

25 YEARS OF CONSERVATION

The Center for Conservation Biology
Annual Report 2016

WILLIAM & MARY
VIRGINIA COMMONWEALTH UNIVERSITY



CCB's

ONGOING MISSION



The mission of The Center for Conservation Biology, through all of its diverse programs, is to provide the global community with the information needed to drive thoughtful, science-based conservation, to educate and train the next generation of conservation scientists, and to make lasting contributions to the natural world through critical thinking, innovation, and ground-breaking research.

The Center for Conservation Biology is a research unit shared by William & Mary and Virginia Commonwealth University. The Center is a part of the VCU Inger and Walter Rice Center for Environmental Life Sciences. Rice Center scientists conduct cutting-edge environmental research on the James River and around the world.

ON THE COVER:

The fruit of years of investment and work, this six-day-old red-cockaded woodpecker was removed from the cavity for banding. Aggressive management has brought the population from 14 individuals to over 65 in 15 years. *Bryan Watts*



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Things often have simple beginnings. When we are young we run with abandon into a flock of gulls and enter the whirl of wings and calls. We want desperately to join with that energy. As time passes we come to feel the calling of sacrifice and we understand the value of commitment and the satisfaction of a deliberate path. We learn that there are some causes so important that we must stand for them with all that we have and all that we are.

All of us want to feel like our brief time has been consequential. We want to look back through the years and see that our hands have contributed in some small way to things that are larger and more lasting than ourselves. The Center for Conservation Biology was established with the simple mission of making lasting contributions to bird conservation and with the hope that such efforts would also improve the life of people. The Center was started and continues to operate with the mandate to do real, tangible work that matters.

This past year represents our 25th year of operation. Since our humble beginning within the "Byrd Lab" we have completed more than 800 research projects, published hundreds of papers, participated in thousands of meetings and advised scores of organizations on various aspects of bird conservation. I can say without reservation that each day has been a privilege.

When we look back over the past 25 years, have we been effective? Has our work changed outcomes? Has our work informed how we manage species? Has our work contributed to what we know about imperiled species? I have dedicated this short annual report to a few examples of the three metrics that we use to evaluate conservation outcomes. These include 1) recovery of imperiled species, 2) changes in policy designed to sustain populations and 3) protection of strategically important locations.

Please join with us and contribute to our efforts to help birds and the environment we share.

Sincerely,

Bryan Watts

Bryan D. Watts
Mitchell A. Byrd Professor of Conservation Biology
Director, The Center for Conservation Biology



A MESSAGE FROM THE DIRECTOR

Dawn rises over the Atlantic Ocean at Lubec Maine. The twenty-fifth anniversary of CCB is a celebration of many accomplishments but also the beginning of a new day. *Bryan Watts*

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Libby Mojica walks across a salicornia marsh in the early morning to return a young peregrine falcon to its nest tower. CCB has been committed to the restoration of eastern peregrines for forty years. *Bryan Watts*



BENDING THE CURVE

By the time most species reach the conservation emergency room they have suffered years or decades of decline and some are surviving only on life support. Each species represents its own conservation puzzle. The bleeding will not be stopped without identifying the underlying factors contributing to the decline. For most species, isolating these factors requires a focused ecological detective effort. Remedies are equally complex and often require the involvement of multiple disciplines. However, the payoffs can be great.

There are few experiences in life more rewarding than changing the trajectory of an entire species. To work with a species that is in complete free fall and bend the curve upward toward recovery is an exciting experience. The Center has been fortunate to have worked with dozens of species that have either recovered or leveled out. Our research has contributed to all phases of the recovery process.





A controlled burn on Piney Grove Preserve. The introduction of fire into Piney Grove Preserve has greatly enhanced habitat quality not only for red-cockaded woodpeckers but the entire pine savannah community. Fire management has transformed the community in a very short period of time. *Bryan Watts*



An adult bald eagle within the Chesapeake Bay. CCB has conducted more than 100 research projects on eagles over the past 25 years focused on ecological and management questions. *Bart Roberts*

BALD EAGLES

HISTORY

By the early 1970s bald eagles had been declining for decades and had reached all-time lows equivalent to less than 5% of historic numbers over much of their range. The primary causes of endangerment were low productivity related to DDT and similar chemicals, habitat loss, and human disturbance. Since the banning of DDT and establishment of legal protections the population has experienced a dramatic recovery leading to the removal of the species from the federal list in 2007 and the Virginia list in 2010. In 2016 the Virginia population reached a milestone when it exceeded 1,000 breeding pairs, a more than 50-fold increase in just 40 years.

CCB WORK

CCB biologists are considered global experts on the bald eagle and have been committed to its recovery since well before CCB was established. Over the past 25 years we have conducted more than 100 research projects focused on a long list of ecological questions and conservation problems. We have investigated virtually all aspects of their ecology and have maintained ongoing research on threats including contaminant exposure, hazard mitigation and human disturbance. This work has filled in the ecological portrait of this species and has changed how we manage populations.

FUTURE

Bald eagles are magnificent birds that are of interest to the American public and are an umbrella species for entire ecosystems. CCB biologists will continue the 60-year bald eagle survey in Virginia in support of the regulatory community. We will continue to monitor emerging threats to the broader continental population and contribute to the ongoing development of management guidelines. We will continue to study large ecological questions that will fill out our understanding of the species. ■

(Opposite page) Bryan Watts repels from a bald eagle nest on the Rappahannock River. CCB has conducted hands on work with eagles in the Chesapeake Bay to address many questions. *Libby Mojica*



PEREGRINE FALCON

HISTORY

The historic population of peregrine falcons in Virginia was primarily confined to cliff sites in the mountains and believed to include approximately 25 breeding pairs. Low productivity resulting from exposure to DDT and similar chemicals led to the extirpation of the species in eastern North America by the early 1960s. With no population remaining, restoration required the establishment of an experimental captive-breeding program and the release of birds back into the wild. Between 1978 and 1993, 250 captive-reared falcons were released in Virginia. The first modern breeding was documented in 1981 and by 2016 the population had grown to 30 breeding pairs.

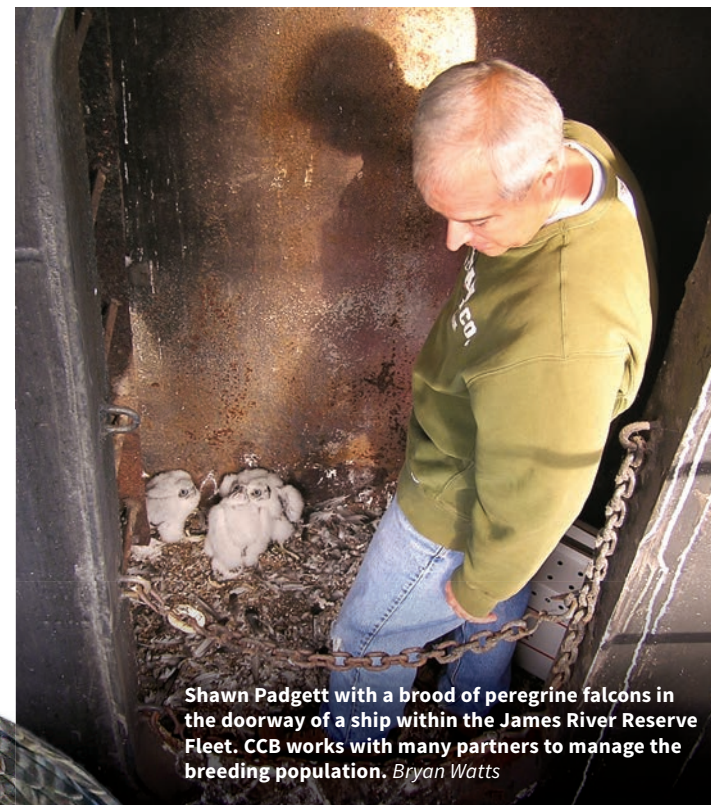
CCB WORK

CCB biologists coordinated the release of peregrine falcons back into Virginia and have been committed to the recovery of the population since that time. We manage the recovering population with several organizational partners including the Virginia Department of Game & Inland Fisheries. We continue to monitor and manage individual eyries. We have investigated many ecological questions within this emerging population including diet, dispersal, migration and lifetime reproductive success. We continue to help develop management guidelines and advise on the management of individual sites and pairs.

FUTURE

CCB is committed to the long-term success of the peregrine falcon population in Virginia. We will continue to work actively with the population and with agency partners to find solutions to ongoing management challenges. We are particularly committed to the restoration of breeding pairs within the historic mountain range. ■

(Right) Banded peregrine falcon on winter territory. CCB has marked hundreds of peregrines with bands and transmitters to learn more about migration and winter distribution. *John McNamara*



Shawn Padgett with a brood of peregrine falcons in the doorway of a ship within the James River Reserve Fleet. CCB works with many partners to manage the breeding population. *Bryan Watts*





Keith Watson (l) and Amanda Allen Beheler (r) look on as Mitchell Byrd prepares a captive-reared peregrine falcon to be placed in a hack box within Shenandoah National Park. More than 500 falcons have been released through hacking in an attempt to repopulate their historic mountain range. *Tim Wright*



RED-COCKADED WOODPECKER

HISTORY

By the mid-1900s the great fire-maintained pine forests of the Southeast had been much reduced and old-growth pines in particular had been harvested down to 1% of historic levels. By this time, specialists like red-cockaded woodpeckers that depend on these trees had suffered catastrophic declines. Virginia represents the northern range limit for this unusual species and declines reached a critical level in 2002 when the population included only two potential breeding groups with 14 individuals. The purchase of the Piney Grove Preserve by The Nature Conservancy would prove to be a turning point and through dedicated efforts the population has been rebuilt to 13 potential breeding groups and more than 65 individuals.

CCB WORK

CCB biologists conducted surveys of red-cockaded woodpeckers in the 1970s that documented early declines and have been dedicated to reversing these declines since that time. Throughout the 1980s and 1990s we could only monitor and watch the population decline on corporate lands. Since the establishment of Piney Grove Preserve we have intensively managed the population, monitoring every breeding attempt and marking every individual. We have moved birds into the site from southern populations and recently have moved birds into the Great Dismal Swamp National Wildlife Refuge in an effort to establish a second population.

FUTURE

Because this species depends on old growth trees, recovery is a long process that will stretch out many decades. CCB has been committed to the restoration of this population for decades and will continue to aggressively manage the population to achieve recovery. ■

Bryan Watts uses Swedish climbing ladders to reach a red-cockaded woodpecker cavity in the Piney Grove Preserve. CCB bands all individuals produced each year so that they may be monitored throughout their life. *Bobby Clontz*



A brood of woodpeckers produced on Piney Grove Preserve. Habitat management has released the population to reach new heights.
Bobby Clontz



Old pines of Piney Grove Preserve owned and managed by The Nature Conservancy. This is the last remaining breeding site of the red-cockaded woodpecker in Virginia and is the nucleus of the recovery program. *Bryan Watts*

PIPING PLOVER

HISTORY

The piping plover spends its entire life cycle on open beaches. The great migration of Americans to the coasts along with the post-World War II building boom led to a wave of habitat loss and disturbance that would result in a dramatic population decline. By the mid-1980s piping plovers were elevated to federal and state lists of threatened and endangered species. Due to its pristine undeveloped barrier islands, Virginia would be a stronghold for the species. However, colonization of the islands by raccoons and foxes would lead to a slow decline that reached a low of 86 pairs in 1996. Initiation of an aggressive predator removal program would reverse this decline and the population nearly tripled to 259 pairs by 2012.

CCB WORK

CCB biologists conducted the first systematic piping plover survey in Virginia during the breeding season of 1986 and would lead the survey for the next 13 years. The effort included coverage of all coastal beaches and after 1989 included targeted productivity surveys. Over many years CCB investigated many questions that would become vital to management decisions including habitat requirements, importance of storm disturbance and landscape dynamics, factors contributing to reproductive suppression and the effectiveness of management techniques.

FUTURE

Due to an insatiable demand for beach access by humans and the continuous movement of ground predators onto the islands, sustaining piping plovers will require intensive management indefinitely. CCB has been committed to the recovery of this species for decades and will contribute to research and management efforts when needed. ■

(From top)

Piping plover incubating within a predator exclosure. In areas where managers are not able to remove ground predators like raccoons, exclosures may be an effective management tool. *Bob Cross*

Clutch of piping plover eggs on Cobb Island within the Virginia Coast Reserve. The large expanse of unspoiled islands is a significant refuge for this species. *Bryan Watts*



The herring gull is one of several chick predators that piping plovers must contend with along the barrier islands. *Bryan Watts*

Alex Wilke surveys through piping plover habitat on the Virginia barrier islands. *Connor Coleman*



OSPREY

HISTORY

In the post-World War II DDT era, the osprey declined on a global scale with many populations being reduced by more than 90%. The Chesapeake Bay supports the largest population in the world. It was considered a stronghold for the species during the global crisis and was used as a source for the restoration of several other populations. The Bay population had reached a low of 1,450 pairs by the early 1970s. Recovery has been dramatic and the population is now believed to include more than 10,000 pairs. Due to the establishment of nest platforms and other artificial structures, the population is now likely larger than pre-colonial times.

CCB WORK

CCB biologists are considered global experts on the osprey and have been committed to its recovery since the population low in 1970. We have monitored designated study areas since this time and have banded thousands of birds to address a wide range of ecological questions. CCB biologists and graduate students have studied virtually all aspects of osprey ecology including diet, growth, substrate use, dispersal, survivorship and migration. We have also continued to monitor contaminant exposure and factors contributing to reproductive suppression. In 2011 CCB established OspreyWatch an online program that engages citizen scientists throughout the world to monitor and submit data on breeding osprey.

FUTURE

The osprey is an enduring symbol of the Chesapeake Bay and over the past three decades has become a global sentinel for environmental health. CCB biologists will continue to both monitor threats to this species and will continue to explore ways that osprey may be used to reveal threats to aquatic environments. ■

Marie Pitts holds a young osprey ready for banding on the James River. CCB biologists have banded thousands of osprey exploring a wide range of ecological and management questions. *Bryan Watts*



Adult osprey on the Chesapeake Bay. The Bay supports the largest population in the world now totaling more than 10,000 breeding pairs. CCB biologists have worked intensively with the population since its low in the early 1970s. *Bryan Watts*



IMPROVING POLICY

Whether federal laws, local ordinances, or corporate directives, these sets of rules provide the boundaries and templates that govern our day-to-day activities. At their best, conservation policies are designed to provide the greatest biological benefit while minimizing impacts to civil liberties or corporate profits. Walking this tightrope requires a deep understanding of cause and effect.

Center leadership has maintained a long-standing commitment to research designed to improve environmental policy. Subtle but strategically placed changes in national policies or directives applied across large land holdings may produce profound benefits to populations of conservation concern. CCB biologists have conducted scores of research projects that have been focused on resolving critical tradeoffs in policy and this research has reshaped how our society interacts with species and their habitats.

A six-week-old osprey brood on a nest platform on the York River. Early work with platforms has led to a public movement that has resulted in the establishment of thousands of platforms that now support an estimated 15-20% of the Chesapeake Bay population. *Bryan Watts*







SUSTAINABLE SHOREBIRD HUNTING

ISSUE

Shorebirds are one of the most migratory bird groups on the planet and one of the most imperiled. Population declines are global in scale. Within the Western Atlantic Flyway more than 70% of species have experienced declines over the past three decades. The underlying causes for these declines remain elusive. One factor appears to be ongoing shorebird hunting. Although the hunting of most shorebird species was outlawed in North America in the early 1900s the sport continues to be legal within many jurisdictions along the flyway. Because shorebirds are a resource shared between all countries throughout the flyway their future depends on international cooperation.

CCB WORK

The work of CCB biologists with shorebird hunting has been recent but significant. While investigating migration pathways using satellite transmitters, CCB biologists would have two whimbrels shot by hunters on Guadeloupe on the same day. This event changed the perception of the shorebird community about the possible impact of unregulated hunting on shorebird populations. Following this event, CCB biologists have conducted studies to estimate sustainable mortality limits for shorebird populations within both the Western Atlantic Flyway and East-Asian Flyway. A follow-up investigation has documented shorebird hunting policies for all countries throughout the Western Hemisphere.

POLICY

The work of CCB has led to an international movement that has resulted in moratoria on the hunting of several species within specific geographic areas and is moving toward multi-jurisdictional agreements to protect shorebird populations throughout the flyway. CCB research will hopefully lead to agreements that are focused on sustainable harvest levels. ■

A bag of pectoral sandpipers taken in agricultural fields by hunters on Guadeloupe. Legal hunting in many places is effectively unregulated. *Anthony Lavesque*



Fletcher Smith wiring a rocket net in a marsh along the Eastern Shore of Virginia to catch/migrant whimbrel. Benchmark work studying whimbrel migration ecology would reveal problems with unregulated shorebird hunting. *Bart Paxton.*

TRANSFORMING PINELANDS

ISSUE

The historic pine savannas of the South were fire-maintained and covered virtually the entire region. Commercial pine production was focused on lumber and was relatively non-intensive through the mid-1950s. Increasing global demand for pulp led to the development of intensively managed pine plantations with short rotations during the 1960s. This sea change resulted in vast areas of the South being converted to pine monocultures over a very short time period. The high stocking rates that were used in this early period resulted in premature canopy closure and canopies that would remain closed until harvest. Crown closure shades out the understory and robs the forest of any meaningful productivity. Pine plantations became ecological deserts for bird populations.

CCB WORK

In the late 1990s, CCB partnered with Weyerhaeuser Corporation to study bird populations within the context of their 30-year harvest cycle. The research revealed that bird density and diversity was high in the first several years post planting, but declined rapidly as pine crowns began to close. The breeding bird community would remain in this state for two-thirds of the growing cycle. The study also demonstrated that by reducing planting densities, crown closure would be delayed supporting birds throughout a greater portion of the cycle. Further, the study showed that conducting a commercial thin soon after crown closure could allow managers to maintain an open-canopy forest and support birds throughout the thirty-year cycle. Because the pine trees grow faster in lower densities, both pines and birds were significantly more productive using lower stocking rates.

POLICY

Weyerhaeuser adopted new pine management prescriptions on hundreds of thousands of acres following the bird study. This same approach has been adopted on many federal and state lands throughout the Southeast including approximately one million acres. Subtle changes in management policy on such a grand scale have supported millions of birds throughout the region. ■

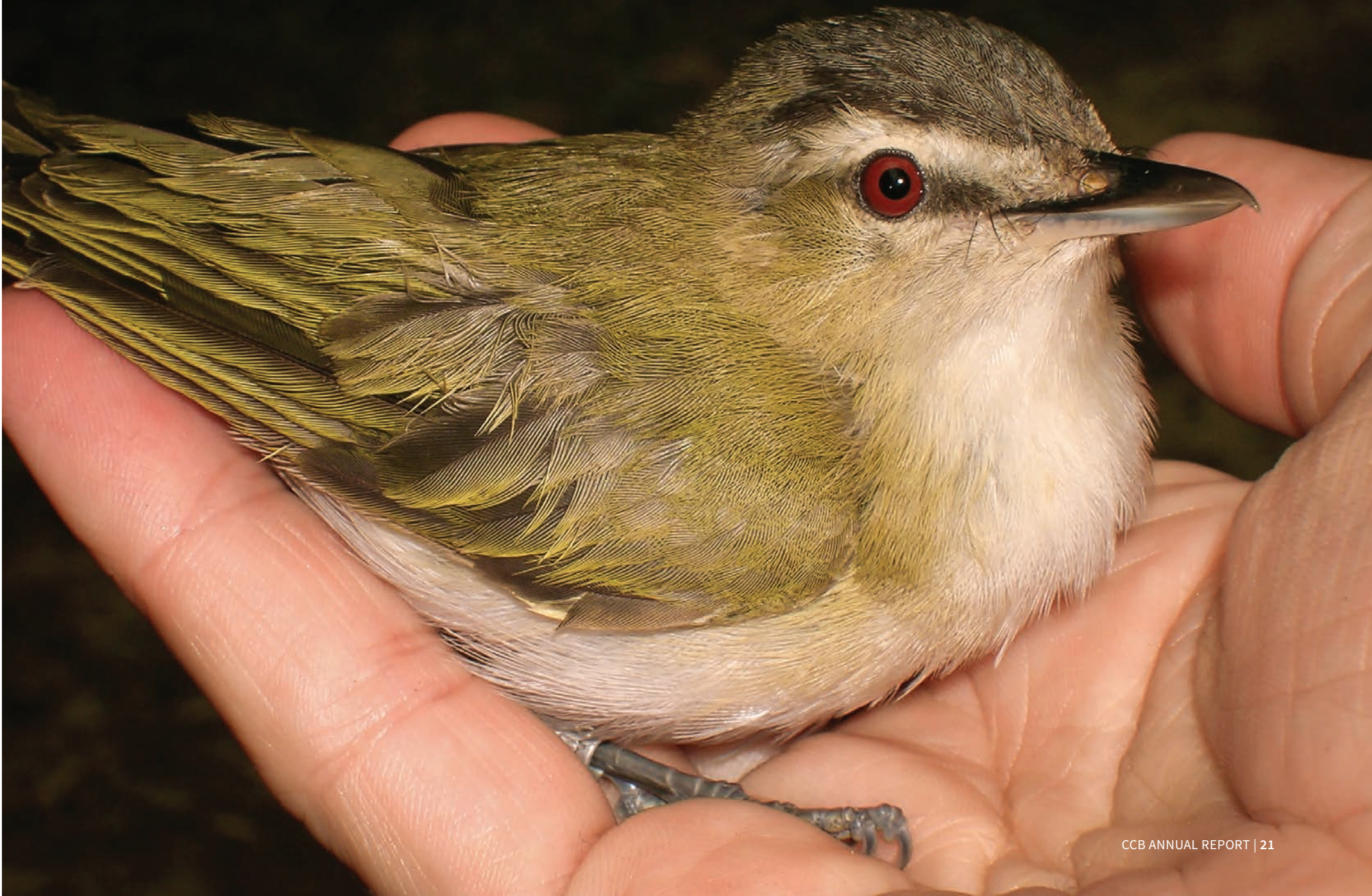


A wild turkey brood just emerging from their shells in a pine forest. Turkeys are one of many species that have benefited from improvements in the management of pine plantations resulting from CCB research. *Bryan Watts*



Sandra Smith measures a pine tree on Weyerhaeuser land in North Carolina. An investigation of the relationship between breeding birds and forest management led to prescriptions that are more bird friendly. These prescriptions have been adopted throughout extensive land holdings and support millions of birds per year. *Bart Paxton*

The red-eyed vireo is a common songbird that requires eastern forests. It is one of many passerines that benefit from a change in management prescriptions. *Carla Schneider Coleman*



SHAPING GRASSLANDS FOR BIRDS



Grasshopper sparrow in mist net. Grasshopper sparrows are complete grassland specialists and indicators of habitat quality. CCB has worked with this species during both the breeding and winter season in Eastern North America. *Bryan Watts*



Color-banded brood of the Bachman's sparrow. Bachman's are a species of open pine savanna but also occur in grass and shrublands. CCB biologists have studied their habitat requirements and monitored their status and distribution in Virginia. *Bryan Watts*

ISSUE

Following the Civil War land clearing reached a climax throughout eastern North America both to expand agricultural lands and to harvest wood products. Several species of grassland birds expanded into this breach and established successful breeding populations. However, the fortunes of these birds would begin to shift dramatically by the 1950s when farming practices began to intensify and idle lands were reforested. By the 1990s half of the bird species of conservation concern listed in many eastern states were grassland birds. The question has become how to support grassland bird populations on a greatly reduced land base and how this support should be assessed within the broader portfolio of eastern habitats.

CCB WORK

CCB biologists have worked with grassland birds for decades, often focusing on population management of individual species such as common barn owl, American kestrel, and Bachman's sparrow. However, beginning in the mid-1990s CCB partnered with the National Park Service, the Department of Defense, and the Fish and Wildlife Service to conduct a series of benchmark studies to understand management tradeoffs for the broader community of grassland and shrubland birds during the breeding, winter, and migratory periods. These studies determined that patch size and management intensity were related factors within the system and that bird populations could be maximized if these dimensions were considered together. Surprisingly, the studies also demonstrated that the best solution was a win-win where less expensive management supported more birds.

POLICY

The benchmark research conducted by CCB has resulted in changes in the management of open habitats on conservation lands across eastern North America. These changes have improved support for large numbers of grassland birds. ■

(Opposite page) Barn owl nestling. Barn owls require open grasslands to hunt and have suffered from the loss of open habitats over the past 50 years. CCB has worked directly with this species to provide and manage nest structures. *John DiGiorgio*



A rural landscape in southeastern Virginia. As many of the open lands have been filled by forests or development, much of the remaining grasslands exist as small farms. Work is needed to improve farm management to accommodate grassland birds. *Bryan Watts*





MITIGATING HAZARDS

ISSUE

The infrastructure we have built to support modern society kills billions of birds every year. Birds fly into hazards that we have erected in the airspace like tall buildings, radio towers, transmission lines and wind turbines. Virtually any structure erected in the airspace has the potential to kill birds. However, location matters. Placing structures within primary migration corridors, around major feeding areas, or next to large communal roosts may have the potential to cause population declines due to excessive mortality. A critical question is how do we maintain the infrastructure that modern society requires while minimizing the impact to bird populations?

CCB WORK

CCB biologists have always worked to identify and mitigate factors that contribute to bird mortality. However, in recent years the expansion of human infrastructure appears to have reached a tipping point, placing bird populations at risk across some regions of the world. One strategy to minimize mortality is to place hazards away from major bird activity centers. A map of activity centers is needed to inform hazard placement. Over the past twenty years, CCB has conducted extensive surveys to identify hundreds of communal roosts, nesting colonies, and feeding areas where birds congregate and have used transmitters to track birds of several species in order to delineate major migration pathways. These locations are the raw materials needed to plan bird-friendly infrastructure.

POLICY

Government agencies and corporations recognize that early planning to avoid bird mortality is environmentally responsible and cost-effective. CCB data layers that map activity hotspots are increasingly being used earlier and earlier in the decision process to minimize mortality conflicts. This ongoing change is benefiting bird populations. ■

A great blue heron that flew into an electrical distribution line that runs along a marsh. Placement of hazards away from major flightlines is a key strategy for reducing bird mortality. *Bryan Watts*

A close-up photograph of a young bald eagle (nestling) perched on a thick, reddish-brown tree branch. The eagle has dark brown, downy feathers and a large, dark, hooked beak. A small, yellow and black satellite transmitter is attached to its back, with a thin wire extending from it. The background is a dense, green forest.

Bald eagle nestling with transmitter. CCB has used satellite transmitters to track eagle movements in order to identify migratory pathways and high activity areas. Resulting probability maps are being used by agencies and corporations to site hazards in low-use areas. *Bryan Watts*

FINDING CONSERVATION VALUE

With very limited resources and across the vast global landscape how do we select conservation sites to protect? Just as a value investor evaluates thousands of companies to choose those that offer the greatest upside potential per cost we identify lands that are strategically important to species and ecosystems and that represent the highest return per cost. As with investing, this requires data and an experienced hand. Data is needed to find the golden needle in the haystack, and experience is needed to anticipate not just which lands support the highest diversity today, but how the local to global risks are likely to change the calculus moving forward.

The Center is recognized as a trusted source of data on the distribution of many bird species of conservation concern and as an experienced hand in reading the winds that dictate the fate of these species. We have been involved in the delineation and protection of scores of land parcels dedicated for bird conservation. It is thrilling to peruse a conservation map and to recognize so many lands that were protected based on our data resources or assessments.





Dave Hoppler (l), Steve McIninch (m) and Adam Duerr (r) help to count pelican nests on Smith Island in the Chesapeake Bay as part of a colonial waterbird survey. CCB monitors many species and maintains more than 1,000 historic data sets on species of conservation concern. This information is the raw material used to assess the value of potential conservation lands. *Bryan Watts*

UPPER BAY OF PANAMA

SETTING

Due to its position between two huge land masses, Panama is a continental crossroad for migrant birds. Like sand through an hour glass, each year millions of birds fly from all corners of North America only to converge on the narrow Isthmus of Panama before moving on to the vast reaches of South America. The lands around the Panama Canal are particularly significant to these birds. Since 1977 when President Jimmy Carter signed the Panama Canal Treaty assuring the transfer of canal lands to Panama in 2000, there has been an effort to assist planning efforts for the management of critical habitats.



Bart Paxton (l) and Dana Bradshaw (r) against the skyline of Panama City remove western sandpipers from a mist net as dawn ends a full night of trapping. Marking and resighting individuals in 1997 along with aerial surveys allowed us to estimate turnover rates and the number of birds using the upper Bay. Estimates would ultimately lead to the protection of critical areas. *Bryan Watts*



CCB WORK

At the request of both the State Department and Department of Defense CCB biologists conducted a four-month study of waterbirds around the Pacific entrance to the canal and the broader Bay of Panama during the fall of 1997. This was a landmark study that identified the upper Bay as one of the top five shorebird sites in the Western Hemisphere. The study focused on many aspects of waterbird ecology that have relevance to management. Since this time, CCB has continued to work within the site to advise, train, and improve local capacity to work toward conservation objectives.

PROTECTION

The benchmark work conducted in 1997 led to the designation of this site as a Western Hemisphere Shorebird Reserve with Hemispheric status and a globally important wetland under the RAMSAR Convention. The significant areas delineated during the study have been protected by the Panama Ministry of the Environment. ■

Banding western sandpiper on wintering grounds in Panama. CCB has handled many shorebirds in Panama to investigate molt, condition, residency time and migration pathways. *Bryan Watts*



A flock of small sandpipers spin over a mudflat along the upper Bay of Panama. The Bay is one of the most important shorebird sites in the Western Hemisphere. CCB continues to work in the area and contribute to conservation efforts. *Bart Paxton.*



LOWER DELMARVA PENINSULA

SETTING

The lower Delmarva Peninsula is one of the most significant migration bottlenecks in eastern North America where large numbers of birds become concentrated within a relatively small land area. Habitats on the peninsula receive extremely high use by migrant land birds during the fall months and are considered to have some of the highest conservation values on the continent. Each year millions of migrants including both passerines and raptors funnel down the Atlantic Coast and are trapped within the limited habitats of Northampton County.

CCB WORK

CCB biologists have worked for decades with fall migrants that stop on the lower Delmarva Peninsula. Research has focused on species composition, diet, seasonality of passage, stopover duration, and migrant condition. In the falls of 1992 and 1993, CCB conducted one of the largest passerine migration studies ever executed, mapping tens of thousands of migrants within the lower 20 kilometers of the peninsula. The study quantified fine details of habitat use and broad patterns in density. Information from the study has led to habitat management guidelines, local zoning, and identified conservation targets for acquisition. Continuing studies have refined guidance in these areas.

PROTECTION

The comprehensive work conducted in the early 1990s has resulted in the purchase of thousands of acres of land within the lower ten kilometers of the peninsula by several conservation partners. Lands have been acquired specifically for the purpose of migrant conservation. In addition to their purchase, the work has informed how these lands should be managed to maximize conservation benefit. ■

(Opposite page) Reese Lukei, Jr. with an adult red-tailed hawk captured at the Wise Point trapping site on the lower Delmarva Peninsula. CCB biologists have processed more than 10,000 migrating raptors on the peninsula contributing to what we know about migration and informing management decisions. *CCB photo*

(Above) Marian Urbi Watts with an American redstart captured as part of a study of fall migrants on the lower Delmarva Peninsula. CCB has worked with migrant passerines within this site for decades unraveling their ecology and using this information to inform management. *Bryan Watts*

(Right) Fruit of the devils walking stick on the lower Delmarva Peninsula. CCB research has shown that this fruit is among the most highly sought after fruits by fall migrants and the plant should be encouraged on conservation lands. *Bart Paxton*





INSTITUTIONAL PARTNERS 2016

Advanced Conservation Strategies	EA Engineering	Michigan Dept of Natural Resources	Progress Energy
Aluminum Company of America	Environment Canada	Michigan Natural Features Inventory	Richmond Audubon
American Bird Conservancy	Exelon Corporation	Microwave Telemetry, Inc.	Richmond Times Dispatch
American Eagle Foundation	Florida Fish and Wildlife Conservation Commission	Midstream Technology, LLC	Richter Museum of Natural History
American Wind Wildlife Institute	Friends of Dragon Run	Midwest Coordinated Bird Monitoring Partnership	Seaturtle.org
Arborscapes, LLC	Friends of Rappahannock River	Mississippi Museum of Natural Science	Smithsonian Institution
Arizona Bird Conservation Initiative	George Mason University	Mississippi State University	Smithsonian Tropical Research Institute
Atlantic Coast Joint Venture	Georgia Dept of Natural Resources	Mount Allison Univeristy	Solertium Corporation
Audubon North Carolina	Georgia Ornithological Society	Movebank	South Carolina Dept of Natural Resources
Audubon South Carolina	Georgian Bay Osprey Society	MPJ Wildlife Consulting, LLC	Southern Company
Avian Research and Conservation Institute	Hampton Roads Bird Club	National Aeronautics and Space Administration	Southern Illinois University
Bird Studies Canada	Hanover Aviation	National Audubon Society	State University of New York
Birds Caribbean	Idaho Bird Observatory	National Fish and Wildlife Foundation	Tennessee Ornithological Society
Boreal Songbird Initiative	Illinois Natural History Survey	National Park Service	Tetra Tech Inc
Brooks Bird Club	Institute for Integrative Bird Behavior Studies	New Hampshire Audubon	Texas Parks and Wildlife
Canadian Wildlife Service	James River Association	New Jersey Audubon	The Carolina Bird Club
Center for Coastal Resources Management	Jim Reed Enterprises, Inc.	New Jersey Conservation Foundation	The Curtis Group
Chesapeake Bay Bridge Tunnel Authority	Kentucky Dept of Fish and Wildlife Resources	New Jersey Division of Fish and Wildlife	The Hermitage Foundation
Chesapeake Bay Foundation	Kleinschmidt Associates	Norfolk Southern Corporation	The Nature Conservancy
Chesapeake Conservancy	Laramie Audubon	North Carolina Wildlife Resources Commission	The Peregrine Fund
CLS America, Inc.	Louisiana Fish and Wildlife	Northern Neck Audubon Society	The Wildlife Center of Virginia
Coastal Virginia Wildlife Observatory	Low Country Institute	Northern Virginia Conservation Trust	Toronto Ornithological Club
Colorado State University	Maine Dept of Inland Fisheries and Wildlife	Ohio Dept of Natural Resources	United States Army Corps of Engineers
Conserve Wildlife New Jersey	Manomet Center for Conservation Sciences	Oklahoma State University	United States Coast Guard
Cornell Laboratory of Ornithology	Martha's Vineyard Raptor Research	Panama Audubon	United States Dept of Agriculture
Delaware Division of Fish and Wildlife	Maryland Dept of Natural Resources	Partners in Flight	United States Dept of Defense
Delaware Natural History Museum	Maryland Ornithological Society	Pennsylvania Game and Fish Commission	United States Dept of Transportation
Discover the James	Math/Science Innovation Center		United States Fish and Wildlife Service
Dominion Virginia Power	Michigan Audubon		United States Forest Service

United States Geological Survey
Universidad de La Pampa, Argentina
University of Connecticut
University of Delaware
University of Georgia
University of Maine
University of Maryland
University of Rhode Island
University of Virginia
Virginia Academy of Science
Virginia Aquarium
Virginia Coastal Zone Management Program
Virginia Dept of Conservation and Recreation
Virginia Dept of Environmental Quality
Virginia Dept of Game & Inland Fisheries
Virginia Dept of Mines, Minerals, and Energy
Virginia Dept of Transportation
Virginia Institute of Marine Science
Virginia Marine Resources Commission
Virginia Master Naturalists
Virginia National Estuarine Research Reserve
Virginia Outdoors Foundation
Virginia Society of Ornithology
Virginia Transportation Research Council
West Virginia Dept of Natural Resources
West Virginia University
Wildlife Management Institute
Williamsburg Bird Club
Wisconsin Bird Conservation Initiative





THE CENTER FOR CONSERVATION BIOLOGY

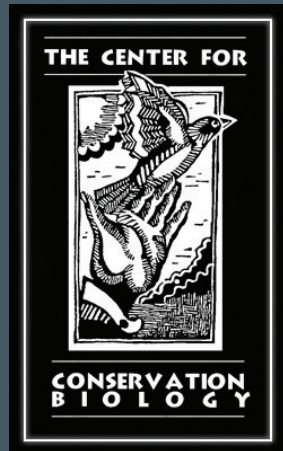
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