à bandes* and is illustrated on plate 105. The salamander figured ("yellow variety from the vicinity of New Orleans"), however, is apparently a large *Ambystoma tigrinum* with a *mavortium* color pattern.

• ETYMOLOGY. The name *opacum* is from the Latin *opacus* meaning shaded, dark or obscure.

LITERATURE CITED

- Anderson, J. D. and R. E. Graham. 1967. Vertical migration and stratification of larval *Ambystoma*. *Copeia*, 1967(2): 371-374.
- Babbitt, Lewis H. 1937. The Amphibia of Connecticut. Hartford: State Geological and Natural History Survey, Bulletin No. 57, pp. 1-50.
- Baird, Spencer F. 1849. Revision of the North American tailed batrachia, with descriptions of new genera and species. *J. Acad. Sci. Philadelphia* (2nd series), 1:281-294.
- Baker, C. L. and W. W. Taylor, Jr. 1964. The urogenital system of the male *Ambystoma*. *J. Tennessee Acad. Sci.*, 34:1-10.
- Barth, Lester G. 1953. Embryology (revised edition). Dryden Press, New York. xi + 516 pp.
- Bishop, Sherman C. 1924. Notes on salamanders. *New York State Mus. Bull.*, (253):87-102.
- 1941. The salamanders of New York. *Ibid.*, (324):1-365.
- 1947. Handbook of salamanders: the salamanders of the United States, of Canada, and of Lower California. Comstock Publ. Co., Ithaca, New York. xiv + 555 pp.
- Bragg, A. N. and W. F. Hudson. 1951. New county records of Salientia and a summary of known distribution of Caudata in Oklahoma. *Great Basin Nat.*, 11(3-4):87-90.
- Brandon, Ronald B. 1961. A comparison of the larvae of five northeastern species of *Ambystoma* (Amphibia, Caudata). *Copeia*, 1961(4):377-383.
- Brown, Bryce C. 1950. An annotated check list of the reptiles and amphibians of Texas. *Baylor Univ. Studies*. xii + 259 pp.
- Cahn, A. R. 1929. The herpetology of Waukesha County, Wisconsin. *Copeia*, (170):4-8.
- Cochran, Doris. 1961. Living amphibians of the world. Doubleday Co., Garden City, New York. 199 pp.
- Conant, Roger. 1958. A field guide to reptiles and amphibians of the United States and Canada east of the 100th meridian. Houghton Mifflin Co., Boston. xv + 366 pp.
- Cook, Fanny A. 1957. Salamanders of Mississippi. *Surv. Bull. Mississippi Game and Fish Comm.*, (6):1-28.
- Cope, Edward Drinker. 1867. A review of the species of the Amblystomidae. *Proc. Acad. Nat. Sci. Philadelphia* (2nd series), 19:166-211.
- 1889. Batrachia of North America. *U. S. Natl. Mus. Bull.*, (34):1-525.
- Czopek, Juliusz. 1962. Vascularization of respiratory surfaces in some Caudata. *Copeia*, 1962(3):576-587.
- Dickinson, W. E. 1965. Handbook of amphibians and turtles of Wisconsin. Milwaukee Public Mus. Popular Science Handbook No. 10:1-45, 3 pls.
- Duméril, Andre-M.-C., Gabriel Bibron, and Auguste H. A. Duméril. 1854. *Erpétologie générale ou histoire naturelle complète des reptiles*. Paris, vol. 9, xx + 440 pp.
- Dunn, E. R. 1918. The collection of Amphibia Caudata of the Museum of Comparative Zoology. *Bull. Mus. Comp. Zool.*, 62(9):445-471.
- Grant, M. P. 1931. Diagnostic stages of metamorphosis in *Amblystoma jeffersonianum* and *Amblystoma opacum*. *Anat. Rec.*, 5(1):1-15.
- Gravenhorst, Johann Ludwig Christian. 1807. *Vergleichende Uebersicht des Linneischen und einer neuern zoologischen Systeme*, etc. Göttingen.
- Green, Jacob. 1818. Descriptions of several species of North American Amphibia, accompanied with observations. *J. Acad. Nat. Sci. Philadelphia* (1st series), 1:348-359.
- Green, N. Bayard. 1956. The ambystomid salamanders of West Virginia. *Proc. West Virginia Acad. Sci.*, 27:16-18.
- Hoffman, R. L. 1947. Distribution of two salamanders in Virginia. *Herpetologica*, 4(2):67-68.
- Hoheisel, W. F. 1931. Distinctive skull characters in species of the genus *Ambystoma*. *Trans. Illinois Acad. Sci.*, 24(2):203-221.
- Hoopes, Isabel. 1938. Marbled salamander from New Hampshire. *New England Mus. Nat. Hist. Bull.*, (87):16-17.
- Hutchison, Victor H. 1961. Critical thermal maxima in salamanders. *Physiol. Zool.*, 34(2):92-125.
- King, Willis. 1935. Ecological observations of *Ambystoma opacum*. *Ohio J. Sci.*, 35(1):4-17.
- Lantz, L. A. 1930. Notes on the breeding habits and larval development of *Ambystoma opacum*. *Ann. Mag. Nat. Hist.*, 5(10):322-325.
- Mohr, Charles E. 1930. The ambystomid salamanders of Pennsylvania. *Proc. Pennsylvania Acad. Sci.*, 4:50-55.
- Monath, Thomas. 1966. The opercular apparatus of salamanders. *J. Morphology*, 116(2):149-170.
- Moore, John A. 1939. Temperature tolerance and rate of development in eggs of Amphibia. *Ecology*, 20(4):459-478.
- Noble, G. K. and M. K. Brady. 1933. Observations on the life history of the marbled salamander, *Ambystoma opacum*. *Zoologica*, 11(8):89-132.
- Peters, J. A. 1946. Records of certain North American salamanders. *Copeia*, 1946(2):106.
- Salthe, Stanley N. 1963. The egg capsules in the Amphibia. *J. Morphology*, 113(2):161-171.
- Siebert, Henri C. and Ronald A. Brandon. 1960. The salamanders of southeastern Ohio. *Ohio J. Sci.*, 60(5):291-303.
- Smith, Philip W. 1961. The amphibians and reptiles of Illinois. *Illinois Nat. Hist. Survey Bull.*, 28(art. 1):1-298.
- and Sherman A. Minton, Jr. 1957. A distributional summary of the herpetofauna of Illinois and Indiana. *Amer. Midland Nat.*, 58(2):341-351.
- Stewart, Margaret McB. 1956. The separate effects of food and temperature differences on development of marbled salamander larvae. *J. Elisha Mitchell Sci. Soc.*, 72(1):47-56.
- Stokely, Paul S. and Paul A. Holle. 1953. Variation in the vertebral axis of the Ambystomidae. *Herpetologica*, 9(3):133-138.
- 1954. Appendicular skeleton of the Ambystomidae. *Ibid.*, 10(1):57-61.
- Thompson, Fred G. 1955. Three notable records of the marbled salamander in northern Ohio. *Herpetologica*, 11(3):183-184.
- Tihen, Joseph A. 1958. Comments on the osteology and phylogeny of ambystomid salamanders. *Bull. Florida State Mus.*, 3:1-50.
- Valentine, B. D. and D. M. Dennis. 1964. A comparison of the gill-arch system and fins of three genera of larval salamanders, *Rhyacotriton*, *Gyrinophilus* and *Ambystoma*. *Copeia*, 1964(1):196-201.
- Viosca, Percy. 1924. Observations on the life history of *Ambystoma opacum*. *Copeia*, (134):86-88.
- Walley, H. and P. W. Smith. 1951. The marbled salamander, *Ambystoma opacum* (Gravenhorst), in Michigan. *Copeia*, 1951(4):309.
- Whitford, W. G. and V. H. Hutchison. 1966. Cutaneous and pulmonary gas exchange in ambystomatid salamanders. *Copeia*, 1966(3):573-577.
- 1967. Body size and metabolic rate in salamanders. *Physiol. Zool.*, 40(2):127-133.

J. D. ANDERSON, RUTGERS UNIVERSITY, NEWARK, NEW JERSEY 07102.

Published 11 August 1967 by the American Society of Ichthyologists and Herpetologists. Publication is supported by National Science Foundation grant G24231.

Primary editor for this account, Richard G. Zweifel.