Human–Wildlife Interactions 4(2):202–206, Fall 2010

Selection of pathways to foraging sites in crop fields by flightless Canada geese

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***Abstract*:** Geese, especially when they are flightless, can cause significant crop damage. We determined the effects of shoreline characteristics on foraging site selection by flightless Canada geese (*Branta canadensis*) in South Dakota. Distance from edge of crop field to wetland and visual obstruction by vegetation were important determinants of pathway selection by geese. Geese used crop fields for foraging that were closer to water than unused fields. Geese accessed those fields along pathways with less visual obstruction by vegetation than unused pathways. Our data suggest that this distance of crops to wetlands is the most important shoreline characteristic determining where flightless geese cause crop damage.

Key words: *Branta canadensis*, crop damage, distance, forage, geese, human–wildlife conflicts, molt, predation risk, South Dakota, visual obstruction

CANADA GEESE (*BRANTA CANADENSIS*) are considered a nuisance in many urban and rural settings and are causing ecological and economic damage in the northern hemisphere (Conover and Chasko 1985, Ankney 1996). In urban areas, geese forage and loaf on beaches, golf courses, parks, and lawns, often damaging lawns and leaving behind fecal material (Conover and Chasko 1985, Conover 1991). In agricultural areas, geese can cause crop damage. Much of this damage occurs during summer when adult geese are molting and goslings have not yet attained flight capabilities. Thus, all birds are flightless. Because of this, geese have limited mobility and show a preference for foraging near their molting wetland (Giroux et al. 1984, Fox et al. 1998, Fox and Kahlert 2000). Foraging near water is a common trend among many species of flightless geese (Giroux et al. 1984, Buchsbaum and Valiela 1987, Madsen and Mortensen 1987, Laing and Raveling 1993).

To date, most research on flightless goose foraging has focused on the sites that geese select for foraging and the causes of that selection, and little research is being done on the importance of pathways geese use to access those sites. Characteristics of pathways between wetlands and foraging sites may strongly influence foraging site selection. Understanding how characteristics of potential pathways affect foraging site selection may be especially important in areas where geese cause crop damage and where effective abatement techniques are needed. For example, strips of alfalfa planted around wetland borders to provide a barrier between crop fields and wetlands have deterred geese from accessing crops (Flann 1999). It is believed that these strips create unfavorable pathways to crops for 2 reasons: limited visibility of potential predators (Owen 1975) and additional travel distance (the width of the strip) through the alfalfa to access crops. These strips were 12 m wide and were successful at stopping most, but not all, geese from accessing crops. Where geese accessed crops, there was significantly lower visual obstruction by vegetation than the rest of the barrier. Flann (1999) suggested that visual obstruction is a more important factor than travel distance in determining pathways geese select through vegetation to access crops. Slope has also been suggested to be an important characteristic, with geese selecting gentle slopes over steep slopes (Schaible et al. 2005). However, this assertion has not been evaluated.

Predation risk, food quantity, and food quality influence foraging patterns of flightless geese (Buchsbaum and Valiela 1987, Madsen and Mortensen 1987, Fox and Kahlert 2000). We studied foraging patterns in an agricultural environment with highly-preferred food.

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Because the food in all the foraging sites was essentially the same (soybeans), selection of sites should be determined by factors other than food availability and quality. We determine how shoreline characteristics between soybeans and wetlands affect foraging site selection and the relative importance of those characteristics. We evaluated 3 characteristics expected to affect goose pathway selection to soybean fields. Predation risk is implicated in all three. Distance of crop field to water will determine how quickly geese can reach the safety of water to escape predation. Visual obstruction by vegetation and ground slope may affect detection of predators. We expected geese to choose pathways that had less visual obstruction by vegetation, less slope, and shorter distances between wetlands and soybean fields than unused pathways. Knowledge of what shoreline characteristics geese avoid traveling through may allow agricultural producers and managers to create those characteristics, thus, reducing crop damage.

Study area

We worked in the Prairie Pothole Region of eastern South Dakota, USA. The Prairie Pothole Region contains many small depressions left behind by retreating glaciers. Much of the land surrounding these wetlands was in crop production, with soybeans, corn, and wheat being the most common crops. Our study focused only on the selection of pathways to soybean fields.

Methods

We evaluated shoreline characteristics between soybean fields and wetlands to identify their importance in determining Canada goose foraging site selection. We used wetlands for which soybean damage had been reported to the South Dakota Game, Fish, and Parks Department. We selected for our study all wetlands that were bordered by damaged soybeans and undamaged (but available to geese) soybeans of the same crop field that were located at least 50 m away from damaged soybeans. Fifteen wetlands met these criteria, all of which were far enough apart (>4 km) to be considered independent from each other. We collected all data on shorelines between the edge of the wetland and the edge of the soybean field. We considered the edge of the wetland to be the edge of standing water. The characteristics measured were (1) distance between wetland and crop, (2) visual obstruction of vegetation, and (3) percentage of slope. We took measurements on pathways to both used and unused soybean foraging sites of the same water body. Evidence of goose foraging on soybeans was obvious, and it was easy to distinguish between damaged and undamaged sites. Damaged areas always coincided with goose feces and had pathways leading to them from water. Areas considered undamaged had no goose feces and no evidence of foraging by geese. Measurements at used sites were taken along pathways that geese used to access crops. We took measurements near unused sites at random locations where soybeans bordered the same wetland but no goose damage had occurred. Although no geese had accessed soybeans at unused sites, we still use the term pathway to refer to the potential route between crops and water at that location. Random sites sampled were 50 m away from any damaged soybeans or any previously sampled random site. We took measurements from June through August 2006 and attempted to take them as early in the growing season as possible to accurately measure the characteristics of pathways initially chosen by geese.

We took visual obstruction readings halfway between the wetland and crops using a cover pole with intervals marked every 2.5 cm (Robel et al. 1970). We placed the cover pole at a distance of 4 m in each of the 4 cardinal directions and took readings from a height of 0.75 m, the approximate height of an adult goose. We noted the lowest interval on the pole that was not completely obscured by vegetation. We then recorded the distance from the ground to the bottom of that interval. We averaged the 4 readings for that point for analysis. We measured percentage of slope using a clinometer (Suunto, Ogden, Ut.). We took readings from the edge of the soybean field to the edge of standing water of the wetland. Additionally, we recorded the percentage of slope on any portion of a pathway at least 1 m in length that had a slope >45%. This was done to identify pathways that may have been too steep for flightless geese to traverse.

We measured distance from standing water

to crops. Although some of the pathways used by geese did not form a straight path between the wetland and the crops, we measured the distance linearly to be consistent with measurements taken at the unused sites.

If crop fields around a wetland had multiple-damaged areas or a single-damaged area with multiple goose trails leading to it, we took multiple readings (up to three), one along each available pathways. When many pathways existed, we measured the 3 pathways that appeared to be visited by geese most often, as evidenced by more goose feces. We also sampled up to 3 pathways at each unused site. We averaged the values of used and unused sites for each wetland. Each wetland then represented a sampling unit with 1 pair of values for each of the 3 variables. We analyzed the 3 pairs of values with paired *t*-tests (JMP statistical software, SAS Institute, Cary, N.C.) to test for differences in shoreline characteristics between used and unused sites of the same field.

Results

Geese used foraging sites that were closer to standing water than other sites (t_{14} = 5.36, $P < 0.001$; for used sites, 11.6 ± 1.7 m [$\bar{x}$ ± SE throughout]; for unused sites, 23.8 ± 3.3 m). The longest recorded distance that geese traveled from water to reach soybeans was 36 m. Geese also selected pathways to soybeans (18.5 ± 3.5 cm) with lower visual obstruction by vegetation (t_{14} = -3.16, P = 0.007) than random, unused pathways (32.9 ± 3.6 cm). Shoreline slope had no effect (t_{14} = 0.33, P = 0.75) on selection of pathway (for used sites, 11.1% ± 1.2%, for unused sites, 10.4 ± 2.1%). We measured only 2 pathway portions that had slopes >45%. On 1 wetland, geese readily used a pathway that had a slope of up to 54% along a 1.5-m portion of it. We measured the other portion on an unused pathway; it had a slope of 64% along approximately 2 m, which appeared too steep for geese to use.

Discussion

Distance to water appeared to be the most important shoreline characteristic, with geese selecting pathways to foraging sites that were closer to water than those of unused sites on every wetland sampled. Geese typically chose pathways with lower visual obstruction. But the visual obstruction was actually greater at used pathways than at unused pathways on three of the 15 wetlands. On these 3 wetlands, geese had a choice between a pathway a short distance away but with high visual obstruction versus one with a longer distance, but with a lower visual obstruction. Geese always chose the pathway with the shortest distance regardless of visual obstruction, suggesting that distance is the primary characteristic that flightless geese used in determining where to access soybeans. This is contrary to Flann (1999), who suspected that visual obstruction was more important than distance. While visibility was important, our results suggest that it was secondary to distance. It has been suggested that geese prefer to access soybeans where shoreline slope was lowest, making travel easier (Schaible et al. 2005). We found slope to be unimportant unless it was so great that geese were physically unable to traverse it. Although very steep slopes can hinder or stop geese from using some areas, they rarely limited movements of geese in this study.

The trend of foraging near water has been shown to be common in many species of molting geese throughout the world (Giroux et al. 1984, Buchsbaum and Valiela 1987, Madsen and Mortensen 1987, Laing and Raveling 1993). Evidence suggests that predation risk is more important than food quantity or quality for causing this pattern. During the molt, geese are sensitive to predators or other stimuli (Madsen and Mortensen 1987, Kotrschal et al. 1992, Kahlert et al. 1996, Kahlert 2003), likely because flight, the most effective escape, is not possible (Kahlert 2006). Foxes were known to prey on geese (Madsen and Mortensen 1987), and flightless geese either avoided areas of preferred food when predators are present (Loonen et al. 1997, Stahl and Loonen 1998) or began feeding at night presumably in response to predators (Kahlert et al. 1996). Goose preference for foraging where visibility is great has also been shown previously (Owen 1975) and is likely important for early detection of predators.

We suggest that predation risk is an important mechanism causing the foraging pattern commonly observed in flightless geese. In the absence of predation risk, geese would still be expected to forage near a wetland

simply from an energetics standpoint. Yet, if energetics were more important, we might also expect to see geese avoid steep slopes, which they did not. High susceptibility to predator-like stimuli is advantageous for geese because it lowers the probability of predation; but, it is disadvantageous because of the costs of abandoning foraging and the costs associated with locomotion. However, if sufficient high-quality forage exists, geese may have ample time to make up for energy lost due to displacement. Because of the abundant high-quality forage available to geese in this study, predation risk should have a strong influence on goose foraging site selection (Lima and Dill 1990). We suspect that high selectivity by geese for foraging on soybeans nearest to water and for pathways with greater visibility is due primarily to perceived predation risk.

Management implications

Buffer strips of vegetation can be planted around the edge of a wetland between water and crops to deter geese from accessing crops. Ideally, the vegetation should be of sufficient height and density to obstruct the vision of adult geese. However, the width of the buffer strip may have a greater effect on its ability to deter geese than its height and density. The longest distance we recorded geese traveling on land to reach soybeans was 36 m, suggesting that buffer strips may need to be at least 36-m wide to sufficiently deter geese. However, the required width of a buffer strip in agricultural areas may be relative to the distance geese need to travel to access soybeans on other locally available fields. Because geese choose soybeans that are closer to water, a field will not likely be damaged unless its crops are closer to water than other crops that border the same wetland. Planting crops farther from water is likely to reduce goose damage by flightless geese.

Acknowledgments

Funding for this research was provided by the South Dakota Department of Game, Fish and Parks, South Dakota State University, and the Federal Aid to Wildlife Restoration Fund (Project W75-R Amendment # 161) administered by the South Dakota Game, Fish and Parks. We thank South Dakota Game, Fish and Parks personnel S. Bork and L. Vandestroet for assistance throughout the project and N. Dieter for field assistance. B. D. Pinno, J. P. Severson, and S. D. Wilson provided valuable editing for this manuscript.

Literature cited

Ankney, C. D. 1996. An embarrassment of riches: too many geese. Journal of Wildlife Management 60:217–223.

Buchsbaum, R., and I. Valiela. 1987. Variability in the chemistry of estuarine plants and its effect on feeding by Canada geese. Oecologia 73:146–153.

Conover, M. R. 1991. Herbivory by Canada geese: diet selection and effect on lawns. Ecological Applications 1:231–236.

Conover, M. R., and G. G. Chasko. 1985. Nuisance Canada goose problems in the eastern United States. Wildlife Society Bulletin 13:228–233.

Flann, C. J. 1999. Flightless giant Canada goose depredation abatement and digestibility of selected crops in South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Fox, A. D., and J. Kahlert. 2000. Do moulting greylag geese (*Anser anser*) forage in proximity to water in response to food availability and/or quality? Bird Study 47:266–274.

Fox, A. D., J. Kahlert, and H. Ettrup. 1998. Diet and habitat use of moulting Greylag geese (*Anser anser)* on the Danish island of Saltholm. Ibis 140:676–683.

Giroux, J. F., Y. Bédard, and J. Bédard. 1984. Habitat use by greater snow geese during the brood-rearing period. Arctic 37:155–160.

Heinrich, J. W., and S. R. Craven. 1990. Evaluation of three damage abatement techniques for Canada geese. Wildlife Society Bulletin 18:405–410.

Hogan, E. P. 1991. The geography of South Dakota. Center for Western Studies, Sioux Falls, South Dakota, USA.

Hughes, R. J., G. Gauthier, and A. Reed. 1994. Summer habitat use and behaviour of greater snow geese (*Anser caerulescens*). Wildfowl 45:49–64.

Kahlert, J. 2003. The constraint on habitat use in wing-moulting greylag geese (*Anser anser*) caused by anti-predator displacements. Ibis 145:E45–E52.

Kahlert, J. 2006. Factors affecting escape behaviour in moulting greylag geese (*Anser anser*). Journal of Ornithology 147:569–577.

Kahlert, J., A. D. Fox, and H. Ettrup. 1996. Nocturnal feeding in moulting greylag geese (*Anser anser*)—an anti-predator response? Ardea 84:15–22.

Kotrschal, K., J. Hemetsgerber, and J. Dittami. 1992. Vigilance in a flock of semi-tame greylag geese (*Anser anser)* in response to approaching eagles (*Haliaceetus albicilla* and *Aquila chrysaetos*). Wildfowl 43:215–219.

Laing, K. K., and D. G. Raveling. 1993. Habitat and food selection by emperor goose goslings. Condor 95:879–888.

Lima, S. L., and L. M. Dill. 1990. Behavioral decisions made under the risk of predation: a review and prospectus. Canadian Journal of Zoology 68:619–640.

Loonen, M. J. J. E., K. Oosterbeek, and R. H. Drent. 1997. Variation in growth of young and adult size in barnacle geese (*Branta leucopsis*): evidence for density dependence. Ardea 85:177–192.

Madsen, J., and C. E. Mortensen. 1987. Habitat exploitation and interspecific competition of moulting geese in east Greenland. Ibis 129:25–44.

Owen, M. 1975. Cutting and fertilizing grassland for winter goose management. Journal of Wildlife Management 39:163–167.

Radtke, T. M. 2008. Crop damage by resident Canada geese in eastern South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Robel, R. J., J. N. Briggs, A. D. Dayton, and L. C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Rangeland Management 23:295–297.

Schaible, D., C. D. Dieter, R. Losco, and P. Mammenga. 2005. Quantifying crop damage by giant Canada geese in Day County, South Dakota, 2003. Proceedings of the South Dakota Academy of Science 84:259–264.

Stahl, J., and M. J. J. E. Loonen. 1998. Effects of predation risk on site selection of barnacle geese during brood rearing. Pages 91–98 *in* Research on Arctic geese. Proceedings of the Svalbard goose symposium, Oslo, Norway.

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