

Breeding Season Status of the American Oystercatcher in Virginia, USA

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Abstract.—Surveys of the American Oystercatcher (*Haematopus palliatus*) were conducted in all suitable nesting habitat in coastal Virginia, USA 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 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 closed to public use during the bird-breeding season. Only 13% of the pairs were on land that affords no protection to breeding birds. Received 10 February 2005, accepted 7 April 2005.

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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 of high 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 have been the impetus for several studies in recent years aimed at furthering our understanding of the population status and general biology of the American Oystercatcher (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, follow population trends and evaluate management strategies (Brown *et al.* 2001). In response, several of the recent studies of the American Oystercatcher 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; Sand-

ers *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 in that area. 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 the American Oystercatcher (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

greater than 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, ten 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 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 are 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 use by 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. The American Oystercatcher breeds 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

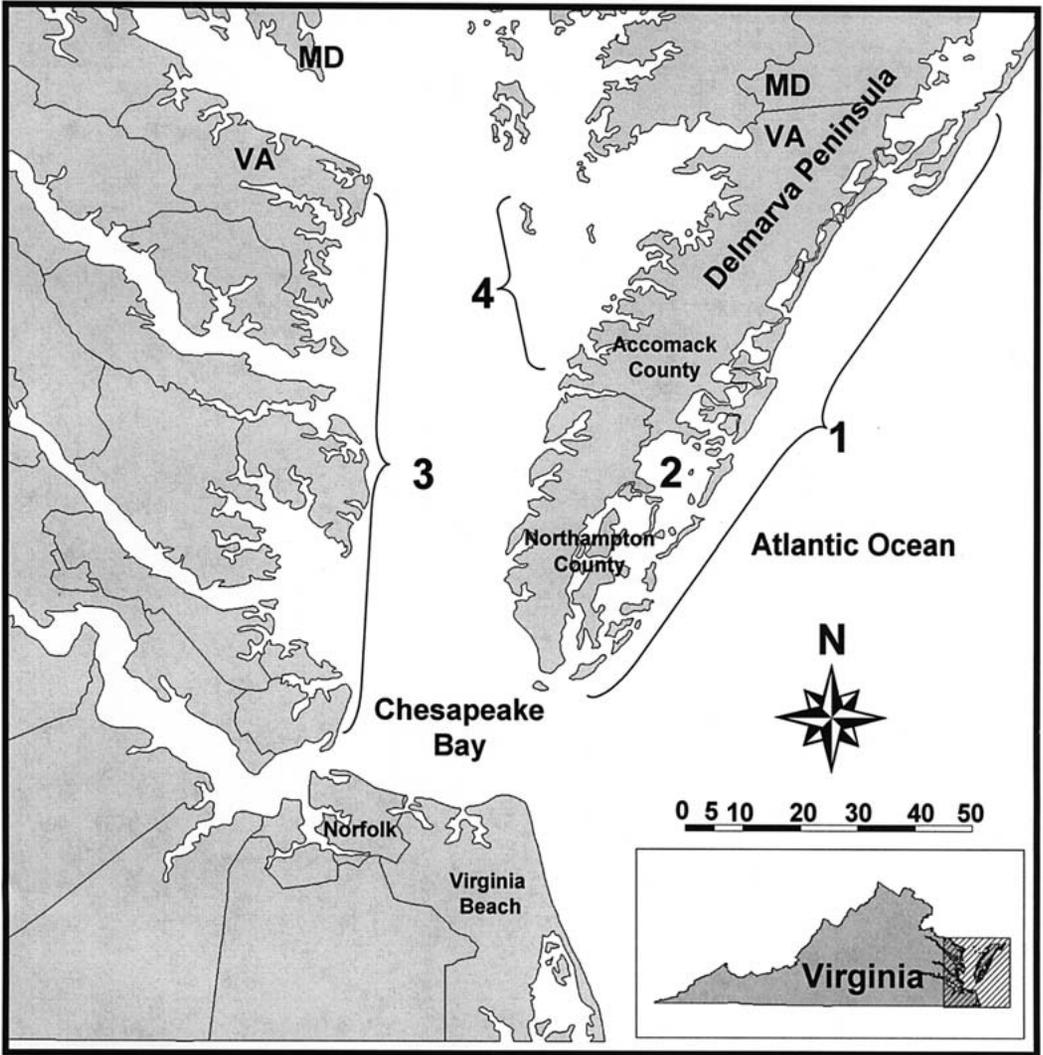


Figure 1. Map of coastal Virginia showing the four geographic areas surveyed for American Oystercatchers during the 2003 breeding season: (1) barrier islands of the Delmarva Peninsula, (2) seaside lagoon system of the Delmarva Peninsula, (3) western shore of the Chesapeake Bay and (4) Chesapeake Bay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

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 shells, wrack deposits, fringing sandy beaches and topographic high spots provide nesting habitat for a variety of colonial nesting waterbirds, as well as the American Oystercatcher (Rounds 2003). The 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).

For the purposes of this survey, the western shore of the Chesapeake Bay is defined as the western edge of the bay, extending from the mouth of the James River north to the mouth of the Potomac River. The 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 the adjacent marshes are dominated by Smooth Cordgrass and Black Needlerush (*Juncus roemerianus*) (CCIP 2001). The Chesapeake Bay shoreline of the Delmarva Peninsula, includes the western shoreline and Bay islands of Accomack County, but 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 was 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 short time period. The American Oystercatcher exhibits 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, 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 in monitoring the breeding of oystercatchers, we believe that one-time surveys during the time period specified resulted in an accurate estimate of breeding pairs.

In all cases, 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 to confirm 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. The 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

A total of 588 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. In addition, 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 agen-

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

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

¹Total number of singles included 40 single birds and 12 birds in flocks.

²Total number of singles included 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

cy, 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 used 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 access 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 the American Oystercatcher 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 and the 2003 survey for the state is due mostly to the 223 pairs found within the lagoon system of the Delmarva Peninsula.

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)			
		Status 1	Status 2	Status 3	Status 4
State ¹	242 (41)	29	3	210	—
Non-governmental ²	159 (27)	25	—	134	—
Federal ³	104 (18)	60	9	35	—
Private	77 (13)	1	—	—	76
Municipal ⁴	6 (1)	—	—	6	—
Total	588 (100)	115 (20)	12 (2)	385 (65)	76 (13)

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

²The Nature Conservancy.

³United States Fish and Wildlife Service and National Aeronautics and Space Administration.

⁴City of Hampton.

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 emphasizes 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 the European Oystercatcher (*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 predated before they were detected. There is no conclusive evidence in the literature that American Oystercatcher pairs will defend a breeding territory without attempting to breed, but 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 found very few 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 the European Oystercatcher 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 1980s (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 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 used for human recreation. No information is available on oystercatcher food sources on the shores of the Chesapeake Bay. 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 of Virginia for which long-term oystercatcher survey data exist. These 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 de-

cline on the barrier islands represents an actual change in the overall numbers in Virginia or a geographical shift in the distribution of the oystercatchers. Researchers and managers have suggested that, throughout their breeding range, the American Oystercatcher has shifted 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 move to other areas such as the lagoon system. The relationship between mammals and the barrier island oystercatchers is currently being investigated in detail. 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 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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LITERATURE CITED

- Brown, S., C. Hickey, B. Harrington and R. Gill (Eds.). 2001. The U.S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, Massachusetts.
- Brown, S., B. Winn and S. Schulte. 2003. A bird's eye view of Oystercatchers. *Birdscapes*, Fall issue: 21.

- U.S. Fish and Wildlife Service, Division of Bird Habitat Conservation, Albuquerque, New Mexico.
- Clark, K. E. and L. J. Niles. 2000. Northern Atlantic Regional Shorebird Plan, Version 1.0. Endangered and nongame species program, New Jersey Division of Fish and Wildlife, Woodbine, New Jersey.
- Comprehensive Coastal Inventory Program. 2001. Shoreline Manager's Assessment Kit. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia.
- Davis, M. B., T. R. Simons, M. J. Groom, J. L. Weaver and J. R. Cordes. 2001. The breeding status of the American Oystercatcher on the east coast of North America and breeding success in North Carolina. *Waterbirds* 24: 195-202.
- Erwin, R. M., B. R. Truitt and J. E. Jimenez. 2001. Ground-nesting waterbirds and mammalian carnivores in the Virginia barrier island region: running out of options. *Journal of Coastal Research* 17: 292-296.
- Frohling, R. C. 1965. American Oystercatcher and Black Skimmer nesting on salt marsh. *Wilson Bulletin* 77: 193-194.
- George, R. C. 2002. Reproductive ecology of the American Oystercatcher (*Haematopus palliatus*) in Georgia. Unpublished M.Sc. thesis, University of Georgia, Athens.
- Harris, M. P. 1970. Territory limiting the size of the breeding population of oystercatchers, *Haematopus ostralegus*: a removal experiment. *Journal of Animal Ecology* 39: 707-713.
- Heg, D., B. J. Ens, H. P. Van der Jeugd and L. W. Bruinzeel. 2000. Local dominance and territorial settlement of nonbreeding oystercatchers. *Behaviour* 137: 473-530.
- Humphrey, R. C. 1990. Status and range expansion of the American Oystercatcher on the Atlantic coast. *Transactions of the Northeast Section of the Wildlife Society* 47: 54-61.
- Hunter, W. C., R. Noffsinger and J. A. Collazo. 2000. Southeastern Coastal Plains—Caribbean Regional Shorebird Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia.
- Keiss, O. 2001. Mammalian predator distribution and abundance on the Virginia barrier islands in relation to breeding habitats of colonial birds. Unpublished MSc thesis, Utah State University, Logan.
- Lauro, B. and J. Burger. 1989. Nest-site selection of American Oystercatchers in salt marshes. *Auk* 106: 185-192.
- McGowan, C. P. 2004. Factors affecting nesting success of American Oystercatchers (*Haematopus palliatus*) in North Carolina. Unpublished MSc thesis, North Carolina State University, Raleigh.
- Moore, K. A. 1977. Northampton County Tidal Marsh Inventory. Special Report No. 139. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia.
- Nol, E. 1989. Food supply and reproductive performance of the American Oystercatcher in Virginia. *Condor* 91: 429-435.
- Nol, E. and R. C. Humphrey. 1994. American Oystercatcher (*Haematopus palliatus*). In *The Birds of North America*, No. 82 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences, Philadelphia; The American Ornithologists' Union, Washington, D.C.
- Nol, E., B. Truitt, D. Allen, B. Winn and T. Murphy. 2000. A survey of wintering American Oystercatchers from Georgia to Virginia, U.S.A., 1999. *Wader Study Group Bulletin* 93: 46-50.
- Pilkey, O. H. 2003. A celebration of the world's barrier islands. Columbia University Press, New York.
- Rounds, R. A. 2003. Nest-site selection and hatching success of four waterbird species in coastal Virginia. Unpublished MSc thesis, University of Virginia, Charlottesville.
- Sanders, F. J., T. M. Murphy and M. D. Spinks. 2004. Winter abundance of the American Oystercatcher in South Carolina. *Waterbirds* 27: 83-88.
- Shields, M. A. and J. F. Parnell. 1990. Marsh nesting by American Oystercatchers in North Carolina. *Journal of Field Ornithology* 61: 431-433.
- Silberhorn, G. M. and A. F. Harris. 1977. Accomack County Tidal Marsh Inventory. Special Report No. 138. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia.
- Toland, B. 1992. Use of forested spoil islands by nesting American Oystercatchers in southeast Florida. *Journal of Field Ornithology* 63: 155-158.
- Virginia Marine Resources Commission. 1999. Management plan for the ungranted state lands of Accomack and Northampton Counties. *Virginia Register Volume 15: Issue 15, Regulation no. 4 VAC 20-1030-10*, Newport News, Virginia.
- Wilke, A. L. 2003. American Oystercatcher productivity monitoring and banding on the Eastern Shore of Virginia: Year 2003 report. Center for Conservation Biology Technical Report Series. CCBTR-04-01. College of William and Mary, Williamsburg, Virginia.
- Wilke, A. L. and B. D. Watts. 2004. American Oystercatcher productivity monitoring, breeding survey and banding in Virginia: 2004 report. Center for Conservation Biology Technical Report Series. CCBTR-04-09. College of William and Mary, Williamsburg, Virginia.
- Williams, B., B. Akers, M. Beck, R. Beck and J. Via. 2000. The 1998 colonial and beach-nesting waterbird survey on the Virginia Barrier islands. *Raven* 71: 42-45.
- Winn, B. 2000. The spatial distribution of American Oystercatchers in Georgia. *Oriole* 65: 41-49.