Bicknell’s Thrush Problem

Bicknell’s Thrush is a migratory songbird that breeds in spruce/fir forests of New York, New England, and Atlantic Canada, and winters in the Greater Antilles, especially the island of Hispaniola.

The International Bicknell’s Thrush Conservation Group (IBTCG) is a conservation partnership working to protect and manage habitat across this rare bird’s annual life cycle. The partnership would like advice on which of a suite of possible conservation activities they should focus their efforts and resources in order to halt population declines and ultimately increase their population to a level that is considered more sustainable in the long term.

The total adult population is currently estimated at about 100,000 individuals.

A male-biased adult sex ratio exists for Bicknell’s Thrush on the breeding grounds of about 2 males to every 1 female. The sex ratio of fledgling birds leaving the nest is even at 1:1. It is hypothesized that the male-biased sex ratio results from differential annual survival of males and females caused by behavioral dominance of males over females during the wintering period, forcing more females into sub-optimal winter habitat where they experience lower over-winter survival.

Some information on annual survival rates exists for males, but less is available for females, in part because they are more difficult to capture. However, existing information suggests that males survive equally well in both optimal and sub-optimal winter habitats, whereas anecdotal evidence suggests that females survive about as well as males in optimal winter habitat but have lower survival rates in sub-optimal winter habitat.

The Bicknell’s Thrush population has been declining at an annual rate of about 7% for the last 20 years.

The IBTCG is asking you to develop a Bicknell’s Thrush population model based on the information below in order to:

1. Gain some understanding of how large of a difference in adult female survival rates between birds wintering in optimal and sub-optimal habitat would result in the 2:1 adult sex ratio and a 7% annual population decline.

2. Based on your population model, understand which of the conservation activities (described below) you would recommend that the IBTCG undertake if they had a budget of $300,000 to invest in Bicknell’s Thrush habitat conservation. Your recommendation could be in the form of either a single activity or a portfolio of activities. The IBTCG would also like to know if this budget is likely to be sufficient to achieve a stable or increasing Bicknell’s Thrush population. If not, how large of a budget would be required to at least reach a stable population?
Population Parameters:
Adult sex ratio - 2 males: 1 female
Fledgling sex ratio - 1 male: 1 female

Productivity:
Annual productivity ranges between 1.5 and 2.2 fledglings per mature female (females mature and are able to breed in the year after they hatch) – lower and higher annual productivity rates are typically observed in alternating years due to biannual cycles in red squirrel populations (a major predator on bird nests) and spruce-fir cone crops (a major food source for red squirrels).

Annual Survival Probability:
Fledglings (both sexes) – 0.40
After Hatch Year (AHY) Males – 0.75
AHY Females in Optimal Habitat – similar to males
AHY Females in Sub-optimal Habitat – lower than males

Winter Population Distribution:
- approximately 55% of the total population winters in optimal habitat, with the other 45% of the population wintering in sub-optimal habitat;
- the sex ratio in optimal winter habitat is 4 males: 1 female; the sex ratio in sub-optimal winter habitat is 1 male: 1 female;
- approximately 33% of the female population winters in optimal habitat and 67% in sub-optimal habitat

Conservation Alternatives with Costs and Benefits per Acre:

<table>
<thead>
<tr>
<th>Conservation Action</th>
<th>Winter Habitat</th>
<th>Breeding Habitat</th>
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<tbody>
<tr>
<td></td>
<td>Cost/Acre</td>
<td>Benefit/Acre</td>
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<tr>
<td><strong>Winter Habitat</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection/Management</td>
<td>$500</td>
<td>$0.0001 increase in ♀survival</td>
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<tr>
<td>Reforestation</td>
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<td>$0.00035 increase in ♀survival</td>
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<tr>
<td><strong>Breeding Habitat</strong></td>
<td>Cost/Acre</td>
<td>Benefit/Acre</td>
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<tr>
<td>Management of Breeding Habitat</td>
<td>$2000</td>
<td>0.005 increase in fledglings per female</td>
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