

Catalogue of American Amphibians and Reptiles.

Walley, H.D. and M.V. Plummer. 2000. *Opeodryas aestivus*.

Opeodryas aestivus (Linnaeus)
Rough Green Snake

Coluber aestivus Linnaeus 1766:387. Type locality, "Carolina," based on a specimen sent to Linnaeus by Alexander Garden. Holotype unknown. Type locality restricted to Charleston, South Carolina by Smith and Taylor (1950). See **Remarks**.
Leptophis aestivus: Bell 1826:329.

Herpetodryas aestivus: Schlegel 1837:151. *Herpetodryas aestivus* is a composite name that included not only *Herpetodryas* (*Opeodryas*) *aestivus*, but also *Philodryas aestivus* Duméril, Bibron, and Duméril 1854, of southern South America. Duméril et al. (1854) separated the two species and, confusingly, used the same epithet to name the South American species (Kraig Adler, pers. comm.).

Leptophis majalis Baird and Girard 1853a:107. Type locality, "Indianola and New Braunfels, Texas, and Red River." Holotype, National Museum of Natural History (USNM) 1436, female, collected by J.D. Graham, date of collection unknown (not examined by authors). Grobman (1984) restricted the type locality to New Braunfels, Comal County, Texas. See **Remarks**.

Opeodryas aestivus: Cope 1860:560. First use of combination.

Cyclophis aestivus: Cope 1875:38.

Phyllophilophis aestivus: Garman 1892:283.

Phillophilophis aestivus: Hurter 1893:256.

Contia aestivus: Boulenger 1894:258.

Opeodryas aestivas: Gates 1929:555.

Opeodryas aestivus aestivus: Grobman 1984:160. Type locality, "one mile west of Parkville, McCormick County, South Carolina." Neotype, United States National Museum (USNM) 92473, male, collected by C.W. Burn, 19 July 1933 (not examined by authors).

Opeodryas aestivus majalis: Grobman 1984:162. Type locality, "in the vicinity of Indianola, Calhoun County, Texas." Lectotype, United States National Museum (USNM) 1436-a, female, collected by J.D. Graham (not examined by authors). See **Remarks**.

Opeodryas aestivus carinatus Grobman 1984:164. Type locality, "Archbold Biological Station, Highlands County, Florida." Holotype, American Museum Natural History (AMNH) 65637, adult male, collected by C.M. Bogert in 1944 (not examined by authors). See **Remarks**.

Opeodryas aestivus conanti Grobman 1984:166. Type locality, "Paramore Island, Accomack County, Virginia." Holotype, Carnegie Museum (CM) 27847, male, collected by R. Conant et al., 28 April 1947 (not examined by authors). See **Remarks**.

• **CONTENTS**. No subspecies are recognized (see **Remarks**).

• **DEFINITION**. This species is a slender, arboreal snake reaching a maximum SVL of 735 mm (1,160 mm TL), characterized by keeled dorsal scales, divided cloacal scale, and a bright green dorsal pattern that turns gray-blue or black in preserved specimens. The venter is uniform white, yellow, or cream, and the chin occasionally pale yellow, or greenish yellow. Dorsal scales are typically in 17 rows, reducing to 15 posteriorly. The frontal shield is angulate in front, sides are straight and evenly tapering. Posterior chin shields are long and widely divergent for half their length. A loreal is present. Temporals are 1–3 (usu-



FIGURE 1. Green and blue color phases of *Opeodryas aestivus* from White County, Arkansas (photograph by M.V. Plummer).



FIGURE 2. Adult *Opeodryas aestivus* from White County, Arkansas (photograph by M.V. Plummer).

ally 1 + 2. Preoculars are usually 1–1, but occasionally 2–2. Two postoculars are present. The nasal is single (not divided). Supralabials number 6–8 (usually 7); infralabials 7–10 (usually 8); ventrals 139–171, and subcaudals 110–152. Tail length is about 32–47% of TL. Grobman (1984) noted only slight sexual dimorphism, males exhibiting a reduction in the number of ventral scales (by 3) and a slight increase in the number of caudals (7 or more).



FIGURE 3. Hemipenis of *Opeodryas aestivus* (from Dowling and Savage 1960).

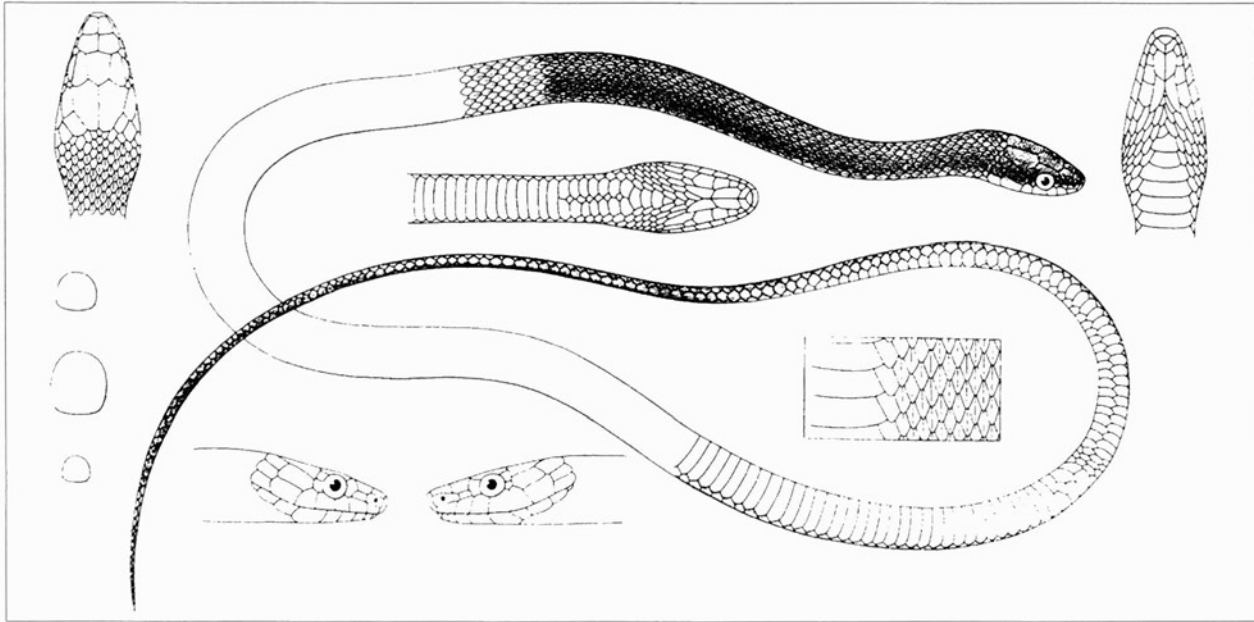
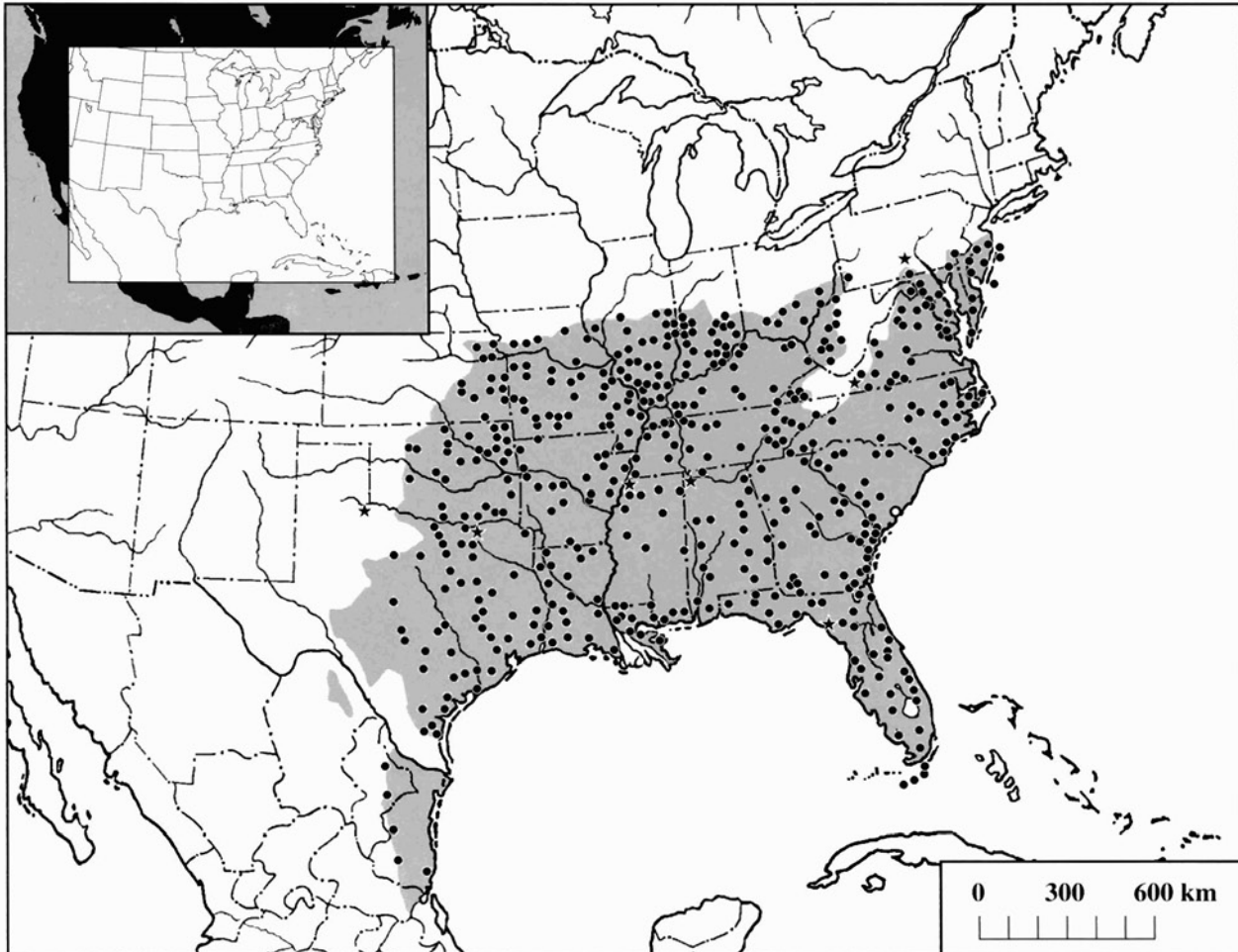


FIGURE 3. *Opheodrys aestivus* (from Jan and Sordelli 1869).

• **DESCRIPTIONS.** Grobman (1984) described variation in scutellation, clinal variation, and sexual dimorphism, and recognized three subspecies, none of which we consider valid (see **Remarks**). Other descriptions include those in Harlan (1827),

Holbrook (1842), Baird and Girard (1853a,b), Dumeril et al. (1870), Garman (1883), Bocourt (1895), Cope (1898 [1900]), McCauley (1945), Wright and Wright (1957), Anderson (1965), and most of the regional guides (see **Distribution**). Keys were



MAP. Distribution of *Opheodrys aestivus*; the restricted type locality is indicated by the circle, dots indicate other records, and stars mark fossil localities.

provided by Blanchard (1924), Ortenburger (1927), Curtis (1949b), Perkins (1949), Cagle (1957), Keiser and Wilson (1969), Casas Andreu and McCoy (1987), and Powell et al. (1998).

• **ILLUSTRATIONS.** **Lithographic drawings** of the entire body, and dorsal, lateral, and ventral views of head and neck were provided by Baird and Girard (1853b), Jan and Sordelli (1869), Duméril et al. (1870), Garman (1883), and Bocourt (1895). **Color photographs and color illustrations** were provided by Holbrook (1842), Zim and Smith (1953), Cochran (1954), Schmidt and Inger (1957a,b), Conant (1958), Barker (1964), Cochran and Goin (1970), Barbour (1971), Shaw and Campbell (1974), Conant (1975), Behler and King (1979), Linzey (1979), Martof et al. (1980), Paulduro (1980), Ashton and Ashton (1981), Linzey and Clifford (1981), Trutnau (1981), Smith and Brodie (1982), Jackson (1983), Tennant (1985), Stebbins (1985), Christiansen and Bailey (1986), Green and Pauley (1987), Johnson (1987), Mehrtens (1987), Obst et al. (1988), Sievert and Sievert (1988), Dundee and Rossman (1989), Ernst and Barbour (1989), Carmichael and Williams (1991), Coborn (1991), Conant and Collins (1991, 1998), Brothers (1992), Mattison (1992), Paulduro and Paulduro (1992), Rossi (1992), Collins (1993), Coborn (1994), Mitchell (1994), Mitchell and Anderson (1994), Carletti (1995), Mattison (1995), Paulduro and Paulduro (1995), Ernst and Zug (1996), Holfert (1996), Mara (1996), Boundy (1997), Tennant (1997), Gibbons and West (1998), Griswold (1998), Mattison (1998), Phillips et al. (1999), Tennant and Bartlett (2000), Walls (2000), and Werler and Dixon (2000). Johnson (1987) provided a color photograph of an adult eating a grasshopper and a hatchling emerging from an egg, and Paulduro and Paulduro (1992) and Holfert (1996) provided color photographs of mating behavior, eggs, juveniles, and defensive behavior. **Black and white photographs** were provided by Fowler (1906), Surface (1906), Ditmars (1912), Haltom (1931), Parker (1937), Trapido (1937), Ditmars (1939), Schmidt and Davis (1941), Smith (1950), Conant (1951a), Parmalee (1955), Smith (1956), Klingelhöffer (1959), Smith (1961), Anderson (1965), Huheey and Stupka (1967), Harrison (1971), Minton (1972), Breen (1974), Collins (1974, 1993), Mount (1975), Linzey (1979), Vermersch and Kuntz (1986), Vosjoli (1995a,b), and Mount (1996). Harrison (1971) and Paulduro and Paulduro (1995) provided black and white photographs of clutches of eggs, and Anderson (1965) of a juvenile emerging from an egg. Plummer (1989) figured tree hollows and *Opheodrys aestivus* entering nesting sites. Cundall (1981) provided illustrations of osteological features of the skull and dentition. Illustrations of the palatine and supraoccipital were in Rossman and Schaefer (1974), and precaudal vertebra were figured by Auffenberg (1963) and Parmley (1990). Holman (2000) illustrated dorsal, lateral, anterior, and posterior views of trunk vertebra. Illustrations of the hemipenis were in Cope (1898 [1900]) and Dowling and Savage (1960). Intrinsic integumentary muscles were illustrated by Oldham and Smith (1991) and cephalic muscles in Cundall (1986). Gates (1929) and Cunningham (1937) illustrated dicephalous bifurcation.

• **DISTRIBUTION.** *Opheodrys aestivus* occurs from southern New Jersey and southwestern Pennsylvania southward through Florida, westward to central Texas, Oklahoma, and eastern Kansas, and throughout the Gulf States to extreme northeastern Tamaulipas, México. The species ranges northward in the Mississippi River Valley to central Missouri, southern Illinois, central Indiana, and Ohio. Stout et al. (1988) restricted the range to long leaf pine/turkey oak habitat in peninsular Florida, and Dodd and Franz (1995) and Franz (1995) found this species only in xeric oak and mesic hardwood hammocks in Florida. Neill

(1958) found these snakes in the supertidal vegetation and occasionally in mangrove swamp areas in Florida. Platt et al. (1989) collected specimens from open marsh and spoilbank habitat in Louisiana. Smith (1961) and Plummer (1985b) considered *O. aestivus* an arboreal species that prefers brushy vegetation of forest rows and forest edge in Illinois and Arkansas, respectively. Gibbons (1978) associated this species with thickly vegetated areas in South Carolina. Degenhardt et al. (1996) questioned the New Mexico reports of Cope (1898 [1900]) and Van Denburgh (1924) from Cimmarron River, Fort Bliss, and Old Fort Cobb, and asserted that *O. aestivus* should not be considered a part of the New Mexican herpetofauna. Ditmars (1896) first reported this species from Plymouth County, Connecticut, followed by Lamson (1935) and Dowhan and Craig (1976). Klemens (1993) felt that a relictual population may have once occurred, but no longer existed in Connecticut, and that the Massachusetts localities are questionable. Christiansen and Bailey (1986) reported an early record from Davis County, Iowa, but extensive searches failed to detect additional specimens and this species was deleted from the state's fauna.

Opheodrys aestivus is most frequently found in or near moist habitats. Although not aquatic, it has been frequently observed in water or habitats only reached by crossing water (Duellman 1949, Richmond 1952). It is a good climber, frequently found above ground in bushes and shrubs (Burt and Hoyle 1935; Plummer 1981b, 1985b). Force (1930) found this species most commonly in grassland and bushes at the edge of wooded pastures in Oklahoma, and Norton and Harvey (1975) in roadside bushes and shrubs in Kentucky. Gibbons and Coker (1978) and Mitchell and Pague (1987) found this species on most of the Atlantic Coast barrier islands.

This species has been listed in several regional guides and annotated bibliographies: **Alabama** (Löding 1922, Haltom 1931, Chermock 1952, Mount 1975, Linzey 1979, Mount 1996), **Florida** (Cope 1888, Carr 1940, Duellman and Schwartz 1958, Ashton and Ashton 1981, Wilson and Porras 1983, Enge 1992b, Tennant 1997), **Georgia** (Martof 1956; Williamson and Moulis 1979, 1994a,b; Gibbons and Semlitsch 1991; Gibbons and West 1998), **Illinois** (Parmalee 1955, Smith 1961, Phillips et al. 1999), **Indiana** (Minton 1966, 1972), **Kansas** (Smith 1950, 1956; Collins 1974, 1993), **Kentucky** (Barbour 1971), **Louisiana** (Dundee and Rossman 1989, Boundy 1997), **Maryland** (McCauley 1945), **Mississippi** (Cook 1954, Lohofener and Altig 1983), **Missouri** (Hurter 1911; Anderson 1965; Johnson 1987; Johnson and Powell 1988; Powell et al. 1990, 1992, 1993, 1996, 1997; Hendershott 1996; Powell and Daniel 1997; Daniel et al. 1998, 1999), **New Jersey** (Fowler 1906), **New York** (DeKay 1842, Eckel and Paulmier 1902), **North Carolina** (Martof et al. 1980, Palmer and Braswell 1995), **Ohio** (Smith 1882, Conant 1951a), **Oklahoma** (Webb 1970, Sievert and Sievert 1988), **Pennsylvania** (Roddy 1928, McCoy 1982, Shaffer 1991), **South Carolina** (Martof et al. 1980, Gibbons and West 1998), **Tennessee** (Huheey and Stupka 1967, Redmond et al. 1990), **Texas** (Brown 1950; Raun 1965; Tennant 1985; Vermersch and Kuntz 1986; Dixon 1987, 2000; Werler and Dixon 2000), **Virginia** (Martof et al. 1980, Mitchell 1994, Mitchell and Anderson 1994, Mitchell and Reay 1999), **West Virginia** (Tobey 1985, Green and Pauley 1987), and **México** (Gauge 1937; Smith 1944a,b; Flores-Villela 1993). Liner (1994) provided scientific names and English and Spanish "common" names.

• **FOSSIL RECORD.** Holman and Richards (1981), Parmley (1990), and Holman (2000) described characteristics distinguishing vertebrae of *Opheodrys aestivus* from those of *Liochlorophis* (formerly *Opheodrys*) *vernalis*. Pleistocene fossils have been identified on the basis of vertebral characters from Bell Cave,

Alabama (Holman et al. 1990); the Rancholabrean of Florida (Auffenberg 1963; Gut and Ray 1963; Meylan 1982, 1984); Kingston Saltpeter Cave, Bartow County, Georgia (Fay 1988); New Paris Sinkhole, Bedford County, Pennsylvania (Fay 1988); Frankstown Cave, Blair County, Pennsylvania (Fay 1988); Rancholabrean of Texas (Holman 1962, 1963, 1966, 1969); Miler Cave, Texas (Patton 1963; Holman 1966, 1969); and Clark's Cave, Virginia (Parmley 1986, 1990; Fay 1988). Gehlbach (1965) and Holman (1995) summarized the known localities from the Pliocene and Pleistocene of North America. Hill (1971) was unable to separate *O. aestivus* from *Liochlorophis vernalis* on the basis of Holman's (1962) criteria, except by size of the vertebrae.

• **PERTINENT LITERATURE.** Wright and Wright (1957) and Grobman (1984) provided the most comprehensive reviews on the biology of the species. The papers cited in the distribution section above also contain some ecological information.

Further information on **ecology and distribution** is in DeKay (1842), Smith (1882), Loennberg (1894), Ditmars (1896, 1907, 1910, 1931, 1933, 1936, 1937, 1939, 1943), Brown (1901), Bailey (1905), Stone (1906), Strecker (1908a,b, 1909, 1930), Brady (1925), Strecker and Frierson (1926), Corrington (1929), Taylor (1929, 1935), Force (1930), Burt (1933, 1935), Van Hynning (1933), Necker (1934), Burt and Hoyle (1935), Parker (1937, 1939, 1947), Tihen (1937), Dellinger and Black (1938), Richmond and Goin (1938), Schwardt (1938), King (1939), Welter and Carr (1939), Cagle (1942), Engels (1942), Smith (1944a,b), Allen and Slatten (1945), Curtis (1949a), Brown (1950), Neill (1950), Peterson (1950), Conant (1951b, 1979), Werler and Mc-Callion (1951), Engels (1952), Swanson (1952), Telford (1952), Wright and Wright (1952, 1957), Bonn and McCarley (1953), Goin and Goin (1953), Guidry (1953), Hoffman (1953), Endsley (1954), Liner (1954, 1955), Fouquette and Lindsay (1955), Freeman (1955), Oliver (1955), Smith and List (1955), Clarke (1956), Cooper (1956), Dowling (1956, 1957), Pope (1956), Reed (1956, 1957a,b,c,d, 1958), Kilbourne (1957), Myers (1957), Schmidt and Inger (1957a,b), Cliburn (1958), Dennis (1958), Scott and Snyder (1958), Tanner (1958), Witt (1958), Bush (1959b), Myers (1959), Raun (1959), Tinkle (1959, 1960), Rossman (1960), Martof (1963), Walker (1963), Kennedy (1964), Brothers (1965), Harris (1967), Webb and Dalby (1967), Hirschfeld (1969), Lee (1969), Blaney (1971), Breen (1974), Norton and Harvey (1975), Clifford (1976), Lardie (1977), Liner et al. (1977), Lardie (1979, 1982, 1985a,b), Preston (1979), Jones and Ferguson (1980), Laerm et al. (1980), Vance (1980, 1987), DeGraaf and Rudis (1981), Gibbons and Harrison (1981), Goldsmith (1981, 1984, 1988), Lardie and Black (1981), Campbell and Christman (1982a,b), Kiviat (1982), Mecham (1982), Seehorn (1982), Rakowitz et al. (1983), Killebrew (1984), Mitchell and Pague (1984), McCoy (1985), Plummer (1985b), Mitchell (1987), Nagle and Bazuin (1987), Richards (1987), Whiting et al. (1987), Dundee and Rossman (1989), Ernst and Barbour (1989), Schafer and Kasper (1989), Conant et al. (1990), Crawford and Wright (1990), Meade (1991), Dalrymple et al. (1991a), Schwaner and Anderson (1991), Hibbitts (1992), Stevenson and Crowe (1992), Hayslett (1993), Hall (1994), D'Alessandro and Ernst (1995), Essner and Hendershott (1996), Mara (1996), Thornton et al. (1996), Ernst et al. (1997), Griswold (1998), Gutberlet et al. (1998), Bauer and Das (1999), Bryant (1999), Jensen and Moulis (1999), and Smith and Johnson (1999).

Conservation and Management were addressed in Nordstrom et al. 1977), McCoy (1985), Klemens (1993), and Mitchell (1994).

Systematics and/or phylogenetic studies include Boulenger (1894), Brown (1901), Schmidt and Necker (1936), Smith and

Taylor (1945, 1950), Burger (1947), Dessauer (1967), Marx and Rabb (1972), Hardaway and Williams (1976), Cundall (1981), Dowling et al. (1983, 1996), Grobman (1984, 1992a), Frost and Hillis (1990), Oldham and Smith (1991), Collins (1992), Frost et al. (1992), and Beltz (1995). Rabb and Marx (1973) described *O. aestivus* as originating primarily from tropical stock in East Asia.

Works on **historical biogeography** include those of Bailey (1905), Milstead et al. (1950), Brattstrom (1967), Smith and Buechner (1947). Other **biogeographical studies** are by Cope (1880), Blair (1949), Neill (1958), Blaney (1971), Conant (1979), and Mitchell and Pague (1984).

Data on **food habits and diet** are organized by topic as follows: **general** (Ditmars 1912; Van Hynning 1932; Parker 1937; Uhler et al. 1939; Guidry 1953; Hamilton and Pollack 1956; Wright and Wright 1957; Carpenter 1958; Bush 1959a; Blair 1960; Licht 1968; Minton 1972; Mushinsky 1978; Brown 1979, 1992; Plummer 1981b, 1991; Jackson 1983; Ford and Shuttlesworth 1986; Tennant 1997; Walls 2000), **food competitors** (Blair 1960), **food in captivity** (Rossi 1992; Vosjoli 1995a,b), **stalking behavior** (Goldsmith 1986), **predation** (Guthrie 1932, Schmidt 1932, Loveridge 1938, Lewis 1946, Stephenson and Mietzen 1946, Clark 1949, Carpenter 1958, Blair 1960, Tomkins 1965, Sledge 1969, Brown 1979, Jackson and Franz 1981, Mount 1981, Greene 1984, Mueller and Whiting 1989, Nugent et al. 1989, Plummer 1990b, Mitchell and Beck 1992, Mushinsky and Miller 1993, Blem and Blem 1995, Palmer and Braswell 1995, Roze 1996, Conners 1998, Husak and Ackland 2000), **cannibalism** (Mitchell 1986), **effects of pollution and contaminants** (Brisbin et al. 1974, Brown 1994, Mitchell and Anderson 1994), **mortality** (Jones and Ferguson 1980), **spider web** (Zippel and Kirkland 1998), **antipredator behavior** (Hammerson 1988), and **cryptic coloration** (Ford and Shuttlesworth 1986).

General studies of **reproduction and growth** include Cook (1954), Richmond (1956), Carpenter (1958), Fitch (1970), Aldridge (1979), Morris (1982), Plummer (1983, 1984, 1985a,b), Goldsmith (1984), Seigel and Fitch (1985), Dalrymple et al. (1991a), Morris and Vail (1991), Aldridge et al. (1995), Palmer and Braswell (1995), Tennant (1997), and Tennant and Bartlett (2000). Other related topics include: **courtship and copulation** (Secor 1987, Ernst and Barbour 1989, Morris and Vail 1991, Ford and Cobb 1992, Palmer and Braswell 1995), **development** (Minton 1972, Kofron 1983), **female reproductive cycle** (Aldridge 1979, Plummer 1984, Barron 1997), **male reproductive cycle** (Aldridge et al. 1990), **oviposition** (Plummer 1984, Ernst and Barbour 1989, Fitch 1970), **ovarian cycle** (Fitch 1970, Plummer 1984), **hemipenial structure** (Cope 1898 [1900], Rossman and Schaefer 1974, Dowling and Savage 1960), **nests** (Force 1930, Palmer and Braswell 1995, Plummer 1990a), **nest site ecology and selection** (Smith 1961; Plummer and Snell 1988; Plummer 1989, 1990a), **egg and clutch sizes** (Force 1930; Walker 1931; Conant and Downs 1940; Curtis 1950; Guidry 1953; Carpenter 1958; Dennis 1958; Sabath and Worthington 1959; Dial 1961; Kennedy 1964; Anderson 1965; Webb 1970; Mount 1975; Plummer 1984, 1997b; Johnson 1987; Plummer and Snell 1988; Dundee and Rossman 1989; Ernst and Barbour 1989; Ford and Seigel 1989; Ford et al. 1990; Seigel and Ford 1991; Brown 1992; Smith and Powell 1993; Mitchell 1994; Holfert 1996; Palmer and Braswell 1995; Gutberlet et al. 1998), **clutch mass in relation to body weight** (Seigel and Fitch 1984; Plummer 1984, 1988, 1997a; Krohmer and Aldridge 1985; Seigel et al. 1986; Seigel and Ford 1987; Ford and Seigel 1989; Ford et al. 1990; Barron 1997), **clutch size in relation to food intake** (Seigel and Ford 1991), **incubation period** (Guidry 1953; Fitch 1970; Tinkle and Gibbons 1977; Plummer 1984, 1990a; Plummer and Snell 1988; Smith 1990; Ernst and Zug 1996; Gutberlet et al. 1998), **substrate moisture in relation to devel-**

opment (Plummer 1990a), **embryogenesis** (Kofron 1983), **external incubation** (Cox et al. 1984), **hatching and hatchlings** (Force 1930; Carpenter 1958; Sabath and Worthington 1959; Anderson 1965; Minton 1972; Plummer 1984, 1988; Parker and Plummer 1987; Ford et al. 1990; Ernst and Zug 1996), **size of hatchlings** (Brown 1992; Plummer and Snell 1988), **multiple clutches** (Holfert 1996), **autumn mating** (Richmond 1956), **communal nesting** (Palmer and Braswell 1976, 1995; Swain and Smith 1978; Plummer 1981a), **growth and maturity** (Parker and Plummer 1987, Plummer 1985a), **geographic variation in body size** (Christman 1980, Plummer 1987), **maximum size** (Allen and Slatten 1945, Hirschfeld and Collins 1961, Plummer 1987, Powell 1994, Conant and Collins 1998), **maturity** (Plummer 1985a), **longevity** (Snider and Bowler 1992, Collins 1993, Dunham et al. 1994, Ernst and Zug 1996), **sex ratio** (Plummer 1985b, Parker and Plummer 1987), **spermatogenesis** (Aldridge et al. 1990, Van Wyk 1995), **twinning** (Curtis 1950), **husbandry and captive breeding** (Klingelhöffer 1959; Hermansen 1980; Trutnau 1981; Paulduro and Krabbe-Paulduro 1982, 1992, 1995; Steehouder 1983; Hobson 1988; Evans 1990; Rossi 1992; Grathwohl 1994; Mattison 1995, 1998; Papez 1995; Vosjoli 1995a,b; Slavens and Slavens 1996; McAllister 1998); and **viviparity** (Tinkle and Gibbons 1977).

Studies of **habitat relationships and behavior** include: **social behavior** (Secor 1987; Plummer 1989, 1993; Dalrymple et al. 1991a), **adaptive coloration** (Cott 1940), **population size and density** (Clifford 1976, Plummer 1985a, Parker and Plummer 1987, Rudolph and Dickson 1990, Dalrymple et al. 1991a, Ford et al. 1991, Lillywhite and Henderson 1993, Zug 1993), **population size and age structure** (Parker and Plummer 1987), **survivorship and recapture rates** (Plummer 1985a,b, 1990a, 1997b; Parker and Plummer 1987), **activity pattern** (Clifford 1976, Gibbons and Semlitsch 1978, Morris 1982, Vermersch and Kuntz 1986, Plummer 1989, Dalrymple et al. 1991b, Ford and Cobb 1992, Lillywhite and Henderson 1993, Ballard 1994, Zappalorti and Reinert 1994, Mills et al. 1995), **habitat utilization** (Plummer 1981b), **movement pattern** (Plummer 1981b, 1990a), **species association** (Jones and Ferguson 1980, Whiting et al. 1987, Ford et al. 1991), **captive management** (Evan 1990, Zappalorti and Reinert 1994, Carletti 1995, Mara 1996), **conservation** (Zappalorti and Reinert 1994), **threatened species in Pennsylvania** (Genoways and Brenner 1985, Frank and Ramus 1994), **daily and seasonal activity** (Plummer 1981b, 1990a; Dalrymple et al. 1991b; Ford and Cobb 1992), **effects of habitat modification** (Babbitt and Babbitt 1951, Wilson and Porras 1983), **defensive behavior** (Smith 1961, Minton 1972, Seigel and Fitch 1984, Holfert 1996, Tennant and Bartlett 2000), **temperature and preferred body temperature** (Plummer 1993, Touzeau and Slevert 1993), **foraging behavior** (Mushinsky 1978, Lillywhite and Henderson 1993, Plummer 1997b), **prenesting behavior** (Plummer 1989, 1990a), **arboreal habits** (Scott and Synder 1958, Lee 1969, McComb and Noble 1981, Plummer 1981b, Reinert 1993), **aquatic habitats** (Richmond 1952, Walker 1963), **use of tree cavities and nest boxes** (McComb and Noble 1981; Plummer 1989, 1990b), **radiotelemetry** (Plummer 1989, 1990a,b), **sleeping behavior** (Oliver 1955), **speed and endurance** (Plummer 1997a), **sexual dimorphism in size and coloration** (Smith 1961; Plummer 1985a,b, 1987; King 1989; Mitchell 1994; King et al. 1999), **sexual dimorphism in tail length** (Smith 1961, Clark 1966, Fitch 1981, Mitchell and Anderson 1994), **species diversity and seasonal abundance** (Rudolph and Dickson 1990), **stereotypic behavior** (Carpenter and Ferguson 1977), **trapping techniques** (Campbell and Christman 1982b, Rodda and Nishimura 1999), and **human exploitation** (Enge 1992a).

References to **physiology** include: **chemosensory organs** (Young 1997), **critical thermal maximum** (Pough and Gans

1982), **energetics** (Plummer 1983, 1997a), **evaporative water loss** (Dove et al. 1982, Baeyens and Rountree 1983), **locomotor performance** (Plummer 1993), **preferred body temperature** (Plummer 1990a, 1993), **parasitism** (Brennan 1945, McAllister et al. 1995), **diseases** (Karstad 1961, Hoff and Trainer 1973), **fat bodies and total lipid dynamics** (Plummer 1983, Seigel and Ford 1987, Scott and Fischer 1995, Scott et al. 1995, Barron 1997, Blem 1997), **feces production** (Plummer 1991), **abnormalities** (Plummer 1980, Merilä et al. 1992), **effects of pesticides** (George and Stickel 1949, Fleet et al. 1972, Fleet and Plapp 1978, Ernst and Barbour 1989, Klemens 1993), **radionuclide studies** (Brisbin et al. 1974), **sexual dimorphism in body temperature** (Plummer 1993), **thermoregulation** (Plummer 1993), and **water relations** (Plummer 1990a). Ashton and Ashton (1981) reported *O. aestivus* as being mildly venomous, although this species never attempts to bite.

Anatomical studies have dealt with: **myology** (Cundall 1973, Rossman and Schaefer 1974, Tanner and Avery 1982, Dennis 1986, Oldham and Smith 1991), **ear structure** (Baird 1970), **hyoid and associated muscles** (Langebartel 1968, Cundall 1973), **costal cartilaginous structure** (Hardaway and Williams 1976), **cranial osteology** (Schaefer 1965, Underwood 1967, Cundall 1973, 1981, 1986), **egg shell composition** (Cox et al. 1984), **haemoglobin** (Graizer and Allison 1960), **preglottal structure** (Saiff 1975), **postcloacal vertebrae** (Keiser 1970), **skin structure** (Jackson and Reno 1975), **umbilical scar position** (Grobman 1992b), **lungs** (Wallach 1998), **taste buds** (Young 1997), **ventral scale anomalies** (Plummer 1980, Merilä and Lindell 1992), and **dicephalism** (Cunningham 1937, Belfit and Nienaber 1983).

• **REMARKS.** Schmidt (1953), followed by Smith and Taylor (1950), restricted the type locality, "Carolina," designated by Linnaeus (1766) to Charleston, South Carolina for *Coluber aestivus* (= *O. aestivus*). Grobman (1984) departed from the treatment of Smith and Taylor (1950) and Schmidt (1953), designating USNM 92473, male, collected one mile west of Parksville, McCormick County, South Carolina, by C.W. Burn, 19 July 1933 as a neotype. According to Traci Hartsell (pers. comm.), "a handwritten note on one of the National Museum of Natural History specimen cards indicates USNM 48337 was selected as neotype by W.L. Burger, but this apparently was never published."

According to ICZN rules, the designation of a neotype is probably not necessary or valid. As long as no doubt exists about the application of *Coluber aestivus* Linnaeus 1766 to the snake we know today as *Ophedryx aestivus*, no neotype need be designated. Under the current rules of zoological nomenclature, loss of the holotype does not constitute sufficient reason for designating a neotype.

The lectotype of *O. a. majalis* is the specimen identified as a "co-type" (= syntype) of *Leptophis majalis* Baird and Girard 1853a in the United States National Museum (USNM 1436 and 1436a) museum records (Cochran 1961, Yarrow 1883). Burger (1947) was the first to use the combination *O. a. majalis*.

Grobman (1984) recognized a new subspecies, *Ophedryx a. conanti*, on the offshore islands of Virginia, on the basis of these snakes having fewer ventrals and subcaudals than do those from other parts of the species' range. Conant et al. (1990), Mitchell (1994), Mitchell and Anderson (1994), and Palmer and Braswell (1995) noted similar reductions in specimens from offshore islands of Virginia and North Carolina, but chose not to recognize *O. a. conanti*. Grobman (1984) also recognized *O. a. carinatus*, which he restricted to the southern half of the Florida peninsula on the same premises used by Carr (1940) and Christman (1980), although the latter authors felt that the distinctiveness of these populations was inadequate for recogniz-

ing a subspecies. Grobman (1984) also recognized *O. a. majalis* from northeastern México through central and eastern Texas. This subspecies had been recognized previously by Burger (1947), but only in an abstract. These races generally have not been recognized by the herpetological community (e.g., Frost and Hillis 1990; Conant and Collins 1991, 1998; Frost et al. 1992), because the distinctions among them were based on one or two differences in variable scale characters and on outmoded taxonomic practices.

• **ETYMOLOGY.** The name *aestivus* is from the Latin for "summer," in obvious reference to the green dorsal color.

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