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**AN EVALUATION OF NEST BOX USE BY BARN
OWLS AND THE INITIATION OF A NEW NEST
BOX PROGRAM WITHIN COASTAL
MARSHLANDS OF VIRGINIA**



**CENTER FOR CONSERVATION BIOLOGY
COLLEGE OF WILLIAM AND MARY**

AN EVALUATION OF NEST BOX USE BY BARN OWLS AND THE INITIATION OF A NEW NEST BOX PROGRAM WITHIN COASTAL MARSHLANDS OF VIRGINIA

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Center for Conservation Biology**

Front Cover: *David Whalen measuring Barn Owl chick in an off-shore duckblind on the Rappahannock River. Photo by Bryan Watts.*



The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

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EXECUTIVE SUMMARY

In recent years, many North American populations of the Common Barn Owl (*Tyto alba*) have suffered substantial declines. Explanations for declining trends vary regionally but include secondary succession on cleared lands, intensification of agricultural practices, biocides, and urban development. In Virginia, the Barn Owl is considered an uncommon to rare resident species. Population strongholds continue to be the Shenandoah Valley, the northern Piedmont, and the open marshlands of the Coastal Plain. From 1976 to 1985 there were 111 documented nest sites for Barn Owls in Virginia but only 43 of these sites supported active breeding pairs in 1986. During that year, the Virginia Department of Game and Inland Fisheries (VDGIF) initiated a nest box program in an attempt to reverse recent population trends. The objectives of this project were to 1) resurvey VDGIF nest structures to evaluate condition and use, and 2) to expand the nest box program in Virginia by establishing a new network of boxes within extensive open marsh habitats of the Coastal Plain.

During the breeding season of 1997, 71 boxes and trays were examined throughout Virginia including 30 in the ridge and valley region, 21 in the piedmont, and 20 in the coastal plain. Twenty-one of 71 (29.6%) VDGIF boxes were found to be active during the 1997 breeding season. An additional 25 boxes appear to be available for use but were not used during the 1997 breeding season. Fifteen boxes erected between 1986 and 1990 had been destroyed. Five boxes were judged to be currently unusable by nesting Barn Owls. Overall, the rate of occupation by breeding Barn Owls was very similar to that reported in 1989 and 1990, the last two years that nest boxes were monitored. More than 45% of boxes that were judged to be available for use supported active pairs. This evaluation demonstrates that the aggressive use of nesting substrates within appropriate locations could have a significant impact on Virginia's population and highlights the need for a broad-based management plan that outlines the remaining strongholds for this species and identifies specific locations where management actions would have the greatest probability of success.

Extensive short-grass marshes are the most natural and stable foraging habitats available to Barn Owls in Virginia. Providing nesting substrate within these foraging habitats is a logical progression in the management of this species. A total of 60 nest boxes that were specifically designed for use in coastal marshes were constructed. A network of 44 boxes were established within extensive open marshes. The remaining 16 boxes have been, or will be, installed within inland sites with appropriate grassland habitats. The initial 24 nest boxes that were deployed in 1997 were monitored for 2 years after establishment. This effort did not identify any indication of use during this time period. A follow-up survey of all box sites is needed to adequately evaluate the success of this effort. Such a survey could evaluate both the longevity and condition of the marsh boxes and give an indication of their use.

BACKGROUND

Context

The Common Barn Owl (*Tyto alba*) is the most widely distributed owl in the world (Burton 1984). In recent years, many populations of this species in North America have suffered substantial declines (Marti 1988). Recent declines, in part, have followed earlier range expansions. Clearing of forested lands for agriculture, increased use of irrigation, and the availability of man-made structures for nesting have all been cited as factors contributing to earlier range expansions (Stewart 1980, Colvin 1985). Explanations of declining trends vary regionally but include secondary succession on cleared lands, intensification of agricultural practices (Colvin 1985), and biocides (Henny et al. 1984, Mendenhall and Park 1980, Mendenhall et al. 1983). The Common Barn Owl appeared on "The Blue List" of the National Audubon Society from 1972 to 1981 because populations were judged to be "down" or "greatly down" and was listed as a species of special concern from 1982 through 1986 (Tate 1986). By the late 1980's, the species appeared on the threatened and endangered species list within fifteen different states (Marti 1988).

The Barn Owl is considered an uncommon to rare resident species throughout the state of Virginia (Kain 1987). Population strongholds continue to be the Shenandoah Valley, the northern Piedmont, and the open marshlands of the Coastal Plain (Rosenburg 1991). From 1976 to 1985 there were 111 known nest sites for Barn Owls in Virginia but only 43 of these sites supported active breeding pairs in 1986 (Byrd et al. 1986). As a result it was recommended that the species be listed as Threatened in the state (Byrd et al. 1986). Due in part to some early success of a state nest box program the number of known active pairs increased to 65 by 1989 and the recommended status for the Barn Owl was downgraded to Special Concern (Byrd et al. 1990). However, recent observations suggest that continued loss of suitable Barn Owl foraging habitat and nest sites may have resulted in a decline in the breeding population to below the level of 1989 (Whalen and Watts, pers. obs.).

Nest boxes are readily accepted by Barn Owls and are the best-known method for the management of Barn Owl populations (Marti et al. 1979, Marti 1988). From 1986 to 1990, Barn Owls made at least one breeding attempt in 36 of 82 nest boxes erected by the Virginia Department of Game and Inland Fisheries (VDGIF) and 58% of all 147 known nest sites were in boxes (Byrd et al. 1990). Nest boxes afford Barn Owls with vital nesting substrate that is frequently lacking near good foraging areas and provide added nest security. Studies have shown that Barn Owl productivity is higher in nest boxes than in other nest sites (Byrd et al. 1986, Colvin 1984). In 1986 Barn Owls in Virginia produced 3.4 young per productive nest in 16 boxes versus 2.8 young per productive nest in 35 other sites (Byrd et al. 1986).

Barn Owls are well known to nest in a number of man-made structures. The species frequently nests in off-shore duck blinds in proximity to marshes in both Maryland (Reese 1972, Bendel and Therres 1993) and Virginia (Byrd et al. 1990, Watts unpub. data). Many of the blinds in Virginia are rapidly deteriorating to the point of collapse and relatively few new blinds are being constructed annually due to changes in recreational hunting activities. The mortality rate for Barn Owls fledging from off-shore blinds appears to be quite high because young owls may have difficulty surviving their first flights over open water (Bendel and Therres 1993). Many of the blinds occupied by nesting Barn Owls are 100 m or more from shore so fledgling owls may land in the water and drown before a suitable perches can be reached. On the other hand, the occupancy rate for blinds located directly on marshes or a short distance away is close to zero (Watts unpub. data) presumably due to pressure from mammalian predators.

Nest boxes equipped with predator guards and placed on marshes provide nesting substrate and extensive foraging habitat vital to breeding Barn Owls. Such boxes have proven to be highly productive for Barn Owls in Maryland (D. F. Brinker, pers. comm.). Radio telemetry showed that all young from 5 nest boxes placed on marshes survived fledging whereas 73% of young from 18 off-shore nests either disappeared or were found dead shortly after attempting their first flight (Bendel and Therres 1993).

There is good reason to believe that ongoing changes in agricultural practices and the conversion of farms and grasslands to residential neighborhoods have caused the destruction of nest sites and the loss of suitable foraging habitat for Barn Owls (Rosenburg 1991). Virginia's coastal marshlands support large populations of small mammals and could compensate for some of the loss of Barn Owl habitat elsewhere provided that nesting substrate is made available. Although past efforts with installing nest boxes (primarily in upland habitats) have proven successful in attracting breeding Barn Owls, the state of many of these boxes is unknown.

Objectives

The objectives of this project were:

- 1) to resurvey all Barn Owl nest structures established by the College of William and Mary and the VDGIF between 1986 and 1990 to evaluate status and use.
- 2) to establish a new network of nest boxes within extensive open marsh habitats within the Coastal Plain.

METHODS

A survey of all VDGIF Barn Owl boxes was conducted during the breeding season of 1997. Boxes examined included those installed by Rosenberg (unpublished field notes) between 1986 and 1990 under VDGIF programs. For the majority of sites, status was determined by direct inspection. Landowners were contacted and permission was obtained to inspect nest boxes/trays and associated structures. In a relatively few cases, status could not be determined because landowners would not grant access to the site. Each site was inspected to determine activity status, condition of box/tray, condition of associated structure, and condition of surrounding habitat. Whenever possible, landowners/managers were questioned to evaluate recent history of use.

A new network of Barn Owl boxes was established within the system of extensive marshlands in coastal Virginia. The boxes that were constructed and deployed were specifically designed for use within coastal marshlands (Appendix 1). These boxes had been successfully field tested in Maryland for several years prior to the initiation of this project (Brinker, pers. comm.). Boxes were designed to 1) be free standing within the marsh, 2) withstand the extreme weather and conditions experienced within coastal marshes, 3) prevent access by ground predators, 4) allow for easy access to owl broods, and 5) prevent use by nesting Osprey.

The initial agreement between VDGIF and W&M was that volunteers and/or the Virginia Department of Corrections (VDC) would be responsible for building the 60 Barn Owl boxes required to complete the box network. During 1997 and 1998, volunteers built 12 boxes and VDC produced 10 boxes. The remaining 38 boxes were ultimately built by personnel of the Center for Conservation Biology.

Marsh boxes were installed within extensive open marshes. Virtually all marsh sites were accessible by boat only. When possible, boxes were installed near deep water to allow for better boat access. Boxes were mounted on two posts with a mounting board. Posts were sunk approximately 1 meter into a topographic high within the marsh using post-hole diggers. The mounting board was then leveled and nailed to the posts. Boxes were then bolted to the mounting board facing the open marsh. Posts were secured with a foot brace and two diagonal side braces facing opposite directions. Each post received a sheet metal predator guard.



Front view of Barn Owl box illustrating hinged access door and entrance hole. Note that box is bolted to mounting board. Photo by David Whalen.

Side view of installed Barn Owl box illustrating posts and sheet metal predator guards. Note the toe and diagonal side braces. Photo by David Whalen.



RESULTS

Resurvey of Barn Owl Boxes

A total of 71 boxes and trays were examined throughout Virginia including 30 in the ridge and valley region, 21 in the piedmont, and 20 in the coastal plain. Twenty-one of 71 (29.6%) VDGIF boxes were found to be active during the 1997 breeding season (Table 1). An additional 25 boxes appear to be available for use but were not used during the 1997 breeding season. Four of these additional sites had been used in the previous 2 years but not during the 1997 breeding season. A total of 15 of the boxes erected between 1986 and 1990 had been destroyed. These included 6 in the ridge and valley region, 5 in the piedmont region, and 4 in the coastal plain. Five boxes were judged to be currently unusable by nesting Barn Owls. Overall, the rate of occupation by breeding Barn Owls was very similar to that reported in 1989 and 1990, the last two years that nest boxes were monitored (see Figure 1). More than 45% of boxes that were judged to be available for use supported active pairs.

Table 1. Evaluation of VDGIF Barn Owl nest box/tray structures during the 1997 breeding season.

Site Name	County or City	VDGIF Site Code	Year Erected	Past Use (<1991)	Disposition (1997)
Ridge and Valley					
Beverly Lane Oak Cavity	Augusta	AU-69-01	1987	No	Destroyed
Emily Heatwoll Silo	Augusta	AU-86-03	1986	Yes	Destroyed
The Old Plantation	Augusta	AU-90-01	1990	No	Active
Hunt Farm	Augusta	AU-86-04	1990	No	Active
Gun Shop Barn	Botetourt	BO-85-01	1985	Yes	Active ¹
Clermont Farm	Clarke	CL-90-01	1990	No	Active
Shepherd Residence	Clarke	CL-86-02	1986	No	Available
Bandy Experimental Farm	Clarke	CL-90-02	1990	No	Available
Bowman Farm	Frederick	FD-86-01	1990	No	Destroyed
Shiley Farm	Frederick	FD-86-02	1986	Yes	Unusable ²
Sempeles Farm	Frederick	FD-90-01	1990	Yes	Active ¹
Monte Vista	Frederick	FD-86-03	1986	No	Destroyed
Macedonia Barn	Frederick	FD-86-04	1986	No	Unknown ³
Spriggs Farm	Frederick	FD-86-05	1986	No	Active
Sinkland Farms	Montgomery	MO-90-01	1990	Yes	Available
Long's Dairy Farm	Page	PA-84-01	1986	Yes	Available
Kite Farm	Page	PA-86-03	1986	Yes	Available ⁴
Montain View Barn	Pulaski	PU-84-01	1985	No	Destroyed
Lila Road Silo	Roanoke	RA-85-01	1985	Yes	Available ⁵
Countryside Golf Course	Roanoke	RO-85-03	1990	No	Available
Red Hill Farm	Rockbridge	RB-85-01	1986	Yes	Unknown ⁶
East Lexington Barn	Rockbridge	RB-86-01	1990	No	Available

Table 1. -continued-

Site Name	County or City	VDGIF Site Code	Year Erected	Past Use (<1991)	Disposition (1997)
Ridge and Valley					
Silver Lane Farm	Rockingham	RH-83-01	1982	Unknown ⁷	Destroyed
Reedy Run Farm	Rockingham	RH-86-05	1986	Yes	Active
Jerridale Farm	Rockingham	RH-86-06	1986	Yes	Active
Cave Hill Dairy	Rockingham	RH-85-01	1986	Yes	Available ⁸
Burkes Garden Barn	Tazewell	TA-85-01	1986	No	Available
Tin Silo	Warren	FD-90-02	1990	No	Active
Gentley Farm	Warren	WR-86-01	1986	Yes	Active
Stickley Farm	Warren	WR-86-02	1986	Yes	Available
Piedmont					
Mount Air Farm	Albemarle	AL-86-01	1986	No	Destroyed
Springhaven	Albemarle	AL-86-03	1986	Yes	Active
Cottonwood Farm	Albemarle	AL-86-04	1986	Yes	Destroyed
Amelia W.M.A.	Amelia	AM-86-01	1986	Yes	Unknown
Appomattox Tobacco Barn	Appomattox	AP-84-01	1986	No	Unknown
Windrinker Farm	Brunswick	BR-85-01	1986	No	Available
Cleveland Farm	Culpeper	CU-86-01	1986	No	Available
Inskeep Silo	Culpeper	CU-86-02	1986	No	Available
Lakeside Dairy	Fauquier	FQ-86-01	1986	No	Active
George Farm	Fauquier	FQ-86-03	1986	Yes	Active
DuBay Silo	Fauquier	FQ-86-04	1986	Yes	Destroyed
Stinson Residence	Fauquier	FQ-64-01	1986	No ⁹	Unusable ¹⁰
Locust Grove Farm	Greene	GN-86-01	1986	No	Available
Revelation Church Oak	Halifax	HF-85-01	1986	No	Destroyed
Opeka Farm	Loudoun	LD-84-01	1986	No	Destroyed
Courtland Farm	Loudoun	LD-90-01	1990	No	Active
Cole Farm	Loudoun	LD-82-02	1986	Yes	Active
Bike Trail Silo	Loudoun	LD-82-03	c. 1980	Yes	Available
Wood Farm	Louisa	LO-84-01	1986	Yes	Active
Cellar Creek Silo	Nottoway	NW-84-01	1986	Yes	Available
Kelona Dairy	Powhatan	PO-75-01	1986	No	Available ¹¹
Coastal Plain					
Mapp Deer Blind	Accomack	AC-83-01	1984	No	Available
Parker's Island Wood Shed	Accomack	AC-79-01	c. 1986	Yes	Active
Chickahominy W.M.A.	Charles City	CC-90-01	1990	No	Unusable ¹²
Shirley Plantation	Charles City	CC-90-02	1990	Yes	Destroyed

Table 1. –Coastal Plain continued-

Site Name	County or City	VDGIF Site Code	Year Erected	Past Use (<1991)	Disposition (1997)
Coastal Plain					
Baige Silo	Chesapeake	CP-86-01	1986	No	Active
Presquile, N.W.R.	Chesterfield	CD-85-01	1985	No	Destroyed
Fairview Silo	Essex	ES-89-01	1989	Yes	Active
Kendale Farm	Essex	ES-86-02	1986	Yes	Active
Broadus Barn	Hanover	HA-85-01	1986	Yes	Available
Midview Farm	Henrico	HE-84-01	1985	Yes	Destroyed
Curles Neck Barn	Henrico	HE-84-02	1985	No ¹³	Moved ¹⁴
Strawberry Silo (Curles Neck)	Henrico	HE-84-03	1986	Yes	Active
Curles Neck Silo	Henrico	HE-90-01	1990	Yes	Available
Pamunkey Farm	New Kent	NK-86-01	1986	Yes	Destroyed
Northberry Farm	New Kent	NK-86-02	1986	Yes	Available
Plum Point Silo	New Kent	NK-86-03	1990	No	Unusable ¹⁵
Denbeigh Silo	Newport News	NN-84-01	1985	Yes	Unusable ¹⁰
Newton Silo (Gatr Tract)	Northampton	NT-86-09	1986	No ¹³	Available
Fisherman's Island, N.W.R.	Northampton	NT-83-01	1986	No	Available
Brandon Plantation	Prince George	PG-85-01	1986	Yes	Available

¹Nest tray may be a roost site used by pair in the immediate vicinity.

²Nest box is a tray and the silo roof has blown off.

³Current tenant will not allow site to be visited.

⁴Active in 1996 but not in 1997.

⁵Active through 1995 but not in 1997.

⁶Owner could not be reached.

⁷Site was once active but unclear if nesting ever occurred in nest box.

⁸Active through 1996 but not in 1997.

⁹Site was active 1964-1984, nest box erected later.

¹⁰Site probably unusable due to heavy residential development in area.

¹¹Box contained an active pair of Kestrels in 1997.

¹²Dense vines completely block silo opening.

¹³Site was once active but box was never used.

¹⁴Box was moved to nearby silo in 1990; site was used as a roost in 1994 and 1995.

¹⁵Silo entrance has been sealed.

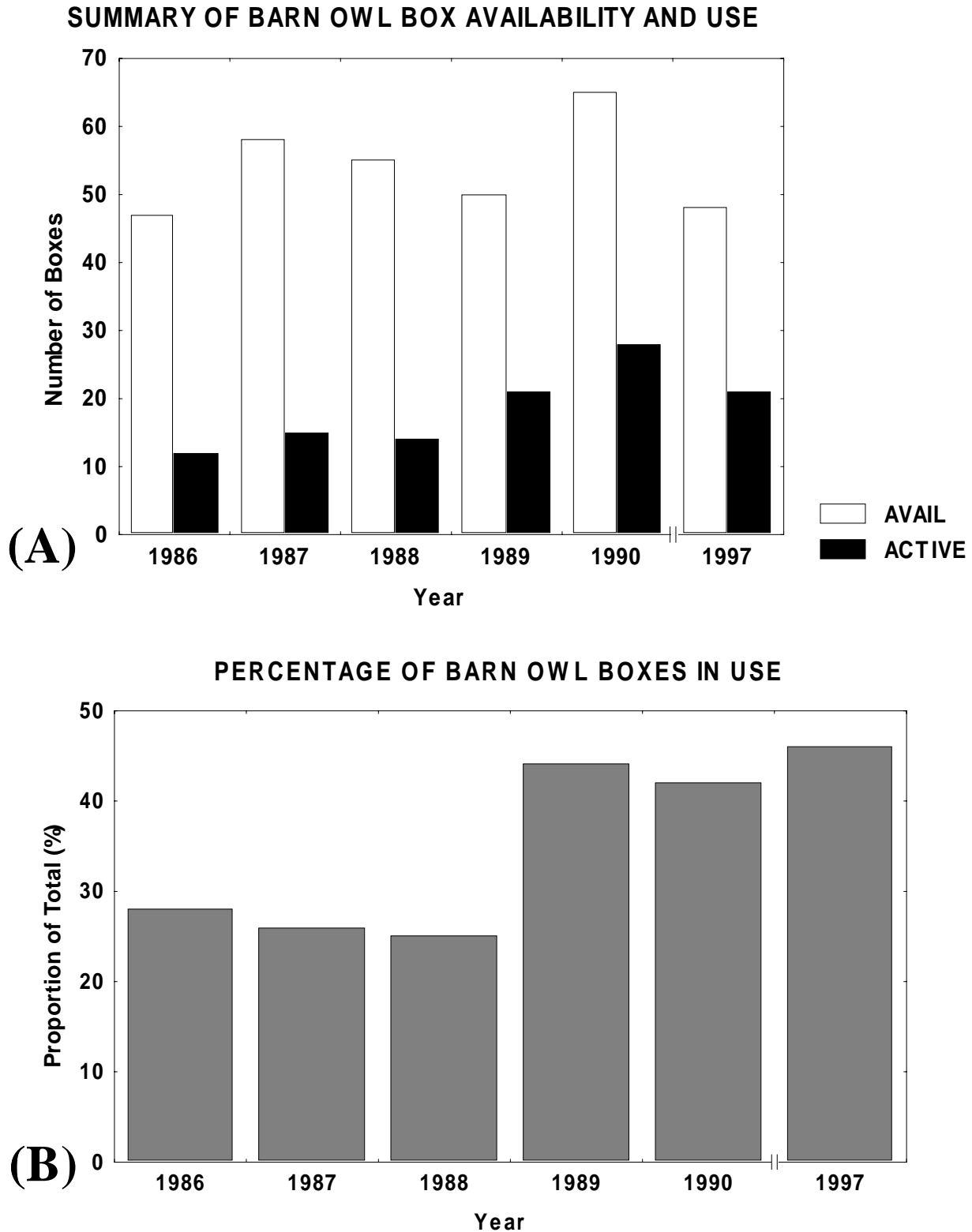


Figure 1. Historical occupation patterns for VDGIF Barn Owl boxes/trays. (A) Number of available and active nesting structures by year. (B) Proportion of structures occupied by year.

Establishing Marsh Box Network

A total of 44 boxes were established within extensive open marshes (Figure 2). Boxes were deployed primarily within public lands that contained appropriate habitat (Table 2). Of the initial list of public lands designated to receive boxes, a few did not receive boxes because upon closer inspection habitat was believed to be unsuitable. In addition, 2 properties did not receive boxes because agencies did not grant permission for boxes to be installed. The remaining 16 boxes have been or are intended to be installed within inland sites with appropriate grassland habitats. Four of these boxes have been deployed along the Rappahannock River by personnel of the Rappahannock River, NWR. Three boxes are being deployed within plantations with appropriate habitat along the James River. Nine boxes have been transferred to biologists of VDGIF for deployment within state wildlife management areas.

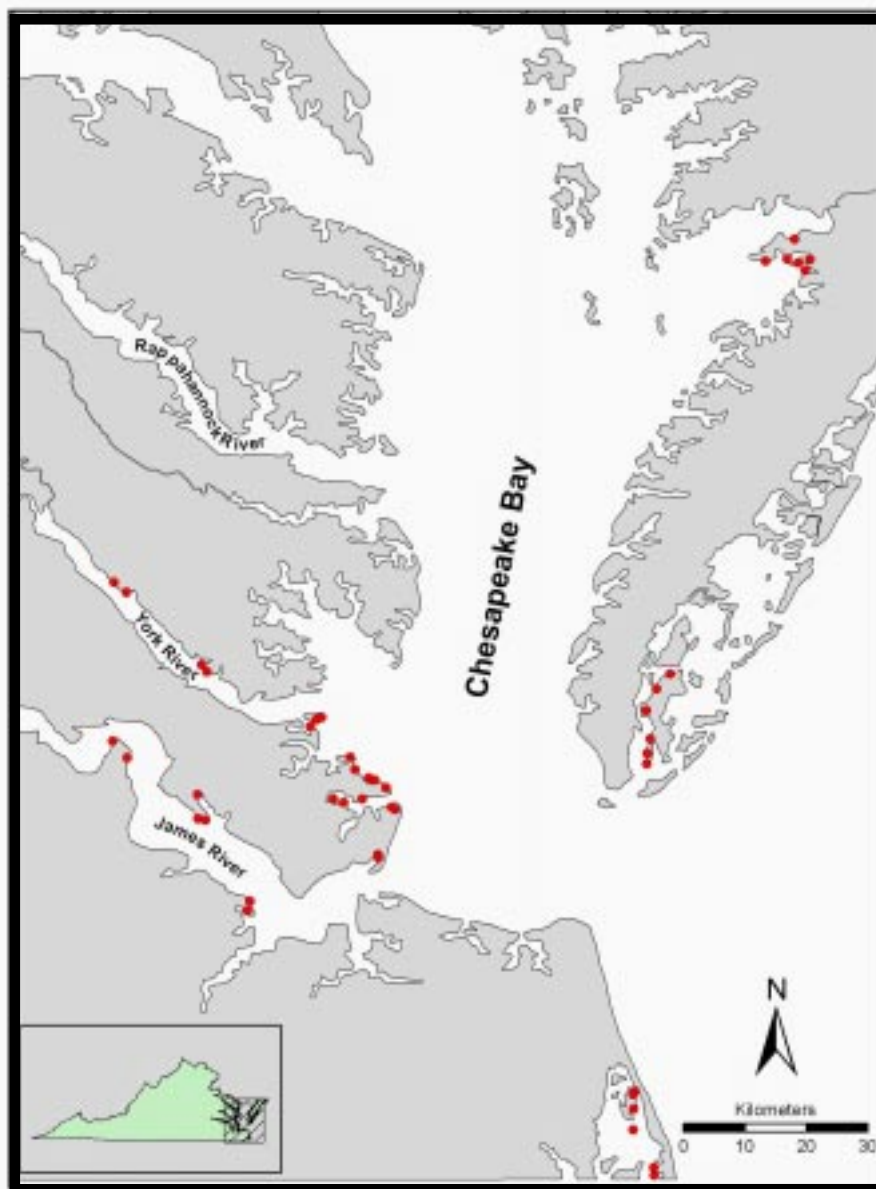


Figure 2. Distribution of marsh boxes established for breeding Barn Owls (see Table 2 for box coordinates).

Table 2. List of marsh Barn Owl boxes established. Coordinate projections are NAD 27 Zone 18 UTM meters.

Property	Box Code	TOPO QUAD	X coordinate	Y coordinate
Catlett Islands	CBO-01	Claybank	362235.78974	4128549.92973
	CBO-02	Claybank	361582.93205	4129684.35076
Fort Eustis	CBO-03	Mulberry Island	360711.23772	4104682.73988
	CBO-04	Mulberry Island	361640.08986	4104451.93420
	CBO-05	Mulberry Island	360683.09069	4108578.28947
Hog Island, WMA	CBO-06	Hog Island	349817.05632	4117469.21878
	CBO-07	Hog Island	351634.60733	4114748.53683
Plumtree Island, NWR	CBO-08	Poquoson East	382958.83867	4110921.48435
	CBO-09	Poquoson East	383793.54763	4110556.89883
	CBO-10	Poquoson East	385203.91794	4109339.78626
	CBO-11	Poquoson East	380650.56676	4114307.46882
	CBO-12	Poquoson East	381206.71491	4112342.09784
Goodwin Island	CBO-13	Poquoson West	375494.85500	4119424.45236
	CBO-14	Poquoson West	376339.33880	4120561.48947
	CBO-15	Poquoson West	377011.90982	4120920.39509
Fort Monroe	CBO-16	Hampton	379652.15241	4107010.92903
	CBO-17	Hampton	378320.86332	4107596.52771
Hampton City	CBO-18	Hampton	382061.95417	4107512.26891
Messick Marsh	CBO-19	Hampton	386315.96722	4105751.49404
Hampton City	CBO-20	Hampton	385896.98364	4106117.70488
Langley, AFB	CBO-21	Hampton	384009.78888	4098418.13415
	CBO-22	Hampton	384045.37919	4097919.86978
Mockhorn Island, WMA	CBO-23	Cheriton	420484.01839	4125009.84956
	CBO-24	Cheriton	422263.44431	4127414.00490
	CBO-25	Townsend	419153.62750	4121527.88187
	CBO-26	Townsend	419644.71867	4116859.69664
	CBO-27	Townsend	419228.11200	4114516.61505
	CBO-28	Townsend	419153.71969	4112805.59201
Saxis, WMA	CBO-29	Saxis	435209.12376	4194476.28668
	CBO-30	Saxis	437976.16257	4194823.54768
	CBO-31	Saxis	439384.54940	4194195.40122
	CBO-32	Saxis	440894.14489	4194714.47348
	CBO-33	Saxis	440306.02173	4192973.91465
	CBO-34	Saxis	438967.86295	4198064.63255
Purtan Island	CBO-35	Gressitt	350460.18143	4143318.48896
	CBO-36	Gressitt	351999.89044	4141652.42085
False Cape State Park	CBO-37	Knotts Island	416757.68542	4053263.40131
	CBO-38	Knotts Island	419412.29081	4047105.17490
Back Bay, NWR	CBO-39	Knotts Island	419443.33284	4045863.49398
	CBO-40	Northbay	417061.61560	4059587.31689
	CBO-41	Northbay	416817.59226	4058995.82554
	CBO-42	Northbay	416873.29324	4056677.60383
Ragged Island, WMA	CBO-43	Newport News S.	367256.14267	4091122.78336
	CBO-44	Newport News S.	366866.51092	4089554.13605

DISCUSSION

Barn Owls require secure nest sites in close proximity to extensive complexes of open habitats for breeding. In coastal Virginia (Rosenburg 1986) and in nearby New Jersey (Colvin 1984) this species has been shown to have home ranges of several hundred ha that contain nearly 100 ha of grasslands. For foraging, Barn Owls require dense grass, lightly grazed pastures, and hayfields (Colvin 1984, Rosenburg 1986). Cultivated fields with the exception of small grain fields, are of little value because of low prey populations or dense protective cover. The decline of this species within the region has been attributed to the loss of idle grasslands required for foraging, the transition to more intensive farming practices, and the loss of nesting substrate.

The current status, distribution, and importance of grasslands and their relationship to the conservation of open-habitat bird populations such as the Common Barn Owl must be viewed in the appropriate historical context. Prior to European settlement, open grassland habitats were uncommon within the mid-Atlantic region. Such habitats were maintained as relatively small patches within a forested landscape by populations of native Americans (Brush 2001, Walsh 2001). In the years following European settlement, open lands likely increased with the expansion of land development for agricultural use. However, throughout the nineteenth century, broad-scale clearing of forested lands occurred throughout northeastern North America that resulted in a significant wave of open lands. Subsequently, the availability of open lands has declined dramatically throughout the twentieth century. This decline was due initially to secondary succession on lands cleared during the previous century and more recently due to the conversion of remaining farmlands to other human uses.

Currently, prominent grassland habitats within Virginia are primarily derived from agricultural fields and pasturelands. Some of the most productive grassland habitats within the region are fallow agricultural fields in the early stages of oldfield succession. Without regular maintenance to set back succession, these fields will proceed from a mixed stand of grasses and forbs with no woody vegetation to a shrubland dominated by woody shrubs and saplings and eventually to forest. The specific form of these early successional grasslands is influenced by agricultural history, moisture, and soils. Other managed grasslands within the physiographic region include pasturelands, airports, golf courses, military training areas, parks, and recreational fields.

Results from the survey of breeding sites across the state demonstrate that Barn Owls may be successfully managed within areas where foraging habitat appears to be stable by providing safe nesting substrates. Quite a few sites were identified that were apparently used continuously for more than 10 years indicating use by several generations. Since the efforts of the late 1980's several sites have been identified that support breeding Barn Owls in Virginia (Watts et al. unpub. records). This highlights the need for a broad-based management plan for this species in Virginia that outlines the remaining strongholds for this species and identifies specific locations where management actions would have the greatest probability of success. As demonstrated here, the aggressive use of nesting substrates within appropriate locations could have a significant impact on the future of Virginia's population.

Extensive short-grass marshes are the most natural and stable foraging habitats available to Barn Owls in Virginia. Concentrations of this habitat type on the lower western shore of the Chesapeake Bay and both the bayside and seaside margins of the Delmarva Peninsula have been known to support breeding populations of Barn Owls throughout recent history. Providing nesting substrate within these foraging habitats is a logical progression in the management of this species. This project established a network of 44 nest boxes specifically designed for this application. Production of these boxes was both expensive and time consuming. Installation of these boxes was logistically difficult and labor intensive. Many of these boxes were placed in situations where breeding pairs were already known within nearby structures.

The initial 24 nest boxes that were deployed in 1997 were monitored for 2 years after establishment. This effort did not identify any indication of use during this time period. However, the effort also documented that some of the boxes did withstand greater than 70 mph winds and showed no evidence of access by mammalian predators. A follow-up survey of all box sites is needed to adequately evaluate the success of this effort. Such a survey could evaluate both the longevity and condition of the marsh boxes and give an indication of their use.

ACKNOWLEDGEMENTS

Many individuals contributed to the results of this project. David Whalen conducted both the resurvey of VDGIF boxes and the initial phase of marsh box deployment. Biologists from VDGIF that were involved in the project over the years include Keith Cline, Lisa Sauseville, Don Schwab, Jeff Cooper, Andy Zadnick, Ray Fernald, and Becky Wajda. Numerous individuals assisted with box construction or installation including Dana Bradshaw, Mitchell Byrd, Eric Fleming, Lex Hauffman, Tom Meier, Lance Morrow, Jeffrey Ozmon, Bart Paxton, Marian Watts, Mike Wilson. Joe McCauley and Sandy Spencer were gracious enough to utilize some of the remaining boxes on the Rappahannock River, NWR. Bob Anderson, Kyle Barbour, Don Hayes, Jeffrey Shields, Stephen McCall, Melissa Pease, Terry Sanders, John Stasko, Gary Williamson, Jim Wilson, Thomas Wittkamp all granted permission to establish nest boxes within agency-controlled marshes. Carlton Adams, Renee Peace, Lydia Whitaker, Mark Roberts, Cheryl Pope, Bonnie Willard, Anne Womack, and Gloria Sciole from the College of William and Mary provided logistical support. Financial support was provided by the Virginia Department of Game & Inland Fisheries and the Center for Conservation Biology.

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APPENDIX I: Plans and construction information for marsh Barn Owl nest boxes (provided by Maryland Department of Natural Resources).

Materials

(needed to construct one box)

Lumber

1. One sheet of $\frac{3}{4}$ inch exterior plywood
2. Two 8 foot salt treated 4 x 4 inch posts
3. One 3 foot section of 1 x 12 board
4. Two 4 foot sections of 2 x 4 lumber
5. One 3 foot section of 2 x 4 lumber

Hardware

6. 1 and $\frac{1}{2}$ inch drywall screws
7. 10 penny galvanized nails
8. Four $\frac{5}{16}$ inch stainless steel bolts
9. Two 3 foot, 10 inch diameter sheet metal stove pipes
10. Two strap hinges
11. One hook and eye for door lock

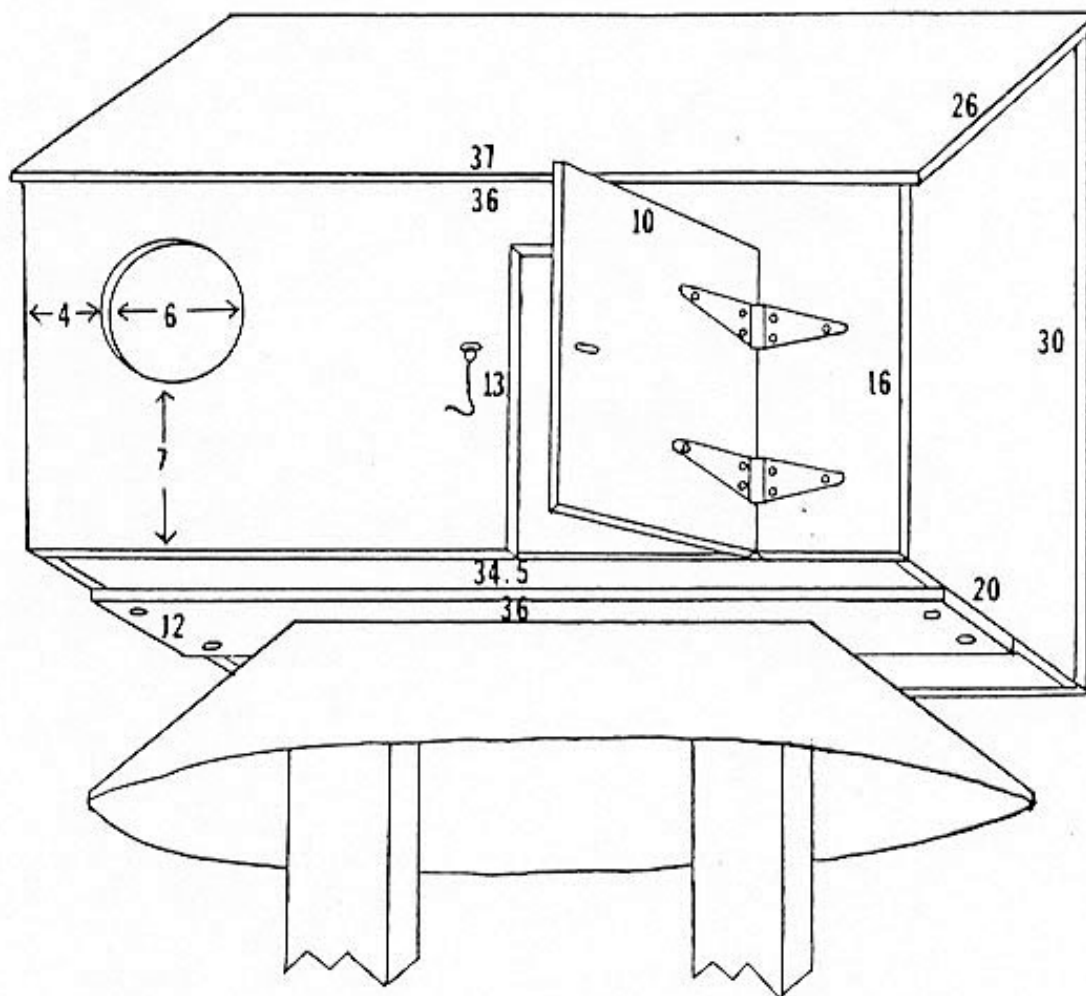
Preservative

12. Marine varnish

Procedures

Nest boxes are constructed of $\frac{3}{4}$ inch exterior plywood and assembled with 1 and $\frac{1}{2}$ inch drywall screws as shown in diagram below. Place 2-3 coats of marine varnish on the outer surface of the nest box. This will increase the life of the box.

Nest boxes are installed by sinking posts 3 feet into the ground approximately 3 feet apart. The top of posts must be level to correctly support the box. The 1 x 12 mounting board is then nailed to the top of the posts. Place the owl box on the mounting board and bolt in place with four $\frac{5}{16}$ inch bolts. This is much easier to accomplish if the box and mounting board have been precisely pre-drilled. The toe brace is then nailed into both posts to reduce side to side movement. Sharpened 4 foot sections of 2 x 4 are then driven into the ground forward and backward and nailed into posts to brace against front to back movement. Sheet metal predator guards are then nailed in place around each post and directly under the mounting board. Be sure that metal seems are done cleanly to prevent any access by raccoons.

Appendix I: - continued -**Marsh Barn Owl box plan (provided by Maryland Department of Natural Resources)**

Appendix I: - continued -

Plywood cuts for marsh Barn Owl box (provided by Maryland Department of Natural Resources)

