EFFECTS OF HABITAT DETERIORATION ON BIRD POPULATIONS OF A SMALL UTAH MARSH

By MILTON W. WELLER, BILLY H. WINGFIELD, and JESSOP B. LOW

The effects of changing habitat on the abundance and species composition of populations of waterbirds have often been noticed but seldom measured. Bennett and Hendrickson (1939) presented data indicating an increase in the number of species present in northwest Iowa after drainage. However, their comparative data were weak and the magnitude of the change was uncertain. Marshall (1952) and Evans and Black (1956) reported reduction in waterfowl numbers in potholes due to drought in Minnesota and South Dakota, respectively, and Johnsgard (1956) showed a reduction in waterfowl abundance and changes in species composition as a result of the flooding of potholes in Washington. The present paper reports the effects of grazing and reduced water on a small marsh in Utah. Populations and productivity of the Knudson Marsh were studied by Wingfield in 1950 (Wingfield and Low, 1955). After several years of reduced water supply because of increasing irrigation demands and reduced rainfall, populations were studied in 1955 by Weller. Low maintained observations during the intervening years and in 1956. During the course of this study, financial assistance was received from the Delta Waterfowl Research Station, the Wildlife Management Institute, and the Missouri and Utah Cooperative Wildlife Research units.

DESCRIPTION OF THE AREA

The Knudson Marsh is four miles west of Brigham, Utah, in the alkaline silt flats at the mouth of the Bear River, in Great Salt Lake Valley. It is privately owned and lies one and one-half miles from Unit 5 of the Bear River Migratory Bird Refuge and one mile from the nearest house and road. The marsh contains approximately 250 acres and is divided into two units connected by several channels. The lower section is smaller and contains relatively little vegetation for nesting; only the upper section is considered in detail in this paper. The upper marsh consists of 174 acres: 120 acres of vegetation and 54 acres of water. Fresh-water plants dominate because of leaching of the saline soil by fresh water from the nearby Wasatch Mountains (Nelson, 1954). Important plant species (names from Holmgren, 1948) and their percentage of the total vegetation in 1950 were: hardstem bulrush (*Scirpus acutus*), 56 per cent, Olney's bulrush (*Scirpus olneyi*), 24 per cent, cat-tail (*Typha latifolia*), 12 per cent, saltgrass (*Distichlis stricta*), 7 per cent, alkali bulrush (*Scirpus paludosus*), 1 per cent, and cane (*Phragmites communis*), trace.

Channels of water surround and dissect the marsh and many small and large bodies of water are scattered throughout the vegetation. During years of normal rainfall, the speed of mountain run-off is reduced by an irrigation dam in the mountains, and water fluctuation in the marsh is not usually severe. Fluctuations occurred chiefly following rains; a maximum rise of three inches was recorded in one 24-hour period in 1955. The water level of the marsh is partly regulated by natural topography and partly by a low, earthen dam constructed by the owners to improve the marsh. However, diversion of water for irrigation in recent years has reduced the size of the marsh. Water levels fell gradually throughout the season in both 1950 and 1955.

The sparse vegetation of the surrounding mud flats is principally saltgrass, glasswort (*Salicornia rubra* and *S. pacifica*), and greasewood (*Sarcobatus vermiculatus*). The saltgrass was heavily grazed by cattle.

BIRDS OF THE MARSH

Table 1 shows the species and abundance of common birds nesting in the upper marsh during 1950 and 1955. In addition, the Long-billed Marsh Wren (*Telmatodytes palustris*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), and Redwinged Blackbird (*Agelaius phoeniceus*), which nested in the marsh in 1950, were found in abundance only in the lower section in 1955, because of the reduction of high and dense emergents in the upper marsh. The following species nested on the flats surrounding the marsh: Snowy Plover (*Charadrius alexandrinus*), Long-billed Curlew (*Numenius americanus*), Avocet (*Recurvirostra americana*), Black-necked Stilt (*Himantopus mexicanus*), Wilson's Phalarope (*Steganopus tricolor*), and Black-billed Magpie (*Pica pica*).

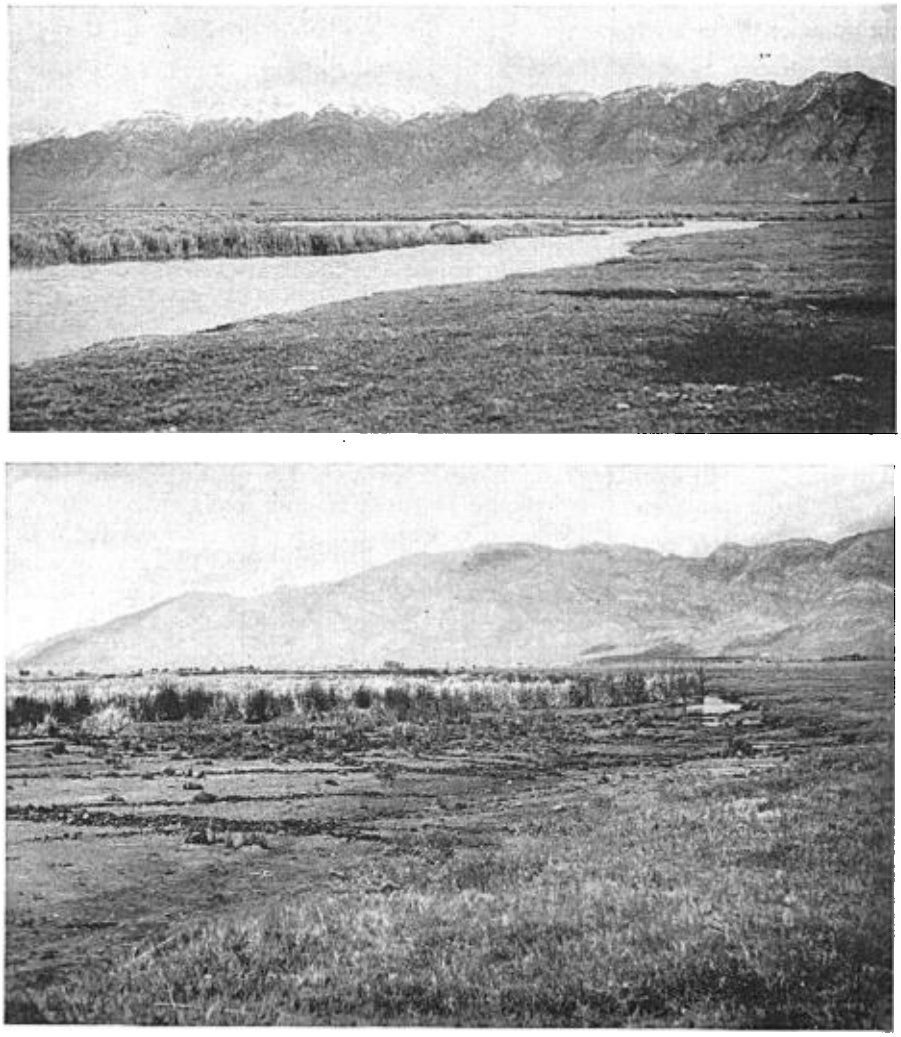

Fig. 1. Above: channel of water between grazed saltgrass flats and marsh on April 29, 1955. Below: the same channel on May 27, 1955, showing cattle trails and marginal growth of Olney bulrush.

Transient or occasional visitors to the marsh were: Eared Grebe (*Podiceps caspicus*), White Pelican (*Pelecanus erythrorhynchos*), Whistling Swan (*Olor columbianus*), Shoveler (*Spatula clypeata*), Common Goldeneye (*Bucephala clangula*), Bufflehead (*Bucephala albeola*), Golden Eagle (*Aquila chrysaëtos*), Peregrine Falcon (*Falco peregrinus*), Common Snipe (*Capella gallinago*), California Gull (*Larus californicus*), Violet-green Swallow (*Tachycineta thalassina*), and Common Raven (*Corvus corax*).

Predatory species were the Peregrine Falcon, which killed White-faced Ibis (*Plegadis chihi*) while the latter were feeding in the marsh, and the California Gull and Black-billed Magpie, which ate duck eggs. Striped skunks (*Mephitis mephitis*) were also present in the marsh, and undoubtedly preyed upon the eggs and young of marsh birds. The California Gulls were few in number but were highly efficient in finding nests that had been exposed because of the investigators' presence. Magpies were most destructive late in the summer when family groups entered the marsh and moved around through the vegetation, apparently in search of eggs.

HABITAT CHANGES

In April, 1950, water in the marsh vegetation was one to 12 inches deep. Most duck nests were constructed over water one to six inches deep. In late May and early June, the northern portion of the marsh, where the vegetation was chiefly Olney's bulrush, dried up. However, the channels and pools remained full. Hardstem bulrush was six to 12 inches tall by late April and reached a height of six to ten feet over the entire marsh by mid-June. This plant was so dense that walking through it was nearly impossible.

Three adverse conditions operated to reduce water levels in the Knudson Marsh: first, due to natural deepening of the water channel entering the Bear River Refuge, less water was pushed into the channel entering the Knudson Marsh; second, increasing demands for irrigation water decreased the total water available for the marsh; and third, lower than normal rainfall was recorded over the period of study. The average annual rainfall data for Utah show that rainfall was below normal in 1952, 1953, and 1954.

By 1955, the marsh was strikingly different from its lush condition in 1950. In late April, almost no vegetation was standing in water and only the channels and potholes were full. Patches of saltgrass, which had been flooded with six to 12 inches of water in the early spring of 1950, were merely soggy in 1955. Virtually no duck nests were constructed over water as is shown by the following comparison of the depth of water at the bases of the nests of the Redhead (*Aythya americana*) in 1950 and 1955.

	1950	*1955*
No water	29	41
1–3 inches	73	1
4–6 inches	17	0
7–13 inches	3	0
Total nests	122	42

By the end of May, water in the shallower channels had dried up (fig. 1) and by early July, even the main body of open water had receded (fig. 2). Lack of water during the growing season seriously affected both the height and density of plant growth. However, no distinct change in plant acreages was apparent as a result of this water shortage. Hardstem bulrush developed more slowly and reached only six inches in height by late April, as opposed to 12 inches in 1950. The maximum height of six feet was reached in late June and this developed only at the edges of pools and channels. Even by mid-July, the new plant growth was insufficient to change the marsh entirely from winter brown

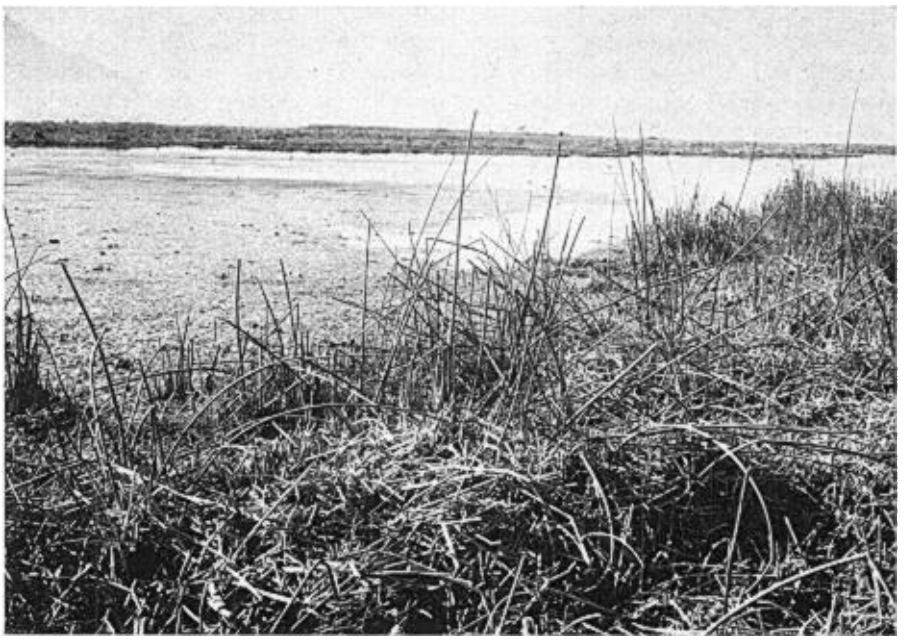

Fig. 2. The main pool of the Knudson Marsh on July 12, 1955. Notice the old and new hardstem bulrush which has been trampled or eaten by cattle.

to green. The effect of cattle grazing on the vegetation was as serious as the lack of water. Cattle rarely entered the marsh in 1950, but their use of the area increased from 1951 to 1955 when the dried-up channels around the marsh edges permitted their entry. By April, 1955, the plant growth of the previous season had been broken up or flattened by cattle. As the channels dried up further, cattle not only entered the marsh but remained there for many days at a time. Old plant growth was trampled and new green bulrush was eaten (fig. 2). Occasionally cattle destroyed duck nests by trampling.

CHANGES IN BIRD POPULATIONS

The reduction in the numbers and species of birds from 1950 to 1955 is shown in table 1. Species which preferred deep water, such as Pied-billed and Western grebes, disappeared. Colonial species, such as Black-crowned Night Herons, egrets, and ibises left the marsh entirely, while Great Blue Herons seriously declined in numbers. One colony of Black-crowned Night Herons was present in the lower marsh but comparative numbers for the entire marsh for the two years are not available. An intensive one-day survey by Low and a crew of 25 men on July 16, 1956, revealed no nests of ibises, egrets, or Black-crowned Night Herons in the upper marsh. Marsh Hawks were seen in the area during the courtship period in 1955 but none nested, probably because the limited grassy areas had been trampled by cattle.

The most extensive data are for ducks and geese, in which there was a 60 per cent decline from 790 nests in 1950 to 324 nests in 1955. Even further declines were indicated in the 1956 survey. The decrease in the abundance of most species of ducks is shown in both pair-counts and in the number of nests found. The Ruddy Duck was the most seriously affected by the lack of water in the upper marsh, declining from 25 nests in 1950 to one nest in 1955. No nest of this species was found in 1956. The number of Canada

Goose nests has been declining for several years. During 1940 and 1941, Cecil S. Williams (*in litt.*) found 146 and 144 nests, respectively. In 1950 only 30 nests were found, while in 1955, approximately 25 were located. The survey in the summer of 1956 revealed the remains of only two nests, one of which was unsuccessful. The Gadwall, a bird of dry land nesting habits, increased slightly from 1950 to 1955.

DISCUSSION

The Knudson Marsh once held a population of birds which few marshes of its size could rival, either in numbers or variety. Most spectacular were the populations of Ana-

Table 1

Nesting Birds of Knudson Marsh, Boulder County, Utah, 1950 and 1955

Species	Number of nests		Per cent of change in number of nests
	1950	1955	
Pied-billed Grebe (*Podilymbus podiceps*)	3 nests	No nests, no birds	—100
Western Grebe (*Aechmophorus occidentalis*)	1 nest	No nests, 1 bird	—100
Great Blue Heron (*Ardea herodias*)	65 nests	5 nests	—92
Snowy Egret (*Leucophoyx thula*)	Colony present, number of nests unknown	None nesting	—100
White-faced Ibis (*Plegadis chihi*)	Colony present, number of nests unknown	None nesting	—100
Black-crowned Night Heron (*Nycticorax nycticorax*)	Colony present, number of nests unknown	None nesting	—100
Canada Goose (*Branta canadensis*)	30 nests (estimated)	25 nests (estimated)	—19
Common Pintail (*Anas acuta*)	16 nests	9 nests	—43
Green-winged Teal (*Anas carolinensis*)	No nests	1 nest	——
Mallard (*Anas platyrhynchos*)	390 nests 450 pairs	171 nests* 125–150 pairs	—56
Gadwall (*Anas strepera*)	6 nests	11 nests	+45
Cinnamon Teal (*Anas cyanoptera*)	172 nests 300 pairs	57 nests 60 pairs	—67
Redhead (*Aythya americana*)	151 nests 500 pairs	49 nests 95 pairs	—68
Ruddy Duck (*Oxyura jamaicensis*)	25 nests 50 pairs	1 nest 2 pairs	—96
Marsh Hawk (*Circus cyaneus*)	2 nests	No nests	—100
Ring-necked Pheasant (*Phasianus colchicus*)	2 nests	2 nests	0
American Coot (*Fulica americana*)	77 nests	40–50 nests (estimated)	—36

* More nests than pairs, due to numerous nesting attempts.

tidae: 6.6 nests per acre of vegetation were found in 1950, and even in 1955 there were 2.7 nests per acre. Few comparable data are available, but Williams and Marshall (1938) found only one nest per acre in a large study area in the famous Bear River Refuge. Thus it appears that only on islands (Hammond and Mann, 1956) are there records of a greater density of duck nests per acre of vegetation than found in the Knudson Marsh. These impressive populations may be attributed to two factors. First, water was well interspersed with vegetation, allowing dispersion of birds into many small scattered water areas with minimal territorial friction. Second, under normal water conditions, the marsh is surrounded by a channel of water 3 to 50 feet wide and 1 to 5 feet deep. Thus, in effect, it is an island-like habitat and predation by skunks occurs only when channels dry up. During years of normal marsh conditions, survival is apparently greater than that on the mainland and a relatively large population results (Hammond and Mann, 1956).

This little marsh is an area of unique importance. Clarence Cottam, formerly Assistant Director of the United States Fish and Wildlife Service, recently stated (*in litt.*): "I regarded the Knudson Marsh as one of the outstanding small marsh areas that I had ever visited . . . ." The deterioration of such a marsh is a great loss to ornithologists and conservationists. Its value lies not only in its productivity of ducks and geese but in its potential as a breeding area for the rarer wading birds.

The decline of one-third in the number of species and two-thirds in the number of birds nesting in the Knudson Marsh represents a loss during a period of only five years, the result of intensive grazing, diversion of water, and short-term drought. The quality of the Knudson Marsh warrants protection from both grazing and adverse water conditions. Similar conditions exist in other small marshes in the Great Basin. The purchase of such critical areas is often impossible, but long-term leases, cattle fencing, and inexpensive water control structures might preserve and maintain their productivity.

SUMMARY

Bird populations of a small Utah marsh were studied intensively during 1950 and 1955. During 1950, the vegetation was lush and held large populations of ducks, geese, and wading birds. Nests of Anatidae were most abundant; 6.6 nests were found per acre of vegetation. Colonies of the Great Blue Heron, Black-crowned Night Heron, Snowy Egret, and White-faced Ibis were present.

Drought conditions prevailed from 1952 through 1955, and irrigation demands reduced water available to the marsh. Deterioration of the vegetation from lack of water and intensive over-grazing by cattle was reflected in the bird populations. Duck populations dropped from 6.6 to 2.7 nests per acre and the colonies of all wading birds except the Great Blue Herons disappeared; the latter declined 92 per cent. Especially significant was the disappearance of deep-water species such as the Pied-billed Grebe, Western Grebe, and Ruddy Duck. Only the Gadwall, a bird of dry land nesting habits, increased slightly.

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