METHODS TO MEASURE GEESE IMPACTS ON GRASS SEED PRODUCTION

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Introduction

Conservation programs have resulted in an increase of Canada goose (*Branta canadensis*) wintering and resident populations in the lower Columbia River and Willamette River Valleys of southwest Washington and western Oregon. The increase has been from approximately 20,000 to 25,000 in the 1970s, historical average, to over 225,000 by 1996 (Oregon Department of Fish and Wildlife, 1998).

From autumn to spring, geese prefer to eat wheat (*Triticum aestivum*), peas (*Pisum* sp.), clover (*Trifolium* sp.), corn (*Zea mays*), grass seed, and other farm crops. Substantial crop damage has been reported by farmers and the Oregon Department of Agriculture (Oregon Department of Agriculture, 1998).

Results of several studies differ on the extent and impact of geese foraging on wheat and other crops. Clark and Jarvis (1978) suggested that goose grazing did not adversely impact production of annual ryegrass (*Lolium multiflorum*) seeds in the Willamette Valley, Oregon. However, in other studies, geese have reduced yields of winter wheat in relation to intensity of grazing (Allen et al., 1985; Flegler et al., 1987) and to timing of grazing (Kahl and Samson, 1984).

Significant yield losses in grass and cereal crops have been reported at a wide range of grazing levels by geese (Patterson, 1991). However, estimating loss of yield at specific levels of grazing was difficult. Patterson (1991) suggested that exclosures should be used to measure actual yield losses.

Recent technologies such as Geographical Information Systems (GIS) and Global Positioning Systems (GPS) provide new opportunities to more accurately measure crop yields and damage caused by wildlife or other factors. GIS has the ability to spatially interrelate multiple files or data layers once the layers are in geographic registration (Lillesand and Kiefer, 1994). With GPS we can accurately determine the position of every sample point. Combining these technologies provides visual representations of changes through time (Anderson, 1996) and provides the tools necessary to create yield maps.

During 1996 through 1998 we conducted a preliminary study on winter wheat to develop methods to document when and where geese were grazing on the test fields and to measure the impact of goose grazing on crop yields. A combination of methods proved effective for documenting goose grazing activity and measuring the impacts of grazing on wheat yields. Our methods included:

1. We constructed exclosures with poultry wire and electric fence posts to keep geese from entering small areas scattered throughout the test fields. These areas served as controls that provided the basis for knowing wheat production without goose grazing impacts. The exclosures were large enough for a commercial-size combine to harvest through them.

2. We took aerial photographs through the growing season to see plant cover differences within the fields. Cover differences were generally due to goose grazing impacts, but were also due to soil differences and to standing water.

3. We used ground-level photography and data collection to serve as ground truth verification for causes of the cover differences seen in the aerial photographs.

4. We used a yield-mapping-system equipped combine to record wheat yields throughout the field.

Our results demonstrated that grazing by geese impacts wheat yields (Louhaichi, 1999). Yield reductions were as high as approximately 25% for areas of fields heavily grazed in April, before geese departed for the summer. Lower levels of yield reductions were measured for less intensive grazing or earlier grazing. We recorded specific instances where yields increased, apparently due to goose grazing. We were able to measure impacts on yields for whole fields and for portions of fields subjected to different timing and intensity of grazing by geese.

During September 1999, we initiated a subsequent study to evaluate the methods we developed for wheat for their suitability for use on grass seed fields. Our objectives are to:

1. Identify timing (both season and frequency) and intensity of goose use of selected grass seed fields.

2. Develop reliable methods that farmers can use (or contract out) to document the impact on yield.

3. Provide an estimate of goose impact on grass seed yield on specific fields during the research period.

Timing of plant growth and maturity and harvest procedures are different between wheat and grass seed production. Those differences are likely to require modifications of methods developed for wheat.

Methods

1. Goose-proof exclosures paired with naturally grazed plots are concentrated in parts of the fields in which heavy grazing is anticipated. Others are located in areas anticipated to have moderate to light grazing. Exclosures serve as controls. They have to be large enough to avoid edge effects and to allow a commercial combine to harvest through them.

2. Ground photos are taken from a camera mounted on a frame constructed to place the camera directly above, and at a given height from, ground level. Ground photos and associated data (e.g. goose droppings, plant height, category of grazing intensity, etc.) serve as ground-truth verification of cause of reduced yield where it occurs.

3. Aerial photos taken of entire fields to show grass cover differences within fields at field scale. Ground-truth photographs verify cause of cover differences.

4. Combines equipped with precision-farming, yield-mapping systems (John Deere GreenStar Precision Farming System or its equivalent) to map yields adjacent to and including the goose-impacted portions of the field(s).

Progress

We are cooperating with a mid-Willamette Valley farm, which has provided fields subject to goose grazing pressure for use in the project. During September and October 1999, we selected three tall fescue and two perennial ryegrass fields for the study. Of the three tall fescue fields, one was a new seeding, one was a second year seeding that had been intensively grazed during its first year, and the third was an established field which has been consistently subject to heavy grazing pressure. Of the two perennial ryegrass fields, one was newly seeded and the other was an established field, part of which has been consistently subject to heavy grazing pressure. We established 20 x 65-feet exclosures in all fields. A total of 48 exclosures were installed, numbers per field varied by field size.

We conducted ground-level photography and data collection along transects within each field during December 1999 and March and April 2000. We took aerial photographs from a camera mounted on a fixed-wing aircraft during December, January, March and April, while geese were present, and during July, between swathing and combining of the grass seed. In the newly seeded fields, grass had not yet grown sufficiently to show in the aerial photographs until March.

Crops were swathed beginning in early July and continuing through most of the month. Combining commenced during mid-July and continued through early August on the fields we were using. Each exclosure had one or two swaths through it. Depending on the field and crop, five to nine combines operated in a field. Of those, four were equipped with yield-mapping systems. Two of those were GreenStar® systems and two were AgLeader® systems. We encountered data recording and reporting differences between the GreenStar® and AgLeader® systems.

For the 2000-2001 field season, we returned to three of the five fields we used the previous year. The other two were only slightly used and will be of little benefit in terms of methods development unless they receive heavier use this year. We added one established tall fescue field that was heavily used last year and one newly-seeded tall fescue field. We erected exclosures in all 2000-2001 fields. Number of exclosures per field varies by size of field. We placed exclosures in the same locations as last year on the fields we used last year. In March we will add additional exclosures in areas that have been grazed to enable us to better evaluate early season grazing.

In addition to techniques we used during Phase I on wheat, we are attempting to automate data collection and analysis. If we are successful, we will have better ground coverage of the fields and we will be able to more quickly analyze and interpret data.

Preliminary Results and Discussion

In the preliminary study on wheat, we used a single combine equipped with a yield-mapping system. The analysis was fairly straightforward. In this study, we are using four combines and two different yield-mapping systems. We have machine-to-machine and system-to-system variability to consider in statistical analysis. We are still working at identifying the most appropriate analysis for the type of sampling involved with this study. Initial, very preliminary, data analysis for a portion of the newly seeded perennial ryegrass field indicates that grazing by geese in April reduced seed yield by 11 to 27%. Because we are still refining our analysis procedures, these numbers are subject to change.

Calibration of the yield-mapping system is an important process for reducing system-to-system and machine-to-machine variability.

References

Allen, H.A.Jr., D. Samsons, R. Brinsfield, and R. Limpert. 1985. The effects of Canada goose grazing: an experimental approach. Proceedings of the Eastern Wildlife Damage Control Conference 2:135-141. Wildlife Review 206.

Anderson, G. 1996. The application of spatial technologies for rangeland research and management: state of the art. Geocarto International 11:5-11.

Clark, S.L., and R.L. Jarvis. 1978. Effects of winter grazing by geese on yield of ryegrass seed. Wildlife Society Bulletin 6:84-87.

Flegler, J.E. Jr., H.H. Prince, and W.C. Johnson.1987. Effects of grazing by Canada geese on winter wheat yield. Wildlife Society Bulletin 15:402-405.

Kahl, B.R., and F.B. Samson. 1984. Factors affecting yield of winter wheat grazed by geese. Wildlife Society Bulletin 12: 256-262.

Lillesand, M.T., and W.R. Kiefer. 1994. Remote Sensing and Image Interpretation. John Wiley & Sons, Inc. New York.

Louhaichi, M. 1999. Assessment of Impacts of Canada Geese on Wheat Production. M.S. Thesis, Oregon State University, Corvallis, OR. 104 p.

Oregon Department of Agriculture. 1998. Wildlife Damage to Oregon Agriculture, 1997 Survey Summary. Oregon

Department of Agriculture, Animal Health Division, 635 Capitol Street, Salem, OR 97301-2532. December 1998.

Oregon Department of Fish and Wildlife. 1998. Oregon's Access & Habitat Board News, Fall 1998. Vol. 3, No. 4.

Patterson, I.J. 1991. Conflict between geese and agriculture: does goose grazing cause damage to crops? Ardea 79:179-186.