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American Oystercatchers in Maryland and Virginia, USA: Status and Distribution

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Abstract.—The conservation status of the American Oystercatcher (*Haematopus palliatus palliatus*) along the Chesapeake Bay, coastal bays, and barrier island shorelines of Maryland and Virginia has been investigated in detail in recent years. The region supports approximately 700 breeding pairs with more than 80% occurring on the east coast of the Delmarva Peninsula and less than 20% occurring along the shorelines of the Chesapeake Bay. The number of breeding pairs in Maryland appears to have been stable or to have increased slightly during the past 20 years. The overall trend of the breeding population in Virginia is less clear, but recent evidence suggests that numbers on the barrier islands are increasing after more than two decades of a declining trend. The coastal bays and barrier islands typically support between 1,500 and 2,000 wintering birds with most occurring on the east coast of the Virginia portion of the Delmarva Peninsula. The shorelines of both states together play an important role in supporting core breeding and wintering populations of the American Oystercatcher in the eastern United States. Throughout the region, oystercatchers are facing threats common to all coastal waterbird and shorebird species such as predation and overwash events. The threat of habitat loss to development, however, is not as alarming as in other areas of the species's breeding range due to a significant amount of habitat being in protective conservation ownership or being unfit for development and recreation purposes. Habitat loss attributed to sea level rise, barrier island dynamics, and the indirect effects of development, such as pollution and contaminants, may play more important roles in the stability of breeding and wintering habitat for the American Oystercatcher in Maryland and Virginia.

Key words.—American Oystercatcher, conservation, distribution, *Haematopus palliatus*, status, Maryland, Virginia.

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The eastern race of the American Oystercatcher (*Haematopus palliatus palliatus*) occurs along the east coast of North America from Nova Scotia south to the Yucatan Peninsula (Nol and Humphrey 1994; Mawhinney *et al.* 1999). It is one of only a few shorebird species that breeds and winters in the temperate coastal regions of the Chesapeake Bay and the coastal bays and barrier islands of Maryland and Virginia. The species is found in highly restricted coastal habitats throughout its range during both breeding and wintering seasons. Oystercatchers are territorial, solitary nesters and typically breed on sand and/or shell beaches, salt marshes and dredge spoil islands (Nol and Humphrey 1994). Wintering birds are found in the same coastal areas, close to abundant food resources and suitable roosting areas (Nol and

Humphrey 1994). Much of these habitats are under intense pressure from humans for recreation and development. Coastal regions comprise only 17% of the contiguous land area of the United States, but 53% of the nation's human population inhabits these areas, with population densities reaching their highest on the east coast (Culliton 1998). The American Oystercatcher is inherently intolerant to excessive levels of disturbance, has a small population size and a very restricted year-round range. These characteristics make the species particularly vulnerable to issues affecting all coastal shorebird species, such as habitat loss and alteration due to increasing development and recreation, pollution, human disturbance and expanding predator populations (Erwin 1980; Nol and Humphrey 1994; Davis *et al.* 2001).

The conservation status of the American Oystercatcher has received much attention in recent years. The United States Shorebird Conservation Plan lists the species as one of "high conservation concern" at a national level because of its small population size and restricted range (Brown *et al.* 2001). Although the American Oystercatcher is not listed as threatened or endangered by the United States Fish and Wildlife Service Endangered Species Act, several state governments include oystercatchers on their lists of "species of concern," including Florida and Georgia. The American Oystercatcher is not listed by Maryland or Virginia.

Prior to the early 1980s, there was relatively little information in the literature regarding American Oystercatchers. Earlier published reports focused on oystercatcher distribution along the east coast of the United States and brief notes and observations about the species' behavior (e.g., Frohling 1965; Cadman 1979; Kilham 1979). In the mid-1980s, detailed studies conducted on three northern barrier islands of Virginia provided important fundamental information about the breeding biology of American Oystercatchers (Nol *et al.* 1984; Nol 1985, 1989). In the years following this work, researchers in other parts of the species's range began to expand on these baseline studies. Evidence of population declines (Williams *et al.* 2000; Davis *et al.* 2001; B. Williams, College of William and Mary, unpubl. data) and low productivity (Novick 1996; Davis 1999), along with the aforementioned shorebird conservation plan assessment and a recognition of the American Oystercatcher's potential as a bioindicator of the health of our coastal ecosystems, continued to emphasize the need for a better understanding of the population status and general ecology of the species. Recent studies have focused on documenting site specific productivity and factors affecting reproductive success (Davis *et al.* 2001; George 2002; McGowan 2004; McGowan *et al.* 2005; Sabine *et al.* 2006), specific effects of human disturbance on oystercatcher productivity (George 2002; McGowan and Simons 2006), and status of wintering populations (Nol *et al.* 2000; Sand-

ers *et al.* 2004; Brown *et al.* 2005). Many of these studies have focused on the southeastern portion of the species' range. A significant number of research and monitoring efforts have focused on American Oystercatchers in Maryland and Virginia in recent years as well. The purpose of this paper is to summarize the existing information concerning the breeding and wintering status of American Oystercatchers along the Chesapeake Bay, coastal bays and barrier island shorelines of Maryland and Virginia and to address current threats and research needs for the species in these states.

FOCAL AREA

The geographic scope of information presented here includes three general regions within Maryland and Virginia: (1) barrier islands, (2) extensive marsh/lagoon systems between the barrier islands and mainland portions of the Delmarva Peninsula, hereafter referred to as coastal bays, and (3) western and eastern shorelines of the Chesapeake Bay, not including tributaries (Fig. 1). Detailed descriptions of these areas are found in Wilke *et al.* (2005) for Virginia and Traut *et al.* (2006) for Maryland.

BREEDING POPULATION

Historical Distribution

The details of changes in the range of oystercatchers along the east coast of the United States during the past century have been summarized in the literature. The species is thought to have occurred in the past as far north as Labrador (see discussion in Humphrey 1990); however, Virginia was considered the northern limit of the species' breeding range at the beginning of the Twentieth century (American Ornithologists' Union 1910). At that time, populations north of Virginia were believed to have been decimated by egg collecting, market hunting and human disturbance (Bent 1929; Humphrey 1990). Subsequent breeding records throughout the early to mid-Twentieth century document a northward expansion of

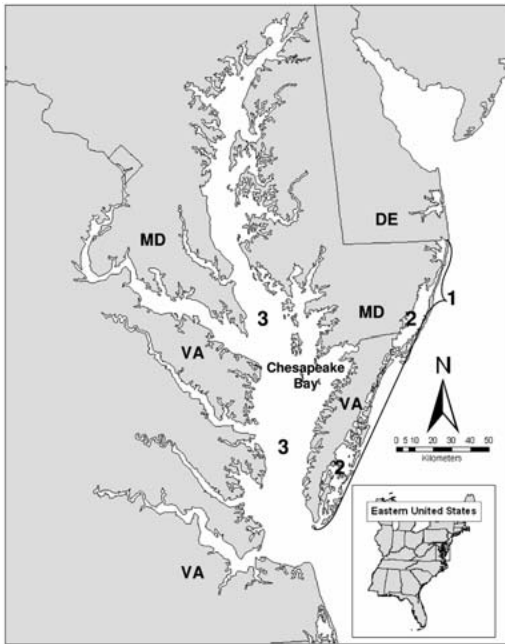


Figure 1. Three focal areas surveyed for American Oystercatcher breeding pairs from April-July 2003 in Maryland and Virginia: (1) barrier islands, (2) coastal bays, and (3) shorelines of the Chesapeake Bay, not including tributaries.

the breeding population and a gradual recolonization of most of the species' former range. The first breeding record in Maryland was documented in 1939 (Stewart and Robbins 1958) and records after 1940 documented continued northward expansion of breeding into New Jersey (Kramer 1948), New York (Post and Raynor 1964) and Massachusetts (Humphrey 1990). More recently, breeding pairs have been documented as far north as Maine and Nova Scotia (Mawhinney *et al.* 1999). Humphrey (1990) and Davis *et al.* (2001) provide overviews of this range expansion or recolonization.

Records of breeding American Oystercatchers in Maryland and Virginia after the turn of the Twentieth century are sporadic until formal surveys were conducted in the early 1980s and late 1970s in each state, respectively. Records of breeding pairs in Maryland include the aforementioned report from 1939, the first record from the Maryland portion of the Chesapeake Bay in 1972 (Robbins 1972), followed by a more

formal survey of breeding pairs during the state's Breeding Bird Atlas Survey of 1983-1987 (Brinker 1996). The Atlas Survey was the most comprehensive at that time and estimated Maryland's breeding population of American Oystercatchers to be 50 to 75 pairs (Brinker 1996).

Bailey stated that the American Oystercatcher "... is the next bird to become extinct on our Virginia coast, for it is truly a scarce bird now" (Bailey 1913). Bailey's remarks and corresponding maps of nesting bird locations suggest that the population of breeding oystercatchers in Virginia was close to being extirpated at the beginning of the 20th century, as it was believed to be north of the state at that time. The next large scale survey of oystercatchers in the state was conducted along the barrier islands in 1979 and it documented over 1,150 adults (Williams *et al.* 1990). A comparison of the 1979 survey results for oystercatchers on Cobb Island (one of Virginia's barrier islands) with notes from 1931, suggests an increase from eight to 157 adults (Austin 1932; Williams *et al.* 1990). Similar dramatic increases likely occurred on all of Virginia's barrier islands during the 20th century, probably due to the passage of the Migratory Bird Treaty Act in 1918 and a subsequent decline in egg collecting and market hunting.

Current Status

Prompted by recent concerns about the conservation status of oystercatchers along the southeast coast of the United States, two studies examined the distribution of breeding American Oystercatchers in Maryland and Virginia in 2003 (Wilke *et al.* 2005; Traut *et al.* 2006). Both studies attempted to encompass all suitable oystercatcher nesting habitat along the coast and consisted of foot and boat based ground surveys for breeding American Oystercatchers. Together, the two studies provide a comprehensive overview of the current breeding season status of the species and offer insight into interpretation of historical trends in both states. The Maryland study documented 108 pairs of American Oystercatchers, with approximately 53%

along the Chesapeake Bay shorelines, 36% in coastal bays, and 11% on barrier islands (Traut *et al.* 2006). These results suggest that there may have been an increase in the number of breeding pairs since the early 1980s, although the extent of the species' breeding range within the state has remained essentially unchanged (Traut *et al.* 2006). These data also suggest that the Maryland population of oystercatchers has experienced a continual increase since being considered extirpated in the beginning of the 20th century. Furthermore, biologists in the state do not consider suitable habitat for the species to be saturated, thus allowing for potential population expansion in the state to continue (DFB, pers. obs.).

The 2003 survey in Virginia documented 588 pairs of American Oystercatchers with 51% on barrier islands, 38% in coastal bays, and 11% along the Chesapeake Bay shorelines (Wilke *et al.* 2005). The results of this survey are particularly important for assessing the statewide status of oystercatchers because prior breeding population assessments focused only on the barrier islands. Barrier island surveys conducted from 1979 through 2002 documented a 66% decline in the number of oystercatcher adults (Williams *et al.* 2000; B. Williams, unpubl. data). The 2003 statewide survey revealed that biologists must consider the limited geographic scope of the long-term barrier island surveys when interpreting those data. For example, opportunistic breeding season surveys of oystercatchers within Virginia's coastal bays in 1983 documented 490 birds, both breeding pairs and non-breeding individuals (M. Byrd, College of William and Mary, and K. Terwilliger, Terwilliger Consulting, unpubl. data). Wilke *et al.* (2005) documented 550 individuals in the coastal bays, 223 pairs plus 104

single birds or birds in flocks. These data suggest that the total number of adults within the system may have increased slightly or at least remained relatively stable. Even so, the number of oystercatchers recorded during surveys of the coastal bays would not be enough to offset the documented declines on the barrier islands during that same time period. The decline of oystercatchers on the islands warrants concern; however without comprehensive, long-term data encompassing the entire distribution of oystercatchers in the state, the exact magnitude of the species' decline in Virginia can not be determined. More recently, intensive annual surveys of the barrier islands between 2000 and 2007 documented a 41% increase in the number of breeding pairs (K. Terwilliger and R. Cross, The Nature Conservancy [TNC] and Virginia Department of Game and Inland Fisheries [VDGIF], unpubl. data). Annual barrier island surveys and repeated comprehensive statewide surveys every five years will contribute to a better understanding of the future overall population trends for breeding oystercatchers in Virginia.

In recent years, breeding season surveys of American Oystercatchers have revealed important information about the species' current status and distribution in Maryland and Virginia (Table 1). Overall, breeding pairs of oystercatchers are evenly distributed between barrier islands and coastal bays. Fewer than 20% of the pairs are located along shorelines of the Chesapeake Bay; however, in Maryland, this represents more than half of the breeding pairs documented in the state. Together, Maryland and Virginia support approximately 27% of the estimated number of breeding pairs on the east coast of the United States (estimated using other published or reported breeding estimates for

Table 1. Number (percentage) of American Oystercatcher breeding pairs counted in three general regions of Maryland and Virginia, 2003. Data were summarized from Traut *et al.* 2006 and Wilke *et al.* 2005.

| Region | Maryland | Virginia | Total |
|-----------------|----------|----------|----------|
| Barrier Islands | 12 (11) | 302 (51) | 314 (45) |
| Coastal Bays | 39 (36) | 223 (38) | 262 (38) |
| Chesapeake Bay | 57 (53) | 63 (11) | 120 (17) |
| Total | 108 | 588 | 696 |

east coast states from Massachusetts south to Florida). Researchers and managers should continue to make regular statewide surveys a priority to detect long-term changes in numbers and distribution of the species and to assess and develop management and conservation strategies based on those changes.

Reproductive Rates

Several detailed studies of the breeding ecology of American Oystercatchers in Maryland and Virginia exist with varying spatial and temporal coverage. In Maryland, information on reproductive rates is limited to a comprehensive study conducted in conjunction with the 2003 statewide survey. Traut *et al.* (2006) monitored 108 pairs of oystercatchers during the 2003 breeding season, and documented 72 confirmed nesting pairs and 38 fledged young. A reproductive rate defined as the number of young fledged divided by the total number of pairs monitored was not reported but may be calculated as 0.35 young per pair. The study found that birds breeding in Maryland's Chesapeake Bay region had significantly higher reproductive success than birds breeding in the coastal bays (Traut *et al.* 2006). The reasons for the difference remain unclear, but are not thought to be associated with human disturbance or development (Traut *et al.* 2006), which is the case in many other studies of oystercatcher breeding success on the east coast (Davis *et al.* 2001; McGowan *et al.* 2005). Flooding events and an unknown degree of mammalian and avian predation pressure are likely the predominant causes of nest failure; however, more detailed studies are needed to further clarify the factors limiting reproductive success (Traut *et al.* 2006; DFB, pers. obs.). In addition, reproductive rates for oystercatchers are highly variable both spatially and temporally (Nol and Humphrey 1994; Davis *et al.* 2001). Information on reproductive rates of oystercatchers breeding in Maryland is limited to one year of study, and further studies are warranted to determine long-term trends.

Detailed studies of the breeding ecology of oystercatchers in Virginia include several

projects conducted in the 1980s (Nol *et al.* 1984; Anderson 1988; Nol 1985, 1989) and projects between 2002 and 2006. Earlier studies focused on relatively small proportions of the local breeding population while later studies encompassed a broader geographic scope.

Nol (1989) investigated reproductive rates on Chincoteague, Wallops, and Assawoman Islands in Virginia and estimated an average of 0.24 young fledged per pair from 44 pairs during three years. High tides were identified as the primary cause of nest loss (Nol 1989). Anderson (1988) investigated reproductive success on Fisherman Island in 1981 and 1982 and documented only one fledged young in 1981 (0.02 young per pair) and ten in 1982 (0.20 young per pair). Fish Crows (*Corvus ossifragus*) were identified as the primary cause of egg loss (Anderson 1988). Studies of reproductive success of oystercatchers on Virginia's barrier islands between 2002 and 2006 encompassed between two to nine sites and 102 to 284 pairs annually (ALW *et al.*, unpubl. data). The maximum number of pairs monitored annually represented approximately 76% of the total number of pairs estimated to be breeding along the Virginia barrier islands. Reproductive rates at these sites ranged between zero to 1.26 young per pair per year (ALW *et al.*, unpubl. data).

The Maryland study and earlier Virginia studies documented oystercatcher reproductive rates similar to those typically reported for the species (Novick 1996; Davis *et al.* 2001; George 2002; McCowan 2005; Sabine *et al.* 2006). Preliminary analysis of the 2002-2006 Virginia data suggests that certain proportions of Virginia's breeding oystercatchers have higher reproductive rates than those typically reported. These oystercatchers may be serving as significant sources of individuals for the regional population. Reasons for higher reproductive success likely include the unique conservation status of much of the region, predator management programs, and food supply. Further analysis of these data will offer insight into how breeding oystercatchers in coastal Virginia are contributing to the population as a whole.

WINTERING POPULATION

Similar to other shorebird species, American Oystercatchers gather in communal, high-tide roosting flocks during the non-breeding season (Nol and Humphrey 1994). Surveys during the non-breeding season and resighting records of banded oystercatchers have revealed that some roost site fidelity is exhibited by wintering flocks and individual birds (F. Sanders *et al.*, South Carolina DNR, unpubl. data; RB and ALW, unpubl. data). This behavior facilitates the task of obtaining wintering population size estimates because birds are concentrated on known roost sites during high tide. Wintering population surveys throughout the range of the species are important for establishing overall population size estimates since breeding season surveys are logistically difficult (solitary nesters spread out over a large geographic area) and do not necessarily account for non-breeding individuals within the population (Sanders *et al.* 2004; Brown *et al.* 2005). The importance of obtaining population size estimates for all shorebird species has been emphasized by the United States Shorebird Conservation Plan (Brown *et al.* 2001). Several studies of American Oystercatchers have focused on this task by conducting winter surveys (Nol *et al.* 2000; Sanders *et al.* 2004; Brown *et al.* 2005) and have resulted in important revisions of the population estimate for American Oystercatchers in the United States. The most comprehensive of these surveys was conducted by air and covered the wintering range of the species in the United States from New Jersey south and west to the Mexican border (Brown *et al.* 2005). The estimated overall wintering population of American Oystercatchers was $10,971 \pm 298$ individuals during the survey period November 2002 through February 2003 (Brown *et al.* 2005).

No systematic surveys of wintering oystercatchers in Maryland exist and Brown *et al.* (2005) did not present numbers for the state. Maryland hosts a small number of wintering oystercatchers within the coastal bays region, including one small flock of at most 50 individuals on Skimmer Island in Worcester County (DFB, pers. obs.). The relatively

short Maryland coastline and scarcity of suitable habitat for high-tide roost sites in the coastal bays region probably explain the absence of large wintering flocks. Further study is warranted to investigate the numbers and distribution of wintering oystercatchers in the coastal bays region.

Extensive data exist on locations of wintering high-tide oystercatcher roosts and on wintering population size estimates for Virginia. Comprehensive, boat-based surveys of wintering oystercatchers in the coastal bays have been conducted annually since 1999, with the exception of 2001 (Nol *et al.* 2000; TNC and VDGIF, unpublished data). Surveys have encompassed all known high-tide roost sites in Virginia's coastal bays, and totals have ranged from 1,084 to 2,263 individuals (Nol *et al.* 2000; TNC and VDGIF, unpublished data). The low estimate of 1,084 was documented in 2004 when aerial surveys were conducted and was probably an underestimate (TNC, unpubl. data) because roosting oystercatchers in Virginia tend to flush upon approach of an aircraft making aerial flock estimates difficult (Brown *et al.* 2005; ALW, pers. obs.). Notwithstanding the 2004 survey data, the wintering population counts for oystercatchers in Virginia between 1999 and 2005 ranged from 1,516 to 2,263 individuals. Based on the results of the 2002-2003 range-wide winter survey, Virginia supported the third highest number of wintering oystercatchers, approximately 16% of the total estimated U.S. east coast population (Brown *et al.* 2005).

Oystercatcher roost sites in Virginia include oyster shell rakes formed along salt marsh edges or in open water, fringing sand beaches along marsh edges, inlet beaches, exposed sand or mud flats and topographic high spots within marshes. Sixty-nine active roost sites have been identified throughout the extensive and remote marshes of the Virginia coastal bays region (TNC and VDGIF, unpubl. data). The availability of roost sites does not appear to be limited as many inactive sites are available throughout the region that share habitat characteristics of highly used sites (ALW, pers. obs.). In addition, not all active roosts are occupied within any giv-

en high tide period and flocks appear to exhibit preferential selection of roosts, likely depending on factors such as roost site habitat characteristics, distance from food sources, tidal height, wind direction and speed and presence of avian predators. The dynamics of roost site selection and fidelity in Virginia's coastal bays are currently being investigated in greater detail.

Less is known about the availability of potential roost sites and the presence of wintering oystercatchers along the Chesapeake Bay shorelines of both states. An aerial survey of the eastern and western Chesapeake Bay shorelines in Virginia, including isolated bay islands, in November 2002 did not detect any wintering flocks of American Oystercatchers (TNC and VDGIF, unpubl. data). This flight was conducted in conjunction with the Brown *et al.* (2005) survey to confirm anecdotal evidence suggesting the absence of oystercatchers in that region (RB, pers. obs.). Suitable habitat for roosting birds may be limited along these shorelines, especially along the western shore of the bay, thus the region probably does not support significant numbers of wintering oystercatchers. Lynhaven Inlet in Virginia Beach, however, supports a small flock of approximately 30 to 40 birds and may be one of only a few roost sites along the Chesapeake Bay shorelines in Virginia (BDW, pers. obs.). Two oystercatchers, one banded as a chick and one as an adult on islands in the upper Chesapeake Bay in Virginia, were subsequently resighted during the non-breeding season on a Virginia barrier island, suggesting that at least a portion of the birds using the bay shorelines during the breeding season disperse to the seaside during the wintering season (TNC and VDGIF, unpubl. data). Additional aerial surveys are needed to confirm the details of wintering oystercatcher flocks along the Chesapeake Bay shorelines in Maryland and Virginia.

Ongoing banding and resighting studies throughout the range of American Oystercatchers are revealing how breeding populations and wintering populations within given areas are linked. These efforts in Virginia and in other states have revealed that a proportion of wintering birds in Virginia are res-

ident birds, while others are birds that breed in states north of Virginia or dispersed sub-adult birds from states south of Virginia (TNC and VDGIF, unpubl. data; American Oystercatcher Working Group [AOWG]), unpubl. reports). In addition, winter resighting efforts in other states have documented the presence of juvenile birds banded as chicks in Virginia (AOWG, unpubl. reports). The relationship between local breeding and wintering populations is still being investigated, but preliminary data suggest that adult inter-seasonal movement patterns are more predictable than those of juveniles.

CURRENT THREATS

Predators

Mammalian predators are a leading cause of reproductive failure in American Oystercatchers throughout much of the species' range (Nol and Humphrey 1994; Davis *et al.* 2001). The degree of this threat to the breeding population described here is spatially variable. In Maryland, most breeding oystercatchers are found on salt marsh islands in the state's coastal bays or in the Chesapeake Bay and may not face severe threats from mammalian depredation. Salt marsh islands within the coastal bays that support about 36% of the total number of oystercatcher pairs, are not suitable for supporting mesocarnivore nest predators (Traut *et al.* 2006; DFB, pers. obs.). Furthermore, Traut *et al.* (2006) reported that oystercatchers nesting on islands within the Chesapeake Bay (53% of the total number of pairs) experienced relatively high productivity in 2003 in spite of there being some evidence of mesopredator presence. The only region in the state where mammalian predation was identified as a significant source of oystercatcher reproductive failure was Assateague Island, which supported 11% of the state's pairs in 2003 (Traut *et al.* 2006; J. Kumar, Assateague National Seashore, pers. comm.). These data suggest that mammalian predation pressure on oystercatchers breeding in Maryland may not be as great as in other parts of the species' range because of the species' distribu-

tion within state. It should be noted, however, that data are still lacking on the impacts of mesocarnivore predators on oystercatchers nesting on the Chesapeake Bay islands within Maryland and the relatively high nesting success rate documented in 2003 may not be reflective of typical predation pressure.

The distribution of oystercatchers in Virginia results in a different threat profile from mammalian predators. More than half of the estimated number of breeding pairs of oystercatchers in Virginia occurs on barrier islands (Wilke *et al.* 2005). Researchers have documented declines in numbers of colonial birds and colonies and an increase in numbers of mammalian predators on the islands over the past 20 years (Williams *et al.* 2000; Erwin *et al.* 2001; B. Williams *et al.*, unpubl. data; R. Dueser, Utah State University, unpubl. data). Additional research on the islands has shown that those with high numbers of mammalian predators have very low numbers of, if any, colonially nesting waterbirds (Keiss 2001). Mammalian predation is a primary threat to breeding oystercatchers on the islands and has likely played an important role in the long-term decline of oystercatchers on the islands between 1979 and 2002. It should be noted, however, that recent local management efforts have focused on addressing the threat of mammalian predation to all nesting birds on the islands and may have reduced the degree of this threat. These management techniques and resulting impacts to nesting birds are currently being investigated in further detail (ALW *et al.*, unpubl. data).

As in Maryland, most of the habitats used by breeding oystercatchers in the coastal bays of Virginia do not support populations of mammalian predators (ALW and BRT, pers. obs.). This area supports almost 40% of the state's breeding pairs. Little is known about the degree of threat from mammalian predators to oystercatchers breeding along shorelines of the Chesapeake Bay in Virginia, which support approximately 11% of the state's breeding birds. Monitoring of American Black Duck (*Anas rubripes*) reproductive success along the eastern shore of the bay has revealed that mammalian predators are often not present on the small marsh islands

adjacent to the mainland shoreline and that the ducks experience relatively high reproductive success (G. Costanzo, Virginia Dept. of Game and Inland Fisheries, pers. comm.). However, if a predator such as a Red Fox (*Vulpes vulpes*) or Raccoon (*Procyon lotor*) accesses one of these isolated islands early in the nesting season, production is almost entirely eliminated for that year (G. Costanzo, pers. comm.). Mammalian predators are likely more of a significant and frequent threat to birds breeding on the marshes attached to this mainland shoreline as opposed to on small, adjacent marsh islands. Additional studies are needed to better understand all factors limiting oystercatcher reproductive success in this region.

The impacts of avian predators on oystercatchers have not been well studied throughout the area, and most available information is limited to anecdotal evidence. The suite of potential avian predators to both breeding and wintering oystercatchers includes but is not limited to Great Black-backed Gulls (*Larus marinus*), Herring Gulls (*L. argentatus*), Laughing Gulls (*L. atricilla*), Peregrine Falcons (*Falco peregrinus*), Great Horned Owls (*Bubo virginianus*), and Fish Crows. Great Black-backed, Herring and Laughing gulls target oystercatcher eggs and young during the breeding season, and at least one Great Black-backed adult was observed successfully depredating an adult oystercatcher (PPD, pers. obs.). Despite these predation threats, monitoring efforts in Virginia and Maryland have documented high reproductive rates of some oystercatchers nesting within or adjacent to mixed species gull colonies (ALW and AHT, pers. obs.). A two-year diet study of breeding Peregrine Falcons on the Eastern Shore of Virginia documented only three observations of American Oystercatchers as prey at nesting platforms (E. Long, College of William and Mary, unpubl. data). Peregrine Falcons target adult oystercatchers as prey during the nonbreeding season; however, the overall impact of peregrine depredation on the wintering population of oystercatchers in Virginia is unknown. Evidence of Great Horned Owl depredation of oystercatcher young has

been found on several barrier islands in Virginia (ALW, pers. obs.), but the potential impact of this species to breeding or wintering oystercatchers has not been investigated. Several studies on Fisherman Island National Wildlife Refuge in Virginia have documented Fish Crows as a primary predator of oystercatcher eggs (Anderson 1988; BDW and PPD, unpubl. data). In addition, observations during nest monitoring on Cobb Island suggest that Fish Crows may be targeting oystercatcher eggs as soon as they are laid (ALW, pers. obs.) Overall, the threat from these avian predators is not well understood and is difficult to document without real-time observations. Innovative research and monitoring techniques, such as camera systems (Sabine *et al.* 2005) are needed to assess the impact that avian predators are having on local oystercatcher populations.

Habitat Loss and Human Disturbance

The habitats currently occupied by breeding and wintering American Oystercatchers in Maryland and Virginia are relatively protected from loss to development and excessive human disturbance. The barrier islands extending from the Maryland-Delaware border south to the Chesapeake Bay are almost entirely in protective conservation ownership with the exception of Ocean City, Maryland. Most oystercatcher pairs breeding on the barrier island of Assateague in Maryland are located on the northern portion of the island that is closed to visitors during the breeding season (J. Kumar, pers. comm.). The Virginia barrier islands are mostly accessible only by boat and receive limited visitor use year-round. Salt marsh islands within the coastal bays of both states are unfit for development because of frequent tidal inundation, they receive little human recreational use and, in Virginia, the vast majority of these marshes are also in protective ownership (Wilke *et al.* 2005; DFB, pers. obs.). Overall, 83% of breeding oystercatcher pairs in both states occurs on barrier islands and within coastal bays and almost 100% of the wintering population occurs within the coastal bays. These regions offer

an exceptionally high level of protection from habitat loss to development and excessive human disturbance.

The threat of habitat loss to sea-level rise is less predictable and a significant future threat to all coastal waterbird and shorebird species. Several studies within Virginia's coastal bays have estimated annual rates of marsh loss attributed to sea-level rise to be from 0.15% to 0.67% (see discussion and references in Erwin *et al.* 2004). Within the coastal bays region and in the Chesapeake Bay, salt marsh islands may become submerged as sea levels rise (Titus and Richman 2001). Several large tern breeding sites on islands have already been lost in the Maryland portion of the Chesapeake Bay (DFB, pers. obs.). In addition to actual habitat loss, chronic reproductive failure of beach-nesting birds may result as the frequency of overwash events on barrier islands and marsh habitats increases as sea level rises. Overwash is one of the most important processes in barrier island dynamics as it results in large quantities of sediment being deposited over the interior of a barrier island, resulting in a change in island shape, position and landscape features (Dolan *et al.* 1980). These same events are responsible for creating the open, sparsely vegetated nesting habitat preferred by nesting species such as the American Oystercatcher. Without such disturbances, island vegetation would succeed to the point of making the habitat unsuitable for many species of beach-nesting birds. At the same time however, overwash events are documented as one of the primary causes of nest loss for American Oystercatchers (e.g., Nol 1989; Nol and Humphrey 1994; Davis *et al.* 2001). An increase in the frequency of these events could lead to low rates of reproductive success, which would be insufficient to maintain a stable population.

Overall, the shorelines of Maryland and Virginia play an important role in supporting core breeding and wintering populations of American Oystercatchers. The unique conservation status of the coastal bays and barrier islands, which support most of the species' numbers year-round, will afford a level of protection for breeding and

wintering habitat into the future that is unparalleled along the U.S. east coast. Biologists and managers are actively addressing the threat of mammalian predators to breeding oystercatchers on the barrier islands with promising results. Sea-level rise will continue to affect these habitats and may be the most significant threat that the species will face over the next century (Erwin *et al.* 2006). Biologists have made significant progress towards understanding the oystercatcher's breeding and wintering ecology in both Maryland and Virginia. However, fundamental information is still lacking. Additional attention should be focused on birds occupying Chesapeake Bay shorelines to better understand the status of the wintering population and factors affecting reproductive success in that region. More information is also needed on year-round diet and foraging habitat requirements for the species throughout its range. The American Oystercatcher will continue to be a focus of research interest, not only because of fundamental information gaps about the species' biology, but also because of concern for the species' conservation status range-wide and its potential to serve as a bioindicator for our coastal ecosystem health.

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