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Cover: Three-week-old bald eagle chick. Photo by C. Markham.

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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.

Summary

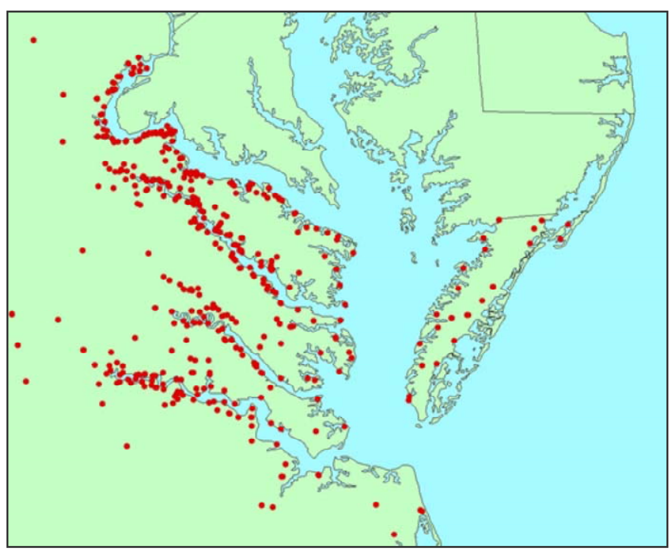
We are currently examining the influence of salinity on diet, prey delivery, and nestling growth in bald eagles (*Haliaeetus leucocephalus*) in the lower Chesapeake Bay. The objective of this project is to use video-monitoring systems to obtain close-range data of nest activities with minimal disturbance. During the 2002 and 2003 eagle breeding seasons, biologists from the Center for Conservation Biology measured eagle chicks and installed small security cameras directly above the nests. Combining growth and weight measurements with observations recorded on tape provides information fundamental to the long-term conservation of bald eagles. This data will help researchers determine core breeding areas for eagles and thus allow for targeted, more efficient management of the species. Potential implications of this study are important in addressing the habitat preservation goals of the 1990 Chesapeake Bay Bald Eagle Recovery Plan.

BACKGROUND

Context

Historically, the bald eagle was common along major river systems, lakes, and coastal areas throughout Virginia. The widespread use of persistent pesticides for crop management in the region resulted in a dramatic population decline over a 30 – 40 year period. By the late 1960's, the Virginia breeding population had been decimated by eggshell thinning and associated low productivity. Concern for populations across North America prompted the elevation of the bald eagle to the federal list of endangered species and led to a national effort to restore historic populations. Since the nationwide ban on most persistent pesticides in 1972, the Virginia population has experienced a dramatic recovery. The number of breeding pairs has increased from approximately 32 pairs in the 1960's to 435 pairs in 2003. However, the distribution of breeding eagles is not uniform throughout the lower Chesapeake Bay.

Recent analysis has indicated that population growth rate varies along a salinity gradient with highest rates being observed within the tidal-fresh reaches of the major tributaries (Watts *unpub. data*). This variation in population growth rate has resulted in significantly higher breeding densities and young production within areas surrounding lower salinity waters. This suggests tidal-fresh reaches represent core breeding areas, yet the ecological significance of these regions remains unknown.



Distribution of active bald eagle nests in the lower Chesapeake Bay in 2002.

Several studies cite the importance of prey availability as a factor affecting the spatial distribution of breeding eagles (Hansen 1987, Livingston *et al.* 1990, Buehler *et al.* 1991, Hunt *et al.* 1992, Dzus and Gerrard 1993). Thus, differential prey abundances may be a potential determinant of core breeding areas. In the Chesapeake Bay, eagles prey primarily on fish during their breeding season (Mersmann 1989) yet fish communities are not uniform throughout the Bay waters. Salinity is one of the key factors known to influence the abundance and distribution of fish species in the Chesapeake Bay (Murdy *et al.* 1997).

Variation in salinity tolerances between fish species has lead to species-specific distribution patterns and to the formation of predictable species assemblages that are salinity based. These patterns suggest that eagle pairs nesting in different salinity zones encounter different suites of prey species. However, how breeding eagles respond to differences in prey communities between salinity zones is unclear.

The fact that these same low salinity areas support the largest concentrations of migrant eagles in the summer months further suggests that prey availability may be an important ecosystem property that drives breeding density. Nonbreeding eagles, freed from the constraint of foraging close to their nests, are motivated to move in response to food availability (Servheen and English 1979, Hunt *et al.* 1992, Dzus and Gerrard 1993) and they are capable of responding to changes in prey numbers quickly (Knight and Knight 1983). Therefore, the location chosen by nonbreeding migratory eagles provides support that the distribution of the breeding population is food-regulated (Dzus and Gerrard 1993).

Objectives

To date, no information has been collected on the relationship between salinity and diet in bald eagles breeding in the Chesapeake Bay. More importantly, no data is available on the relationship between salinity and brood provisioning patterns. Such information is important in the effort to achieve a broader understanding of how bald eagles fit within the Chesapeake Bay ecosystem and where core breeding areas would be expected. This project proposes to use a video-monitoring system to investigate the influence of salinity on diet, prey delivery patterns, and nestling growth and development.

The key elements of the project are:

- To band and measure eagle chicks from nests in both tidal-fresh (0.0 – 0.5 ppt salinity) and mesohaline (5.0 – 18.0 ppt) reaches of the James, York, and Rappahannock Rivers
- To develop a field video-monitoring system powered by a deep-cycle, 12-volt marine battery
- To install, deploy, and remove video-monitoring systems at select nests in both tidal-fresh and mesohaline reaches of the James, York, and Rappahannock Rivers
- To analyze the influence of salinity on diet, prey delivery patterns, and chick growth and development
- To submit findings to regulatory agencies and conservation groups involved in bald eagle management

Three-week-old eagle chicks (left) and a 40-day-old eagle chick (right). Photos by C. Markham.

METHODS

Study Area

The geographic scope of this study focused on bald eagle nests along the James, York, and Rappahannock Rivers. Nests were considered for inclusion by assessing feasibility of the climb, nest history, proximity to the shoreline, and road access. Appropriate federal and state permits and landowner permission were obtained through the Center for Conservation Biology.

Study Design

Video-monitoring

Video-monitoring systems were installed at select nests. The system consisted of a small bullet security camera wired to a remote VHS videocassette recorder. Video cameras were mounted approximately 1 m above the nest so that the entire nest surface was in view. Cameras were wired to a remote location to reduce nest disturbance and improve access for maintenance activities. Systems were powered using DC current provided by a deep cycle, 12-volt marine battery.

Color bullet security camera mounted above eagle nest. Photo by C. Markham.

Recording focused on the time period of maximum growth rate, when chicks are between 15-20 and 40-45 days old (Bortolotti 1984a). Video system installation and removal coincided with first and second measurements on chicks, respectively. Following camera installation, researcher activity around eagle nests was restricted to maintenance requirements. In most cases, volunteer assistance was instrumental in achieving the anticipated scope of coverage. Volunteer responsibilities included regular tape and battery changes throughout the season.

Bryan Watts banding a three week old eagle chick from a nest along the James River. Photo by C. Markham.

Growth Measurements

Growth measurements were taken at the start and end of the maximum growth phase as indicated by Bortolotti's (1984a) bald eagle growth curves. This period was the focus of data collection because (1) it is the phase when growth change is most rapid and (2) it is where variation in diet and provisioning patterns has the greatest impact on growth and development. Further, this time period falls within the constraints of nestlings developing thermoregulatory capabilities at 15 days (Bortolotti 1984a) and the potential for nestlings to jump prematurely from the nest after 60 days (Bortolotti 1984b). Nest trees were climbed and chicks lowered to researchers on the ground for measurements. Chick mass was the principle measurement taken. Eighth primary length, bill depth, and foot pad length were also recorded and used to determine age and sex of the chicks (Bortolotti 1984b).

RESULTS AND MILESTONES

Work for this project will be orchestrated in three phases. Phases include (1) data collection, (2) data analysis, and (3) report writing. The majority of effort thus far has concentrated on data collection and includes fieldwork to obtain chick measurements and video footage.

In the spring of 2002 and 2003, a total of 35 eagle chicks from twenty nests were banded and measured. At 16 of those nests, video cameras were installed and approximately 4,000 hours of nest footage were recorded.

Yearly banding and recording effort.

	2002	2003	Total
Chicks banded/measured	16 chicks (*7 nests*)	19 chicks (*13 nests*)	35 chicks (*20 nests*)
Video hours recorded	~1,500 hours (*6 nests*)	~2,500 hours (*10 nests*)	~4,000 hours (*16 nests*)

FUTURE ACTIONS

Recent effort has been placed on the development of protocols for the analysis of growth data and video tapes. Work over the next six months will continue to focus on data analysis, with an increasing emphasis on report writing. The anticipated project completion date is March 2004.

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Keith Cline preparing to lower chicks from an eagle nest along the James River. Photo by C. Markham.

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