Ecological value of restored and engineered wetlands

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Introduction

Kings County is primarily agricultural and there are very few natural wetlands left in this part of the province; most have been constructed by Ducks Unlimited (DU) or by farmers. Wetlands in Kings County receive an abundance of nutrients from soil runoff which increases productivity (Seymour and Jackson 1996). Nonetheless, in 1970, most lakes in Nova Scotia were classified by the Canada Land Inventory as "severely limited for waterfowl production" (Seymour and Jackson 1996). By 1981 the classification changed to "areas may not be useful for waterfowl production but are important as migration or wintering areas" (Environment Canada 1981). If Nova Scotia wants to improve waterfowl productivity, it needs to ensure that its wetlands are being protected, preserved, and maintained in an appropriate manner. A starting point is identifying factors that influence wetland use by waterfowl.

A critical component of waterfowl productivity is duckling survival; it is during the first 12 days of life that ducklings have the highest mortality rate (Hill et al. 1986), and food is an important influence. Generally, ducklings feed solely on invertebrates for their first two weeks of life (Hill et al. 1986), and invertebrates can continue to make up 90% of duckling diets for up to six weeks in American black ducks (*Anas rubripes*) (Staicer et al. 1994).

Aside from food, physical features of wetlands also affect brood success (Staicer et al. 1994). Wetlands with low pH tend to support fewer duck broods and it is thought that this is because low pH decreases invertebrate productivity (Staicer et al. 1994). Because most lakes in Nova Scotia are acidic (Underwood et al. 1986), the general trend appears to be that if an acidic wetland has sufficient vegetation and shallow littoral zones, it supports more broods (Staicer et al. 1994). American black ducks move their broods great distances over land, rivers, and open water to reach suitable rearing sites (Seymour and Jackson 1996). Duck species that move large distances have higher duckling mortality (Hill et al. 1986), and large home ranges might indicate the need to travel longer distances for food. Although predation and environmental factors (e.g., drought) also often stimulate such moves, regardless of the cause, they are often to wetlands rich with invertebrates (Reinecke 1979). It is therefore important to include the area surrounding a wetland when focusing on conservation and/or restoration efforts aimed at improving duck habitat.

Nutrient availability is also a key indicator of whether or not a wetland is suitable for brood-rearing (Seymour and Jackson 1996). An indicator of nutrient availability is the amount of vegetation or the productivity of invertebrates. There is a clear link, therefore, between the concentration of nutrients in soil and water, and invertebrates, which in turn translates into food available for broods.

Wetland age can influence many of the aforementioned variables; in an ecological context, age is an index of how much time has elapsed since a disturbance. A general pattern that emerges from the study of communities is that both density and diversity increase following disturbance, reaches a peak just before climax, and then decrease slightly. Whether this pattern holds for Kings County wetlands remains to be seen.

There has long been debate about human influences on natural habitats. Do we leave a natural pond as it is, or do we manage it to improve its habitat for species such as waterfowl? Stevens et al. (2003) found that there were more waterfowl broods on restored than natural wetlands, and they attributed this usage to well-developed vegetation (for protection; vegetation development may also correlate with wetland age), and greater invertebrate abundance. Interestingly, Staicer et al. (1994) found that the highest brood densities were on wetlands "receiving large anthropogenic inputs of nutrients". Seymour and Jackson (1996) argue that ducks with broods don't necessarily prefer restored over natural wetlands, but that they prefer "manipulated" wetlands. Farm ponds and sewage-treatment ponds are often included in this category because runoff from nutrient-rich fertilizers results in extremely productive invertebrate populations and thus results in an abundance of food for broods (Seymour and Jackson 1996). Restored or manipulated wetlands can have up to 50-100 and 20-35 times more phosphorus and nitrogen, respectively (Staicer et al. 1994). Nutrient-rich wetlands foster invertebrate productivity and thus are used by more ducks rearing broods.

We are comparing invertebrate abundance on wetlands on which we did not observe (broodless ponds) or did observe ducklings (brood ponds) during systematically conducted surveys. We also compared the age of broodless and brood ponds.

Methods

Study Area

The area surveyed included agricultural land between Berwick and Wolfville (45^{o}N/64^{o}W) in Kings County, Nova Scotia, Canada. The field study was conducted between May and August 2010.

DU provided a current list of wetlands they had constructed, with details including GPS co-ordinates, size, date of construction, and segment type. Natural wetlands were also visited, along with other non-DU man-made ponds. A map of the Cornwallis Hydro Watershed was generated by Applied Geomatics Research Group, and used to locate non-DU sites. All wetlands were located adjacent to agricultural fields. We surveyed a total of 20 wetlands in 2010, most of which we also surveyed in 2009. Surveys on these 20 wetlands are continuing in 2011.

Weather and waterfowl surveys

Temperature was estimated based on data from Environment Canada (2010). Wind speed was classified as none, light, moderate, or heavy, and percent cloud cover was estimated to the nearest 10%. If a wetland could be observed from a vehicle, an initial scan for waterfowl was taken before approach. Once this baseline information was recorded, we approached the open water site. Due to the diverse nature of wetlands, surveying approaches were not uniform. On smaller ponds with perimeters that were accessible by foot, we simply walked the perimeter to collect observations. Where parts of the wetland were obscured by tall grasses or peninsulas, we used chest waders to get a more complete view of the wetland.

Invertebrate Sampling

Once waterfowl surveys were complete, we sampled ponds for invertebrates. Samples of invertebrates were sampled using a modified activity trap consisting of a 35-cm long PVC pipe with a 10-cm diameter, and 2-mm mesh funnels at either end, with 1.5-cm openings at the base of each funnel. These traps were designed to sample invertebrates in the top of the water column where dabbling ducks feed. Two traps were supported on a 3.66 m long wooden pole, one attached at the end and another at the midpoint. Two poles ("A" and "B" with two traps each) were deployed a minimum of 16 m apart along the bank or edge of the pond and were left for 48 h before retrieval. Spatially-paired ponds were sampled for the same 48-h period. Following trap retrieval, invertebrates were removed from both the outside and the inside of the trap using tweezers, and placed in a mason jar containing enough10% formalin to cover. Each jar was labelled as either "NEAR" or "FAR" and as either "A" or "B". If traps were muddy, a strainer was used to separate invertebrates. A spray bottle was also used to dislodge invertebrates from traps.

Once invertebrate retrieval was complete, samples were returned to the lab and organisms were sorted by location and by morpho-species. We transferred Mason jar contents to Petri dishes which were then placed under a dissecting scope at 6X or 12X magnification. Using tweezers and probes, organisms were sorted by morpho-species and placed in vials containing 100% ethanol. Each morpho-species was assigned a letter and each wetland site was assigned a number. This letter-number combination was recorded on both a spreadsheet and on each vial and the number of individuals was entered into a spreadsheet accordingly. Once invertebrates have been sorted, they are identified to order and family. This work is still ongoing.

Results

We are still assembling the invertebrate data, and we have hired a student for the summer to process survey data. Thus, we have not completed analyses; by Sep 2011, we will have data from 3 years to assess relationships among wetland characteristics, invertebrates, and waterfowl use.

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