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## EFFECTS OF DROUGHT ON BALD EAGLES NESTING IN NORTH-CENTRAL FLORIDA

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The Florida Fish and Wildlife Conservation Commission (FWC) began participation in a statewide survey of nesting Bald Eagles (*Haliaeetus leucocephalus*) in 1972. The survey, conducted from fixed- or rotary-winged aircraft, involved various Federal, State, and private agencies (U.S. Park Service, U.S. Forest Service, FWC, and Florida Audubon, Nesbitt et al. 1990). We collected information on whether a territory was active, and if so, how many young were produced. By 1984 FWC personnel had assumed responsibility for most of the survey outside Everglades National Park (which was surveyed by park personnel). Data from the survey have shown a steady increase in eagle nesting in Florida and have been used to help manage the state's eagle population (Nesbitt et al. 1993). Knowledge of the size, distribution, and upward trending population justified the use of eggs from Florida Bald Eagles to aid in population restoration in other parts of the southeastern United States (Nesbitt et al. 1998). Here we report on the use of these survey data to detect reaction of nesting eagles to the recent declines in normal rainfall patterns in an area of north-central Florida.

Proximity to water is an important element of Bald Eagle nesting territories. Wood et al. (1989) found that 96.6% of 116 nests they looked at in Florida were less than 3 km from water. The importance of access to water is understandable since fish are the primary prey for Bald Eagles in Florida (Curnutt 1996). An extended drought that resulted in a significant decline in water levels and affected fish populations could impact eagle nesting success. If declining water levels concentrated fish, making them more available to capture, one might expect to see an increase in eagle productivity. However, if water levels dropped to the point of causing a substantial reduction in the fish population (their primary prey base) the local eagle population could, as a consequence, experience a decrease in the number of young fledged.

Late in the 1997-1998 nesting season (the nesting season in Florida is 1 October through 15 April), an interruption in the normal annual rainfall pattern began which reduced lake water levels throughout much of Florida. Normal rainfall patterns did not return until summer of 2002. We analyzed annual survey data collected in

Alachua and Marion counties from 1998 through 2002 to gauge the reaction of locally nesting Bald Eagles to the reduction of water levels associated with this drought event.

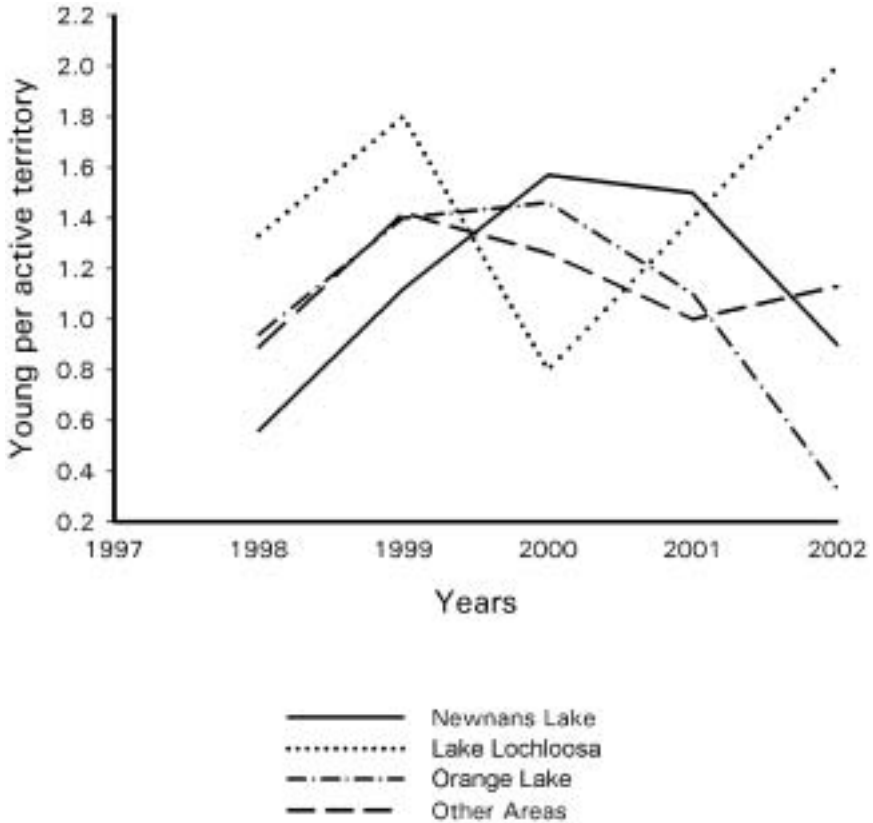
During the survey years we recorded information on 112 active eagle nest territories (S. Nesbitt et al. FFWCC Annual Reports), 46 of which were within 2 km of one of the 3 major lakes in the area: Newnans, Lochloosa, and Orange. We chose to use nests within 2 km of the lakes to focus on territories that were most likely dependent on these lakes as a food source. We compared 4 sets of data; 3 consisted of the number of young eagles fledged per active nest for nests within 2 km of each of the 3 lakes. The fourth set, which served as a control, contained all the other nests in the 2 counties >2 km from any of the 3 lakes (Table 1).

There was a drought related event that set Orange Lake apart from the other 2 lakes in our study. A sinkhole developed at the western end of Orange Lake that exacerbated the water level decline. By May of 2001 the level had dropped to 49.6 feet above mean sea level, the lowest recorded level (lowest level previously recorded was 50.5 feet in July 1956; average level is 57.8 feet). The surface area was reduced to 25% of the normal 5,140 ha, with only 5% of the water volume remaining (*The Gainesville Sun, Local and State* section, 28 June 2003). A fish kill in summer 2001 which followed the sustained low-water level in Orange Lake (E. Nagid; FWC pers. comm.) drastically reduced the fish biomass.

We compared the 4 data sets for the number of young fledged per active territory after the drought began in 1998 (Table 1). When compared to all other years, productivity for all data sets in 2002 was significantly different (Kruskal-Wallis test,  $P < 0.001$ ). We considered a P value significant if it was  $\geq 0.05$ . Orange Lake nests in 2002 were significantly less productive than nests near Lake Lochloosa and the control group (Wilcoxon ranked sum exact test  $P = 0.002$ ). Differences in productivity for nests on Orange Lake and Newnans Lake in 2002 were nearly significant with a P value of 0.06 (Wilcoxon ranked sum exact test).

**Table 1. Number of active territories inventoried and number of young fledged per active territory from 1998 through 2002 in north-central Florida.**

| Year | Number of Active Nest Territories (young fledged/territory) |                |             |             |
|------|---|----------------|-------------|-------------|
|      | Newnans Lake  | lake Lochloosa | Orange Lake | Other Areas |
| 1998 | 9 (0.56)  | 6 (1.33)       | 16 (0.94)   | 37 (0.89)   |
| 1999 | 8 (1.12)  | 5 (1.80)       | 15 (1.40)   | 28 (1.42)   |
| 2000 | 7 (1.57)  | 5 (0.80)       | 13 (1.46)   | 34 (1.24)   |
| 2001 | 6 (1.50)  | 5 (1.40)       | 10 (1.10)   | 38 (1.00)   |
| 2002 | 10 (0.90)   | 5 (2.00)       | 12 (0.33)   | 30 (1.13)   |



**Figure 1. Annual variations in numbers of young Bald Eagles fledged per active territory 1998 to 2002, Alachua and Marion counties Florida.**

In Orange Lake it seemed water levels dropped so low that a majority of the prey base was lost to nesting eagles. Consequently reproductive success declined (Fig. 1). However there may be a different reason for the decline in productivity for eagles nesting on Newnans Lake. The recent drought followed a period of prolonged decline in the quality of the lake's aquatic habitat. The reduced number of young produced per active territory for Newnans Lake may have been more a consequence of this long-term deterioration in the quality of the habitat supporting nesting eagles that brought about a gradual loss in prey. This is in contrast to the abrupt loss of the prey base that affected Orange Lake.

There is something interesting in the differences between Orange and Lochloosa lakes that may have more to do with the behavior of eagles than foraging habitat. The eastern shore of Orange Lake is only

1.6 km from the western shore of Lochloosa and the lake centers are less than 9 km apart. Why didn't the Orange Lake nesting eagles simply feed in Lake Lochloosa where, presumably, there had been no loss in the prey base and where nest productivity actually went up (Fig. 1)? Perhaps even this small distance was enough that the energy cost of travel from their nest sites on Orange Lake to fish in Lake Lochloosa exceeded the value of the resources they would obtain. Another possible reason why there was little advantage from their proximity to Lake Lochloosa was that the pairs there were actively defending their food resources from intruders. This would mean again that the energy (or risk of injury) required in getting the necessary resources from Lake Lochloosa for the Orange Lake birds exceeded the value derived.

Fluctuations in lake levels in Florida have been documented to produce a more dynamic and productive aquatic environment and an increase in fish populations (Wegener and Williams 1975, Moyer et al. 1995). Changes in water levels, even if remarkable, are not necessarily incompatible with a robust nesting eagle population. While short term declines in the number of young produced per active territory (as occurred on Orange and Newnans lakes) may result from fluctuations in lake levels, the loss of those young could be recouped or exceeded as a result of an enhanced future fishery, provided the general quality of the aquatic environment is not compromised.

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