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Annotated Checklist of Terrestrial Mammals of the Virginia Barrier Islands and the Adjacent Delmarva Peninsula Mainland

Nancy D. Moncrief^{1,*}, John H. Porter², and Raymond D. Dueser^{1,2,3}

¹Virginia Museum of Natural History, 21 Starling Avenue, Martinsville, VA 24112. ²Department of Environmental Sciences, University of Virginia, 291 McCormick Road, Charlottesville, VA 22904-4123. ³Department of Wildland Resources, Utah State University, 5230 Old Main Hill, Logan, UT 84322-5230.*Corresponding author - nancy.moncrief@vmnh.virginia.gov

contact information:

NDM phone 276.634.4177 nancy.moncrief@vmnh.virginia.gov

JHP phone 434.924.8999 jhp7e@virginia.edu

RDD phone 435.770.3265 rdd6b@virginia.edu

1 **Abstract** - The Virginia barrier islands lie along the seaward margin of the southern Delmarva
2 Peninsula in the mid-Atlantic region of the United States, and collectively they comprise an
3 internationally recognized biosphere reserve. Despite this recognition, no comprehensive
4 checklist of mammals exists for the islands or the adjacent Delmarva Peninsula mainland. Here
5 we report on the species composition of terrestrial mammals of this region based on 1) a search
6 of museum collections, 2) a compilation of literature sources and personal communications, and
7 3) our own extensive fieldwork (1975–2020). We document 6 orders, 12 families, and 25 species
8 of native terrestrial mammals. The islands are depauperate in comparison with the mainland,
9 with several native species missing from the islands. We also document 3 orders, 3 families, and
10 4 species of non-native mammals that are currently established on the islands. In addition, we
11 present a historical overview of livestock species that were introduced to the islands, but (with
12 one exception) no longer occur there. European settlement of the mainland and the islands began
13 in the early 1600s; however, permanent human structures have been absent from most of the
14 islands for the past 60+ years, leaving them undeveloped and in a natural state. These islands are
15 undergoing rapid geological and ecological change under the pressure of accelerated sea-level
16 rise as a result of climate change. This checklist provides a foundation for future
17 biogeographic studies of mammals in this region and serves as a baseline against which to
18 measure future ecological and distributional changes.

19

20

Introduction

21 The entire coastline of the mid-Atlantic region of the United States is undergoing rapid
22 geological and ecological change under the pressure of accelerated sea-level rise (Boon and
23 Mitchell 2015). Many of the Virginia barrier and marsh islands lying along the seaward margin
24 of the southern Delmarva Peninsula are experiencing unprecedented rates of erosion and
25 migration over sub-decadal time scales (Deaton et al. 2017). Consequent changes in the
26 landscapes of these undeveloped, essentially wild, islands are readily apparent (Wolner et al.
27 2013, Zinnert et al. 2019).

28 The first complete checklist of mammals on any of the islands was compiled for Assateague
29 Island by Paradiso and Handley (1965). Dueser et al. (1979) subsequently conducted systematic
30 surveys and reported comprehensive lists for eleven of the islands south of Assateague. Since
31 then, numerous studies have contributed to our knowledge of the ecology and genetics of the
32 land mammals that inhabit these islands (Adkins 1980, Cranford and Maly 1990, Dueser and
33 Brown 1980, Dueser and Porter 1986, Dueser and Terwilliger 1987, Dueser et al. 2013, Forys
34 and Dueser 1993, Forys and Moncrief 1994, Kirkland and Fleming 1990, Krim et al. 1990,
35 Loxterman et al. 1998, Moncrief and Dueser 2001, Moncrief et al. 2017, Porter and Dueser 1982,
36 Porter et al. 2015, Scott and Dueser 1992). However, with the exception of Paradiso and Handley
37 (1965) and Dueser et al. (1979), there have been no attempts to summarize the entire mammalian
38 species composition for this group of islands.

39 Annotated checklists provide fundamental information for conservation and management
40 efforts as well as for other analyses, such as those that consider questions related to patterns and
41 drivers of species occurrence (e.g., Turvey and Fritz 2011, Svenning et al. 2011). We attempt to
42 provide 1) a comprehensive list of species of terrestrial mammals for the Virginia barrier islands
43 and the adjacent Delmarva Peninsula mainland; 2) a comprehensive list of islands on which each

44 species is a resident; and 3) details of the multiple lines of evidence we used to compile these
45 lists. Based on 45 years of fieldwork on the islands (1975–2020), this checklist provides a
46 baseline against which to assess the response of the terrestrial mammal fauna to the panoply of
47 ecological changes occurring on the islands.

48

49 **Study Area**

50 The Delmarva Peninsula includes of the state of Delaware, the Eastern Shore of Maryland
51 (Caroline, Cecil, Dorchester, Kent, Queen Annes, Somerset, Talbot, Wicomico, and Worcester
52 counties), and the Eastern Shore of Virginia (Accomack and Northampton counties). This
53 peninsula has clear-cut geographical boundaries, a rich archeological history, a long written
54 record of naturalist observations, and extensive remaining potential habitat for mammalian
55 species (Hogue and Hayes 2015).

56 The Virginia barrier islands extend ~150 km along the seaward margin of the Peninsula,
57 centered at approximately 37°30' North and 75°40' West in Accomack and Northampton
58 counties, Virginia, USA (Fig. 1). This was the land of the Accomac and Occohannock people at
59 the time of European settlement (Rountree and Davidson 1997). This 1,000-km² landscape is a
60 dynamic, highly fragmented mosaic of open bays, salt marshes, marsh islands, back barriers, and
61 barrier islands that formed during a period of Holocene era sea-level rise ~5000 years ago
62 (Newman and Munsart 1968, Hayden et al. 1991). We have identified 25 barrier and marsh
63 islands for sampling during the time we have been working on the islands (Fig. 1). The islands
64 lie from 0.4 to 12.1 km offshore, range from 1 to 10 m in elevation, and vary from 14 to 9,344 ha
65 in area. Vegetation composition varies from emergent sandbars to low-lying marsh, to grassland
66 with extensive overwash zones, to shrub thickets, and finally to mature forests on elevated

67 islands (McCaffrey and Dueser 1990). The soils are typically poorly drained, loamy soils in the
68 marshes and deep sands on the uplands (Cobb and Smith 1989; Peacock and Edmonds 1994).
69 The islands are separated by estuarine marshes and bays that connect to the Atlantic Ocean
70 through deep inlets, which are drowned drainage basins (Krantz et al. 2016, Oertel et al. 1989).
71 Moncrief et al. (2017:SD1) provide a brief overview of the recent Holocene geologic history of
72 this watery landscape.

73 As measured from the National Oceanic and Atmospheric Administration (NOAA) Coastal-
74 Change Analysis Program (C-CAP) land cover data layers for the lower Delmarva Peninsula
75 (Virginia and Maryland) for the year 2001 (<http://www.csc.noaa.gov/crs/lca/ccap.html>), the
76 average distance between nearest-neighbor islands was 808 m (SE = 162.7), and the average
77 distance between adjacent islands that are separated by deep, swift-running inlets was 518 m (SE
78 = 83.5). The average distance from the mainland was 5,835 m (SE = 745.5; range: 351–12,868
79 m). Given the rates of erosion and accretion in this dynamic environment, the distances between
80 nearest-neighbor islands might be subject to changes on the order of 10s to 100s of meters in any
81 given year.

82 The three northernmost islands (Assateague, Chincoteague and Wallops) have permanent
83 human residences and facilities. Some of the other islands have been occupied sporadically since
84 at least the 1600s, but have been without permanent structures since a series of severe coastal
85 storms in the early 1930s (Badger and Kellam 1989, Barnes and Truitt 1997, Graham 1976a).
86 From the mid-seventeenth century into the mid-twentieth, many of the islands were used to
87 pasture horses, cattle, sheep, and swine (Barnes and Truitt 1997, Graham 1976b). The islands
88 now exist in a natural state, with the evidence of human presence largely absent. Except for a
89 few small, scattered private in-holdings, the islands are held in public ownership by the U.S. Fish

90 and Wildlife Service, or the Commonwealth of Virginia, or are privately owned by The Nature
91 Conservancy (TNC). TNC holdings comprise the Volgenau Virginia Coast Reserve (VVCR),
92 recognized as a National Science Foundation (NSF) Long-Term Ecological Research (LTER)
93 site (Hayden et al. 1991), a Man and the Biosphere Reserve, and a Western Hemisphere
94 International Shorebird Reserve Network site (Badger 1978, 1991, 1997).

95 The study islands represent a variety of physiographies and vegetation structures: marsh
96 (Chimney Pole, Fowling Point, Mink, Raccoon), grassland (Assawoman, Little Cobb,
97 Metompkin, Myrtle, Sandy, Ship Shoal), shrubland (Cedar, Cobb, Hog, Holly Bluff, Mockhorn,
98 Rogue, Wreck), and forested (Assateague, Chincoteague, Fishermans, Parramore, Revel,
99 Skidmore, Smith, Wallops) islands. Cedar and Hog formerly supported forest, but no longer do.
100 Given the effects of area and elevation, habitat complexity on these islands is cumulative, so that
101 forested islands also have areas of shrubland, grassland, and marsh; shrubland islands have
102 grassland and marsh; and grassland islands have marsh (Dueser and Brown 1980). Assateague,
103 Chincoteague, Fishermans, and Wallops islands are connected to the Peninsula mainland by
104 highway bridges, but all the others in this study are accessible only by crossing open tidal waters.
105 Given the relative absence of the usual sources of anthropogenic threat on barrier islands (e.g.,
106 development pressure, livestock grazing, and wandering pets – Hice and Schmidly 2002), the
107 Virginia islands provide an ideal natural laboratory for assessing the impacts and implications of
108 natural processes on the structure and function of an intact coastal ecosystem.

109

110 Materials and Methods

111 We compiled collection information for specimens in the Mammal Collection of the Virginia
112 Museum of Natural History (VMNH), and we searched 312 electronic museum databases using

113 the VertNet portal on 16 August 2020. In addition to VMNH, the following institutions report
114 specimens from Accomack and/or Northampton counties, Virginia: American Museum of
115 Natural History (AMNH), California Academy of Sciences (CAS), Cornell University Museum
116 of Vertebrates (CUMV), The Field Museum of Natural History (FMNH), University of Kansas,
117 Natural History Museum and Biodiversity Research Center (KU), Louisiana State University,
118 Museum of Natural Science (LSUMZ), University of California, Berkeley, Museum of
119 Vertebrate Zoology (MVZ), North Carolina Museum of Natural Sciences (NCSM), University of
120 Michigan Museum of Zoology (UMMZ), United States National Museum of Natural History
121 (USNM), University of Washington, Thomas Burke Memorial Washington State Museum
122 (UWBM). In addition, between 1975 and 2020, we conducted live-trapping surveys (more than
123 45,000 trap nights) and systematic track surveys (more than 400 observer days) on the islands
124 and the adjacent mainland in Accomack and Northampton counties, Virginia (Dueser et al. 2018,
125 Porter and Dueser 2021). The sandy substrate and generally patchy vegetation make the islands
126 ideal for detecting identifiable tracks and scat, and the low diversity of species reduced the
127 potential for misidentifications. We also compiled and synthesized information from publications
128 and from unpublished reports by colleagues, including capture reports from >100,000 trap nights
129 by USDA Wildlife Services between 2001 and 2018.

130 We consider a native species to be “resident” on an island based on its persistent occurrence
131 over multiple surveys, which we interpret to be indicative of a self-sustaining population.
132 Furthermore, in most cases we also had evidence of reproduction and recruitment for species we
133 consider to be resident. Based on these same criteria, we consider a non-native species to be
134 “established” on an island. We consider species that we detected only infrequently or that we

135 found to be undetectable in multiple recent sampling events to be “absent” from an island or
136 perhaps only transient; only further sampling can clarify the status of these cases.

137

138 **Results**

139 All species in Table 1 occur on the Virginia barrier islands and/or the adjacent mainland of
140 the southern Delmarva Peninsula in Accomack and Northampton counties, Virginia. For each of
141 these, we provide details of their occurrence. Scientific names follow Pagels and Moncrief
142 (2015), and common, or vernacular, names follow Wilson and Reeder (2005).

143

144 **ORDER DIDELPHIMORPHIA (pouched mammals)**

145 **Family Didelphidae (opossums)**

146 *Didelphis virginiana* Kerr (Virginia Opossum). Specimens from the mainland: Accomack
147 Co. (USNM). Specimens from Assateague Island (USNM). We have capture records from
148 Assawoman, Metompkin, and Wallops islands, one report from Hog Island (Bailey 1946), and
149 capture records from Northampton Co. We consider Virginia Opossums to be resident on
150 Assateague and Wallops islands.

151

152 **ORDER SORICOMORPHA (insectivores)**

153 **Family Soricidae (shrews)**

154 *Sorex cinereus* Kerr (Cinereus Shrew). Specimens from the mainland: Accomack Co. (MVZ,
155 USNM). Before Moncrief and Dueser (1998) reported the first record of the Cinereus Shrew
156 from Accomack Co., there was no evidence of its presence on Virginia’s Eastern Shore. We
157 found no specimens from the islands, and we have no capture records.

158 *Blarina brevicauda* (Say) (Northern Short-tailed Shrew). Specimens from the mainland:
159 Accomack Co. (MVZ, USNM); Northampton Co. (AMNH, USNM, VMNH). In addition, we
160 have capture records from Raccoon Island (Dueser et al. 1979) and Wallops Island (Baker et al.
161 2015). We consider Northern Short-tailed Shrews to be resident on Wallops Island.

162 *Cryptotis parva* (Say) (North American Least Shrew). Specimens from the mainland:
163 Accomack Co. (MVZ); Northhampton Co. (AMNH, VMNH). Specimens from the following
164 islands: Assateague (NCSM, USNM, VMNH); Chincoteague (CUMV, MVZ, NCSM, USNM);
165 Fowling Point (VMNH); Wallops (USNM). We have capture records from Cedar Island. We
166 consider North American Least Shrews to be resident on Assateague, Chincoteague, Fowling
167 Point, and Wallops islands.

168

169 Family Talpidae (moles)

170 *Scalopus aquaticus* (L.) (Eastern Mole). Specimens from the mainland: Accomack Co.
171 (MVZ); Northampton Co. (UMMZ, USNM). Bailey (1946) reported this species from Cobb
172 Island. We question this report, and we consider Eastern Moles to be absent from the Virginia
173 barrier islands.

174 *Condylura cristata* (L.) (Star-nosed Mole). Specimens from the mainland: Accomack Co.
175 (USNM). We have capture records of the Star-nosed Mole from the Northampton Co. mainland.

176

ORDER LAGOMORPHA hare-shaped mammals

178 Family Leporidae (hares and rabbits)

179 *Lepus californicus* Gray (Black-tailed Jackrabbit). Specimens from the mainland: none.
180 Specimens from Cobb (VMNH) and Little Cobb (USNM) islands. We have reliable reports (R.

181 Boettcher, Virginia Department of Wildlife Resources, Machipongo, VA, pers. comm.) of this
182 species on Hog Island, and Clapp et al. (1976) reported observations on Rogue Island. This
183 species is not native to Virginia (Pagels and Moncrief 2015). We agree with the conclusion of
184 Clapp et al. (1976) that Black-tailed Jackrabbits are established only on Cobb Island, where a
185 shipping error led to the accidental introduction of mail-order jackrabbits from Kansas in the
186 1960s, rather than the mail-order *Sylvilagus floridanus* (J.A. Allen) (Eastern Cottontail) that had
187 been planned (H. Bowen, Willis Wharf, VA, pers. comm.).

188 *Sylvilagus floridanus* (J.A. Allen) (Eastern Cottontail). Specimens from the mainland:
189 Accomack Co. (MVZ, USNM); Northampton Co. (USNM). Specimens from the following
190 islands: Assateague (USNM), Chincoteague (USNM), Fishermans (USNM), Hog (MVZ,
191 USNM, VMNH), and Smith (USNM). Hanlon et al. (1989) reported three sightings on
192 Parramore Island, and E. Berge (Virginia Tech, Blacksburg, VA, pers. comm.) reported 67
193 camera-trap photos of Eastern Cottontails on Parramore Island. Baker et al. (2015) observed this
194 species on Wallops Island. We have track records from Assawoman, Revel, and Ship Shoal
195 islands. Mayne et al. (1981) reported observing tracks of this species on Cedar Island. The status
196 of the Eastern Cottontail on Fishermans Island is uncertain. Blem and Pagels (1973) reported
197 Eastern Cottontail skulls in pellets regurgitated by *Tyto alba* (Scopoli) (Barn Owl) on
198 Fishermans Island in 1971 and 1972. B. Truitt (The Nature Conservancy, Nassawadox, VA, pers.
199 comm.) observed the Eastern Cottontail on Fishermans Island in 1988. Fies (1991), however,
200 reported that this species is probably absent from Fishermans and Smith islands. Furthermore,
201 despite extensive fieldwork during the past 21 years, P. Denmon (U.S. Fish and Wildlife Service,
202 Cape Charles, VA, pers. comm.) has no recent reports of Eastern Cottontails from Fishermans

203 Island. We consider Eastern Cottontails to be resident on Assateague, Chincoteague, Hog,
204 Parramore, Revel, and Wallops islands.

205

206 **ORDER RODENTIA (gnawing mammals)**

207 **Family Sciuridae (squirrels)**

208 *Sciurus carolinensis* Gmelin (Eastern Gray Squirrel). Specimens from the mainland:
209 Northampton Co. (LSUMZ, USNM, VMNH). Specimens from Chincoteague Island (VMNH).
210 We have capture records from Assateague Island. Dueser et al. (1979) reported single sightings
211 of this species on Parramore and Smith islands. B. Truitt (pers. comm.) reported a dead Eastern
212 Gray Squirrel in the mouth of a Red Fox, *Vulpes vulpes* (L.), on Parramore Island in 1977.
213 Hanlon et al. (1989) later reported Eastern Gray Squirrels on Parramore Island. Baker et al.
214 (2015) observed this species on Wallops Island in summer 2015, and one of us (RDD) observed
215 an Eastern Gray Squirrel on Smith Island in October 2015. Based on 150+ observer days of field
216 work since 1990, we now consider the Eastern Gray Squirrel to be absent from Parramore Island,
217 but resident on Chincoteague, Smith, and Wallops islands.

218 *Sciurus niger* L. (Eastern Fox Squirrel). Specimens from the mainland: none. Specimens
219 from Assateague Island (VMNH). We have capture records from the mainland in Northampton
220 Co. This species was on the Federal Endangered Species List (as Delmarva Fox Squirrel, *S. n.*
221 *cinereus* L.). It was considered extirpated from Virginia at the time of listing in 1967. Later, it
222 was reintroduced to Chincoteague National Wildlife Refuge (NWR) on Assateague Island in
223 Accomack Co. (1968–1971) and to Brownsville Farm, near Nassawadox, in Northampton Co.
224 (1982–83). The Chincoteague NWR introduction was successful, while the Brownsville
225 introduction failed (Terwilliger 2000). We consider the Eastern Fox Squirrel to be resident on

226 Assateague Island, but, despite occasional uncorroborated reports in Northampton Co., not on the
227 mainland.

228 *Glaucomys volans* (L.) (Southern Flying Squirrel). We are not aware of any specimens from
229 Accomack and Northampton counties, Virginia. We have capture records of the Southern Flying
230 Squirrel on the Accomack Co. mainland, but we are not aware of any reports of captures or
231 observations on the islands or in Northampton Co.

232

233 **Family Cricetidae (cricetids)**

234 *Oryzomys palustris* (Harlan) (Marsh Oryzomys). Specimens from the mainland: Accomack
235 Co. (MVZ, NCSM, USNM, VMNH); Northampton Co. (AMNH, FMNH, UMMZ, VMNH).
236 Specimens from the following islands: Assateague (USNM, VMNH); Cedar (MVZ, VMNH);
237 Chimney Pole (VMNH); Chincoteague (CUMV, NCSM, USNM); Cobb (USNM, VMNH);
238 Fishermans (VMNH); Fowling Point (VMNH); Hog (USNM, VMNH); Holly Bluff (VMNH);
239 Little Cobb (VMNH); Metompkin (VMNH); Mink (VMNH); Mockhorn (VMNH); Myrtle
240 (VMNH); Parramore (USNM, VMNH); Raccoon (VMNH); Revel (VMNH); Rogue (VMNH);
241 Sandy (VMNH); Ship Shoal (VMNH); Skidmore (USNM); Smith (USNM, VMNH); Wallops
242 (USNM, VMNH); Wreck (USNM, VMNH). In addition, we have capture records from
243 Assawoman Island. We consider the Marsh Oryzomys to be resident on all these islands.

244 *Peromyscus leucopus* (Rafinesque) (White-footed Deermouse). Specimens from the
245 mainland: Accomack Co. (MVZ, USNM, VMNH); Northampton Co. (AMNH, USNM, VMNH).
246 Specimens from the following islands: Assateague (USNM, VMNH); Cedar (VMNH);
247 Chincoteague (NCSM, USNM); Fishermans (VMNH); Hog (MVZ, USNM, VMNH); Wallops
248 (USNM). In addition, we have capture records from Fowling Point Island. We consider the

249 White-footed Deer mouse to be resident on Assateague, Chincoteague, Fishermans, and Wallops
250 islands.

251 *Microtus pennsylvanicus* (Ord) (Meadow Vole). Specimens from the mainland: Accomack
252 Co. (MVZ, USNM, VMNH); Northampton Co. (AMNH, FMNH, NCSM, UMMZ, USNM,
253 VMNH). Specimens from the following islands: Assateague (NCSM, USNM, VMNH); Cedar
254 (MVZ, VMNH); Chincoteague (CUMV, MVZ, NCSM, USNM); Fowling Point (VMNH); Hog
255 (VMNH); Metompkin (VMNH); Mockhorn (VMNH); Myrtle (VMNH); Parramore (USNM,
256 VMNH); Revel (VMNH); Ship Shoal (VMNH); Smith (USNM, VMNH); Wallops (USNM,
257 VMNH). In addition, we have capture records from Holly Bluff Island. Blem and Pagels (1973)
258 reported Meadow Voles in Barn Owl pellets collected on Fishermans Island. It is possible that
259 the owl(s) captured the voles on the nearby Northampton Co. mainland, because we have never
260 captured Meadow Voles on Fishermans Island during numerous trapping sessions from 1989–
261 2015, and neither has R. Rose (Old Dominion University, Norfolk, VA, pers. comm.), who has
262 also conducted extensive live-trapping surveys of small mammals on Fishermans Island and the
263 Northampton Co. mainland. Mayne et al. (1981) reported captures of the Meadow Vole from
264 Assawoman Island. We consider it to be resident on Assateague, Chincoteague, Fowling Point,
265 Holly Bluff, Mockhorn, Parramore, Smith, and Wallops islands.

266 *Microtus pinetorum* (Le Conte) (Woodland Vole). Specimens from the mainland: Accomack
267 Co. (KU, MVZ, USNM, VMNH); Northampton Co. (AMNH, UMMZ, USNM, VMNH). In
268 addition, Baker et al. (2015) captured Woodland Voles on Wallops Island, and we consider this
269 species to be resident on that island.

270 *Ondatra zibethicus* (L.) (Common Muskrat). Specimens from the mainland: Accomack Co.
271 (MVZ, USNM); Northampton Co. (VMNH). Specimens from the following islands: Assateague

272 (USNM); Chincoteague (CUMV, USNM); Metompkin (VMNH). We observed tracks on Cedar,
273 Cobb, Hog, Myrtle, Parramore, Revel, Ship Shoal, Smith, and Wreck islands. We also observed
274 multiple lodges on Hog Island (Porter 2018). Mayne et al. (1981) reported tracks of this species
275 from Assawoman Island. We consider Muskrats to be resident on all these islands.

276

277 **Family Dipodidae (jumping mice)**

278 *Zapus hudsonius* (Zimmermann) (Meadow Jumping Mouse). Specimens from the mainland:
279 Accomack Co. (USNM, VMNH). Specimens from the following islands: Assateague (USNM,
280 VMNH). We consider the Meadow Jumping Mouse to be resident on Assateague Island.

281

282 **Family Muridae (murids)**

283 *Mus musculus* L. (House Mouse). Specimens from the mainland: Accomack Co. (MVZ,
284 USNM, VMNH); Northampton Co. (CAS, VMNH). Specimens from the following islands:
285 Assateague (USNM, VMNH), Cedar (MVZ, VMNH), Chincoteague (CUMV, MVZ, NCSM,
286 USNM); Fishermans (VMNH), Fowling Point (VMNH); Hog (MVZ, USNM, VMNH);
287 Metompkin (VMNH), Myrtle (VMNH), Parramore (USNM), Raccoon (VMNH); Revel
288 (VMNH); Smith (USNM, VMNH); Wallops (USNM). This species is not native to Virginia
289 (Pagels and Moncrief 2015). We consider the House Mouse to be established on Assateague,
290 Cedar, Chincoteague, Fishermans, Fowling Point, Hog, Metompkin, Parramore, Raccoon, Smith,
291 and Wallops islands.

292 *Rattus norvegicus* (Berkenhout) (Brown Rat). Specimens from the mainland: none.
293 Specimens from the following islands: Assateague (USNM); Cobb (VMNH); Hog (VMNH);
294 Metompkin (VMNH); Parramore (USNM); Revel (VMNH). In addition, we have capture

295 records from Cedar, Chimney Pole, and Sandy islands. Blem and Pagels (1973) reported Brown
296 Rat skulls from Barn Owl pellets collected on Fishermans Island, but we have no capture records
297 to confirm the current presence of this species on the island despite extensive live trapping. It is
298 possible that the rats were captured on the nearby Northampton Co. mainland. We observed
299 tracks on Little Cobb Island. This species is not native to Virginia (Pagels and Moncrief 2015).
300 We consider Brown Rats to be established on Assateague, Chincoteague, Hog, Metompkin,
301 Parramore, and Revel islands.

302

303 **ORDER CARNIVORA (flesh-eating mammals)**

304 **Family Canidae (dogs, foxes, and allies)**

305 *Canis latrans* Say (Coyote). We found no specimens from Accomack and Northampton
306 counties, Virginia. We have capture records from Assateague, Fishermans, and Parramore
307 islands. We have camera-trap records from the Northampton Co. mainland. We have observed
308 Coyote tracks on Metompkin and Sandy islands. We do not believe Coyotes are resident on any
309 of the Virginia barrier islands. Hogue and Hayes (2015) argued that the Coyote was not found on
310 the Peninsula at the time of European arrival, but rather arrived through natural range expansion
311 following the extirpation of the Wolf (*Canis lupus* L.). We consider the Coyote to be a native
312 resident of Accomack and Northampton counties as a result of natural range expansion, but we
313 do not consider it to be resident on any of the islands.

314 *Vulpes vulpes* (L.) (Red Fox). Specimens from the mainland: Northampton Co. (VMNH).
315 Specimens from the following islands: Assateague (USNM); Chincoteague (USNM); Hog
316 (USNM); Metompkin (VMNH); Parramore (VMNH). In addition, we have capture records from
317 Assawoman, Cedar, and Wallops islands. We have observed tracks on Cobb and Revel islands.

318 Notably, one of us (RDD) watched a Red Fox swim from Parramore Island to Revel Island on 5
319 November 2002. We have reliable reports from January 2018 of a Red Fox crossing the ice from
320 Wildcat Marsh on Chincoteague Island over to Assateague Island (D. Leonard, Chincoteague,
321 VA, pers. comm.) and of a Red Fox leaving the mainland from a small neck called “Webb’s
322 Island” in Northampton Co., heading east out onto a vast expanse of icy marsh (M. Killmon, The
323 Nature Conservancy, Nassawadox, VA, pers. comm.). We consider the Red Fox to be resident on
324 Assateague, Chincoteague, Parramore, and Wallops islands.

325 Hogue and Hayes (2015) believed that the Red Fox is not a native species on the Delmarva
326 Peninsula, because it was not present prior to European colonization. Red Foxes in the eastern
327 United States were long thought to be solely of European origin, introduced to the American
328 colonies for sport hunting (Churcher 1959, Kamler and Ballard 2002). However, recent genetic
329 studies indicate that the history of Red Foxes on the Delmarva Peninsula is complicated.
330 Kasprowicz et al. (2016) and Kuo et al. (2019) presented genetic evidence that native
331 populations of North American Red Foxes underwent natural range expansion, moving
332 southward from New England around the same time that European Red Foxes from Britain were
333 introduced to the Delmarva Peninsula. The expanding wave of native Red Fox populations
334 eventually reached the Delmarva Peninsula, and the native animals interbred with British foxes,
335 producing admixed native/non-native populations on the Delmarva Peninsula (Kasprowicz et al.
336 2016, Kuo et al. 2019). Complicating the situation further, Kasprowicz et al. (2016) also found
337 evidence of subsequent interbreeding between captive-bred animals (escapees from fur farms in
338 the 1900s) and the admixed populations of wild Red Foxes on the Delmarva Peninsula. Given
339 the prevalence of the native genotype in the region as a result of natural range expansion, even

340 with some degree of admixture with non-native genotypes, we consider the Red Fox to be a
341 native species on the Delmarva Peninsula.

342 *Urocyon cinereoargenteus* (Schreber) (Gray Fox). Specimens from the mainland: Accomack
343 Co. (VMNH). We have capture records from the Northampton Co. mainland and from Wallops
344 Island (B. Scharle, USDA-Wildlife Services, Wallops Island, VA, pers. comm.). We consider the
345 Gray Fox to be resident on Wallops Island.

346

347 **Family Procyonidae (raccoons)**

348 *Procyon lotor* (L.) (Raccoon). Specimens from the mainland: Accomack Co. (USNM);
349 Northampton Co. (NCSM, VMNH). Specimens from the following islands: Assateague
350 (USNM); Cedar (VMNH); Cobb (VMNH); Fishermans (VMNH); Hog (VMNH); Metompkin
351 (VMNH); Myrtle (VMNH); Parramore (USNM, VMNH); Revel (VMNH); Smith (USNM,
352 VMNH); Wallops (USNM). In addition, we have capture records from Mink, Mockhorn, Rogue,
353 and Skidmore islands. We also have observed tracks on Chimney Pole, Fowling Point, Holly
354 Bluff, Little Cobb, Raccoon, Sandy, Ship Shoal, and Wreck islands. An article in the *Peninsula*
355 *Enterprise* (26 October 1912, Volume 32, Number 16, Page 3) reported that “Our sportsmen (on
356 Chincoteague Island) have had lots of fun this week, killing coons, weighing from 14 to 16 lbs.,
357 and as many as five and six a day. In the memory of the oldest inhabitants a coon was never seen
358 on the island before. A number of them also were found on Assateague.” A subsequent article in
359 the *Peninsula Enterprise* (12 December 1914, Volume 34, Number 22, Page 4) reported that
360 “Tobias Jeems, Esq., the successful coon-hunter, paid Parramore's Beach L. S. Station (on
361 Parramore Island) a visit in the great storm last Saturday and spent two days there with the boys
362 rejuvenating, so he told us, and added that when he again visits the island and departs therefrom

363 we may expect him to return with a full bag of raccoons. And to cap the climax, it is said, he
364 does the trick oftentimes without the aid of canines, running them down or pursuing them to their
365 habitats where they fall an easy prey to his capacious reach and herculean clutch.” Truitt and
366 Peterson (1999) reported observing tracks on Assawoman Island. We consider the Raccoon to be
367 resident on Assateague, Chincoteague, Fishermans, Hog, Mockhorn, Parramore, Revel,
368 Skidmore, Smith, and Wallops islands.

369

370 **Family Mustelidae (weasels and allies)**

371 *Mustela frenata* Lichtenstein (Long-tailed Weasel). Specimens from the mainland:
372 Accomack Co. (USNM). We are not aware of any specimens from the islands; we have no
373 capture records, and we are not aware of any reports of captures in Northampton Co. or on any of
374 the islands. In addition, we have seen a taxidermied Long-tailed Weasel in the Northampton Co.
375 Courthouse that is labeled as follows “Found dead on the side of the road near Locustville in
376 Accomack Co. on September 18, 2003. Found and taxidermied by famous naturalist (and very
377 experienced fur trapper) George W. Reiger who lives in Locustville.”

378 Arquilla (2007) reported “Long-tailed Weasel, *Mustela frenata*” on Cobb Island in his Table
379 8. However, on page 48 he says “South Cobb Island supported a large gull colony and Least
380 Weasel [*Mustela nivalis* L.] tracks were also observed.” We question this report of *Mustela* on
381 Cobb Island on the basis of the meager evidence and the fact that extensive surveys on the island
382 over the past 45 years have produced no other report of any weasel. Cobb is one of the most remote
383 islands and perhaps the least likely to support a terrestrial mammal found nowhere else in this
384 barrier system.

385 *Neovison vison* (Schreber) (American Mink). Specimens from the mainland: none. Specimens
386 from Smith Island (USNM). Hogue and Hayes (2015) report that a road-killed animal was
387 observed by a trapper in Accomack Co. Virginia. We have track records from Cedar, Cobb,
388 Fishermans, Hog, Little Cobb, Metompkin, Mink, Myrtle, Parramore, Ship Shoal, and Wreck
389 islands. We consider the American Mink to be resident on Parramore and Smith islands.

390 *Lontra canadensis* (Schreber) (North American River Otter). Specimens from the mainland:
391 Accomack Co. (VMNH). Specimens from Assateague Island (UWBM). We observed animals on
392 the Northhampton Co. mainland and in creeks behind Parramore and Hog islands, and we
393 observed tracks on Cedar, Chimney Pole, Cobb, Fishermans, Holly Bluff, Metompkin,
394 Mockhorn, Myrtle, Raccoon, Ship Shoal, Smith, and Wreck islands. Truitt and Peterson (1999)
395 reported observing tracks of this species on Assawoman Island. We consider the North American
396 River Otter to be a likely resident on all of these islands.

397

398 **Family Mephitidae (skunks)**

399 *Mephitis mephitis* (Schreber) (Striped Skunk). We are not aware of any specimens from
400 Accomack and Northhampton counties, Virginia. We have no capture records of this species, and
401 we are not aware of any reports of captures in Accomack or Northhampton counties. We have a
402 reliable report (R. Boettcher, pers. comm.) of observations of Striped Skunks on the mainland in
403 both Accomack and Northhampton Co., and we consider this species to be resident in both
404 counties.

405

406 **ORDER ARTIODACTLYA (even-toed hoofed mammals)**

407 **Family Cervidae (deer)**

408 *Cervus nippon* Temminck (Sika). Specimens from the mainland: none. Specimens from
409 Assateague Island (AMNH, NCSM, USNM). This species is not native to Virginia (Pagels and
410 Moncrief 2015). The Sika is established on Assateague Island in Accomack Co., Virginia (Flyger
411 1960).

412 *Odocoileus virginianus* (Zimmermann) (White-tailed Deer). We are not aware of any
413 specimens from Accomack and Northampton counties, Virginia. We have observed this species
414 on the mainland in both counties and on Assateague, Chincoteague, Cobb, Fishermans, Hog,
415 Holly Bluff, Metompkin, Mockhorn, Parramore, Revel, Rogue, Smith, and Wreck islands. We
416 have also observed tracks on Assawoman, Cedar, Little Cobb, Mink, Myrtle, Ship Shoal, and
417 Skidmore islands. Paradiso and Handley (1965) reported this species from Assateague Island.
418 We consider the White-tailed Deer to be resident on Assateague, Chincoteague, Fishermans,
419 Hog, Mockhorn, Parramore, and Smith islands.

420

Discussion

422 The mammalian fauna of the southern Delmarva Peninsula has experienced dramatic changes
423 in species composition through both the extirpation of native species and the introduction of non-
424 natives. Humans have occupied the Peninsula for at least the past 13,000 years (Custer 1989,
425 Rountree and Davison 1997). The prehistoric residents were primarily hunters and gatherers
426 (Custer 1989) who made seasonal use of the Virginia barrier islands for fishing, shellfish
427 gathering and perhaps hunting. Although the evidence of this early activity has been largely
428 erased by the wind and tides, Lowery (2003) identified >20 archeological sites in Accomack and
429 Northampton counties, Virginia, confirming the presence of humans on the islands in prehistoric
430 times. These sites contained a variety of stone hunting tools from different eras, but none

431 contained mammalian faunal remains. The prehistoric fauna on the southern Peninsula probably
432 included a host of species no longer found in the region, including at least *Ursus americanus*
433 Pallas (American Black Bear), *Puma concolor* (L.) (Cougar), *Lynx rufus* (Schreber) (Bobcat),
434 Wolf, and, perhaps, *Cervus canadensis* Erxleben (Wapiti) (Hogue and Hayes 2015, Paradiso
435 1969, Rountree and Davison 1997). We are unaware of any reliable record of these species ever
436 occurring on the barrier islands. There is, however, a generic reference to “wolves” on an island
437 (perhaps Assateague) offshore from what is now Accomack Co., during the winter of 1650
438 (Norwood 1650:27).

439 Permanent European settlement on the southern Delmarva Peninsula began in 1621, when
440 Thomas Savage was granted a tract of 9,000 acres of land in what would become Northampton
441 Co. by Esmy Shichans, the chief of the Accomac tribe (McCartney 2021). The colonists and their
442 descendants added another source of wildlife exploitation to the region, and they also introduced
443 new species to the islands. They extirpated four carnivores: Wolf, American Black Bear, Bobcat,
444 and Cougar (Hogue and Hayes 2015). They unintentionally introduced at least two usually
445 commensal rodent species (i.e., House Mouse and Brown Rat) that persist on many of the
446 islands, even in the absence of permanent human structures. As detailed above, Europeans also
447 purposefully introduced an English version of the native Red Fox. White-tailed Deer were
448 introduced to Parramore Island in the 1920s, at a time when the species was almost extirpated
449 from the entire Delmarva Peninsula through overhunting and possibly other factors (Graham
450 1976b, Paradiso 1969); deer are now observed frequently on many of the islands. The
451 introduction of Black-tailed Jackrabbits to Cobb Island in the 1960s is testimony to the
452 continuing local interest in sport hunting; their successful establishment in this harsh
453 environment reflects their adaptability (Dunn et al. 1982). Despite sporadic captures of the

454 Domestic Cat (*Felis catus* L.) on Assateague, Parramore, and Wallops islands, we do not believe
455 any island currently supports a population. The full impact of these introductions, both
456 intentional and accidental, is impossible to gauge after the fact.

457 The extirpation of the large carnivores on the Peninsula (i.e., Wolf, American Black Bear,
458 and Cougar) left behind a mammalian mesopredator fauna dominated by Raccoons and Red
459 Foxes (Hogue and Hayes 2015). Although it cannot be confirmed, it appears that these species
460 were neither abundant nor widely distributed on the islands at the turn of the 20th century.

461 Numerous hunt clubs operated on the islands from 1880 to 1940, producing a long history of
462 predator removal (Graham 1976b). Some of the last residents of the village of Broadwater on
463 Hog Island in the 1930s reported very few Red Foxes or Raccoons there (Graham 1976b). Red
464 Foxes were seldom hunted or trapped on Smith Island, even during the early 1900s (Graham
465 1976b). Nevertheless, predator control was used against Raccoons and Red Foxes on islands
466 where they were viewed as a hindrance to game stocking. For example, a specialist was hired
467 during the 1920s to rid Parramore Island of Red Foxes to facilitate the successful introduction of
468 game birds, but he reported that “only a few dens were ever found,” suggesting that Red Foxes
469 were not abundant on the island at this time (Graham 1976b:51). Hunting, trapping, and
470 poisoning of Raccoons and Red Fox continued on an occasional basis even after the 1920s. These
471 reports from early in the 20th century and the more recent observations of Raccoon and Red Fox
472 movement between islands (Dueser et al. 2013, reports cited herein) suggest that mammalian
473 carnivores are more abundant and widely distributed on the islands today than in the past. In
474 2000, a new round of predator management was initiated in an effort to reverse the decline of
475 beach-nesting and colonial waterbirds on the islands (Erwin et al. 2001). Much of what we know
476 about current mesopredator distribution, abundance, and dispersal in this mainland-island system

477 has been learned in connection with the predator removal programs instituted by the current
478 managers of the islands (Dueser et al. 2013, Moncrief et al. 2017, Porter et al. 2015). Humans
479 have thus brought about significant changes in the mammalian fauna of the Delmarva Peninsula,
480 including the barrier islands, reducing the number and diversity of native wildlife species,
481 particularly predators, and introducing a number of others.

482 The islands also have a long history of livestock husbandry. Early European colonists
483 introduced a host of domesticated species to the region, including Horse (*Equus caballus* L.),
484 Domestic Pig (*Sus scrofa* L.), Domestic Sheep (*Ovis aries* L.), Domestic Goat (*Capra hircus* L.),
485 and Domestic Cow (*Bos taurus* L.). The islands were considered good pasturage for livestock
486 from the mid-1600s through the twentieth century (Barnes and Truitt 1997, Graham 1976b).
487 Flocks of Domestic Sheep were formerly pastured on Assateague, Chincoteague, Hog, Fowling
488 Point, and Smith, and herds of Domestic Cattle on Assateague, Chincoteague, Hog, Mockhorn,
489 and Smith. These animals usually were unattended, and often went feral. George Washington
490 Parke Custis, the step-grandson of George Washington and father-in-law of Robert E. Lee,
491 extolled the virtues of the wool of the “native sheep of Smith’s island” (Barnes and Truitt 1997).
492 Robert E. Lee in 1832 proposed ways to improve the pasture available for Domestic Cattle and
493 Domestic Sheep on Smith Island (Barnes and Truitt 1997). Assateague Island still supports a
494 herd of about 150 feral ponies on Chincoteague NWR (Lowney et al. 2005,
495 https://www.fws.gov/refuge/Chincoteague/wildlife_and_habitat/ponies.html). Domestic Cows
496 and Domestic Goats were reported on Assateague Island as recently as the 1960s (Paradiso and
497 Handley 1965). The last Domestic Sheep were removed from Hog Island in 1978 and the last
498 Domestic Cattle in 1986 (B. Truitt, pers. comm.). The last Domestic Sheep anywhere on the
499 islands were removed from Fowling Point Island in 1994 (J. Kelly, IV, Red Bank, VA, pers.

500 comm.). The 300-year era of livestock husbandry has ended on the islands except for the
501 Chincoteague ponies. The ecological consequences of this long history of grazing on the islands
502 will never be known.

503 We have documented 6 orders, 12 families, and 25 species of native terrestrial mammals on
504 the Virginia barrier islands and the adjacent Delmarva Peninsula mainland. We also documented
505 3 orders, 3 families, and 4 species of non-native mammals that are established on the Virginia
506 barrier islands. Pagels and Moncrief (2015) provide citations of comprehensive monographs with
507 details of each of these species' biology. It is noteworthy that Paradiso (1969) reported five
508 native species from the northern Delmarva Peninsula that do not occur today in Accomack or
509 Northampton counties, Virginia: *Sorex hoyi* Baird (American Pygmy Shrew), *Tamias striatus*
510 (L.) (Eastern Chipmunk), *Synaptomys cooperi* Baird (Southern Bog Lemming), *Castor*
511 *canadensis* Kuhl (American Beaver), and *Marmota monax* (L.) (Woodchuck). We found no
512 specimens of any of these species from Virginia's Eastern Shore, and we have reliable reports of
513 only two: American Beaver and Woodchuck. The American Beaver was extirpated from the
514 entire state by 1911 (Handley and Patton 1947). It was reintroduced to a pond in central
515 Northampton Co. sometime in the 1970s, but recent reconnaissance in the vicinity revealed no
516 evidence of American Beavers (R. Dodd, Eastville, VA, pers. comm.). For the Woodchuck, we
517 have one reliable observation (P. Denmon, pers. comm.) in Northampton Co. in the 2010s, but
518 no reports or observations since then. Given the typical visibility of both of these species, we
519 doubt that either is currently resident in either Accomack or Northampton counties. In addition, a
520 non-native rodent, *Rattus rattus* (L.) (Roof Rat) occurs elsewhere in Virginia, but Paradiso
521 (1969) did not report it from Maryland's Eastern Shore, our searches of collections databases

522 revealed no specimens, and we have no capture records or reports for this species. Hence we do
523 not consider the Roof Rat to be established on the southern Delmarva Peninsula.

524 In considering the current geographic distribution of native species in this mainland-island
525 system, five patterns emerge: 1) Some species have been extirpated and are unlikely to reappear
526 in Accomack and Northampton counties, Virginia, without intentional reintroduction efforts. We
527 place the American Beaver, Wolf, American Black Bear, Bobcat, and Cougar in this category.
528 Of these, only American Beavers are currently resident on the northern Delmarva Peninsula
529 (Hogue and Hayes 2015; M. Whitbeck, US Fish and Wildlife Service, Cambridge, MD, pers.

530 comm.). 2) Some species appear to be expanding southward on the Delmarva Peninsula
531 mainland. The Coyote has already made this journey in recent decades (Paradiso 1969) and has
532 become well-established. Infrequent observations of the Striped Skunk and Woodchuck in
533 Accomack and Northampton counties, Virginia, suggest these species may be advancing. The
534 American Pygmy Shrew, Eastern Chipmunk, and Southern Bog Lemming may yet be found on
535 the lower Peninsula. 3) Seven species that are resident on the Delmarva Peninsula mainland of
536 Virginia have no representatives on the islands. It is likely that the sandy habitats on the islands
537 are unfavorable for fossorial species such as the Eastern Mole and Star-nosed Mole and for
538 species that den such as the Striped Skunk. The Cinereus Shrew, the Southern Flying Squirrel,
539 and the Long-tailed Weasel appear to be rare even where they occur on the mainland and may
540 thus be poor candidates for island colonization. 4) Many species have been reported from one or
541 more islands where they appear not to be resident. This may be a result of either local extinction
542 following an early observation [e.g., Virginia Opossum and White-footed Deermouse on Hog
543 Island; Bailey (1946)] or simply occurrence of occasional transient individuals of a particularly
544 mobile species (e.g., Coyote, Red Fox, Raccoon, and White-tailed Deer). 5) The smaller rodent

545 species vary widely in occurrence. The Meadow Jumping Mouse and Woodland Vole each is
546 resident on only one island and have never been observed on any other. In contrast, the Marsh
547 Oryzomys occurs on every island we have sampled and is apparently resident on all. The White-
548 footed Deermouse and Meadow Vole occur on only a few islands, and they are resident on only a
549 subset of the islands where they have ever been captured. Variability among species in dispersal
550 ability and colonization potential have undoubtedly combined with geography and variability in
551 island physiography to produce these complex patterns of native mammal distribution on this
552 watery landscape (Dueser and Brown 1980, Loxterman et al. 1998, Porter et al. 2015).

553 This checklist provides a foundation for future studies of mammals, especially native species,
554 on the Virginia barrier islands. Well-documented surveys are fundamental to understanding the
555 distribution of species, which is necessary for conservation of biological diversity and informed
556 management decisions (Balmford and Gaston 1999, Jetz et al. 2012, Roberts et al. 2007). This is
557 particularly true for barrier island systems (Hice and Schmidly 2002). Our report establishes a
558 baseline against which to measure future faunal changes during this period of changing climate
559 and accelerated rate of sea-level rise. Given current vegetation trends (Huang et al. 2018, Wolner
560 et al. 2013, Zinnert et al. 2019), forest- and wetland-dwelling mammals (e.g., Eastern Gray
561 Squirrel, Eastern Fox Squirrel, White-footed Deermouse, Woodland Vole, Meadow Vole, Least
562 Shrew, and American Mink) may be particularly sensitive to habitat changes on the islands.
563 Changes in the distribution of island populations of mammals are likely to produce correlated
564 changes in the genetic structure of those species (Loxterman et al. 1998, Moncrief et al. 2017). In
565 light of declines in populations of beach-nesting and colonial waterbirds (Brinker et al. 2007,
566 Williams et al. 2007), it will be important to monitor the occurrence and distribution of

567 carnivores, particularly Raccoons and Red Foxes, on the islands (Dueser et al. 2013, Porter et al.
568 2015).

569

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592

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787

788 Table 1. Terrestrial mammals of the southern Delmarva Peninsula and Virginia barrier islands, including
 789 species that have been introduced (*I*), those that have colonized the region since European contact (*C*),
 790 and those that have been successfully reintroduced (*R*) in recent times. For each species, we indicate 1)
 791 “Presence” (+) or “Absence” (-) on the mainland of Accomack and/or Northampton counties, VA, in
 792 2020 (Main.); 2) the number of islands on which we believe it to be resident or established as of 2020
 793 (Res.); and 3) the number of islands on which it has been reported but is not resident or established as of
 794 2020 (Rep.).

Species	Common name	Main.	Res.	Rep.
Didelphimorpha				
<i>Didelphis virginiana</i>	Virginia Opossum	+	2	2
Soriciomorpha				
<i>Sorex cinereus</i>	Cinereus Shrew	+	-	-
<i>Blarina brevicauda</i>	Northern Short-tailed Shrew	+	1	1
<i>Cryptotis parva</i>	North American Least Shrew	+	4	1
<i>Scalopus aquaticus</i>	Eastern Mole	+	-	1
<i>Condylura cristata</i>	Star-nosed Mole	+	-	-
Lagomorpha				
<i>Lepus californicus</i> <i>I</i>	Black-tailed Jackrabbit	-	1	3
<i>Sylvilagus floridanus</i>	Eastern Cottontail	+	6	5
Rodentia				
<i>Sciurus carolinensis</i>	Eastern Gray Squirrel	+	3	2
<i>Sciurus niger</i> <i>R</i>	Eastern Fox Squirrel	-	1	-
<i>Glaucomys volans</i>	Southern Flying Squirrel	+	-	-
<i>Oryzomys palustris</i>	Marsh Oryzomys	+	25	-
<i>Peromyscus leucopus</i>	White-footed Deermouse	+	4	3
<i>Microtus pennsylvanicus</i>	Meadow Vole	+	8	7
<i>Microtus pinetorum</i>	Woodland Vole	+	1	-
<i>Ondatra zibethicus</i>	Common Muskrat	+	13	-
<i>Zapus hudsonius</i>	Meadow Jumping Mouse	+	1	-
<i>Mus musculus</i> <i>I</i>	House Mouse	+	11	2
<i>Rattus norvegicus</i> <i>I</i>	Brown Rat	+	6	6
Carnivora				
<i>Canis latrans</i> <i>C</i>	Coyote	+	-	5
<i>Vulpes vulpes</i> <i>C</i>	Red Fox	+	4	6
<i>Urocyon cinereoargenteus</i>	Gray Fox	+	1	-
<i>Procyon lotor</i>	Raccoon	+	10	15
<i>Mustela frenata</i>	Long-tailed Weasel	+	-	1
<i>Neovison vison</i>	American Mink	+	2	10
<i>Lontra canadensis</i>	North American River Otter	+	16	-
<i>Mephitis mephitis</i>	Striped Skunk	+	-	-
Artiodactyla				
<i>Cervus nippon</i> <i>I</i>	Sika	-	1	-
<i>Odocoileus virginianus</i> <i>R</i>	White-tailed Deer	+	7	13

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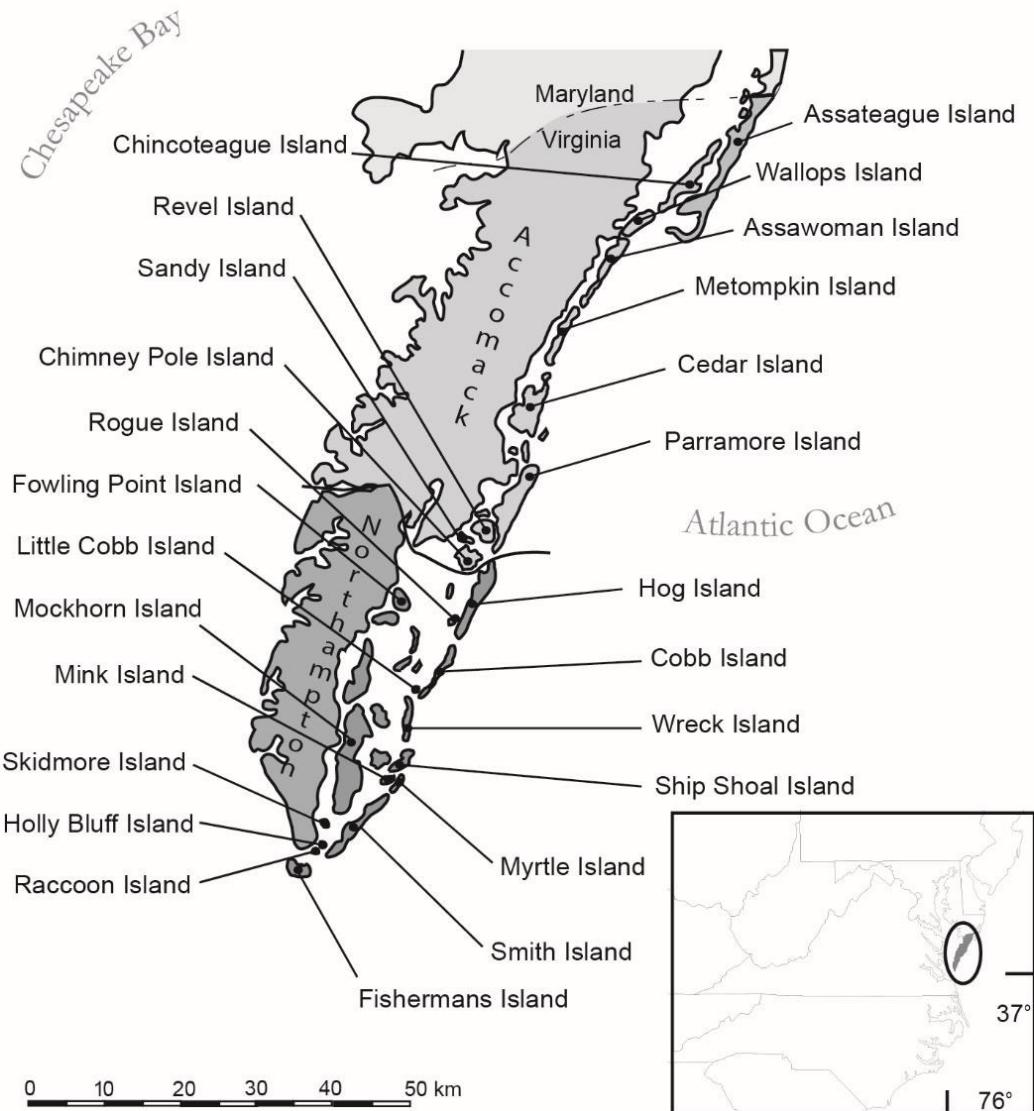
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Figure Legend

799 Figure 1. Location of the barrier and marsh islands of the Virginia barrier island complex.

800 Assateague, Chincoteague, and Wallops islands support permanent human residences and

801 facilities, but the other islands lack human structures and exist in an essentially wild state.



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