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POSSIBLE COMPETITION BETWEEN WATERFOWL AND SANDHILL CRANES AT HIWASSEE WILDLIFE REFUGE, TENNESSEE

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Abstract: As a result of crop planting for waterfowl, numbers of eastern greater sandhill cranes (*Grus canadensis tabida*) staging and overwintering at the Hiwassee Wildlife Refuge in eastern Tennessee have sharply increased over the last 30-40 years. Peak numbers of wintering cranes have reached 14,000, and this large increase in crane numbers raises the possibility that they may be competing with waterfowl for food and space. I examined broad-scale changes in waterfowl numbers using Christmas Bird Count data, as well as small-scale changes using observations of waterfowl numbers and locations in relation to cranes on individual days. Preliminary results indicate that declines in Canada goose (*Branta canadensis*) numbers do not seem to be related to the increase in cranes, and while numbers of other waterfowl species have not shown changes, some species tend to remain farther from shore, and hence deeper water, when there are more cranes present. Waterfowl at Hiwassee may not be able be to deposit as much fat for inclement winter weather, spring migration, or breeding. Competition between cranes and waterfowl increases the need for wildlife managers to provide more food and habitat for both cranes and waterfowl.

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Key words: competition, *Grus canadensis tabida*, Hiwassee Wildlife Refuge, sandhill cranes, Tennessee, waterfowl.

Numbers of eastern greater sandhill cranes (*Grus canadensis tabida*) staging and overwintering at the Hiwassee Wildlife Refuge in eastern Tennessee have sharply increased over the last several decades (Fig. 1). While this might be the result of an overall population increase, the increase coincides with the start of crop planting on the refuge. Regardless of its cause, the large increase in crane numbers has led to a number of management issues at the refuge, such as crop depredation and noise complaints on surrounding properties. Another concern is the potential that the cranes may be competing with waterfowl for the food resources on and around the refuge. Corn is a preferred food of sandhill cranes, Canada geese (*Branta canadensis*), and snow geese (*Chen caerulescens*) (Krapu et al. 1995, 2005), and in the midcontinental U.S. this competition has potentially contributed to reduced fattening in cranes (Krapu et al. 2005). Given that cranes usually outnumber geese at Hiwassee (personal observation), it is possible that the reverse effect could be happening at the refuge. While aquatic foods make up a smaller proportion of their diet, cranes may forage on the same fish, invertebrates, and vegetation (Iverson et al. 1982) as some duck species. Again, competition for food may result in reduced fat stores, reduced survival, or other consequences for either ducks or cranes. I conducted a preliminary assessment of competition examining broad-scale population changes in cranes and waterfowl, as well as the spatial distribution of several duck species in relation to crane numbers.

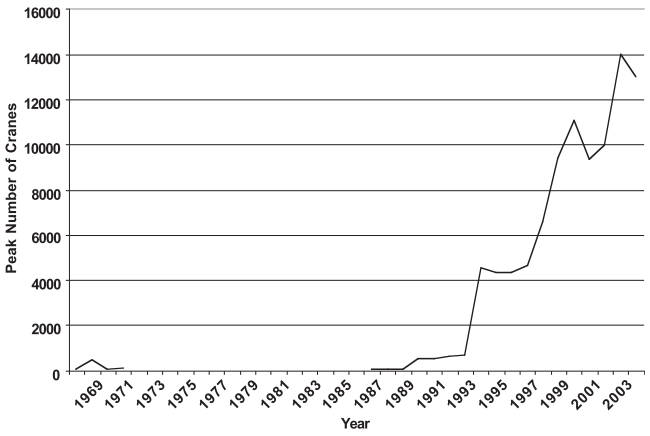

Figure 1. Peak numbers of wintering greater sandhill cranes at Hiwassee Wildlife Refuge, Tennessee. Data were not recorded between 1972 and 1986, but small flocks of sandhill cranes still used the area.

STUDY AREA

The Hiwassee Wildlife Refuge is located in Meigs County, Tennessee (35°24′N, 85°58′W; Fig. 2). The refuge consists of 405 ha of open fields, agricultural fields, riverbanks, and ponds. The refuge is bounded by private property, and some

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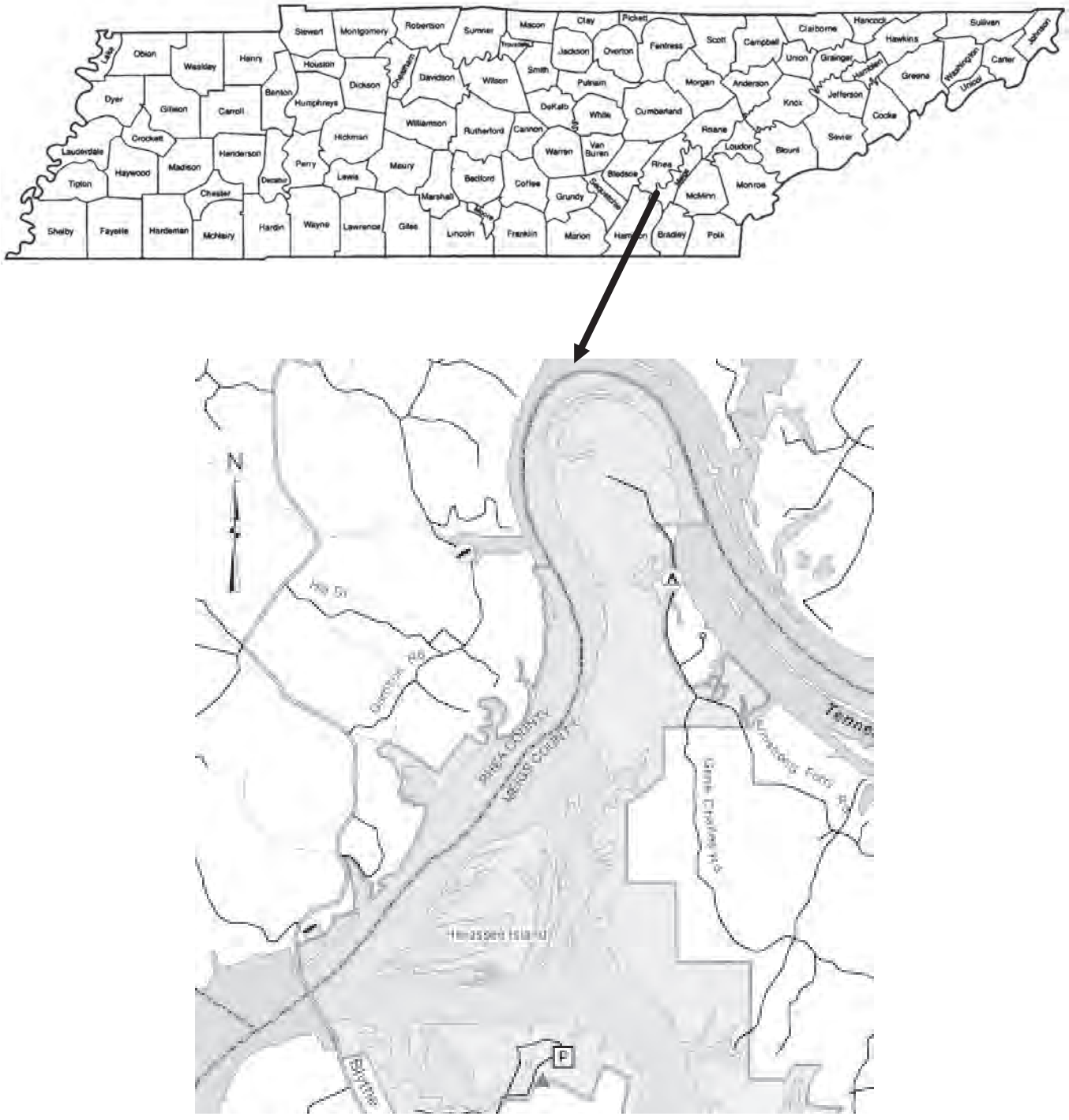

Figure 2. Location of Hiwassee Wildlife Refuge, Tennessee.

property owners plant various cereal crops for sale and consumption. I categorized 4 major habitats on the refuge: agricultural field, grassy field, mudflat, and shallow water. I defined agricultural field as any land planted with an agricultural crop; however, I did not distinguish between the types of crops that were planted. The predominant crop planted was corn, with lesser amounts of millet and sorghum. Of the 4

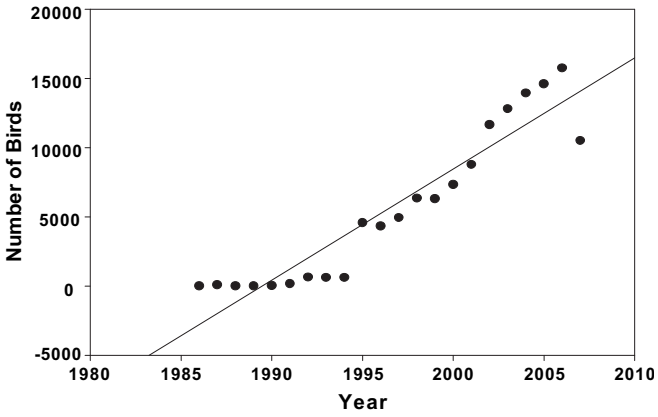

Figure 3. Annual number of sandhill cranes recorded on the Hiwassee Christmas Bird Count.

habitats, agricultural fields comprised 39% of the habitat at the refuge. Grassy field, which covered 30% of the refuge, is characterized by open land vegetated with grasses and forbs. I defined mudflats as any exposed wet ground between the water and dry land. Mudflats make up 20% of the refuge. The remainder of the refuge (11%) is shallow water, which I defined as any water < 0.33 m deep. Habitat availability data were obtained from the Tennessee Wildlife Resources Agency personnel at the refuge.

METHODS

To examine broad-scale changes in abundance I used data from the Hiwassee Christmas Bird Count (National Audubon Society 2007). This count has been conducted every year on 1 January since 1978, with an average of 21 participants and 48 party hours (1 person counting for 1 hr = 1 party-hr). Thus, the count provides a very consistent long-term assessment of crane and waterfowl trends. I downloaded data for sandhill cranes, Canada geese, mallards (*Anas platyrhynchos*), northern pintails (*Anas acuta*), hooded mergansers (*Lophodytes cucullatus*), and ring-necked ducks (*Aythya collaris*). I selected these species because they are typically the most abundant waterfowl species wintering on the refuge. I conducted linear regression analyses for each species to look for significant changes in numbers over time.

To examine finer-scale effects of cranes on waterfowl, I observed how far the different duck species kept from shore in relation to crane numbers. I used a random number table to select 5 days in December 2007 and 5 days in January 2008 for making observations. All observations were made from the public viewing area (Fig. 2) at Hiwassee to avoid disturbing the birds. The viewing area is an exposed gazebo that is 280 m from an impoundment where many waterfowl are commonly seen. Water depth in the impoundment ranges from 0.01 m

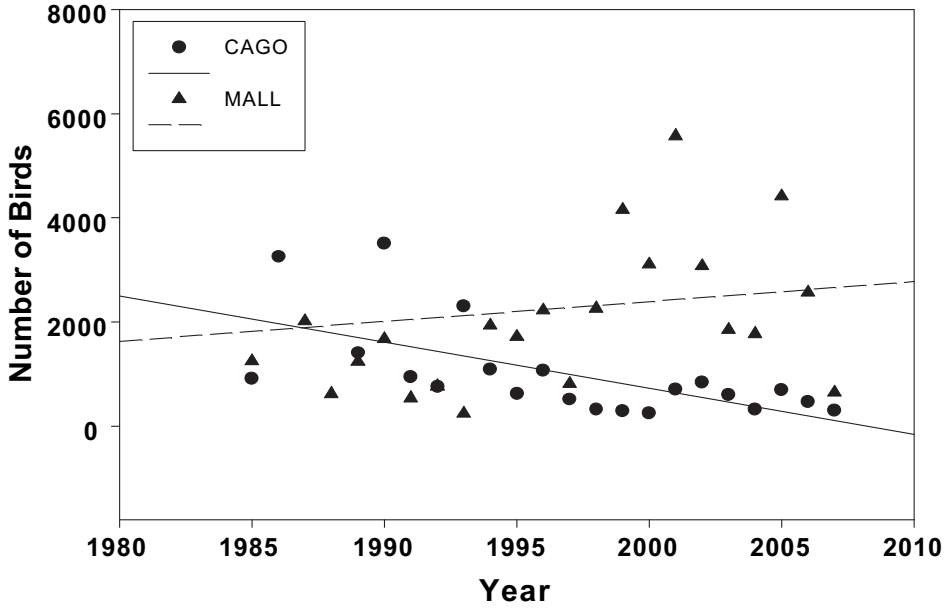

Figure 4. Annual number of Canada geese (CAGO) and mallards (MALL) recorded on the Hiwassee Christmas Bird Count.

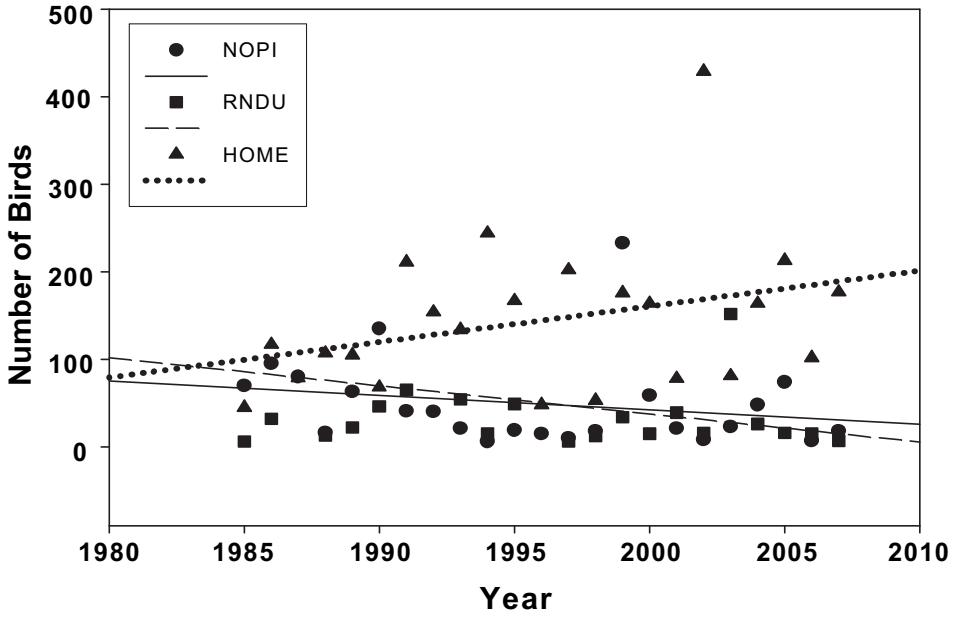

Figure 5. Annual number of northern pintails (NOPI), hooded mergansers (HOME), and ring-necked ducks (RNDU) recorded on the Hiwassee Christmas Bird Count.

along the shoreline to 4 m in the middle of the impoundment. On each of the selected days I haphazardly (non-systematically) selected 10 individuals of each of the focal species and measured their distance from me and my distance from the nearest shore relative to the individual using a laser range finder. I later used those distances and the resulting angle to calculate each individual's distance from the nearest shoreline. After I had recorded the distances, I counted the number of cranes in the area. I then used simple linear regressions to look for trends in distance and crane numbers on those days.

RESULTS

Christmas Bird Count data showed there was a significant increase in crane numbers at Hiwassee from 1978 to 2007 ($F = 159.96$, $P < 0.001$; Fig. 3). During that same period, Canada goose numbers on the refuge showed a significant decline ($F = 12.51$, $P = 0.002$), while the duck numbers showed non-significant trends for all species (mallard: $F = 0.50$, $P = 0.486$; northern pintail: $F = 1.00$, $P = 0.327$; hooded merganser: $F = 2.48$, $P = 0.130$; ring-necked duck: $F = 1.37$, $P = 0.256$; Figs. 4 and 5). To determine if the goose trend was a local phenomenon, and thus more indicative of an effect of the cranes, I subsequently examined Christmas Bird Count trends for Canada geese across the United States, within the state of Tennessee, and in Chattanooga, Tennessee, which is about 97 km from Hiwassee. Nationally and in Chattanooga, Canada goose populations have increased significantly (national: $F = 22.88$, $P < 0.001$; Chattanooga: $F = 6.33$, $P = 0.021$), while at a state level they have remained unchanged ($F = 2.181$, $P = 0.155$) (Fig. 6). However, in 1990 there was a very high number of geese recorded, much higher than in the other years. If this point is removed from the analysis, geese show a nearly significant negative trend ($F = 3.80$, $P = 0.065$). To further separate the effects of Hiwassee trends, state trends, and crane numbers, I conducted a backwards stepwise regression. Results of this analysis indicated that sandhill crane numbers did not improve the model to predict goose numbers at Hiwassee, whereas numbers could be predicted from a linear combination of state trends and year (Table 1).

At a finer scale, mallards did increase their distance from the shoreline when more cranes were present ($F = 5.56$, $P = 0.046$). Both hooded mergansers and ring-necked ducks were also found significantly farther from shore as crane numbers increased, (hooded merganser: $F = 66.06$, $P < 0.001$, ring-necked duck: $F = 50.24$, $P < 0.001$; Fig. 7). Northern pintails were not

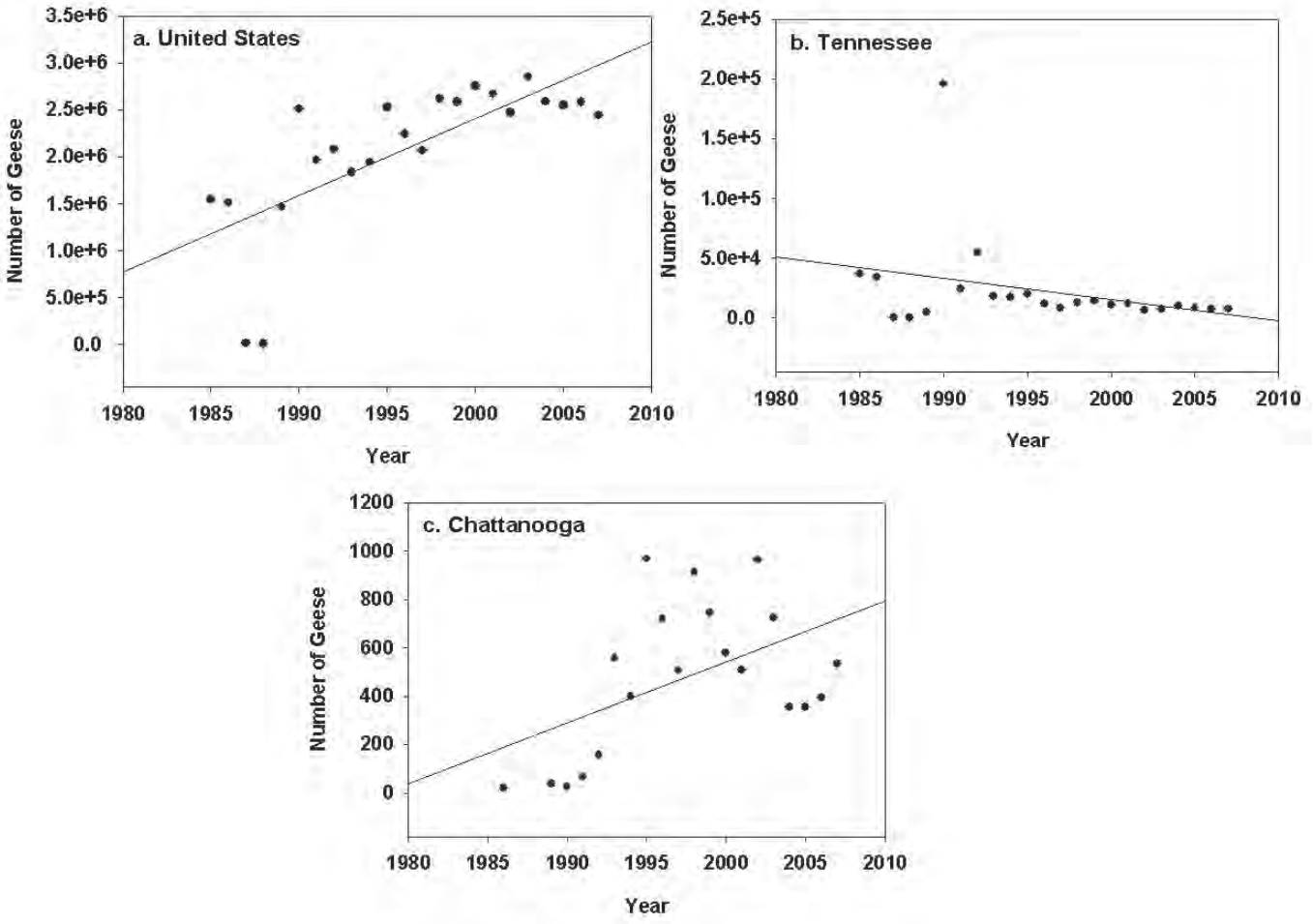

Figure 6. National, state, and local Christmas Bird Count numbers for Canada geese.

present in sufficient numbers during the sampling days to include in the analyses.

DISCUSSION

While initial results suggested that sandhill cranes were negatively affecting Canada geese, subsequent analysis indicates that other factors may be responsible for the decline in goose numbers at Hiwassee. The most likely explanation is the change in migratory habits of some subspecies of Canada geese. The subspecies that winters at Hiwassee is the giant Canada goose (*B. c. maxima*), which has shown a tendency to winter farther north over the last 20 years (Mowbray et al. 2002). This trend, along with the regression analysis, support the idea that the decline in goose numbers at Hiwassee is not because of the cranes, but simply that fewer geese are wintering in Tennessee. Nonetheless, the large number of sandhill cranes at Hiwassee could still lead to competition with geese. This competition could stem from reduced food availability for the geese, or from reduced opportunity for the geese to forage if the cranes actively exclude geese from the fields or simply occupy so much area that the geese cannot land. Whichever mode of competition might exist, the effect on the geese would be reduced energy intake and increased search times, which, in turn, could result in reduced fattening. The reduced fat stores could lead to lower overwinter survival and/or reduced reproduction.

Mallard foraging did not seem to be affected much by cranes. It could be that mallards are simply more tolerant of the cranes, or that they had other opportunities to forage. There are several other ponds on the refuge where mallards congregate, and if there

Table 1. Stepwise regression analysis of sandhill crane (SACR) numbers and Canada goose (CAGO) Christmas Bird Count (CBC) trends.

Group	Coefficient	Standard coefficient	SE	*F*-to-remove	*P*
Constant	16690.163		5734.897		
Year	-170.484	-1.105	62.784	9.389	0.007
Tennessee CAGO CBC	0.0104	0.462	0.00332	8.980	0.009
SACR CBC	0.109	0.637	0.0688	2.517	0.132

is too much disturbance from the cranes, the mallards may simply move to another pond. Hooded mergansers and ring-necked ducks, in contrast, did seem to alter their foraging in response to crane numbers. By being forced to forage in deeper water, both species might face energetic and nutritional consequences. Hooded mergansers feed on fish, crayfish, and other aquatic invertebrates (Dugger et al. 1994). While there is no published information on the diving depth of hooded mergansers (Dugger et al. 1994), a pair of captive hooded mergansers has been observed diving as deep as 2 m (Kevin Calhoon, Tennessee Aquarium, personal communication). This means that mergansers in the impoundment can catch fish, but might not be able to reach some of the benthic invertebrates, such as crayfish and snails. As a result, they may be able to find enough food to survive the winter and fatten for migration, but if the invertebrates contain certain nutrients the birds need for breeding, their reproduction may be compromised. Ring-necked ducks feed on submerged vegetation and aquatic invertebrates, and dive as deep as 1.5 m (Hohman and Eberhardt 1998). As with the mergansers, foraging in deeper water may put some food out of their reach, which may reduce overwinter survival, migratory fattening, and/or reproduction.

My results are preliminary and correlative, and should be viewed with caution. There are alternative explanations for some of the results. For example, the spacing pattern of the ducks may be due to time of day

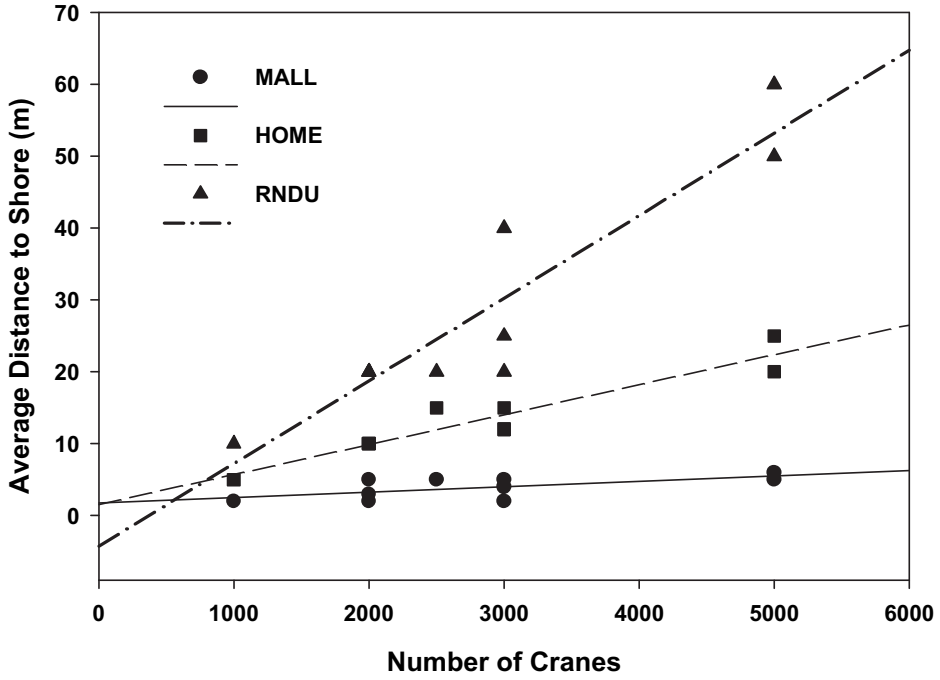

Figure 7. Average distance of 3 duck species to nearest shoreline in relation to sandhill crane abundance: mallards (MALL), hooded mergansers (HOME), and ring-necked ducks (RNDU).

effects, whereby they are located farther from shore during certain times of the day. The pattern of crane activity might also have an influence on the results, as the cranes display different activities during different parts of the day (Aborn 2010). Nonetheless, based on the results from this single location, the large numbers of sandhill cranes at Hiwassee may be negatively impacting some waterfowl species. Possible solutions to reduce competition include providing more food, increasing the amount of waterfowl habitat, and reducing crane numbers. Further research is needed, however, before any management actions are taken. Additional research is needed on behavioral interactions between cranes and waterfowl, particularly Canada geese, as well as foraging rates and dietary composition of the waterfowl. Managers will then have more specific information as to the extent of competition taking place and can therefore make better informed decisions as to how to resolve it.

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