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Rare Animals of Back Bay, Virginia Beach, Virginia

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Introduction

The Back Bay region is located in extreme southeastern Virginia and extends into adjacent North Carolina as the upper reach of the Currituck Sound watershed. The Back Bay ecosystem encompasses the only large intact barrier beach system in Virginia south of the Chesapeake Bay. The dynamic natural resource history of Back Bay is well known for waterfowl and fishes; however, the significance of this region is poorly known for the majority of plants, animals, and natural communities (but see Ludwig, et al. this volume).

Yet, its geographic position and relatively undeveloped condition contain habitats that are unique in Virginia and contain the best remaining example of a barrier island beach in southeastern Virginia. Since barrier island systems often contain depauperate, but unique animal communities, rare species of animals could be expected to occur. Additionally, the southeastern region of Virginia is known to constitute the northern limits of many species representative of the Floridian biotic region, increasing the likelihood for state rarities (Hoffman, 1969).

Much of the land in the Back Bay area is publicly owned and managed as a wildlife refuge, a state park, and a game management area. Therefore it is somewhat surprising that more information is not available on the rare species of the area. Modern conservation strategies that are concerned with the protection of natural diversity emphasize the need to manage natural resource lands by considering the rarest and most sensitive species first and foremost (Soule and Kohm 1989). Other land management practices are judged as to their suitability by the impacts they would have on the rarest and sensitive species.

In this paper we present a synthesis of what is known about the occurrences of rare animal species in the Back Bay area. The fauna is

examined by taxonomic groups. A discussion is presented which considers the forms of rarity for each animal grouping. Finally, recommendations for a conservation strategy that will protect the natural diversity of the Back Bay area are presented.

Methodology

Description of the study area

Figure 1 illustrates the Back Bay study area. The Back Bay drainage extends northward to the areas of Dam Neck, Redwing Lake and Lovetts Marsh. For purposes of this paper the land areas included in the study area are divided into four areas including 1) northern, 2) western (west of Back Bay), 3) barrier beach (east of Back Bay), and 4) Back Bay proper (Figure 1). A large portion of the area is in public ownership. This includes False Cape State Park (Va. Dept. of Conservation and Recreation) and Back Bay National Wildlife Refuge (U.S. Fish and Wildlife Service) as well as several military facilities.

The Back Bay area as we know it today has changed dramatically over the past 150 years. Back Bay was connected to the Atlantic Ocean during the period 1657 to 1728 by means of Old Currituck Inlet. The saltwater estuary provided for the development of a thriving fishery. The northern edge of Old Currituck Inlet was marked as the dividing line between Virginia and North Carolina in 1728, at a time when the inlet was closing. New Currituck Inlet opened in 1713 and closed in 1828, whereupon Back Bay became a body of fresh water (Hennigar 1977).

The western area of the Back Bay region consists of marshes, forest, and agricultural land. The Pungo Ridge, an old dune ridge (Oaks and Coch 1973) divides the North Landing River and Back Bay drainages (Figure 1). The ridge defines the western limit of the area considered in this paper. The northern area includes substantial freshwater wetland areas such as Lovett's Marsh,

Redwing Lake, Lake Tecumseh, and Black Gut.

Data collection

The available literature was searched to locate records for rare species from the Back Bay area. In addition, the Natural Heritage databases were queried for the occurrences of rare animals (invertebrates and vertebrates). These data are accumulated from other published records from Virginia Beach, as well as regional and state checklists. The preliminary results of the Virginia breeding bird atlas project (Virginia Society of Ornithology, 1989) were included in the literature survey. In addition, knowledgeable individuals were contacted to locate unpublished and historical information. Museum searches were made for previously collected material from the Back Bay region, particularly amphibian, reptile, mammal and selected invertebrate records.

Species were considered rare if they were so considered by the natural heritage methodology of The Nature Conservancy. In Virginia, the ranks are assigned by the Virginia Department of Conservation and Recreation's Division of Natural Heritage. Natural heritage methodology assigns two ranks for each species or natural community, one for its overall or global rank (G#) and the other for its local, or in this case state status (S#). For example, a rank of G5/S5 indicates a species that is very common throughout its range, both globally and within the state. A rank of G5/S1 indicates a very common, secure species globally, but extremely rare in the state. A G1/S1 species is extremely rare throughout its entire range. These ranks are especially useful for evaluating the conservation needs of species at multiple scales at a glance. Natural Heritage ranks are included for all species listed as rare in this paper. For further explanations of natural heritage ranks see Lipford, Rouse, and Clampitt (1987).

Field Work

Inventory for rare species in the Back Bay study area has been conducted for amphibians and reptiles (Pague and Mitchell 1982; 1987; 1991), birds (Virginia Breeding Bird Atlas), dragonflies (Carle 1983), butterflies (S. Nicolay, unpublished data) and general inventory (Division of Natural Heritage, unpublished data). Ground-dwelling invertebrates were sampled with several different techniques, including drift fence arrays with pitfalls modified from Campbell and Christman (1982). Other standard methods included aerial netting (butterflies and dragonflies), sweep-netting (grasshoppers, miscellaneous insects), dip-netting (aquatic invertebrates), turning cover objects (reptiles and amphibians), and general visual searching. Amphibians and reptiles have been

sampled using swim-in type turtle traps, minnow traps, dip-netting, and listening for calls (frogs) (Pague and Mitchell, 1991; Mitchell and Pague, 1991). Small mammals were sampled with pitfall, live, and snap-traps.

Results

Invertebrates: Kosztarab (1987) summarized the current status of inventory for the invertebrates of Virginia. He emphasized the poor level of knowledge for most of the groups, particularly insects. For the purposes of this paper we have restricted our presentation of invertebrate groups to those that have had sufficient study to make the results meaningful. There are only seven invertebrate groups which we feel are known well enough to include in this report.

Molluscs (non-marine): No freshwater unionid mussels are known from the Back Bay area. Thirteen species of land snails are known to occur in the City of Virginia Beach (Hubricht 1985). Three of these species are listed as rare by the Division of Natural Heritage, but none have been recorded from Back Bay. There has been no organized inventory for land snails in the study area.

Odonata: The dragonflies of Virginia were intensively surveyed and reported on by Carle (1983). Approximately 132 species of dragonflies are known from Virginia; 32 species occur in Virginia Beach; 17 of those occur in the Back Bay area. Of the 17, three species are considered rare (Table 1): *Brachymesia gravida*, *Erythrodiplax minuscula*, and *Libellula axilena*. These species are common throughout their range, but are known from few localities in Virginia. All are examples of southern species at the northern edges of their ranges. Two of the three species have been observed in the Back Bay area during 1990 (pers. obs.).

Data on the Zygoptera (damselflies) were not specific enough to indicate which species occurred within the Back Bay area. No rare species that were known from Virginia Beach could be confidently judged to be from Back Bay. Apparently there has been no inventory of damselflies in the Back Bay study area.

Orthoptera: Complete information on the distribution of grasshoppers in Virginia is lacking. However, at least 6 rare species are known from Virginia Beach (Otte, 1984). At present, no rare species are known from the Back Bay area, but there has been no inventory reported from Back Bay.

Heteroptera: (Shield bugs) Hoffman (1971) reviewed the shield bugs of Virginia and reported approximately 79 species that occurred in the Commonwealth. Several of the species are rare, a few globally so. However, most species show

distributions that are indicative of perceived rarity that in fact is due to lack of effort or to the difficult nature of capturing the species. Future inventory will in all probability indicate that only a few of these species are truly rare. While there has been some collecting for heteropterans in the Sandbridge area, there has been no intensive study for the Back Bay area.

Only 19 species are known from Virginia Beach and only 2 of those from the Back Bay area. These species are *Camirus porosus* and *Podisus fretus*. Both have wide ranging coastal distributions and represent state rarities.

Heteroptera: (Squash Bugs) Hoffman (1975) determined that there are approximately 27 species of the heteropteran suborder Coreoidea known from Virginia. Several of the species are rare, a few globally so. However, like the shield bugs, most species show distributions that are indicative of perceived rarity and some of which will assuredly be proven to be more common. Only 9 of these species are known from Virginia Beach and none assuredly from the Back Bay area (Hoffman 1975). Again, there has been no thorough inventory of the study area.

Coleoptera: (Cicindelidae-Tiger beetles) The southeastern beach tiger beetle (*Cicindela dorsalis media*) was recorded from the Cape Henry area of Virginia Beach (Knisley 1987). Historic records exist for "Virginia Beach" (1918)(U. Michigan Mus. of Comparative Zoology and for "Cape Henry" (no date) (Amer.Mus. Nat. Hist.) (B. Knisely, pers. comm). No records of *C. d. media* are known and recent inventory did not reveal the presence of this species on the False Cape/Back Bay beaches in 1990 (pers. obs.). This beetle occurs on the barrier island beaches of Virginia's Eastern Shore and portions of the Outer Banks of North Carolina. It is likely that this subspecies of tiger beetle occurred along the entire Atlantic coast of Virginia prior to beach disturbance by vehicular traffic.

Lepidoptera: Nineteen species of rare butterflies have distributions that include southeastern Virginia (Scott 1986). Of these, 4 species are known from or adjacent to the Back Bay area where the proper food plants exist. *Agraulis vanillae* (Gulf fritillary) is a southern species which often migrates northward in late summer. It was observed in False Cape State Park during the summer of 1990 and presumed to be breeding (J. C. Ludwig, unpub. data); it is unknown if an established population exists there. *Poanes aaroni* (saffron skipper) and *P.yehl* (Yehl skipper) are commonly seen in the Back Bay marshes (S. Nicolay, pers. comm.). *Euphyes dukesi* (scarce swamp skipper) is known from the North Landing River marshes and should be found near its host food plant, *Carex hyalinolepis*, which is known

from the Back Bay marshes.

Vertebrates

Characteristically, the vertebrates have been more thoroughly studied than most invertebrate groups. There are 19 species that have sufficient supporting evidence to record as rare breeding species of the Back Bay area. Data appear to be reasonably strong for most groups; however, birds, which are undoubtedly the most popular form of wildlife, have many species that are recorded from the area, but with no information to indicate the status of the species or whether or not they breed in the habitats of Back Bay (Virginia Society of Ornithology, 1989).

Fish: There are no rare fishes known from Back Bay (R. Southwick, pers. comm.; pers. obs.), presumably due to the highly dynamic recent history of the aquatic habitats. Fish have been thoroughly studied in Back Bay (Southwick and Norman, 1991).

Amphibians: Intensive studies conducted in the 1980's have documented the amphibian fauna of the Back Bay region (Pague and Mitchell 1982, 1987, 1991). In summary, 9 amphibian species are known from the Back Bay area; two of these species are rare.

Siren lacertina (greater siren) has been collected from freshwater marshes at the northern part of the Back Bay region (Buhlmann, in press). *Rana virgatipes* (carpenter frog) occurs in freshwater marshes on Knotts Island in the southern part of the area (C.A. Pague, pers. obs.). 7 of 16 amphibian species are known only from the more diverse habitats of the northern part of the Back Bay area (Figure 1)(Pague and Mitchell, 1991).

Reptiles: The reptiles of the study area have been studied in the past decade (Pague and Mitchell 1982, 1987, 1991, Mitchell and Pague 1990, Schwab 1988). Forty-five species are known to inhabit the study area of which three species are rare.

Ophisaurus ventralis (eastern glass lizard) is known from the barrier beach grasslands and high marshes, having been observed as recently as the summer of 1990 (D. Schwab, pers. comm.). This species was first reported from the area in 1942-44 (Werler and McCallion, 1951), but since no specimens were taken, it cannot be determined whether this or a similar species, *O. attenuatus*, was actually found. The eastern glass lizard has been found in ephemeral wet grasslands, high marshes, and dead on the sand road through maritime forests.

Crotalus horridus atricaudatus (canebrake rattlesnake) is known only from historic records from Pungo, in the western region of the study area (Werler and McCallion, 1951). No recent sightings of this species from the Back Bay area have been verified.

Caretta caretta (loggerhead sea turtle) nests on the barrier beaches of the Back Bay area including Back Bay National Wildlife Refuge and False Cape State Park. This species is considered globally rare due to its low numbers throughout most of its range. Several nests were discovered in 1989, but none in 1990 (Anthony Leger, pers. comm.). In addition, dead specimens regularly wash up on the ocean beach of the area, probably as a result of drownings from fishing nets (John Keinath, pers. comm.).

Birds: There are approximately 80 species of birds which are confirmed or probable breeding species in Virginia Beach, Virginia. There are 25 additional species that are possible breeders according to the VSO Breeding Bird Atlas preliminary results (VSO 1989). Of the confirmed/probable breeders, 61 breed in the Back Bay area. Of those species that breed in the Back Bay area, there are 3 confirmed/probable breeding species with an additional possible 8. None of the species are considered rare globally since they have wide distributions, but nearly all of the species are restricted to the barrier beach or low coastal habitats. These habitats are restricted and often threatened in Virginia.

The confirmed/probable breeding species of herons include *Ardea herodias* (great blue heron), *Egretta caerulea* (little blue heron), and *Casmerodius albus* (great egret). *Sterna hirundo* (common tern) has been observed in the Back Bay area during the breeding season (Virginia Society of Ornithology 1989), but we are aware of no nesting colonies in the area.

Possible breeding bird species include *Podilymbus podiceps* (pied-billed grebe), *Ixobrychus exilis* (least bittern), *Nycticorax nycticorax* (black-crowned night-heron), *Laterallus jamaicensis* (black rail), *Rallus elegans* (king rail), *Rallus limicola* (Virginia rail), and *Actitis macularia* (spotted sandpiper). These species are associated with brackish marshes and bordering woodlands and may likely nest in the Back Bay area. Further inventory is needed to document the nesting occurrences of these species and several other species strongly suspected to breed in the Back Bay marshes.

Mammals (non-marine): Twenty-five rare mammals are documented from Virginia. Five of those species are found in Virginia Beach and three of those are found in the Back Bay area.

Plecotus rafinesqui (Rafinesque's big-eared bat) is documented by a road-killed specimen from the Sandbridge area (R. Cashwell, unpub. data). This poorly known Virginia species is listed as a state endangered species by the Virginia Department of Game and Inland Fisheries. The specific sites inhabited by big-eared bats remain unknown.

Sylvilagus palustris (marsh rabbit) has been documented from the marsh and dune swale habitats of Back Bay National Wildlife Refuge and False Cape State Park (Handley and Patton 1947,

personal observation), as well as the western area near Pungo (Handley 1979).

Peromyscus leucopus easti (Pungo mouse) is a diminutive sub-species of the white-footed mouse *P. l. leucopus* (Paradiso 1960). The entire known range is limited to the Atlantic coast beaches from Virginia Beach, Virginia south to near Duck, North Carolina (C. O. Handley, Jr., pers. comm.). Its described habitat is the beach dune habitat. The species is widespread; however, the subspecies is considered globally rare due to its restricted range.

Trichechus manatus (manatee) has been reported during summer months from the Currituck Sound (Campbell 1977) and from Virginia's marine and estuarine waters (Handley, 1979). However, Handley considered its occurrence in Virginia due to accidental summer wandering. There are no reports of the manatee from the Back Bay study area, but its wanderings into Currituck Sound combined with the once vegetation rich waters of Back Bay make it possible that it once occurred there sporadically. Handley (1979) considered this species extirpated from Virginia although there are still occasional reports from the Chesapeake Bay in the appropriate season.

Discussion

Examining the status of survey of the fauna of the Back Bay area revealed that only three groups of organisms were well known: amphibians, reptiles, and fishes. Birds have been extensively viewed and studied, yet no comprehensive inventory has been completed. Of the mammals only the larger species, which are often viewed by the casual observer, and game or fur-bearing species are well known.

The invertebrate fauna of the Back Bay region has not been comprehensively inventoried. The dragonflies and butterflies are well known, but with the butterflies considerably less so. The ongoing inventory efforts of the Virginia Department of Conservation and Recreation and the Virginia Museum of Natural History should greatly expand our knowledge of several of the taxa (Orthoptera, Coleoptera (particularly the Carabidae), Heteroptera, and Arachnida). Although the area must be considered impacted, its relatively well-preserved condition of the terrestrial habitats presents a unique opportunity to examine an invertebrate fauna that represents a best approximation of what may have occurred prior to severe human impacts now occurring in southeastern Virginia.

Of the known animal species occurring in the Back Bay area, eleven vertebrate and nine invertebrates are considered rare. This is 2.3% of Virginia's currently recognized rare, threatened and endangered species. The rarity ranks of The

Nature Conservancy's natural heritage methodology show that only a single species *Caretta caretta*, is considered globally rare (G1-G3) (Table 1). A single subspecies, *Peromyscus leucopus easti*, is also globally rare. Table 2 shows the numbers of Virginia's and Back Bay's known rare species in each animal group. Since the Back Bay study area encompasses approximately 1% of the state's acreage, the numbers of rare species inhabiting the area are slightly higher than its relative acreage. It is noteworthy that of the 232 rare vertebrates of Virginia, approximately 8% occur within the Back Bay ecosystem.

Interpretation of regional or site checklists must be done with the understanding that the species found in the Back Bay area today may not be the same as the composition of a previous time. For example, it is highly likely that the tiger beetle, *Cicindela dorsalis media* existed on the Atlantic beach of the Currituck Banks. However, intensive use of the beach by humans, particularly vehicular traffic, is known to eliminate this species (Knisley, 1987) and this species is not found there today. Certainly the beach nesting birds, common on the barrier islands of Virginia's Eastern Shore, utilized the beaches of Back Bay, but are also not found there today. Other documented human impacts including timbering, overgrazing, and alteration of the sand dune system may have impacted other species, perhaps eliminating some. Therefore, this discussion of rare species may be based on a reduced number of species, or at least a different species composition from that of a pristine Back Bay area.

It is useful to examine the composition of rare species relative to the causes of the rarity. The notion of rarity may seem broadly understood, yet there is not a consensus on the causes or definitions of it, particularly natural rarity (Cody 1986, Gentry 1986, Rabinowitz et al., 1986). The topic is clouded further by anthropogenic causes of rarity, all of which may, in the broadest sense, be considered natural. Drawing from numerous sources we will consider the following causes of rarity: narrow geographic range, restricted habitat specificity, small numbers (even if widespread), anthropogenic losses, and peripheral populations (Table 1). It is important to consider that virtually all rare species may be considered to have suffered habitat losses from human causes; however, they may have been naturally rare due to habitat specificity or other reasons prior to human impacts.

Table 1 illustrates the causes of rarity for each rare species known from Back Bay. Each of the causes of rarity listed in the above paragraph appear to act on at least one species from the Back Bay area. However, the only species which is considered to have a narrow range is the mouse, *Peromyscus leucopus easti*. The low amount of

endemism is likely a result of the relatively young composition of the flora and the dynamic nature of near coast barrier island systems (Fisher 1977).

Three species are rare because they appear to always occur in relatively low numbers. For example, *Rana virgatipes* is distributed in much of the middle Atlantic states, but occurs in disjunct areas and often occurs in relatively low numbers at each site.

While humans have no doubt impacted all of these species, only three species were considered to have been so used or abused by humans and are now considered rare. The bat, *Plecotus rafinesqui*, used caves and large hollow trees for roosting and overwintering. These habitats have been largely destroyed or disturbed, causing declines in the numbers of bats. The rattlesnake, *Crotalus horridus atricaudatus*, as are most venomous snakes, is persecuted out of fear of their ability to injure humans and their animals. The sea turtle, *Caretta caretta*, has been killed in fishing nets, its eggs robbed from the beaches, and killed directly for food. Its numbers have declined dramatically as a result of overharyesting. However, human persecution and endemism are not the major causes of rarity in the Back Bay ecosystem.

Human impacts are not solely direct. The Back Bay area has been utilized by European-derived humans for nearly 400 years. The impacts to the natural habitat are detailed by Hennigar (1977). Aerial photographs of the Currituck Banks from 1937 make it clear that the vegetation, and therefore the animals, that we observe on the barrier beaches of southeastern Virginia today are quite different than 60 years before. In fact, Pague and Mitchell (1991) believe that the human alterations of the barrier beach habitats are the primary cause of the present amphibian and reptile species composition. Certainly, most of the other animal groups have been similarly affected.

Fourteen species of rare animals from Back Bay have specific habitat requirements or preferences that restrict them to or near the coast. Such species will be naturally rare since their habitat consists of a thin band adjacent the oceans, bays and larger rivers. Such a limited distribution combined with the popularity of the coastline with people predisposes these species to the need for special consideration.

The most frequent cause of rarity in the Back Bay area is due to species that occur at or near the northern limits of their ranges. These are considered peripherals (Table 1) and sixteen species are so distributed. This distributional pattern was considered by Hoffman (1969) in the discussion of biotic regions of Virginia and is not restricted to the fauna, but exhibited even more strongly in plants. Of the 37 species of rare plants found in the Back Bay area, almost all are found

in Virginia as peripherals (Ludwig, et al. 1991). They point out that the diversity of natural communities of the Back Bay area are generally of types found commonly south of Virginia.

The conservation significance that can be placed on an area is derived from many factors including: 1) how rare are the inhabitants, 2) how many rare species occur and are viable at the site, and 3) how important is the site to other rare or potentially rare species that may not inhabit the area (such as habitat corridors and concentration points). So how significant is the Back Bay area for the conservation of rare species?

For the single subspecies that is narrowly distributed, *Peromyscus leucopus easti*, the barrier beaches are the largest possible preserve remaining. Only two much smaller managed areas occur in North Carolina, and the remaining habitat in Virginia is currently under development. The barrier beaches may act as a genetic corridor. The Back Bay area also serves as an important corridor for other rare species, not generally considered in this paper. For example, the peregrine falcon (*Falco peregrinus*) uses the coastal beaches as a major migratory route, feeding and resting along the way. Many shorebirds, wading birds and waterfowl use the Back Bay habitats for temporary feeding and resting areas. Other organisms that assemble in or pass through Back Bay include shorebirds, waterfowl, wading birds, some warblers, several species of butterflies, and bats. Further investigations will be necessary to determine the significance of the Back Bay area to these groups. Therefore, Back Bay is significant to a few rare and other more common species as a corridor or stopover site.

The greatest significance of the Back Bay area for the conservation of rare species is for those species that are limited to the coastal habitats, therefore rare, and those species that occur at the periphery of their ranges. As for plants (Ludwig, et al. this volume), the Back Bay area supports the only Virginia populations of several rare animals and the best remaining sites for other peripheral species. The natural communities and their inhabitants should be protected as the best examples of what was always rare in Virginia.

Conservation land managers in the Back Bay area should be concerned first and foremost with the protection of known rare species and the natural communities that they inhabit. This is particularly significant in view of the increasing isolation and fragmentation of this ecosystem resulting from the rapid development of the southeastern Virginia and northeastern North Carolina coastal habitats. Efforts should be made to assure that large areas of significant habitats and their supporting ecosystem level functions, are protected from alterations which may affect the populations of rare species. Specific strategies

to protect rare invertebrates will have to wait until a more thorough inventory has been completed. However, it is likely that the protection of the rare vertebrates of the Back Bay area will aid in the protection of the invertebrate fauna.

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Number	Sex	Age	Color	Notes
1	♂	Ad.	Dark	
2	♀	Juv.	Light	
3	♂	Ad.	Dark	
4	♀	Juv.	Light	
5	♂	Ad.	Dark	
6	♀	Juv.	Light	
7	♂	Ad.	Dark	
8	♀	Juv.	Light	
9	♂	Ad.	Dark	
10	♀	Juv.	Light	
11	♂	Ad.	Dark	
12	♀	Juv.	Light	
13	♂	Ad.	Dark	
14	♀	Juv.	Light	
15	♂	Ad.	Dark	
16	♀	Juv.	Light	
17	♂	Ad.	Dark	
18	♀	Juv.	Light	
19	♂	Ad.	Dark	
20	♀	Juv.	Light	
21	♂	Ad.	Dark	
22	♀	Juv.	Light	
23	♂	Ad.	Dark	
24	♀	Juv.	Light	
25	♂	Ad.	Dark	
26	♀	Juv.	Light	
27	♂	Ad.	Dark	
28	♀	Juv.	Light	
29	♂	Ad.	Dark	
30	♀	Juv.	Light	
31	♂	Ad.	Dark	
32	♀	Juv.	Light	
33	♂	Ad.	Dark	
34	♀	Juv.	Light	
35	♂	Ad.	Dark	
36	♀	Juv.	Light	
37	♂	Ad.	Dark	
38	♀	Juv.	Light	
39	♂	Ad.	Dark	
40	♀	Juv.	Light	
41	♂	Ad.	Dark	
42	♀	Juv.	Light	
43	♂	Ad.	Dark	
44	♀	Juv.	Light	
45	♂	Ad.	Dark	
46	♀	Juv.	Light	
47	♂	Ad.	Dark	
48	♀	Juv.	Light	
49	♂	Ad.	Dark	
50	♀	Juv.	Light	

Table 1. The rare animals known from the Back Bay study area and their causes of rarity. Ranks are those of The Nature Conservancy's Natural Heritage Methodology.

Group	Natural Heritage Rank ¹	Range Narrow	Habitat Specific	Low Numbers	Human Losses	Peripheral Population
INVERTEBRATES						
Odonata (dragonflies only)						
<i>Brachymesia gravida</i>	G5/S1					X
<i>Erythrodiplax minuscula</i>	G5/S2					X
<i>Libellula axilena</i>	G5/S1					X
Heteroptera (shield bugs)						
<i>Camirus porosus</i>	G5/S1		X			X
<i>Posidus fretus</i>	G5/S1		X			X
Lepidoptera (butterflies only)						
<i>Agraulis vanillae</i>	G5/S1					X
<i>Poanes aaroni</i>	G4/S3					X
<i>Poanes yehl</i>	G4/S3					X
<i>Euphyes dukesi</i>	G3G4/S2		X			X
VERTEBRATES						
Amphibia						
<i>Siren lacertina</i>	G5/S1					X
<i>Rana virgatipes</i>	G5/S3			X		
Reptilia						
<i>Ophisaurus ventralis</i>	G5/S1					X
<i>Crotalus horridus atricaudatus</i>	G5/S1				X	X
<i>Caretta caretta</i>	G3/S1		X	X	X	X
Aves²						
<i>Ardea herodias</i>	G5/S3		X			
<i>Egretta caerulea</i>	G5/S2		X			
<i>Casmerodius albus</i>	G5/S2		X			
<i>Sterna hirundo</i>	G4/S2		X			
<i>Podilymbus podiceps</i>	G5/S3					X
<i>Ixobrychus exilis</i>	G5/S2		X			
<i>Nycticorax nycticorax</i>	G5/S3		X			
<i>Laterallus jamaicensis</i>	G4/SU		X			
<i>Rallus elegans</i>	G4/S2		X			
<i>Rallus limicola</i>	G5/S2		X			
<i>Actitis macularia</i>	G5/S3		X			
Mammalia						
<i>Plecotus rafinesqui</i>	G4/S1			X	X	X
<i>Sylvilagus palustris</i>	G5/S31					X
<i>Peromyscus leucopus easti</i>	G5T1/S1	X				

¹ Natural Heritage Ranks are based on the numbers of occurrences of the species, numbers of individuals, threats, and viability. G-ranks represent its rarity throughout the world and S-ranks represent its rarity throughout the state. S1 - extremely rare or low numbers, S2 - very rare or low numbers, S3 - rare, S4 - abundant or large numbers, and S5 - common and believed to be secure. The abbreviation SU represents an uncertain status. A T-rank represents that of a subspecies throughout its range.

² Includes the three known and 8 rare species thought to breed in the Back Bay area.

Table 2. The numbers of rare species extant in Back Bay and Virginia, by group. The numbers for invertebrates are based on only a few well known taxa.

GROUP	STATE	BACK BAY
Selected Invertebrates		
Odonata (dragonflies only)	132	3
Heteroptera (shield bugs only)	79	2
Lepidoptera (butterflies only)	34	4
Total Invertebrate	245	9
Vertebrates		
Fish (freshwater only)	95	0
Amphibia	18	2
Reptilia	16	3
Aves	79	3
Mammalia	24	3
Total Invertebrate	232	11
Total Animals	477	20

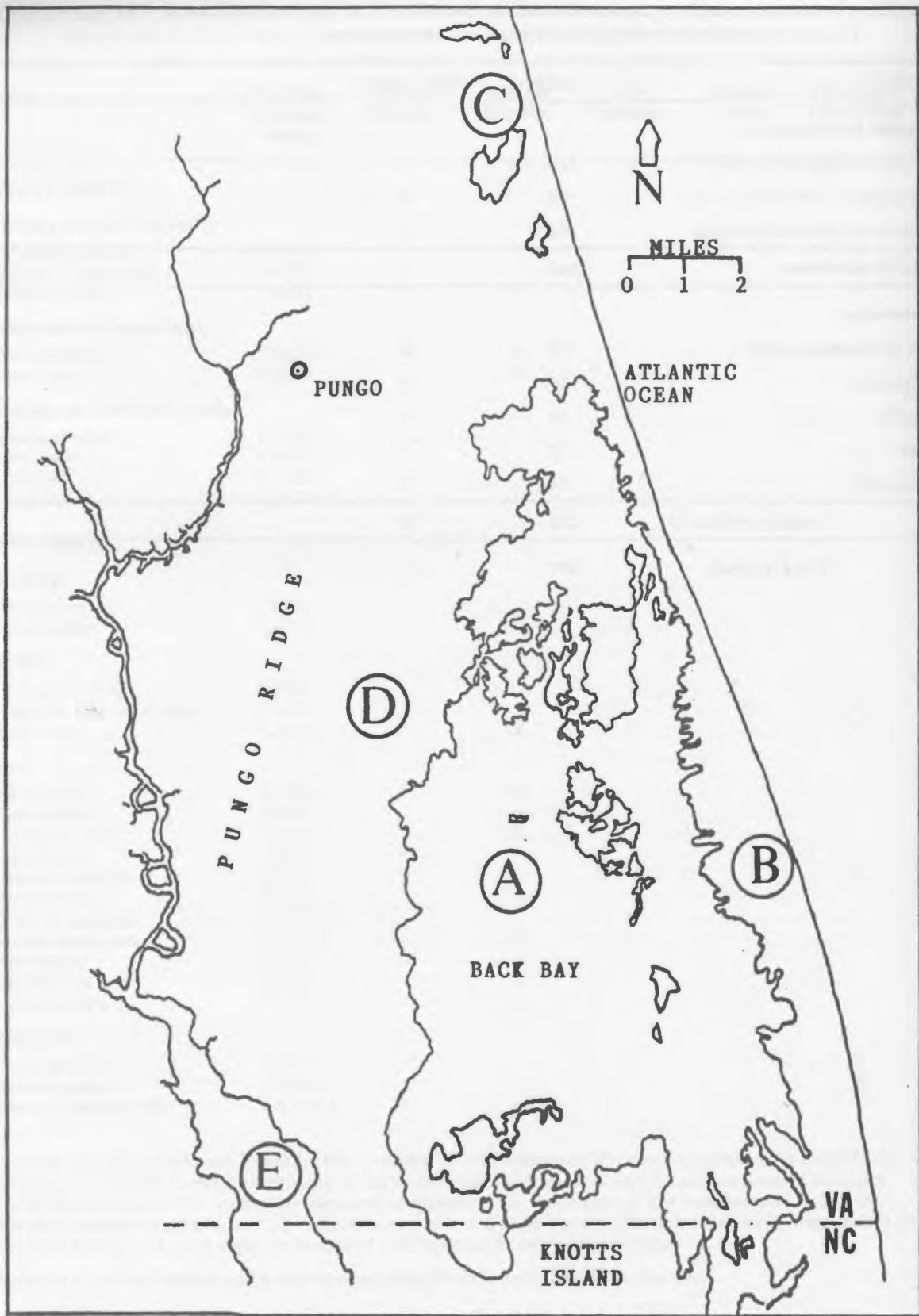


Figure 1. The Back Bay drainage study area in southeastern Virginia. Capital letters represent the following portions of the study area: A = Back Bay Proper, B = the barrier beach area, C = northern portion, D = western area, and E = North Landing River. The Pungo Ridge divides the North Landing and Back Bay drainages.