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## Status, Distribution and Reproductive Rates of American Oystercatchers in Virginia

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Status, Distribution and Reproductive Rates of American Oystercatchers in  
Virginia

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A Thesis presented to the Graduate Faculty  
of the College of William and Mary in Candidacy for the Degree of  
Master of Science


Department of Biology

The College of William and Mary  
January, 2008

## APPROVAL PAGE

This Thesis is submitted in partial fulfillment of  
the requirements for the degree of

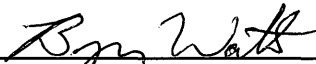
Master of Science



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Alexandra Lee Wilke

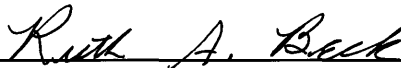
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## ABSTRACT PAGE

The conservation status of the American Oystercatcher (*Haematopus palliatus palliatus*) has received much attention in recent years. 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. Prior to the early 1980s, there was relatively little information in the literature regarding American Oystercatchers. Moreover, prior to the work presented here, information on the status and reproductive biology of oystercatchers in Virginia was lacking. The objectives of this study were to examine the status, distribution and reproductive rates of American Oystercatchers in Virginia and provide much needed information to guide conservation and management efforts. A comprehensive survey of breeding American Oystercatchers in coastal Virginia during the 2003 breeding season more than doubled previous estimates for the state and suggests that Virginia supports the largest number of breeding oystercatchers (588 pairs) on the Atlantic coast. Reproductive rates of American Oystercatchers breeding on barrier islands in Virginia were investigated between 2002 and 2006. Overall annual productivity estimates for pairs breeding in this system were well above what has been reported for this species in other parts of its breeding range and may be attributed to the conservation status of Virginia's barrier islands and to ongoing mammalian predator management efforts. Given the comparatively high reproductive rates reported here, it seems possible that some of the barrier islands in Virginia may serve as important population sources for the American Oystercatcher. 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 of our coastal ecosystems.

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**DEDICATION**

Dedicated to my dear friend  
Benjamin Tassinari.

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I sincerely hope that I do not omit anyone in these acknowledgements, and if I do, it is a reflection on my memory and not his or her contribution to increasing our understanding of American Oystercatchers in Virginia. So in addition to the folks listed in the individual acknowledgement sections of this thesis, I would like to thank:

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## INTRODUCTION

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). The species is found in highly restricted coastal habitats throughout its range during both breeding and winter seasons, and 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 Virginia. 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). Currently, 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). In addition to the national plan, two regional shorebird plans that encompass the species' breeding and wintering ranges along the east coast of the United States (Northern Atlantic and Southeastern Coastal Plain), rank the species as one of highest regional conservation priority (Clark and Niles 2000) and extremely high priority (Hunter *et al.* 2000) respectively. Oystercatchers in these areas face threats in the form of habitat loss and alteration, pollution, high levels of human disturbance and expanding predator populations. 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 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' 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, unpublished 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; Sanders *et al.* 2004; Brown *et al.* 2005). Many of these studies have focused on the southeastern portion of the species' range. Prior to the work presented here, information on the current status and reproductive biology of oystercatchers in Virginia was lacking.

The objectives of this study were to: 1) conduct a comprehensive breeding season survey of American Oystercatchers in coastal Virginia, 2) assess the conservation status of occupied breeding areas within the state, 3) investigate oystercatcher reproductive success along the barrier island chain in Virginia to evaluate the impact of mammalian predator management efforts and to put the reproductive potential of this region in context with other portions of the species' breeding range and 4) present an overview of the current status and distribution of oystercatchers encompassing the entire Chesapeake Bay and coastal lagoon systems of Maryland and Virginia.

## Chapter 1

### **BREEDING SEASON STATUS OF THE AMERICAN OYSTERCATCHER IN VIRGINIA, USA\***

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### ABSTRACT

We conducted surveys of the American Oystercatcher (*Haematopus palliatus*) in all suitable nesting habitat in coastal Virginia during the 2003 breeding season. The total of 588 pairs more than doubles previous estimates for the state and provides a benchmark for the comparison of future surveys. These results suggest that Virginia supports the largest number of oystercatchers in the breeding season relative to other east coast states. Previous surveys in Virginia focused only on one coastal area, the barrier islands. Over two hundred pairs recorded in the seaside lagoon system of the Delmarva Peninsula in 2003 accounted for the large discrepancy between previous estimates for the state and the results of this survey. Over 89% of the total number of pairs was observed on the islands and in the lagoon system of the Delmarva Peninsula. Approximately 87% of the pairs were observed on land that is managed or regulated to some degree for the conservation of nesting birds by federal, state, municipal and non-governmental organizations, including 20% that occurred on land that is closed to public use during the bird-breeding season. Only 13% of the pairs were on privately owned land that affords no protection to breeding birds.

Keywords. – American Oystercatcher, *Haematopus palliatus*, status, distribution, conservation.

Running head: Oystercatcher Status in Virginia

## INTRODUCTION

The American Oystercatcher (*Haematopus palliatus*) is one of 50 shorebird species considered in the United States Shorebird Conservation Plan and is ranked nationally as a species of high conservation concern (Brown *et al.* 2001). Two regional shorebird plans that encompass the species' breeding and wintering ranges along the east coast of the United States (Northern Atlantic and Southeastern Coastal Plain), list the species as one of highest regional conservation priority (Clark and Niles 2000) and extremely high priority (Hunter *et al.* 2000) respectively. These conservation assessments, along with recent evidence of low productivity and declining numbers of American Oystercatchers, have been the impetus for several studies in recent years aimed at furthering our understanding of the population status and general biology of the species (Williams *et al.* 2000; Davis *et al.* 2001; George 2002; Brown *et al.* 2003; McGowan 2004; Sanders *et al.* 2004; Wilke and Watts 2004). The national shorebird plan highlights the importance of obtaining current estimates for numbers of all shorebirds that occur in the United States in order to accurately prioritize species and their habitats, track population trends and evaluate management strategies (Brown *et al.* 2001). In response, several of the recent studies of American Oystercatchers have focused on the fundamental task of obtaining current estimates of the number of non-breeding or wintering oystercatchers at both the national and state levels (Nol *et al.* 2000; Brown *et al.* 2003; Sanders *et al.* 2004). American Oystercatchers are large, conspicuous shorebirds that use restricted coastal habitats within the United States during both the breeding and wintering season (Nol and Humphrey 1994). The northernmost breeding birds apparently move south during the winter and mix with the southern breeding birds (Humphrey 1990; Nol and Humphrey

1994). Researchers have suggested that winter surveys provide better overall population estimates when compared to breeding surveys because of the tendency of wintering American Oystercatchers to roost in large flocks at known locations as opposed to being dispersed as pairs over larger areas on breeding territories (Brown *et al.* 2003; Sanders *et al.* 2004). Sanders *et al.* (2004) concluded that annual, winter surveys along coastal South Carolina are precise enough to detect at least a 13% change in the numbers. These survey efforts have resulted in important revisions of the estimate of wintering American Oystercatchers along the east coast of the United States (Nol *et al.* 2000; Brown *et al.* 2003).

Comprehensive winter surveys do not, however, replace the need for annual breeding surveys at national and state levels. Davis *et al.* (2001) provided the most recent national estimate for breeding American Oystercatchers (1,624 pairs) by compiling information from regional biologists at the state level. Much of that information was reported to be outdated or incomplete, and the authors recognized that their estimate is most likely an underestimate of the actual population size of American Oystercatchers (Davis *et al.* 2001) – something that has been substantiated by the recent national wintering population estimate of approximately 10,000 individuals (Brown *et al.* 2003). This discrepancy highlights the need for comprehensive breeding surveys so that managers can identify benchmark breeding numbers and distributions and can monitor population changes, both temporally and spatially, in order to identify important areas of loss or gain. Winter roost surveys may provide overall population estimates and trends into the future, but they will not specifically identify where losses or gains may be occurring during the breeding

season, since the details of how breeding birds and wintering flocks are linked remains unclear.

Researchers have recently recognized the importance of Virginia as a stronghold for the American Oystercatcher, both during the breeding and wintering seasons (Nol 1989; Nol *et al.* 2000; Davis *et al.* 2001; Wilke 2003). Recent studies have shown that Virginia supports the third largest number of breeding oystercatchers (Davis *et al.* 2001) and the second largest number of wintering oystercatchers relative to other east coast states (Nol *et al.* 2000). Anecdotal information, however, suggests that the number of breeding oystercatchers in Virginia may be well over what has previously been reported because not all suitable habitats have been systematically surveyed (Davis *et al.* 2001). The objectives of this study were to provide a comprehensive survey of American Oystercatchers in coastal Virginia during the 2003 breeding season and to assess the ownership and management status of areas occupied by oystercatcher pairs.

#### **METHODS AND SURVEY AREAS**

Surveys were conducted for American Oystercatchers in four geographic areas of coastal Virginia including: (1) the barrier islands of the Delmarva Peninsula, (2) the seaside lagoon system of the Delmarva Peninsula, (3) the western shore of the Chesapeake Bay and (4) the Chesapeake Bay shoreline of the Delmarva Peninsula and adjacent Bay islands of Accomack County (Fig. 1). Based on a preliminary assessment of potential breeding habitat, we believe that these four regions encompass the suitable nesting habitat for American Oystercatchers in the state. Surveys did not cover the highly developed coastal areas in the cities of Norfolk and Virginia Beach, the Atlantic



facing beaches south of Virginia Beach or the Chesapeake Bay shoreline of the lower Delmarva Peninsula in Northampton County because there has been no historic indication of breeding in those areas.

Virginia's barrier island chain borders the seaward margin of the Delmarva Peninsula and extends approximately 100 km from Assateague Island at the Virginia/Maryland border south to Fisherman Island at the mouth of the Chesapeake Bay. The chain consists of 14 transgressive barrier islands, 10 of which are accessible only by boat. The islands are, for the most part, uninhabited and undeveloped and represent the most pristine barrier island chain in North America, south of the Arctic Circle (Pilkey 2003). The primary habitats on the islands include sand and shell beaches, maritime shrub thickets and forests and salt marsh. With the exception of a few private inholdings, the islands are owned and managed by various federal, state and private conservation organizations. The Nature Conservancy of Virginia owns the majority of the islands and their associated marshes (all or part of nine islands totaling approximately 14,170 ha), which is designated as The Virginia Coast Reserve. The island chain has been recognized as an International Shorebird Reserve within the Western Hemisphere Shorebird Reserve Network because of its importance to the survival of over 100,000 shorebirds annually. In addition, the Virginia Coast Reserve has been designated as a Man and the Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization. American Oystercatchers are known to breed on all of the barrier islands, and this is the only region in the state in which breeding oystercatchers have been systematically surveyed in the past (Williams *et al.* 2000; Wilke and Watts 2004).

The Virginia barrier islands are separated from the mainland of the Delmarva Peninsula by an extensive lagoon system comprised of low-lying salt marsh islands separated by shallow creeks and bays. The lagoon marshes are dominated by Smooth Cordgrass (*Spartina alterniflora*) and are scattered with high marsh ridges vegetated mainly with Marsh Elder (*Iva frutescens*), Groundsel Bush (*Baccharis halimifolia*) and Wax Myrtle (*Myrica cerifera*) (Moore 1977; Silberhorn and Harris 1977). The lagoon system is accessible only by boat and is unfit for development because of frequent tidal inundation and erosion. Within the marshes and along their borders, storm deposited oyster shell rakes, wrack deposits, fringing sandy beaches and topographic high spots provide nesting habitat for a variety of colonially nesting waterbirds, as well as American Oystercatchers (Rounds 2003). The vast majority of the marshes within the lagoon system is owned by the Commonwealth of Virginia and is managed by the Virginia Marine Resources Commission. Anecdotal information and studies that have focused on small sections of the lagoon system indicate that American Oystercatchers regularly breed in this habitat, although no systematic survey of the entire lagoon system has been conducted (Rounds 2003).

The western shore of the Chesapeake Bay, for the purposes of this survey, is defined as the western edge of the Chesapeake Bay extending from the mouth of the James River north to the mouth of the Potomac River. The area's shoreline is characterized by sandy beaches, many of which are used for recreation and have been modified by residential development and erosion control structures, and adjacent marshes dominated by Smooth Cordgrass and Black Needlerush (*Juncus roemerianus*) (CCIP 2001).

The Chesapeake Bay shoreline of the Delmarva Peninsula, for the purposes of this survey, includes the western shoreline and Bay islands of Accomack County. The area does not include the interior shorelines of Bay tributaries. The area is characterized by marshes and islands dominated by Smooth Cordgrass with outer beaches (Silberhorn and Harris 1977).

Surveys were conducted between 2 April and 3 July 2003, and each geographic area was surveyed separately either on foot or by boat. The barrier islands were surveyed between 1 June and 9 June. Groups of two or three people walked the length of each island, surveying all suitable nesting habitat. The lagoon system was surveyed between 27 May and 3 July. All accessible marsh edges were surveyed by boat. The western shore were surveyed by boat between 5 May and 2 July. The eastern shore and upper bay islands were surveyed between 2 April and 2 July. All accessible marsh edges were surveyed by boat. Due to the large size of the survey area and logistical constraints, it was not possible to survey all four regions during a condensed time period. American Oystercatchers exhibit strong territorial behavior throughout the breeding season, and second nesting attempts are most often located in close proximity to the initial nesting attempt (Nol and Humphrey 1994). Our studies have suggested that breeding oystercatcher pairs in Virginia, successful or unsuccessful, do not begin to move off breeding territories until late July. Therefore, although the regional surveys were conducted over three months during the breeding season, we feel confident that the risk of double counting birds that may have moved between regions was low. Most areas, with the exception of three barrier islands and portions of the lagoon system and of the eastern shore of the bay, were surveyed only once. Based on experience monitoring

oystercatcher breeding biology, we believe that one-time surveys during the time period specified and in the absence of any recent storm events that cause widespread nest failure result in an accurate estimate of breeding pairs.

In all cases, observations of oystercatcher pairs, single birds and flocks were recorded. The location of each observation was recorded with a Global Positioning System (GPS) unit and mapped using ArcGIS 8.3. Evidence of breeding activity (eggs, chicks, defensive behavior) was recorded, but due to time constraints during survey efforts, observers did not spend extra time in order to differentiate between confirmed breeding pairs and pairs showing no confirmation of active breeding. We report the number of pairs, the number of single, unpaired birds and the overall total number of individuals observed.

Using the distribution results from the four regional surveys, the ownership and breeding season management status of all areas occupied by oystercatcher pairs was determined. Breeding season is considered to be approximately April through August. Breeding season management status was divided into four categories: Status 1 – closed to public use for the protection of nesting birds; Status 2 – open to public use by permit only and managed to protect nesting birds; Status 3 – open to the public for low-impact day use and managed to protect nesting birds; and Status 4 – privately owned and unregulated. We report a summary of ownership information and management status in order to assess the conservation status of suitable nesting habitat for oystercatchers in Virginia.

## RESULTS

Five hundred and eighty-eight American Oystercatcher pairs were recorded in coastal Virginia during the 2003 breeding season (Table 1). The barrier island beaches and the marshes of the seaside lagoon system supported 89% of the total number of pairs. Five different habitat types were identified within the marshes of the lagoon system, and over half of the marsh pairs were observed on storm-deposited shell rakes (Table 2). Only 11% of the total number of pairs was observed along the shores of the Chesapeake Bay (Table 1). Of those pairs, 87% were observed on small islands and islets within the bay, and the remaining 13% were observed on sandy beaches of the bay shoreline. A total of 161 unpaired American Oystercatchers were recorded, 96 (60%) of which were observed in flocks (Table 1).

Five different groups of landowners were identified for all areas occupied by American Oystercatcher pairs in 2003 (Table 3). State groups include the Commonwealth of Virginia, the Virginia Department of Conservation and Recreation, the Virginia Department of Game and Inland Fisheries and The College of William and Mary. Together, they own land that supported the largest number of oystercatcher pairs in the state in 2003 (Table 3). Of those pairs, 85% occurred on land owned by the Commonwealth of Virginia and managed by an additional state agency, the Virginia Marine Resources Commission. This includes predominantly areas within the marshes of the seaside lagoon system. The Nature Conservancy, the only non-governmental organization identified, owns and manages land that supported 27% of the total pairs, mostly barrier beach habitat. Two federal agencies were identified including the United States Fish and Wildlife Service and the National Aeronautics and Space Administration.

With the exception of four pairs observed on Watts Island in the upper Chesapeake Bay (part of Martin National Wildlife Refuge) and one pair observed on NASA property, the pairs observed on federal land included 57 pairs on Chincoteague National Wildlife Refuge, 40 pairs on Fisherman Island National Wildlife Refuge and two pairs on Plum Tree National Wildlife Refuge. Privately owned land occupied by oystercatchers included mostly small islands and islets located within the Chesapeake Bay.

Of the total number of pairs observed, 87% occurred on land that is managed or regulated to some degree for the protection of nesting birds (Table 3). This includes the one pair on NASA owned property that is closed to public use and managed for nesting birds by Chincoteague National Wildlife Refuge. Only 13% of pairs occurred on privately owned land with no known management or regulations to protect nesting birds.

#### DISCUSSION

The results presented here more than double previous estimates of breeding season numbers of American Oystercatchers in Virginia (Davis *et al.* 2001; Wilke and Watts 2004). Prior to 2003, oystercatcher survey efforts in the state focused only on the barrier islands, and no systematic surveys of the lagoon system or the shores of the Chesapeake Bay were conducted. The number of pairs recorded on the barrier islands increased slightly in 2003 from previous estimates within the last four years (Wilke and Watts 2004). Even so, the numbers on the islands do not account for the large increase in the estimate for Virginia reported here. Furthermore, only 63 pairs (11%) were recorded on the shores of the Chesapeake Bay in 2003. The large discrepancy between previous

estimates for the state and the 2003 survey results is due mostly to the 223 pairs documented within the lagoon system of the Delmarva Peninsula.

The results presented here suggest that Virginia supports the largest number of American Oystercatchers during the breeding season relative to other east coast states (Davis *et al.* 2001). This finding underscores the importance of Virginia as a stronghold for the species during the breeding season and the importance of continued revisions of population estimates for American Oystercatchers throughout their range (Brown *et al.* 2001). The 2003 results provide a benchmark for the comparison of future surveys of American Oystercatchers in Virginia.

Certain factors may influence the way that these results are interpreted. We report territorial pairs but did not differentiate between confirmed and unconfirmed breeding pairs. Therefore, the number of pairs reported could include non-breeding pairs observed on territories. Unconfirmed breeding pairs have not been treated consistently in the literature. Harris (1970) assumed that territorial pairs of European Oystercatchers (*Haematopus ostralegus*) for which no nesting attempt was found were non-breeders. Conversely, in a long-term study of the same species focusing on territory settlement of non-breeding individuals, Heg *et al.* (2000) assumed that territorial pairs for which no nesting attempt was found had attempted to nest and clutches were depredated before they were detected. These pairs were considered breeders. There is no conclusive evidence in the literature that American Oystercatcher pairs will defend a breeding territory without attempting to breed. We were unable to conduct multiple surveys that would be required to delineate this possibility. However, during more intensive

monitoring efforts on several barrier islands in 2003, we documented very few records of territorial pairs for which no nesting attempt was found.

Overall, the relatively small number of single birds or birds in flocks that were observed suggests that Virginia may not support large numbers of immature birds or non-breeding adults during the breeding season, as is seen in studies of *H. ostralegus* in the Netherlands (Heg *et al.* 2000). Nol did not report observations of groups of non-breeding birds during studies in Virginia during the early 1980's (Nol and Humphrey 1994). However, we did not record information on bill color for single birds or birds in flocks, which would have enabled us to estimate the percentage of immature birds (Sanders *et al.* 2004), and our surveys did not necessarily correspond with high tides, which would have concentrated non-territorial birds into roosting flocks. Methods for identifying immature birds and tidal stage should be considered in the design of future surveys.

Oystercatcher pairs occurred in each of the four geographic areas surveyed in 2003, but 89% were concentrated on the seaside of the Delmarva Peninsula (Table 1). Over half of the total number of pairs occurred on barrier island beaches. Similarly, breeding season surveys in North Carolina and Georgia have indicated that 50% and 57%, respectively, of oystercatcher pairs occur on barrier island beaches (Winn 2000; S. Cameron pers. comm.). In Virginia, the islands and the lagoon system together provide large expanses of undeveloped and relatively undisturbed nesting habitat for oystercatchers. In addition, food sources for oystercatchers breeding on the islands and in the marshes appear to be abundant and easily accessible. In contrast to the seaside region, the shores of the Chesapeake Bay provide only scattered patches of suitable nesting habitat, and areas along the western shore are heavily disturbed by human



recreation. No information is available on oystercatcher food sources on the shores of the Chesapeake Bay. In fact, very little is known about oystercatchers breeding in those areas, and future studies are needed to examine factors affecting their distribution and reproductive success.

The barrier islands are the only area in Virginia for which long-term oystercatcher survey data exist. That data indicate that oystercatcher numbers on the islands have declined by 47% since 1984 (Williams *et al.* 2000; B. Williams unpubl. data). Based on our 2003 survey results, it is clear that the downward trend observed on the islands over the past 20 years offers a limited perspective on the status of Virginia's oystercatchers. Because data do not exist for other geographic areas in the state, it is not possible to determine whether the observed decline on the barrier islands represents an actual change in the overall number of oystercatchers in Virginia or a geographical shift in the distribution of birds. Researchers and managers have suggested that American Oystercatchers, throughout their breeding range, have been shifting into non-traditional nesting habitats because of various factors making more traditional habitats either unavailable or unsuitable (Frohling 1965; Lauro and Burger 1989; Shields and Parnell 1990; Toland 1992). On the barrier islands of Virginia, increases in the numbers of mammalian predators and habitat dynamics could be contributing to a shift in distribution. Local researchers and managers have long suspected that increasing numbers of mammalian predators have caused declines of colonial waterbirds on the islands (Erwin *et al.* 2000; Keiss 2001; R. Dueser pers. comm.). The increase may have also caused island-breeding oystercatchers to shift into other areas such as the lagoon system. The relationship between mammals and the barrier island oystercatchers is

currently being investigated in further detail (Wilke *et al.* in prep). Habitat dynamics could also be a factor affecting the suitability and availability of breeding habitat for oystercatchers as the barrier islands migrate and transform over time. The potential role of these habitat dynamics in maintaining the stability of suitable nesting habitat over time is not yet understood but could offer insight into the observed decline of oystercatchers on the islands and a hypothetical geographical distribution shift.

The distribution of oystercatchers in Virginia during the breeding season encompasses the jurisdiction of federal, state, municipal and non-governmental organizations, as well as private landowners. Over 87% of the oystercatcher pairs observed occurred on land that is managed or regulated to varying degrees for the protection of nesting birds, including 20% that occurred on land that is closed to public use during the bird-breeding season. That also includes 57% that occurred in areas that have little or no threat of being developed and experience very low levels of human disturbance (VMRC 1999). Only 13% of territorial pairs occurred on privately owned land with no known management or regulations to protect nesting birds. Moreover, much of the privately owned land occurs in areas that are unfit for development and do not experience high levels of human disturbance. Habitat loss due to development or chronic human disturbance is often one of the most severe threats to the conservation of oystercatchers in other parts of the species' range (Davis *et al.* 2001; George 2002; McGowan 2004). Because oystercatcher pairs are known to use the same breeding territories year after year (Nol and Humphrey 1994), the ownership and management regulations of land occupied by oystercatchers in 2003 is encouraging for the overall stability and protection of suitable nesting habitat in Virginia.

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Table 1. Numbers of American Oystercatchers in coastal Virginia during the 2003 breeding season summarized by geographic area. Parentheses indicate percentage of total number of pairs and individuals.

Geographic Area	Pairs	Single	Total individuals
Barrier islands	302 (51)	52 <sup>1</sup>	656 (49)
Lagoon	223 (38)	104 <sup>2</sup>	550 (41)
Bay – western shore	21 (4)	0	42 (3)
Bay – Accomack shore	42 (7)	5	89 (7)
State total	588	161	1337

<sup>1</sup> Total number of singles includes 40 single birds and 12 birds in flocks.

<sup>2</sup> Total number of singles includes 20 single birds and 84 birds in flocks.



Table 2. Distribution of American Oystercatcher pairs during the 2003 breeding season among five different habitat types identified within the marshes of Virginia's seaside lagoon system.

Habitat Type	Number of pairs	%
Shell Rake	116	52
Marsh	42	19
Fringing Beach	40	18
Wrack	21	9
Salt Pan	4	2
TOTAL	223	100

Table 3. Summary of ownership and management status of land occupied by American Oystercatcher pairs in coastal Virginia during the 2003 breeding season. Parentheses indicate percentage of total number of pairs.

Ownership	Number of pairs	Breeding season management status (Apr – Aug) <sup>5</sup>			
		Status 1	Status 2	Status 3	Status 4
State <sup>1</sup>	242 (41)	29	3	210	-
Non-governmental <sup>2</sup>	159 (27)	25		134	
Federal <sup>3</sup>	104 (18)	60	9	35	
Private	77 (13)	1			76
Municipal <sup>4</sup>	6 (1)			6	
TOTAL	588 (100)	115 (20)	12 (2)	385 (65)	76 (13)

<sup>1</sup> Commonwealth of Virginia; Virginia Department of Conservation and Recreation; Virginia Department of Game and Inland Fisheries and The College of William and Mary.

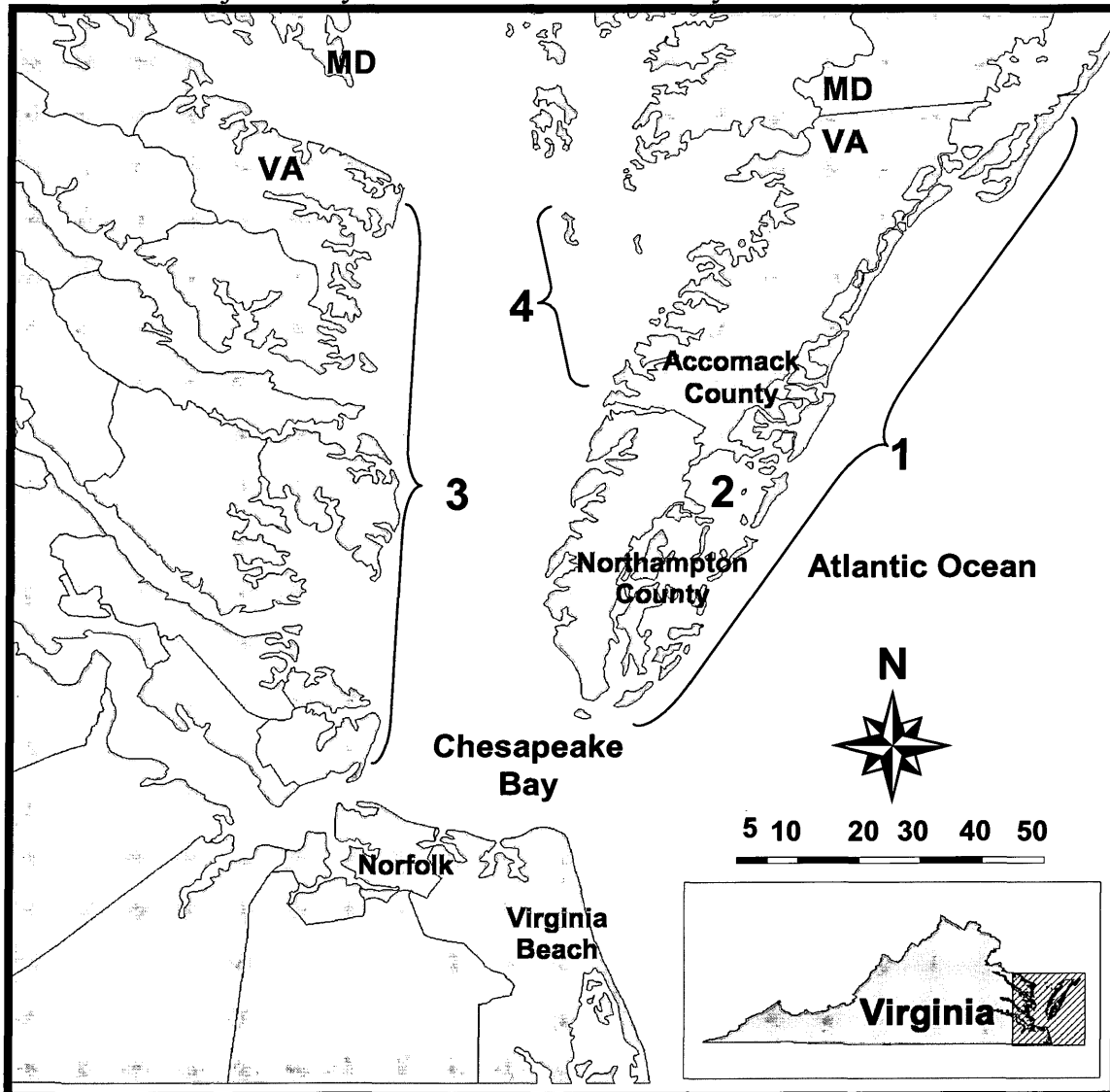
<sup>2</sup> The Nature Conservancy.

<sup>3</sup> United States Fish and Wildlife Service and National Aeronautics and Space Administration.

<sup>4</sup> City of Hampton.

<sup>5</sup> Refer to text.

Figure 1. Map of coastal Virginia showing the four geographic areas surveyed for American Oystercatchers during the 2003 breeding season: (1) barrier islands of the Delmarva Peninsula, (2) seaside lagoon system of the Delmarva Peninsula, (3) western shore of the Chesapeake Bay and (4) Chesapeake Bay shoreline of the Delmarva Peninsula and adjacent Bay islands of Accomack County.



**CHAPTER 2****INVESTIGATION OF AMERICAN OYSTERCATCHER REPRODUCTIVE RATES ON  
BARRIER ISLANDS IN VIRGINIA, USA\***

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**ABSTRACT**

Reproductive rates of American Oystercatchers (*Haematopus palliatus palliatus*) breeding on barrier islands in Virginia were investigated between 2002 and 2006. Two islands (Metompkin and Fisherman Islands) were monitored during all years of the study and five and seven additional islands were monitored during 2005 and 2006 respectively. Across all years of the study, mean daily survival rates of nest contents, mean hatching success, mean fledging success and mean productivity were significantly higher on Metompkin than on Fisherman Island. Metompkin Island supported a sizeable number of breeding pairs (61-90) that produced between 0.86 and 1.18 young per pair per year for five consecutive years. In contrast, 41-50 pairs on Fisherman Island produced 0.10 and 0.41 young per pair per year over the same time period. Differences in mammalian and avian predator activity at the two sites may explain the variation. A total of 209 and 284 pairs were monitored for reproductive success in 2005 and 2006 respectively. Site-specific productivity ranged between 0 and 1.14 young fledged per pair with a combined productivity estimate of 0.70 young fledged per territory over both years. Overall annual productivity estimates for pairs breeding in this system were well above what has been reported for this species in other parts of its breeding range on the east coast of the United States. Given the comparatively high reproductive rates reported here, it seems possible that some of the barrier islands in Virginia may serve as important population sources for the American Oystercatcher.

**Keywords.** – American Oystercatcher, Virginia, *Haematopus palliatus*, reproductive success, shorebirds

**Running head.** – Oystercatcher reproductive rates

## INTRODUCTION

Much of the eastern race of the American Oystercatcher (*Haematopus palliatus palliatus*) breeds and winters in a restricted coastal range in the United States and Central America and is therefore relatively accessible for study throughout its life cycle. The species has attracted research interest along the east coast of the United States in recent years because of concern over its conservation status, recognition of a lack of data for key demographic parameters and its potential as an important bio-indicator of the health of our coastal ecosystems (Brown *et al.* 2001; Schulte *et al.* 2006). As a result, researchers have made great progress with documenting population size and trends during the breeding and winter seasons (Davis *et al.* 2001; Sanders *et al.* 2004; Brown *et al.* 2005; Wilke *et al.* 2005; Traut *et al.* 2006). Documenting local and range-wide population size and trends alone, however, is not sufficient for assessing the status of species of conservation concern (Conway and Martin 2000). For example, an apparently stable local population may be supported by immigration from other populations while actually failing to maintain itself through local recruitment (Pulliam 1988). Monitoring parameters such as nest success and annual fecundity, along with population trends, are relatively simple ways of furthering our understanding of the status of a population, particularly at the local level (Conway and Martin 2000).

Recent studies have examined oystercatcher reproductive rates and factors limiting reproductive success (Davis *et al.* 2001; George 2002; McGowan 2004; McGowan *et al.* 2005; Sabine *et al.* 2006; Traut *et al.* 2006). Several studies in the southeastern United States have documented poor reproductive performance of oystercatchers breeding in barrier island habitats and have identified predation, over wash, and human disturbance,

among others, as causes of reproductive failure (e.g., Davis *et al.* 2001; McGowan *et al.* 2005; Sabine *et al.* 2006). Additional information on reproductive success is needed on a broader geographic scale to better understand how birds breeding in barrier island habitats throughout the species' range are contributing to the status of the population as a whole.

Barrier islands in Virginia support over 300 pairs of breeding American Oystercatchers, approximately 50% of the total number documented in the state (Wilke *et al.* 2005). Existing information about oystercatcher reproductive success on the islands is limited to studies conducted in the early 1980s that examined relatively small, isolated portions of the barrier island breeding population (Nol 1989; Anderson 1988). Similar to reports from other parts of the breeding range, these studies documented low reproductive rates due to factors such as predation and tidal inundation. Information on reproductive success in barrier island habitats over broader spatial and temporal scales is needed and has important implications for interpreting local and regional population trends, as well as for contributing to and evaluating results of demographic modeling.

This study investigated reproductive rates of American Oystercatchers on barrier islands in Virginia on two scales. We examined reproductive rates of breeding oystercatchers on two islands over 5 years (2002-2006) and nine islands over 2 years (2005-2006). Overarching objectives of the study were to collect detailed information on reproductive success of oystercatchers breeding on barrier islands in Virginia and to place the reproductive output of this local population in context with other regions.

## STUDY AREA

This study focused on 9 of 14 barrier islands in Virginia (Fig. 1). A detailed description of the islands and surrounding region is provided in Wilke *et al.* (2005). Two islands, Metompkin Island and Fisherman Island, were monitored over 5 breeding seasons (2002-2006). An additional 5 islands were monitored in 2005 and 7 islands in 2006.

## METHODS

Nest searches began during the first or second week of April in each year of the study (Nol and Humphrey 1994). All suitable nesting habitat on each island was surveyed on foot, with the exception of Fisherman Island which was surveyed either on foot, bicycle, or by vehicle. Nests were found by locating incubating adults from a distance or by following adult tracks to the nest. Nest locations were recorded with a Global Positioning System (GPS) unit and were marked with 30cm paint sticks placed 10m from the scrape. For nest attempts found with young, the initial location of the brood was recorded with a GPS unit. Each site was surveyed every 2 – 7 days and the status of each active nest was recorded and searches continued for new nest attempts or re-nest attempts. On occasion, intervals of 13-15 days passed between site visits. Nests were monitored until at least one egg hatched or eggs were lost. Following McGowan *et al.* (2005), partial clutch loss was not considered. Cause of clutch loss was determined when possible by examining evidence in and around the scrape such as egg shell remnants and tracks. Young were monitored until they disappeared or were considered fledged at 35 days after hatching or when observed flying (Nol and Humphrey 1994). Causes of brood loss were difficult to document and are not reported.



We report apparent hatching success (percentage of all nest attempts found at the egg stage that hatched at least one egg) for Metompkin and Fisherman Islands over 5 years (2002-2006). Percentages are reported as a range to account for nests with unknown fate of the eggs. The lower limit takes into account those nests with unknown fate that may have failed to hatch and the upper limit represents those nests that may have been successful (hatched at least one egg). We also report daily clutch survival rates (DSR) and hatching success rates (probability of a nest surviving from onset of incubation to hatching) calculated using the Mayfield estimator for both islands in all years (Mayfield 1961, 1975). The mid-point method was used to calculate the number of exposure days for successful and failed nests and nests with unknown outcome (Manolis *et al.* 2000). The standard error and 95% confidence intervals for DSRs was calculated according to Johnson (1979). Hatching success was calculated by raising the DSR to the 27<sup>th</sup> power based on an average incubation period of 27 days (Mayfield 1961; Nol and Humphrey 1994) and 95% confidence intervals were calculated by raising the upper and lower bounds of the DSR 95% confidence intervals to the 27<sup>th</sup> power (Johnson 1979). We did not calculate survival rates for the brood rearing stage because of the difficulty of determining exactly when young disappeared. Finally, we report fledging success (percentage of breeding pairs that fledged at least one young) and productivity (number of young fledged per breeding pair) at each site for every year it was monitored.

The program CONTRAST (Hines and Sauer 1989) was used to compare annual within-site DSRs on Metompkin and Fisherman Islands. The 5-year means of all reproductive parameters reported for Fisherman and Metompkin Islands were compared using two-tailed independent t-tests with a significance level set at  $\alpha = 0.05$ . Spearman's

rank correlation coefficients were calculated for comparative analysis of causes of nest lost at both sites over 5 years and of productivity rates between years at the 7 sites monitored in both 2005 and 2006.

## RESULTS

The number of pairs monitored on Fisherman and Metompkin Islands during the 2002 through 2006 breeding seasons ranged from 41 to 50 pairs and 63 to 93 pairs, respectively (Table 1). Annual variation of DSRs at both sites was significant (Fisherman:  $\chi^2 = 21.78$ , d.f. = 4,  $p = 0.0002$ ; Metompkin:  $\chi^2 = 13.20$ , d.f. = 4,  $p = 0.0104$ ). Pair-wise comparisons of annual DSRs on Metompkin Island indicated that 2006 was significantly lower than all years except for 2005. All other comparisons were not significantly different. Pair-wise comparisons of annual DSRs on Fisherman Island indicated that 2002 and 2004 were not significantly different and were significantly higher than all other years. Across all years of the study, mean DSR of nest contents, mean hatching success, mean fledging success and mean productivity were significantly higher on Metompkin compared to Fisherman Island (Table 2). On Metompkin Island, 377 young were documented as having fledged over 5 years with fledging success and productivity estimates ranging between 58% and 76% and 0.86 and 1.18 young per pair, respectively. Only 51 young fledged from Fisherman Island over 5 years and fledging success and productivity estimates ranged between 10% and 32% and 0.10 and 0.41 young per pair, respectively. Wash out was documented as the dominant cause of nest loss on both islands in all years combined, followed by nests lost to unknown causes but with wash out eliminated as a possible cause (Table 3). The remaining observed causes

of nest loss on both islands were similar, however a Spearman's rank coefficient indicates no significant correlation between the relative frequencies of causes between sites in all years ( $r = 0.52$ ,  $p = 0.12$ ).

A total of 209 pairs were monitored at 7 sites during the 2005 breeding season and 284 pairs at 9 sites in 2006 (Table 4). Based on annual surveys for breeding pairs on all barrier islands in the state, these numbers represented 56% and 76% of the total number of pairs on the islands, in each year respectively. Site-specific fledging success in both years ranged between 0 and 89% and productivity ranged between 0 and 1.14 young fledged per pair (Table 4). In both years combined, a total of 346 young fledged from 493 monitored territories for an overall productivity estimate of 0.70 young per pair. A Spearman's rank correlation coefficient calculated to compare productivity rates between the 7 sites monitored in both 2005 and 2006 yielded  $r = 0.72$  and  $p = 0.07$  indicating that spatial variation in reproductive success was generally consistent between years.

## DISCUSSION

The difference in reproductive success of oystercatchers on Metompkin and Fisherman Islands over the years of this study was highly significant despite several similarities between the two sites. Both islands support over 40 breeding pairs of American Oystercatchers and experience relatively little human recreational activity during the breeding season. The relative impact of overwash events on nest loss was similar at both sites over the 5 years of the study. And although difficult to document, no evidence of starvation was found to explain losses of chicks. Moreover, Nol (1989) found no significant relationship between food supply and fledging success in a study of

American Oystercatchers breeding on three Virginia barrier islands directly north of this study area. A difference in the level of mammalian and avian predator activity may instead be responsible for the significantly lower reproductive success on Fisherman Island. Metompkin is one of six islands considered in this study that is actively managed for the two mammalian predators known to impact beach nesting birds on the Virginia barrier islands, the red fox (*Vulpes vulpes*) and the common raccoon (*Procyon lotor*) (Keiss 2001; Erwin *et al.* 2001). Currently, the habitat on Metompkin does not support a stable population of these predators and annual management efforts are usually successful in removing most, if not all, individuals prior to the bird nesting season (U. S. Department of Agriculture\APHIS\Wildlife Services, unpubl. data; R. Dueser, pers. comm.). Fisherman Island, however, has a substantial amount of upland habitat suitable for supporting a more stable population of mammalian predators. Furthermore, Fisherman is the only barrier island within the scope of this study that is connected to the mainland of the Eastern Shore of Virginia by a bridge. Built in 1964, this link to the mainland most likely facilitated the colonization of the island by raccoons beginning in the late 1990s (U. S. Fish and Wildlife Service 2005). Despite periodic management efforts to reduce raccoon numbers on the island throughout the study period, raccoon activity was documented in nesting areas during all breeding seasons, and at least nine percent of clutches were lost to raccoons during the study period.

Avian predators most likely also played a role in the difference in reproductive success between the two sites. Anderson (1988) reported over 300 Fish Crows on Fisherman Island in the early 1980s and implicated them as a major cause of oystercatcher nest loss. More recently, Fish Crows were documented as the second

highest cause of nest loss on the island during a camera study conducted on select oystercatcher nesting attempts in 2005 (Watts *et al.* 2006). In contrast, Fish Crows are seen only in small numbers on Metompkin Island and are not suspected to be a predominant cause of nest loss. Gulls are also a known threat to the success of breeding oystercatchers (e.g., Harris 1967; Hartwick 1974; Heppleston 1972; Vermeer *et al.* 1992). Throughout the study period, Fisherman supported a large Herring (*Larus argentatus*) and Great Black-backed Gull (*Larus marinus*) colony of over 500 pairs while Metompkin Island supported only a small colony of less than 10 pairs. Watts *et al.* (2006) did not document any depredation of oystercatcher nests by gulls on Fisherman, however the extent of the impact of gulls on pre-fledged oystercatcher young on the island is unknown and needs further study. The impact of other avian predators such as Peregrine Falcons (*Falco peregrinus*) and Great Horned Owls (*Bubo virginianus*) at both sites is unknown, although evidence of both species taking oystercatcher adults and young has been documented on the Virginia barrier islands (E. Long, unpubl. data).

Significant annual variation of DSRs at both sites over 5 years was most likely due to nest losses to tidal inundation. Wash out events in 2006 on Metompkin Island resulted in lower nest survival in that year. Variation on Fisherman Island was also likely driven by wash out events in 2003, 2005 and 2006. Unlike all other primarily east facing barrier islands in coastal Virginia, Fisherman Island is circular in shape and nesting beaches face high-energy wave action in all directions. Therefore, the beaches of Fisherman are often impacted more frequently and severely by storm-driven high tide events of varying wind direction.

Results from Metompkin Island describe a site that supports a sizeable number of breeding pairs (61-90) with relatively consistent high annual productivity. To our knowledge, this level and consistency of productivity for American Oystercatchers has not been reported. Similar reproductive success has been reported for other oystercatcher species in fewer years at sites with little or no threat from mammalian predators (Harris 1967; Gill *et al.* 2004). These results highlight the fact that isolated, predator free islands may serve as population sources for oystercatchers, as suggested by Hockey (1996).

Previous studies of American Oystercatcher reproductive success in barrier island habitats have focused on relatively small numbers of pairs within limited geographic areas. Results presented here offer the most comprehensive evaluation of oystercatcher reproductive success on the Virginia barrier islands to date. Overall annual productivity estimates for pairs breeding in this system in 2005 and 2006 were well above what has been reported for this species in other parts of its breeding range (e.g., Nol 1989; George *et al.* 2002; McGowan *et al.* 2005) and in studies of reproductive success of other oystercatcher species (e.g., Hartwick 1974; Kersten and Brenninkmeijer 1995). In addition to Metompkin Island, several other barrier islands in Virginia are selectively managed for mammalian predators. Moreover, all of the islands considered in this study are remote, undeveloped, accessible only by boat and receive relatively little human recreational activity (Wilke *et al.* 2005). We believe the combination of these factors plays an important role in the relatively high oystercatcher reproductive success documented on the islands. Complete reproductive failure documented on Little Cobb and Myrtle Islands in 2006 was due to an over wash event that lowered the overall productivity estimate for that year.

Typical reproductive output of oystercatcher species throughout the world is thought to be generally low (delHoyo *et al.* 1996) but populations may persist because low reproductive rates are offset by longevity. Although many of the key demographic parameters for the American Oystercatcher are not yet available to be incorporated into a rigorous population viability analysis that would predict what level of productivity is needed to maintain a stable population (Schulte *et al.* 2006), models performed by Davis *et al.* (1999) using demographic parameters from the closely related European Oystercatcher (*Haematopus ostralegus*) predicted that annual productivity values as low as 0.14 young per pair per year are sufficient for maintaining a stable population of this species. Given the comparatively high reproductive rates reported here, it seems possible that some of the barrier islands in Virginia may serve as important population sources for the American Oystercatcher. Researchers have recently questioned whether the northward expansion of the breeding range of American Oystercatchers over the past 60 years represents a shift in habitat use by the species or is the result of local population increases (McGowan *et al.* 2005). Prior to this study, no consistently productive local oystercatcher populations have been reported. Pockets of ‘source’ populations in Virginia may be responsible to some degree for documented increases in numbers in the northern parts of the species’ breeding range. The recent establishment of a coordinated banding network will help to evaluate this possibility. For example, an oystercatcher observed breeding along the New Jersey coastline in 2006 was banded as a chick in Virginia in the summer of 2003.

The conservation status of the Virginia barrier islands offers a unique opportunity to study oystercatcher reproductive biology over a large geographic area in the relative

absence of threats such as coastal development and high levels of human disturbance (Wilke *et al.* 2005). Results of this study offer important insight into the reproductive potential of this species in barrier island habitats and will assist managers with assessing the status and management of oystercatchers throughout the species' range.

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Table 1. Apparent hatching success, daily nest survival rates (DSR), nest success, fledging success and productivity of American Oystercatchers breeding on Fisherman and Metompkin Islands, Virginia, 2002-2006.

Site/Year	No. pairs	No. clutches	Apparent hatching success	Exposure days	No. failures	DSR (S.E.)	DSR 95% CI	Hatching success	Hatching success 95% CI	No. fledglings	No. succ. pairs	Fledging success	Productivity
<b>Fisherman Island</b>													
2002	41	46	56.5 – 69.6	738.5	13	0.98 (0.0048)	0.97-0.99	0.62	0.47-0.81	17	13	0.32	0.41
2003	48	78	33.3 – 39.7	996	43	0.96 (0.0064)	0.94-0.97	0.30	0.21-0.44	10	9	0.19	0.21
2004	50	58	46.6 – 53.5	977.5	25	0.97 (0.0050)	0.96-0.98	0.50	0.38-0.66	5	5	0.10	0.10
2005	47	82	26.8 – 30.5	995	46	0.95 (0.0067)	0.94-0.97	0.28	0.19-0.41	6	5	0.11	0.13
2006	42	74	28.4 – 32.4	966.5	43	0.96 (0.0066)	0.94-0.97	0.29	0.20-0.42	13	8	0.19	0.31
<b>Metompkin Island</b>													
2002	61	56	69.6 – 76.8	789.5	6	0.99 (0.0031)	0.99-1.00	0.81	0.69-0.96	57	42	0.69	0.93
2003	63	79	75.9 – 86.1	1284.5	8	0.99 (0.0022)	0.99-1.00	0.84	0.75-0.95	66	48	0.76	1.05
2004	79	86	75.6 – 84.9	1530	11	0.99 (0.0022)	0.99-1.00	0.82	0.73-0.93	93	54	0.68	1.18
2005	74	80	72.5 – 76.3	1394.5	17	0.99 (0.0029)	0.98-0.99	0.72	0.61-0.84	84	54	0.73	1.14
2006	90	111	63.1 – 66.7	1747	34	0.98 (0.0033)	0.97-0.99	0.59	0.49-0.71	77	52	0.58	0.86

Table 2. Comparison of daily survival rates (DSR), hatching success, fledging success and productivity of American Oystercatchers on Fisherman and Metompkin Islands, 2002-2006. Five-year means  $\pm$  SD are presented with results of two-tailed independent t-tests with significance set at  $\alpha = 0.05$ .

Reproductive Parameter	Fisherman Island	Metompkin Island	t-value	d.f.	p-value
DSR	0.964 $\pm$ 0.011	0.988 $\pm$ 0.004	-4.3818	8	0.002343
Hatching success	0.398 $\pm$ 0.154	0.756 $\pm$ 0.104	-4.3129	8	0.002570
Fledging success	0.182 $\pm$ 0.088	0.688 $\pm$ 0.068	-10.1444	8	0.000008
Productivity	0.232 $\pm$ 0.129	1.032 $\pm$ 0.136	-9.5632	8	0.000012

Table 3. Documented causes of American Oystercatcher nest loss on Fisherman and Metompkin Islands, Virginia, 2002-2006. Parentheses indicate percentage of total.

Cause of nest loss	Fisherman (n = 195)	Metompkin (n = 93)
Wash out	74 (37.9)	35 (37.6)
Unknown, not wash out	51 (26.2)	11 (11.8)
Unknown	26 (13.3)	5 (5.4)
Raccoon	18 (9.2)	6 (6.5)
Avian predator	4 (2.1)	3 (3.2)
Ghost crab	1 (0.5)	9 (9.7)
Unknown predator	6 (3.1)	9 (9.7)
Overdue <sup>1</sup>	7 (3.6)	7 (7.5)
Abandoned	8 (4.1)	7 (7.5)
Crushed in scrape	0 (0)	1 (1.1)

<sup>1</sup> Eggs incubated past hatching due date.

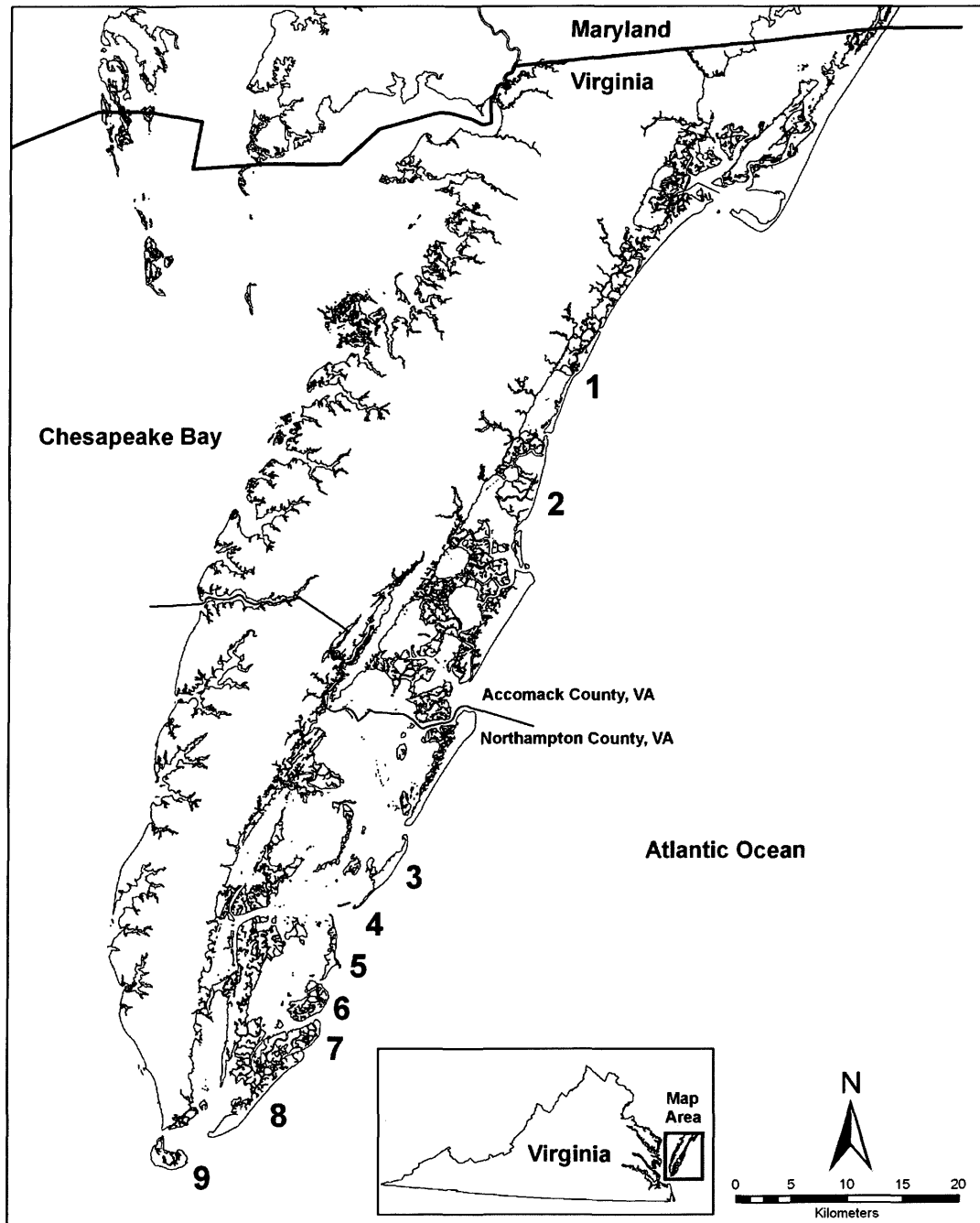
Table 4. Fledging success and productivity of American Oystercatchers on barrier islands in Virginia in 2005 and 2006.

SITE	2005				2006					
	No. pairs	No. fledglings	No. succ. pairs	Fledging success	Productivity	No. pairs	No. fledglings	No. succ. pairs	Fledging success	Productivity
Fisherman Island	47	6	5	0.11	0.13	42	13	8	0.19	0.31
Smith Island	-	-	-	-	-	13	1	1	0.08	0.08
Myrtle Island	12	2	1	0.08	0.17	9	0	0	0.00	0.00
Ship Shoal Island	18	20	16	0.89	1.11	22	17	10	0.45	0.77
Wreck Island	22	19	18	0.82	0.86	33	23	19	0.58	0.70
Little Cobb Island	6	6	5	0.83	1.00	6	0	0	0.00	0.00
Cobb Island	-	-	-	-	-	10	8	5	0.50	0.80
Cedar Island	30	32	19	0.63	1.07	59	38	29	0.49	0.64
Metompkin Island	74	84	54	0.73	1.14	90	77	52	0.58	0.86
TOTAL (%) <sup>1</sup>	209 (56%)	169	118	0.56	0.81	284 (76%)	177	124	0.44	0.61

<sup>1</sup> Percentage indicates what proportion of the barrier island breeding pairs were monitored for productivity in each year. Total number of breeding pairs on the islands documented in annual on-the-ground surveys and productivity monitoring efforts; 2005 total = 374 pairs, 2006 total = 376 pairs.



Figure 1. Map of coastal Virginia showing 9 barrier islands monitored for breeding American Oystercatchers: (1) Metompkin Island, (2) Cedar Island, (3) Cobb Island, (4) Little Cobb Island, (5) Wreck Island, (6) Ship Shoal Island, (7) Myrtle Island, (8) Smith Island, and (9) Fisherman Island.



**CHAPTER 3****AMERICAN OYSTERCATCHERS IN MARYLAND AND VIRGINIA, USA: STATUS AND  
DISTRIBUTION\***

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CHANGE?*

## 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's 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 the breeding population and a gradual recolonization of most of the species's 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 20<sup>th</sup> 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's 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, unpublished 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, unpublished 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's decline in Virginia can not be determined. More recently, intensive annual surveys of the barrier islands between 2000 and 2006 documented a 33% 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], unpublished 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's 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 29% of the estimated number of breeding pairs on the east coast of the United States (estimated using other published or reported breeding estimates for 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 2005. 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 in Virginia between 2002 and 2005 encompassed between two to thirteen sites and 106 to 301 pairs annually (ALW *et al.*, unpublished data). The maximum number of pairs monitored annually represented approximately 54% of the total number of pairs estimated to be breeding along the Virginia barrier islands and coastal bays. Reproductive rates at these sites ranged between 0.02 to 1.26 young per pair per year (ALW *et al.*, unpublished 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 2002-2005 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, unpublished data; RB and ALW, unpublished 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 +/- 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, unpublished 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 given 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, unpublished 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, unpublished 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 resident 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, unpublished data; American Oystercatcher Working Group [AOWG]), unpublished reports). In addition, winter resighting efforts in other states have documented the presence of juvenile birds banded as chicks in Virginia (AOWG,

unpublished 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's 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's range because of the species's distribution 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.*, unpublished data; R. Dueser, Utah State University, unpublished 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.

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, unpublished 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, unpublished 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's 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's biology, but also because of concern for the species's conservation status range-wide and its potential to serve as a bioindicator our coastal ecosystems.

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

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