Natural Resources Canada | Ressources naturelles Canada

Bulletin 74

FRONTLINE EXPRESS

Canadian Forest Service – Great Lakes Forestry Centre

Forest bird populations and spruce budworm outbreaks

INTRODUCTION

Birds are an integral part of Canadian forests and fulfill numerous ecological roles, such as pollinating plants, spreading seeds and feeding on insect pests. Their presence reflects the sustainability of the forest and they are an important component of biodiversity. Over 450 species of birds are known to live in Canadian forests and half of these species use the boreal forest for food and breeding habitat.

Spruce budworm

Spruce budworm (*Choristoneura fumiferana* Clemens) is North America's most damaging native forest insect pest and periodic outbreaks have been part of the ecology of spruce-fir forests for centuries, typically occurring every 25-40 years. The area of defoliation at the peak of an outbreak can be extremely high. In 1975 for example, close to 52 million ha were defoliated. At the height of outbreaks, a highly abundant food source becomes available for insectivorous birds. However after repeated defoliation, widespread tree mortality occurs, which affects forest composition and alters bird habitat. This may lead to changes in the bird population and species diversity. An understanding of the relationship between spruce budworm outbreaks and bird populations is useful for predicting the long-term effects of these wide scale disturbances on birds. It will also help ensure that provision of bird habitat is taken into account during forest management planning.

GREAT LAKES FORESTRY CENTRE (GLFC) ROLE

Lisa Venier and Steve Holmes are research scientists with the Ecosystems Impacts group at GLFC. They work to ensure that the science guiding forest management and the provision of bird habitat remains current. One aspect of their research has been to study the relationship between bird populations and spruce budworm outbreaks to better understand the ecological changes that ensue. This work has involved field observations in their research study plots as well an examination of previous bird studies dating back as far as 1947. Examining historical data is particularly important in the case of spruce budworm, due to the length of time between outbreaks. It appears that a new cycle is just beginning - 1.5 million ha were defoliated across Canada in 2010, up from one million ha in the previous two years - making this research particularly timely.

Response of bird populations to budworm outbreaks

Birds respond to a budworm outbreak directly by taking advantage of the abundant food source; they feed mostly on fifth and sixth instar larvae of budworm as well as pupae. They may also respond indirectly by adapting to the change in habitat as a result of defoliation and tree mortality. An examination of various studies across eastern Canada and the US indicates that there is a broad response by the bird community to budworm infestations, with at least 30 species showing evidence of being linked to the outbreaks.

An analysis of studies in the boreal forest of Northern Ontario indicates that three bird species in particular are budworm-linked, meaning that they respond more consistently and strongly than other species to the presence of budworm. They are able to take advantage of the increase in food supply and increase their densities significantly (4-12 fold) by increasing their number of chicks. These species are the bay-breasted, Tennessee and Cape May warblers. Another group of species consumes significant amounts of larvae when budworm levels are low but do not appear to increase in number during outbreak conditions. These include the red-breasted nuthatch, white-throated sparrow, Nashville warbler and black-capped chickadee.

The studies examined showed that the total number of birds increases where outbreaks occur. For example, on a 40-ha area near Black Sturgeon Lake (160 km north east of Thunder Bay, Ontario) bird densities were 123 pairs during a non-outbreak period (1966-1968) and much higher near the peak of outbreaks (319 pairs in 1947 and 638 pairs in 1983). Similarly, in plots near Manitouwadge, Ontario, bird densities increased from 156 to 329 pairs in a 40-ha area over the span of four years as a budworm outbreak progressed (1979-1983).

Species richness also increased, with the number of species increasing from 50 to 60. This is due partly to the ability of some species to change their feeding behaviour, allowing birds to take advantage of the increase in budworm larvae, either by changing their pattern of foraging or increasing the proportion of budworm larvae in their diet. As many as 14 species have been observed foraging in unusual ways to feed on budworm larvae.

Other researchers have observed changes in populations of bird species related to altered habitat following budworm outbreaks. Species that prefer more open habitats for example, such as least flycatchers and white-throated sparrows, were abundant in stands that had high tree mortality, while boreal chickadees, a species that requires suitable cavity trees, were less abundant.

Control of budworm outbreaks

Researchers have considered whether the increased number of birds feeding on budworm larvae could actually be a mechanism to control the population. However, for birds to have such an effect, they would have to consume an increasing amount of larvae as the intensity of an outbreak increased, whether through more birds moving into an area or birds changing their diet to feed more on budworm. It appears that when budworm populations are at high densities, bird predation does not have a significant influence. At endemic levels, it seems that the feeding pattern of birds may influence the average level of budworm populations as they fluctuate, but is not the primary cause of oscillations.

Currently the natural pesticide Bt (*Bacillus thuringiensis*) is used to control spruce budworm in order to mitigate potential serious economic losses to the forest industry. In 2010 for example, 10,000 ha of forest were sprayed in Quebec, where a new budworm outbreak is starting. While Bt does not directly affect birds, the reduction in food supply could influence their population patterns. By examining the pattern of outbreaks, control measures, and subsequent changes to bird populations, researchers may help ensure methods used to treat spruce budworm outbreaks contribute to the sustainability of forest bird populations.

Considerations for the future

Spruce budworm cycles will continue to affect boreal forests, but future outbreaks are expected to be more frequent and last longer with the trend to a warmer climate. Bird behaviour is also expected to change with regard to the timing of bird migration and nesting. It is difficult to predict how these factors will interact, given that forest composition and patterns of fires are also expected to change.

CONCLUSION

The critical analysis of trends in bird populations is a useful tool for increasing the understanding of the broader ecological effects of budworm outbreaks. Distinct signals of large-scale budworm infestations are evident when examining bird survey records, so interpretation of these trends should take into account what is known about the ecology of budworm cycles. Birds are affected by the immediate abundance of food, but longer-term results of habitat change as a result of defoliation and tree mortality will also affect species distribution patterns. Continued monitoring of bird populations will need to take into account this and other disturbances such as climate change.

COLLABORATORS

Jennie Pearce, Pearce and Associates Ecological Research
Don McNicol and Don Fillman, Canadian Wildlife Service
The late Dan Welsh and Chris Sanders

CONTACT INFORMATION:

Lisa Venier or Steve Holmes
Great Lakes Forestry Centre
1219 Queen St. East
Sault Ste. Marie, Ontario, Canada
P6A 2E5
Phone: 705-949-9461
Fax: 705-541-5700
E-mail: GLFCWeb@nrcan.gc.ca
Web Site: cfs.nrcan.gc.ca/centres/glfc

POLICY PERSPECTIVE

Natural Resources Canada has a mandate to conduct research relating to the protection of the forest resources of Canada under the Forestry Act. Also, under the Department of Natural Resources Act, one of the general duties of the Federal Minister of Natural Resources is to assist in the development and promotion of Canadian scientific and technological capabilities. It is through these Acts that this research is supported.

The Migratory Birds Convention Act was first passed in 1917 and was last updated in 2005. This Act implements the Migratory Birds Convention, a treaty signed with the United States in 1916. The Act lists migratory birds which are protected under the Migratory Birds Regulation, and includes all bird species mentioned in this paper. The regulation also monitors scientific research of migratory birds.

Aussi disponible en français sous le titre : Nouvelles Express, Bulletin N° 74.

ISSN 1496-7847