Black Duck pair and brood abundance before and after wetland stabilisation

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Changes in the abundance of Black Duck pairs and broods in four manipulated wetlands and 52 reference wetlands were compared. There was an increase in the number of pairs and broods at manipulated sites following manipulation, while unstabilised sites experienced a decline in bird numbers during the same period. However, there were no significant differences in brood sizes or hatching success either at manipulated or reference sites. The results have implications for current management practices regarding stabilisation processes as a means to increase species abundance.

Key Words: Ducks, habitat, distribution, management implications.

The construction of artificial impoundments is a widely practiced wetland management technique in North America, and managers often cite increased duck densities resulting from augmented recruitment as a reason for undertaking such work. Mendall (1949), suggested the density of breeding Black Ducks *Anas rubripes* can be increased significantly by constructing artificial impoundments, and by controlling water levels of existing natural wetlands. Whitman (1976) reported significant increases of breeding Black Ducks on artificial impoundments. However, Van Horne (1983) cautioned that density may be a misleading indicator of habitat quality, and Kirby (1988) questioned the outcomes of 'stabilising' water levels and artificially impounding wetlands for Black Ducks. He warned that unless a lack of breeding habitat is limiting the population, there is no reason to believe increased recruitment will occur, and suggested that this practice may only change the spatial distribution of breeding birds. Munro (1967) believed the dramatic increases of breeding on new and stabilised wetlands were most probably the result of ingress from a wide area, ie redistribution without an increase in local population numbers.

This study quantifies changes in the abundance of Black Duck pairs and broods during the five year period before and after water level stabilisation at four manipulated wetlands. Changes in abundance were also determined for 52 non-manipulated 'reference' wetlands in a 5km radius around each manipulated site. In addition, hatching success and brood size at fledging were measured. The key objectives were to examine changes in:

(1) the number of pairs and broods at the four manipulated sites

(2) the number of pairs and broods at the reference wetlands after the four sites were stabilised

(3) hatching success and brood size at fledging at the manipulated and reference sites after water level stabilisation.

Study Area and Population

The study sites were within a 750km^2 watershed in Antigonish County in northeastern Nova Scotia (for more details see Seymour & Jackson 1996). Although females nested and raised broods in estuary, lake and river habitats, most used widely dispersed (rarely closer together than 2km) freshwater wetlands in forested habitats. These ranged in size from 0.1 to 5.5 ha, and were typically mesotrophic (Seymour & Jackson 1996). This was true of the four manipulated and 52 reference sites used in this study.

Prior to stabilisation of water levels, the four manipulated sites were covered with dense emergent vegetation. During the brood rearing period only small patches (<0.1 ha) of open water were present, and each year water levels declined until these patches were almost dry. After flooding and stabilisation, these sites increased to an average area of 12, 15, 20 and 25 ha, with several patches of open water (0.1 to 2.0 ha) at each site. There was little change throughout the study in the surface area of water, and in the area or pattern of vegetation at the 52 reference sites.

Methods

Pairs and broods were located at the four manipulated sites and at the 52 reference sites. The latter were the only wetlands available to breeding Black Ducks in a 5km radius around each manipulated site. This distance was arbitrarily chosen and was not biologically significant. There was no spatial overlap of the wetlands associated with any of the manipulated sites. The period of five years before and after manipulation was chosen to increase sample size for statistical analysis. Annual variation in the number of pairs and broods was small and habitat conditions were similar between the five year periods.

Data used in this study were compiled from long term studies of habitat selection (1972-1995), brood movement, fledging success, and territorial behaviour by the senior author. All 56 wetland sites were visited on a five day schedule throughout the breeding season (mid-April to mid-July), between 1985 and 1994. Nineteen intensively monitored sites were visited daily during a study of brood movement and fledging success, between 1986 and 1993. Several females were marked with nasal saddles to facilitate identification (Bartonek & Dane 1964). Females that hatched at least one duckling were considered 'successful' and considered as having a brood.

The carrying capacity of the watershed was estimated by identifying sites that were used by pairs and broods during the five year period prior to this study. These sites were also used by females during some years of the study, and during the five years after the study. Water levels and other environmental conditions at these sites varied little during 20 year study period, and it was therefore assumed that they were potentially available to breeding females throughout that period.

Data were analysed using SPSS software. A χ^2 test of independence was used to investigate changes in the number of pairs or broods at both manipulated and reference sites. Significant tests were performed to investigate changes in brood sizes at manipulated and reference sites.

Results

Average pair densities in the study area (and adjacent watersheds to the east and west) were 1.1 per 10 km^2, and there was rarely more than one pair of Black Ducks at any wetland. Throughout the study, the number of pairs in forested habitat in Antigonish watershed, including those in this study, varied from 37 to 41, and the same annual trends in abundance were evident in all three watersheds (Seymour unpublished data).

There were significantly more pairs (χ^2=27.1, P<0.005) and broods (χ^2=4.5, P <0.05) at the four manipulated sites during the five year period after water levels were stabilised (**Table 1**). In contrast, there were significant declines in pairs and broods during this period at the 52 unmanipulated sites. Overall, there was a increase of 19 (79%) pairs at the four manipulated sites over the five year period. Similarly, brood numbers show an increase of 13 (68%). There was a decline of 14 pairs (7%) and 16 broods (11%) at the 52 non-

Table 1. Total number of Black Duck pairs and broods at four manipulated 52 non-manipulated wetlands, during the five year period before and after water level stabilisation.

Location	Pairs		Broods	
	Before	After	Before	After
Manipulated sites	24	43	19(79.2%)[a]	32(74.4%)
Non-manipulated sites	195	181	148(75.9%)	132(72.9%)
All sites combined	219	224	167(76.3%)	164(73.2%)

[a]Hatching success (ratio of broods to pairs)

manipulated sites during the same period (**Table 1**).

All 52 non-manipulated sites were used by Black Duck pairs at least once during the five year periods before and after water level stabilisation, and females were successful in fledging broods at least once at each site. However, all sites were never occupied in any single year of the study. Hatching success declined after water level manipulation, but the results are not significant at either the manipulated (P>0.65) or non-manipulated sites (P>0.50) (**Table 2**). Fledging success did not differ between manipulated and non-manipulated sites after stabilisation (t=1.14, P=0.25, n.s.). The mean brood size did not differ between manipulated and reference sites after stabilisation (t=0.19, P=0.93, n.s.). This was also true for broods of a small sample of marked females, which provided a complete record of fledging success. Broods were followed from hatching until fledging during the period after manipulation. The mean brood sizes at the non-manipulated sites was 5.14 (2.91 (n=7), and 5.58 (2.87 (n=12) at the manipulated sites. The difference is not significant (Mann-Whitney U=35, P=0.67, n.s.).

Discussion

Williams *et al.* (1999) highlighted the difficulties of attributing increases in bird population to specific conservation oriented initiatives, and whilst Pollard (1998/99) reported an increase in Black Duck pairs/broods after stabilisation of water levels at wetlands in southwestern Nova Scotia, he could only speculate that "redistribution of waterfowl from adjacent forested habitat did not appear to occur". This study also reported increases of Black Duck pairs and broods after water level stabilisation, but there was no net increase across the general area. Although these unique, long-term data do not provide conclusive evidence that re-

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Table 2. Mean Black Duck brood size at fledging at four manipulated wetlands and at 19 intensively monitored non-manipulated wetlands during the five year period before and after water level stabilisation.

Manipulated sites		Non-manipulated Sites	
Before	After	Before	After
5.36, n=11 S.D. 1.12	5.76, n=17 S.D. 2.25	5.25, n=28 S.D. 1.67	5.97, n=31 S.D. 2.55

distribution of Black Duck pairs was occurring, it suggest that this possibility needs further investigation.

Kirby (1988) suggested that the increased reproductive success of females at manipulated wetlands might support the idea that conservation initiatives such a water level stabilisation was enhancing within year recruitment rates. In this study, however, hatching and fledging success did not increase after manipulation, nor were females at manipulated sites more successful than those at non-manipulated sites. Seymour & Jackson (1996), showed that female Black Ducks fledged no more young at nutrient-rich sites than they did at small, widely dispersed, mesotrophic sites, such as those used in this study.

Kirby (1988) proposed that there is a need to demonstrate that a lack of breeding habitat is 'limiting' the population in order to justify management initiatives designed to augment productivity. Wright (1948) and Bartlett (1987) both doubted that breeding Black Ducks occupied all suitable sites available in Atlantic Canadian forested habitats, and Erskine (1987) suggested that there is no evidence that breeding habitat is limiting for Black Ducks in the region. The present study showed that a proportion of the non-manipulated wetlands were unoccupied during each year of the study. It is assumed that these sites were all suitable for breeding Black Ducks, as at least one brood was successfully fledged from all sites before and after manipulation. Seymour (in preparation) estimates that the Antigonish watershed was between 12% and 18% below its 'carrying capacity' for Black Ducks during the period 1978 to 1988.

Enhanced hatching success and brood survival are main goals of the North American Waterfowl Management Plan's Eastern Habitat Joint Venture (Williams *et al.* 1999). This plan is the major source of funding for conservation initiatives such as water level stabilisation at wetlands. However, even if it can be demonstrated that increased production does occur at a manipulated sites, the benefits are probably localised and have little impact on population recruitment in regions and habitats where Black Ducks breed at low densities. If the objective of creating new wetlands or stabilising water levels at existing ones is solely to augment productivity, then accrued benefits are unlikely to justify costs. The present study points to the need for further biological and economic investigation into the value of these and other related conservation initiatives. The long-term effect of water stabilisation on non-avian species and habitats also needs considerable further investigation.

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