

Wildlife Refuge reported above is based on the first known observations of these animals in this area. The tentative list is presented here so that it may stimulate a more complete inventory in the future and serve as a baseline against which changes in species composition may be judged.

A number of species not encountered in my survey may yet be found on Mackay Island because their ranges encompass this area and because the habitats in which they are known to occur are also found there. These include southeastern shrew (*Sorex longirostris*), least shrew (*Cryptotis parva*), star-nosed mole (*Condylura cristata*), eastern harvest mouse (*Reithrodontomys humulis*), white-footed mouse (*Peromyscus leucopus*), golden mouse (*Ochrotomys nuttalli*), woodland vole (*Microtus pinetorum*), and meadow jumping mouse (*Zapus hudsonius*).

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Literature Cited

Handley, C. O., Jr. 1991. Mammals. Pp. 539-562 *In* K. Terwilliger (Coordinator), Virginia's Endangered Species.

McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Marshall, H. G., and M. D. Norman. (eds.). 1991. Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Pague, C. A., and K. A. Buhlmann. 1991. Rare animals of Back Bay, Virginia Beach, Virginia. Pp. 148-158 *In* H. G. Marshall and M. D. Norman (eds.) Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Priest, W. I., III, and S. Dewing. 1991. The marshes of Back Bay, Virginia. Pp. 248 *In* H. G. Marshall and M. D. Norman (eds.) Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Webster, W. D., J. F. Parnell, and W. C. Biggs, Jr. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press, Chapel Hill, North Carolina. 255 pp.

[Editor's note: The Norfolk Museum of Natural History, initiated about 1952, ceased to exist in the early 1970s, and was taken over by the Chrysler Museum of Art. The natural history specimens collected by de Rageot were stored in a warehouse; the mammals were subsequently lost or destroyed.]

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Invertebrate Prey of *Bufo woodhousii fowleri* (Anura: Bufonidae) from a Virginia Barrier Island

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The Virginia barrier islands harbor a diverse flora and fauna considerably different from those on the mainland (Klotz, 1986; Conant et al., 1990). The island's flora and vertebrates have been the primary subjects of research and inventory (e.g., Clovis, 1968; Dueser and Brown, 1980; Hill, 1986; Scott, 1986; Cranford and Maly, 1990;

McCaffrey and Dueser, 1990a), while the terrestrial invertebrate fauna has received little attention.

Toads of the genus *Bufo* are well known prey generalists, consuming a wide range of invertebrate taxa. Most of the summaries of prey taken by *Bufo woodhousii fowleri* (Fowler's toad) refer simply to broad

taxonomic categories, generally to order or family level (e.g., Brown, 1974), or simply insects and other invertebrates (Barbour, 1971; Mount, 1975; Green and Pauley, 1987). Few papers report generic-level identifications (Bush and Menhinick, 1962), and none provide species-level information except for one observation of an amphipod as prey of this species on Smith Island (Conant et al., 1990). Prey diversity of this anuran on either the Virginia mainland or the barrier islands has not been reported.

Among the stomach content files in the U.S. Fish and Wildlife Service facility at Patuxent, Maryland (archives of the former U.S. Biological Survey) is a series of cards containing information on the prey of *B. w. fowleri* from Smith Island, Virginia. The 13 toads (in the collection of the U.S. National Museum of Natural History, USNM) were collected on 16 May 1894 (USNM 22637-22645) by C. W. Richmond and on 10-20 May 1910 (USNM 40228, 40235, 40238, 40246) by E. A. Mearns. The stomach contents of these specimens were subsequently examined by Remington Kellogg and C. W. Leister, and the prey identified to the species level where possible. Note that because the invertebrate identifications were not made by professional entomologists, the taxonomic names should be confirmed with additional research.

Smith Island lies in the southeastern portion of Northampton County, Virginia, and is the second from last large, southern island in the string of barrier islands fringing the Atlantic Ocean margin of the Delmarva peninsula. It is approximately 512 hectares in size, lies 4.7 km off the mainland, and harbors a diverse flora and assortment of plant associations (Dueser and Brown, 1980; McCaffrey and Dueser, 1990a, 1990b).

Table 1 contains the first list of invertebrate taxa for the Virginia barrier islands and the first list of prey for *B. w. fowleri* from the Commonwealth. The thirteen toads consumed a wide variety of prey species consisting mostly of terrestrial beetles and ants. Beetle taxa vastly outnumbered other taxa but hymenopterans (ants) dominated in number of individual prey. The toads that contained the largest numbers of ants (*Aphaenogaster fulva*, *Crematogaster lineolata*, *Lasius niger*) probably consumed them at colony sites. The dominance of these two insect orders in the Smith Island sample of Fowler's toads is concordant with the results in Bush and Menhinick (1962). Dipterans and hemipterans were scarcely represented. Although lepidopteran larvae and spiders were not identified to family or species, they were consumed by several individual toads and represented a substantial number of individuals. The majority of the listed taxa are mainly or strictly terrestrial invertebrates and their representation here supports Brown's

(1974) observations in Arkansas that *B. w. fowleri* are essentially limited to ground-dwelling prey.

Bush and Menhinick (1962) listed the insect genera they found in the stomachs of Fowler's toads collected around Athens, Georgia. The following genera were found in both the samples reported by Bush and Menhinick (1962) and in this paper: Coleoptera - *Amara*, *Aphodius*, *Ataenius*, *Clivina*, *Scarites*, *Selenophorus*, *Tyloderma*; Hymenoptera - *Crematogaster*. All are apparently habitat generalists, as they occur in urban and insular environments.

As prey generalists, toads should eat anything of appropriate size that they encounter in the terrestrial environment. If the prey consumed by the thirteen toads represent a random sample of invertebrates on Smith Island, then the above-listed ants and beetles of the genus *Anisodactylus* are the most commonly encountered species. The terrestrial insect diversity appears to be high, as the remaining taxa were encountered in low but similar numbers. Additional inventories of insects and other invertebrates should be undertaken on Smith Island and other Virginia barrier islands to confirm the presence of the taxa reported here, and to provide a baseline database on these animals against which future changes in the habitats can be assessed.

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Literature Cited

- Barbour, R. W. 1971. Amphibians and Reptiles of Kentucky. University of Kentucky Press, Lexington, Kentucky. 334 pp.
- Brown, R. L. 1974. Diets and habitat preferences of selected anurans in southeast Arkansas. *American Midland Naturalist* 91:468-473.
- Bush, F. M., and E. F. Menhinick. 1962. The food of *Bufo woodhousei fowleri* Hinckley. *Herpetologica* 18:110-114.
- Clovis, J. H. 1968. The vegetation of Smith Island, Virginia. *Castanea* 33:115-121.

Conant, R., J. C. Mitchell, and C. A. Pague. 1990. Herpetofauna of the Virginia barrier islands. Virginia Journal of Science 41:364-380.

Cranford, J. A., and M. S. Maly. 1990. Small mammal population densities and habitat associations on Chincoteague National Wildlife Refuge, Assateague Island, Virginia. Virginia Journal of Science 41:321-329.

Dueser, R. D., and W. C. Brown. 1980. Ecological correlates of insular rodent diversity. Ecology 61:50-56.

Hill, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). Castanea 51:265-305.

Mount, R. H. 1975. The Reptiles and Amphibians of Alabama. Agricultural Experiment Station, Auburn University, Auburn, Alabama. 347 pp.

Green, N. B., and T. K. Pauley. 1987. Amphibians and Reptiles in West Virginia. University of Pittsburgh Press, Pittsburgh, Pennsylvania. 241 pp.

McCaffrey, C. A., and R. D. Dueser. 1990a. Preliminary vascular flora for the Virginia barrier islands. Virginia Journal of Science 41:259-281.

McCaffrey, C. A., and R. D. Dueser. 1990b. Plant associations of the Virginia barrier islands. Virginia Journal of Science 41:282-299.

Scott, D. 1986. Notes on the eastern hognose snake, *Heterodon platirhinos* Latreille (Squamata, Colubridae), on a Virginia barrier island. Brimleyana 12:51-55.

Table 1. List of invertebrate prey in samples of thirteen *Bufo woodhousii fowleri* from Smith Island, Virginia. The first column in the table refers to the number of specimens with the particular prey taxon and the second is the number of prey items (total = 245).

Coleoptera

<i>Agonoderus infuscatus</i> (Dejean)	1	1
<i>Agonoderus lineola</i> (Fabr.)	3	7
<i>Agonoderus</i> sp.	1	3
<i>Amara</i> sp.	1	1
<i>Anomala undulata</i> Melsheimer	2	5
<i>Anisodactylus</i> sp.	3	13
<i>Aphodius</i> sp.	2	2

<i>Ataenius</i> sp.	2	4
<i>Ataenius cognatus</i> Le Conte	1	1
<i>Bembidium</i> sp.	1	1
<i>Brachinus</i> sp.	2	2
<i>Calleida viridipennis</i> Say	1	1
Carabidae (unid.)	4	4
Cerambycidae (unid.)	1	4
<i>Clivina</i> sp.	1	3
<i>Dyschirius</i> sp.	2	6
Elateridae (unid.)	2	1
<i>Geotrupes</i> sp.	1	1
<i>Hyperodes</i> sp.	1	1
Lampyridae (unid.)	1	1
<i>Lasioderma serricorne</i> (Fabr.)	1	1
<i>Ludius</i> sp.	1	1
<i>Melanotus (fissilis</i> Say ?)	3	5
<i>Monocrepidius bellus</i> Say	1	1
<i>Nacerda melanura</i> (Linnaeus)	2	5
<i>Platyderma</i> sp.	1	1
<i>Rhyssenus scaber</i> Haldeman	2	1
<i>Scarites subterraneus</i> Fabr.	3	4
<i>Selenophorus</i> sp.	1	1
Staphylinidae (unid.)	1	1
<i>Stenolophus</i> sp.	3	3
Tenebrionidae (unid.)	2	2
<i>Tyloderma aerea</i> Say	1	1
Diptera		
<i>Hylemyia</i> sp.	1	1
<i>Limonius</i> sp.	1	1
Hemiptera		
<i>Blissus leucopterus</i> Say	1	1
<i>Cryphula trimaculata</i> (Distant)	1	2
Hymenoptera		
<i>Aphaenogaster fulva</i> Roger	1	23
<i>Crematogaster lineolata</i> Say	2	31
<i>Lasius niger</i> (Linnaeus)	4	48
<i>Lasius</i> sp.	1	6
<i>Myrmica rubra</i>	2	3
<i>Prenolchis</i> sp.	1	1
<i>Sphecodes</i> sp.	1	1
<i>Tapinoma sessile</i> (Say)	1	4
<i>Tetramorium caespitum</i> (Linnaeus)	1	4
Orthoptera		
Acrididae (unid.)	1	1
<i>Gryllotalpa hexadactyla</i> (Perty)	1	1
Crustacea		
<i>Gammarus</i> sp.	1	9
<i>Porcellio</i> sp.	1	2
Miscellaneous Taxa		
Lepidoptera larvae	5	9
Spiders (unid.)	8	10
