BIRD MIGRATION MONITORING: A WINDOW ON BOREAL AND ARCTIC ECOSYSTEMS


Rusty Blackbird
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Parc national du Saguenay
Photo: Michel Savard

Management issues

- Increasing anthropogenic impact on ecosystems implies the need for a more active management of landbird populations.
- Sound management relies on quality data of population trends and productivity; this is lacking for most boreal and arctic species.
- In the short term, migration monitoring and Christmas Bird Count surveys appear to be the most efficient means for obtaining population data (Rich *et al.* 2004). Project FeederWatch and checklist programs (e.g., ÉPOQ and eBird) may also have a valuable role to play.

Objectives

- Use birds to follow the yearly cycle of the boreal ecosystem.
- Evaluate the productivity, movement and trends of key boreal species.
- Adapt visual count techniques used traditionaly for raptor monitoring to monitor landbird species.
- Use mist netting as a means of assessing species productivity.

Study site

The Observatoire d'oiseaux de Tadoussac (OOT) is located at the junction of the Saguenay and St. Lawrence rivers (Québec, Canada).

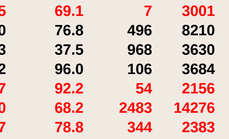
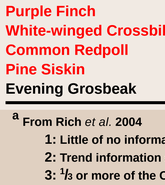


Photo: Thomas Bileau

Monitoring at the OOT is done on a sparsely vegetated marine terrace.



In the fall, the estuary acts as a barrier for southward dispersal and concentrates birds along the north shore of the St. Lawrence.

Birds are thought to come from the north-eastern portion of the Québec-Labrador peninsula.

Methods

- Daily counts (07:00-16:00, early August to late November) of migrating birds are done simultaneously from two fixed points 800m apart, one on the coast, the other inland.
- At each point, an observer actively scans the sky according to a standardized protocol and records all birds seen or heard. Data are compiled on an hourly basis.

Photo: Alexandre Hinard

Results

Abundance of key boreal species monitored at Tadoussac and possible contribution to the Partners In Flight (PIF) monitoring action needs

For species in red, migration monitoring could be added to the current suite of monitoring action

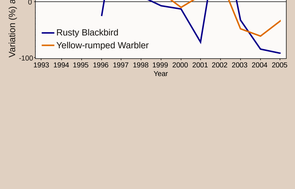
Species	Monitoring needs[a]	Counts (1993-2005) Mean	CV	Min	Max
Raptors					
Bald Eagle	3	103	49.0	21	178
Sharp-shinned Hawk	3	5193	26.7	2639	7922
Northern Goshawk	2, 3	246	30.4	124	381
Red-tailed Hawk		5846	46.9	2311	10993
Golden Eagle	3	54	38.8	26	105
Rough-legged Hawk	2, 3	471	56.4	177	958
Merlin	2, 3	199	38.0	92	335
Boreal Owl	1, 3	106	164.5	0	555
Northern Saw-whet Owl	2	114	71.7	35	237
Woodpeckers					
American Three-toed Woodpecker	2, 3	70	104.6	0	180
Black-backed Woodpecker		153	52.0	9	239
Passerines					
Northern Shrike	2, 3	38	29.0	27	60
Gray Jay	3	91	206.4	0	605
Common Raven	3	1296	29.0	856	1910
Horned Lark	3	2729	76.8	547	5386
Black-capped Chickadee		1382	96.0	234	4134
Boreal Chickadee	2, 3	1163	144.6	0	5215
American Robin	3	2708	77.5	496	6763
American Pipit	2, 3	1764	56.6	399	4054
Bohemian Waxwing	2, 3	1505	69.1	7	3001
Cedar Waxwing		3540	76.8	496	8210
Yellow-rumped Warbler	3	2593	37.5	968	3630
Dark-eyed Junco	3	1032	96.0	106	3684
Rusty Blackbird	2, 3	767	92.2	54	2156
Pine Grosbeak	3	6350	68.2	2483	14276
Purple Finch	3	837	78.8	344	2383
White-winged Crossbill	2, 3	6996	125.0	271	23261
Common Redpoll	3	11183	93.8	1108	30038
Pine Siskin	3	10462	135.7	952	36785
Evening Grosbeak		970	79.0	200	2842

[a] From Rich *et al.* 2004
1: Little of no information on population status
2: Trend information available from an existing survey, but trend precision is low
3: 1/3 or more of the Canadian/U.S. breeding range is not covered by a breeding-season survey

Do abundance, movement and productivity of birds assessed during fall migration reflect what is happening in boreal and arctic ecosystems?

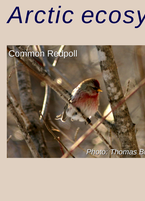
Boreal ecosystem

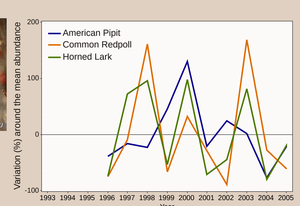
Boreal Owl
Photo: Michel Savard



Vole cycle

The natural population cycle of Red-backed Voles (about four years) may explain the low reproductive output of Red-tailed Hawks in certain years. This is highlighted by the synchrony of this cycle with important irruptions of Boreal Owls, indicating food shortage in the north. Movements of Northern Saw-whet Owls coincide with good vole years. Over the last ten years, numbers of Red-tailed Hawks observed at Tadoussac suggest a population decline. Could this decrease be linked to certain aspects of global warming that are affecting more rapidly and more severely the boreal forest region than other ecosystems? For example, low hawk productivity is typically recorded following hot dry summers. Could this be further accentuated by Large Aspen Tortrix outbreaks, which reduce protective foliage cover?

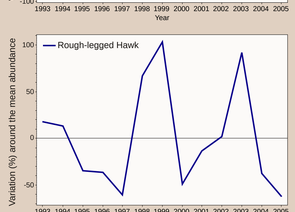

Sharp-shinned Hawk
Photo: Jean-Sébastien Guénette



Predator cycles

For the seven years up until 1999, the population cycles of Sharp-shinned Hawks, Northern Goshawks and Golden Eagles were synchronised; since then, a yet unexplained desynchronisation has been observed. In the case of Sharp-shinned Hawks, could this be due to interactions between vole peaks and passerine productivity? For Northern Goshawks and Golden Eagles, could there be an interaction between vole numbers, and hare and grouse abundance?


Boreal Chickadee
Photo: Thomas Bileau



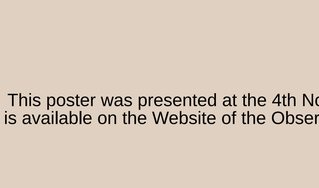
Habitat capacity and juvenile dispersion

Black-capped Chickadees are generally associated with mixed boreal forests, whereas Boreal Chickadees are associated with coniferous forests. In certain years, fall movements of the two species of chickadees occur in opposite directions: Boreal Chickadees move towards the southwest, while Black-capped Chickadees move towards the northeast.

Ninety-five percent of the birds from these two species banded in Tadoussac are first year birds. Could this dispersion represent an index of productivity, or is it a question of habitat carrying capacity? Could different conditions in their respective habitats explain their asynchronous cycles?

It is interesting to note that for the ten-year study period, Boreal Chickadees and Gray Jays, two strongly residential boreal species, irrupted only once and in the same year.

Cedar Waxwing
Photo: Samuel Denault



Fruit and seed production pulses

Cedar Waxwings, Purple Finches, Pine Siskins and White-winged Crossbills show peak movements every two years, possibly reflecting fruit and seed production. Since 2002, these cycles are more diffuse. This is likely due to two consecutive years of low fruit and cone production. An important increase in numbers of fruit- and seed-dependant species is expected in 2006, due to increases in food availability. Interestingly, the fall abundance pattern of Pine Grosbeaks (not shown here) resembles that of the above species, with peaks observed in different years (1997, 1999, 2001 and 2003).

Three-toed Woodpecker
Photo: Thomas Bileau

Natural fire cycle

American Three-toed and Black-backed Woodpeckers, both resident species of the boreal forest, show post-breeding juvenile dispersion. Ninety-five percent of individuals banded at Tadoussac are first year birds. Rather than strictly reflecting population fluctuations, the variation in the number of juveniles recorded each fall likely reflects the varying carrying capacity of the habitat available. The dramatic decrease in numbers observed in 2005, could be explained by the significantly larger forest area (100,000 ha) burnt north of Tadoussac during the summer of that year compared to previous years (mean of 2,200 ha per year for the 1996 to 2005 period). This would have created vast areas of new habitat for these two species, thus reducing dispersion distance of juveniles.

Yellow-rumped Warbler
Photo: Thomas Bileau

Predator-prey cycle

Peaks in numbers of Yellow-rumped Warblers and Rusty Blackbirds are typically recorded in years following large movements of Boreal Owls due to low vole abundance. Is this four-year cycle being observed linked to the abundance of small predators and voles in the boreal forest? Following a significant decrease in vole numbers, small mammalian predator numbers are reduced. These recover as the abundance of voles increases. The combination of low numbers of predators with increasing vole numbers may reduce predation pressure on birds, creating the pulse observed in the numbers of Yellow-rumped Warblers and Rusty Blackbirds.

The four-year fall abundance cycle observed for the Rusty Blackbird likely contributes to increasing its long-term vulnerability.

North Atlantic oscillation

This cyclical climatic phenomenon likely influences, at least to some degree, bird productivity; potential links should be investigated more closely.

Arctic ecosystem

Common Redpoll
Photo: Thomas Bileau

Horned Lark, American Pipit and Common Redpoll numbers fluctuate synchronously and are likely related, either directly or indirectly, to seed availability.

Rough-legged Hawk

Numbers of Rough-legged Hawks likely reflect lemming abundance (a four-year cycle).

Trend analysis

- Trend analyses were conducted according to the method described in Dunn & Hussel (2003) and were based solely on count data and do not account for weather effects.
- Counts were adjusted for daily effort (number of minutes of observation per day).
- Analysis windows were determined separately for each species and exclude data that could be associated with local individuals.
- Migration windows (shaded area on pulse figures) are defined as the period each year during which 95% of birds are counted (2.5% of counts removed from each tail).
- Migration indices were calculated using count data from 1996 to 2005. In figures representing trends, indices are displayed on a logarithmic scale. Confidence intervals are given by the 90% confidence limits for the expected value of the logarithm of the migration index. Trends are given by the slope of the regression curve.
- Analyses were conducted using ten years of count data. Trends presented here cannot necessarily be extrapolated beyond this period.

Migration pulse (3-day running mean 1996-2005) | **Ten-year regression models**

White-winged Crossbill

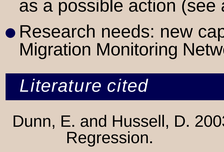
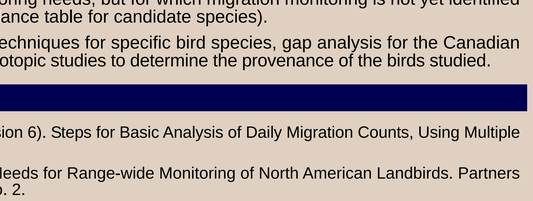
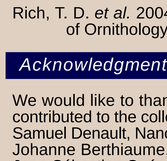


Photo: Samuel Denault



Pine Grosbeak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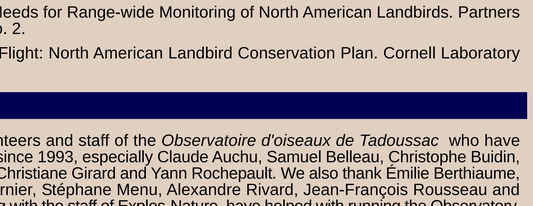
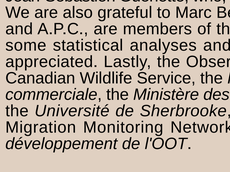


Rusty Blackbird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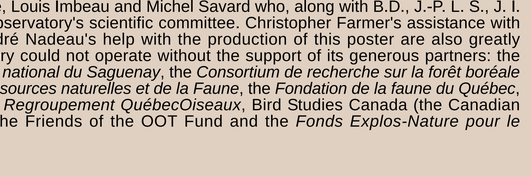

Yellow-rumped Warbler

Photo: Thomas Bileau

Conclusions

- Counts conducted at Tadoussac during the fall migration clearly reflect various aspects of the functioning of boreal and arctic ecosystems; a greater understanding of the cycles observed will allow for an improved monitoring of northern species and a better assessment of associated population trends.
- Continued monitoring, supplemented with more highly focussed studies, will lead to a greater understanding of the functional links between boreal and arctic landbirds and their habitats. Information obtained through migration monitoring will provide an insight into what is occurring, on a yearly basis, in boreal and arctic ecosystems.
- At least some of the species migrating through Tadoussac are mainly represented by dispersing juveniles. However, it must be determined whether this is the case for other boreal and arctic species: those for which age cannot be determined visually, or those for which efficient capture techniques are not yet available. Capture of these species will allow the determination of adult to juvenile ratios, from which productivity indices can be derived.
- Comparison of fall movements to Christmas Bird Count data is being conducted. Combining information from both surveys will help increase our understanding of the fluctuations in numbers and of their relationship to changes occurring in boreal and arctic ecosystems.
- In the short-term, priority should be given to the development of an adequate migration monitoring network. Such a network would make for a more efficient way of obtaining productivity estimates than breeding studies do. In addition, a well-distributed network will allow for an evaluation of the spatial synchrony of cycles in boreal and arctic ecosystems.
- Bird counts from migration stations located on the edge of the boreal forest would provide important data for species with high monitoring needs, but for which migration monitoring is not yet identified as a possible action (see abundance table for candidate species).
- Research needs: new capture techniques for specific bird species, gap analysis for the Canadian Migration Monitoring Network, isotopic studies to determine the provenance of the birds studied.

Literature cited

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