

## RESPONSE OF NESTING WATERFOWL TO FLOODING IN GREAT SALT LAKE WETLANDS

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**ABSTRACT.**—Great Salt Lake wetlands were inundated in 1983, displacing approximately 20,000 nesting waterfowl. Ten protected marshes in the Great Basin were surveyed for changes in numbers of breeding pairs of waterfowl during each of four years preceding Great Salt Lake flooding and four years following flooding. The hypothesized increase in numbers of breeding birds did not occur, indicating that flood-displaced waterfowl did not move into nearby suitable habitat to nest.

Much research has addressed waterfowl response to region-wide drought conditions (Hansen and McKnight 1964, Smith 1970, Henny 1973); yet little is known about waterfowl response to more localized flooding. This paper investigates changes in regional breeding populations of three species of ducks prior to and following extensive flooding of Great Salt Lake shoreline marshes.

The marshes along the north and east shores of Great Salt Lake have been extremely important breeding grounds for redheads (*Aythya americana*) (Weller 1964) and cinnamon teal (*Anas cyanoptera*) (Bellrose 1976). Gadwalls (*Anas strepera*) and mallards (*Anas platyrhynchos*) were also locally common breeders (Williams and Marshall 1938).

Continental subpopulations such as these operate under a migratory tradition; after maturing, females return to the marsh near the area in which they were raised.

Hens that nest successfully in a given wetland show strong tendencies to return to the same part of the same wetland year after year (Borden and Hochbaum 1966, Doty and Lee 1974, Bishop et al. 1978). This behavior is called philopatry and, in an evolutionary perspective, may have strong selective advantages. Relinquishing philopatry and seeking suitable alternative habitats in response to drought is essential (Weller 1964). This also raises the question of whether or not waterfowl have some instinctive contingency response when they return or "home" to previously used marshes and find them unsuitable. Pintails (*Anas acuta*) homing to drought-stricken prairie potholes have been shown to

overfly to the more stable wetlands in Alaska and Siberia, USSR (Henny 1973, Derkson and Eldridge 1980). Redheads may respond similarly but not travel as far north (Weller 1964). Blue-winged teal (*Anas discors*) may move north and west, and lesser scaup (*Aythya affinis*) appeared to shift eastward from drought-stricken Saskatchewan (Rogers 1959). In each of these cases ducks have moved out of a large area of lowered habitat quality. Their response may be quite different when faced with flooding of a much smaller, yet intensively used area of breeding habitat such as Great Salt Lake marshes.

During 1983–1986 the Great Salt Lake experienced consecutive record-breaking lake level rises, inundating approximately 175,000 ha of wetlands. Shorelines and emergent stands of plants were completely overtopped with as much as 3 m of water; in addition, wind-induced seiches caused wave-wash into areas up to .75 m above this extreme lake level. Essentially all 175,000 ha of Great Salt Lake nesting habitat had been temporarily eliminated.

From previous studies (Williams and Marshall 1938, Bellrose 1976, Utah Division of Wildlife Resources, unpublished data) I estimate that over 20,000 ducks nested in the Great Salt Lake marshes prior to flooding. The number of individual birds, returning adults and offspring of the previous year's birds, homing to these marshes cannot be estimated directly. However, Doty and Lee (1974) found that 46% of female mallards returned to previously used nest sites (baskets in this study), and virtually all successful

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females that survived returned to nest within 10 km of the previous year's nest. It seems reasonable to expect that perhaps 10,000–15,000 pairs (young of the previous season and 2+-year-old females) would return to their previously used marshes. Fifteen thousand nesting pairs of returning birds represents approximately one third of Utah's total waterfowl nests.

Utah is the second driest state in the United States, and the wetlands that occur here are usually discrete units of quality habitat in a desert setting. Many of these wetlands are government-owned and managed for waterfowl habitat. I refer to these wetland "islands" of quality habitat in a desert region as "satellite marshes."

Bancroft et al. (1988) documented colony relocations by wading birds in consecutive years resulting from hydrological changes. When Great Salt Lake flooded the stands of emergent vegetation in the adjacent shoreline marshes, several large colonies of Franklin gulls (*Larus pipixcan*) and white-faced ibis (*Plegadis chihi*) moved to nearby satellite marshes to nest. This raised the question of whether waterfowl that returned to nest in the flooded marshes might have displaced into nearby suitable habitat as well.

#### METHODS

The objective of this study was to see if these, the best available data, indicate a displacement of nesting waterfowl from the Great Salt Lake marshes into nearby suitable habitats such as satellite marshes. Spring pair counts were used to estimate changes in duck numbers on satellite marshes coincident with bird displacement from Great Salt Lake marshes.

The hypothesis is that if displaced ducks nested in satellite marshes, an increase in breeding pairs would be observed there after Great Salt Lake flooding occurred.

The study period was 1979–1986, four years of data from the preflooding period and four years postflooding. For study areas 10 satellite marshes were selected that fit the following criteria:

1. All were within 100 km of Great Salt Lake.
2. Each presented suitable nesting habitat for the entire study period.

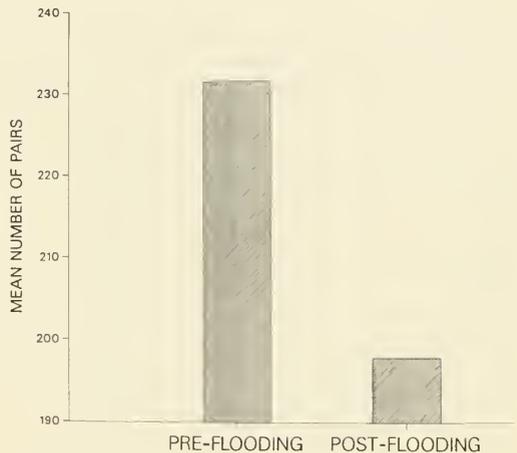


Fig. 1. Mean numbers of indicated breeding pairs of cinnamon teal, gadwalls, and redheads on 10 marshes for the four years before and the four years after the Great Salt Lake flooded.

3. Spring pair count data were available for each marsh throughout the study period.

I requested and received from the Utah Division of Wildlife Resources spring pair count data for the 1979–1986 period on gadwall, cinnamon teal, and redhead, the three most common species of nesting ducks in the Great Salt Lake marshes.

The explicit assumptions of this investigation were:

1. That territorial space was available on the satellite areas and that ducks would distribute themselves in the manner of an "ideal free distribution" (Fretwell and Lucas 1970).
2. That satellite areas chosen were a representative sample of Great Basin wetlands.

Pair data were analyzed with a three-way analysis of variance (year/flood  $\times$  marsh  $\times$  species) to detect differences between factors and between combinations of factors.

#### RESULTS AND DISCUSSION

There was not a significant difference ( $P = .254$ ) in pair numbers counted on satellite marshes during the four pre-flood years and the four post-flood years (Fig. 1). From this it was concluded that there was not an increase in pair numbers on satellite marshes coincident with the flooding of Great Salt Lake marshes.

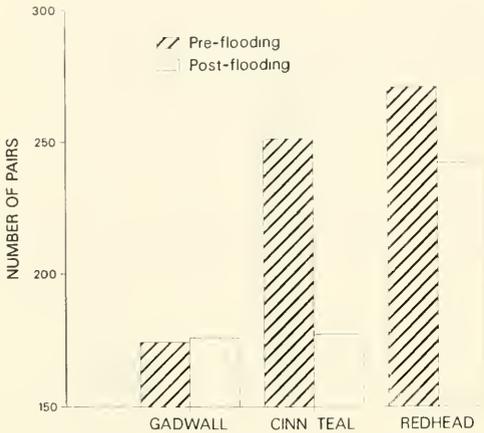


Fig. 2. Mean numbers of indicated breeding pairs of cinnamon teal, gadwalls, and redheads on 10 marshes for each survey year.

The year/flooding interaction reflected a general and significant decrease ( $P = .319$ ) in numbers with time (Fig. 2). The magnitude of decrease correlated well ( $r = .76$ ) with the decreases in continental breeding populations reported by the U.S. Fish and Wildlife Service (1988).

The refuge  $\times$  species  $\times$  flood interaction was significant; for this reason Fisher's least significant difference test was used to find which combinations were significant. Only four combinations were both logical comparisons and significant, and in each case the numbers changed in the downward direction.

Because band data for spring migrants is so scant, most duck movement information is anecdotal, or, as in the case of this study, inferred from relative changes in numbers coincident with discrete events or years. Hard data are not available; therefore, this study attempted to use available descriptive data, general trends, and logic to infer waterfowl movements.

As mentioned earlier, pintails have been shown to assess previously used wetlands as unsuitable, and then continue moving northward out of the region. Although exact settling locations (Johnson 1978) are unknown for displaced ducks, I suspect that ducks continued on past the flooded Great Salt Lake marshes, as do the bulk of the spring migrants. Pre- and postflood numbers of pairs were compared after sorting by species (Fig. 3). Gadwalls

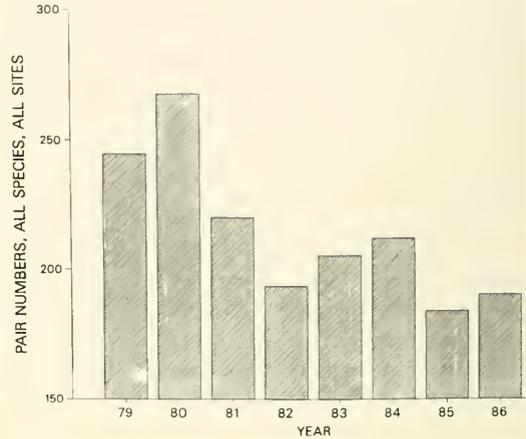


Fig. 3. Mean numbers of indicated breeding pairs of three species of ducks on 10 marshes before and after flooding of Great Salt Lake.

changed little, but cinnamon teal and redhead numbers decreased greatly. Cinnamon teal appear to have responded by moving out of the area. In 1983, concurrent with Great Salt Lake flooding, Canadian Wildlife Service biologists noted unprecedented numbers of cinnamon teal in British Columbia where they are usually uncommon. This probably resulted from long-distance immigration.

It is concluded that waterfowl numbers did not increase significantly on satellite marshes following flooding of the Great Salt Lake marshes; therefore, I reject my hypothesis of local displacement. Given that habitat for 20,000 duck pairs was removed in one season, that ducks are philopatric, and that satellite breeding populations did not increase, it appears that most nesting ducks moved out of the Great Salt Lake region to find suitable nesting habitat elsewhere.

#### ACKNOWLEDGMENTS

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