A COMPARISON OF IDENTIFICATION TECHNIQUES FOR PREDATORS ON ARTIFICIAL NESTS

by Peter Leimgruber and Brij Kishor Gupta

Introduction

Nest predation is the major factor reducing the breeding success of passerine birds (Martin, 1991; Ricklefs, 1969). The identification of nest predators, however, is hampered by technical difficulties and has often not been very successful. Commonly used identification techniques range from rather coarse and speculative approaches, such as incidental observations (Yahner and Cypher, 1987; Yahner and Scott, 1988), conclusions based on the abundance of potential predators (Klett et al., 1988; Stooras and Weege, 1987), and determination of tracks or bite marks on egg shells (Green et al., 1987; Rearden, 1951), to more advanced techniques such as systematical observation of nests (Gömark and Åhlund, 1986; Salathé, 1987), haircatchers (Baker, 1980), trackboards (Angelstam, 1986; Wilcove, 1985), and trip cameras (Leimgruber et al., 1994; Martin, 1987; Picman, 1987; Reitsma et al., 1990). Little is known about how accurate identification techniques are. Nevertheless, major conclusions and management recommendations for the conservation of bird species have been based on predator identification studies such as the studies by Wilcove (1985) or Angelstam (1986)(Askins et al., 1990; Terborgh, 1989). Presented in this paper are the results of a comparative study on the effectiveness and accuracy of three different identification techniques.

Methods

A 4 ha study plot was established at the Conservation and Research Center (CRC), a 1,200 ha research facility 2 km southeast of Front Royal, Virginia. The study plot was located in a 25 ha remnant of deciduous forest and consisted of a grid with 100 stations, each station 20 m apart and marked with red tape.

Between 17 July and 4 August 1991, three 4-day trials were conducted. During each trial, 30 nests were placed at randomly selected stations. Generalized ground nests were constructed within 5 m of the station by forming depressions in the ground or leaf litter close to a shrub, log or tree trunk. These nests were lined with leaves, moss, dry grass or other organic materials found in the vicinity of the nest. In each nest were placed two fresh northern bobwhite quail (Colinus virginianus) eggs. At the end of each 4-day trial the eggs were removed. To reduce the possible impact of human scent, the eggs and nest materials were handled with vinyl rubber gloves. During each trial, the 30 nests were evenly divided into three different categories, i.e. fluorescent pigment nests, trackboard nests and control nests.

Fluorescent pigment nests: Eggs and nest were powdered with fluorescent pigments. Predators that destroy the nests pick up these pigments and leave fluorescent tracks. A Raydetector III portable “Ultra Violet Light” was used to detect tracks.

Trackboard Nests: A thin layer (1 mm) of a mixture of petroleum jelly and clay powder was applied to a 3 mm thin board (32x32 mm) to preserve tracks of nest predators. Eggs and nests were placed on these trackboards (Angelstam, 1986; Schultz, 1991).

Camera systems: Cameras were used in the last trial in combination with trackboards (7 nests) and fluorescent pigments (8 nests). The camera systems operated with an infrared light beam and were activated by sudden changes in the...
“heat-profile” of the monitoring area (Rappole et al., 1986). Nocturnal visitors could be photographed with the aid of an automatic flash. The cameras were also equipped with an automatic film advance and a databack that stamped Day-Hour-Minute on each exposure.

Results

A total of 84 (93.3%) nests were destroyed (i.e. at least one egg was removed or destroyed). There was no significant difference in the number of destroyed nests between trials (n=90, X²=0.037, 2 df., P=0.9817). Although predation rates were lower for control nests than for fluorescent pigment or trackboard nests, this difference was not significant (n=90, X²=0.265, 2 df., P=0.8756).

Predators were identified at 25 of the destroyed nests that were equipped with cameras, fluorescent pigments or trackboards. The most common nest predator was raccoon (Procyon lotor) (30%), followed by opossum (Didelphis virginiana) (5%), gray fox (Urocinereus argenteus) (3.33%), gray squirrel (Sciurus carolinensis) (1.67%), and black bear (Ursus americana) (1.67%). Nest predators remained unknown at 33 of the artificial nests that were equipped with cameras, fluorescent pigments or trackboards. There was a significant difference in the effectiveness between the three identification techniques. Based on their cell contribution to the chi-square value, cameras (86.6%) were the most effective, followed by fluorescent pigments (58.7%) and last by trackboards (20%). Cameras allowed the identification of nest predators when fluorescent pigments (1 nest) or trackboards (4 nests) failed. Trackboards were frequently found to have been removed and severely damaged so that no signs or tracks could be recognized.

Automatic film advance and an internal clock built into the camera allowed us to identify species that showed up at nests after they had been destroyed by a previous predator (n=11). These ‘second’ visitors included raccoon, opossum, striped skunk (Mephitis mephitis), and gray squirrel.

Discussion

Nest predation rates were very high in our study plot. This may be explained by the high density of artificial nests and the location of the study plot within a forest fragment (Wilcove, 1985). However, all species identified at artificial nests in this study were previously reported to be nest predators (Martin, 1987; Wilcove, 1985).

Previously fluorescent pigments were used for tracking of small mammals (Duplanter et al., 1984; Lemen et al., 1985) and to describe physical contact interactions among mammals (Dickman, 1988). MacDonald and McShea (pers.comm.) successfully used fluorescent pigments for the identification of nest predators. However, the major drawback of this inexpensive technique is that rain washes off the pigments. Also, identification is often restricted to medium-sized predators and the detection of small predators is extremely difficult. However, this technique was more effective and accurate than the trackboards in our experiments.

Trackboards with different coatings were commonly used in next predation studies (Angelstam, 1986; Schultz, 1991; Wilcove, 1985), but only the European studies that used grease-based coatings were successful (Angelstam, 1986; Schultz, 1991). Angelstam (1986) and Schultz (1991) identified 75% and 93% of the nest predators. This difference in effectiveness may be explained by the absence of raccoons at the European study sites. Raccoons destroyed or removed many trackboards in our study. However, Angelstam (1986), as well as Schultz (1991), did not identify many small rodents. As for the fluorescent pigment techniques, identification was restricted to medium-sized predators.

Camera systems were the most effective and accurate technique. These systems allowed the identification of predators that were not detected with other techniques. Small predators like gray squirrels did not leave clear tracks in fluorescent pigments or on trackboards. Large predators like black bears did not touch fluorescent pigments or trackboards with their paws but still destroyed nests.
Only recently has the phenomena of 'second' visitors at artificial nests been described in a study that used the same camera techniques for predator identification (Leimgruber et al., 1994). Only cameras with a databack can provide data on the sequence of different predator species at nests. Fluorescent pigments and trackboards are selective and may bias the results towards medium-sized predators such as raccoons or opossums, especially if these species appear as 'second' visitors after the destruction of the nest by a small predator.

We did not find significant evidence that identification techniques had an impact on the number of destroyed nests. However, with camera systems we obtained a series of pictures of raccoons that played extensively with trackboards. On one picture a raccoon even licked the petroleum jelly and clay powder mixture. We suspect that olfactory-oriented nest predators may be attracted to trackboards.

Conclusions

Groups of predators described in previous studies with the help of fluorescent pigments or trackboards may not reflect the true diversity of this guild (Angelstam, 1986; Schultz, 1991; Wilcove, 1985). The role of medium-sized predators may have been overestimated and the role of small rodents, although frequently reported as nest predators (Boag et al., 1983; Maxon and Oring, 1978; Reitsma et al., 1990), may have been underestimated. Nest predation in forest habitats may not depend on a few important species, but on a diverse guild of predators that compensates population fluctuations of a single predator species (Leimgruber et al., 1994; Reitsma et al., 1990). Therefore, management recommendations based on a single or a few important predator species should be reviewed.

Number of artificial nests at which particular predator species were successfully identified with at least one of the identification techniques at the Conservation and Research Center, 1991

<table>
<thead>
<tr>
<th>Predator Species</th>
<th>Nest predators identified by</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trackboard</td>
<td>Pigment</td>
</tr>
<tr>
<td>Raccoon</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Gray fox</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opossum</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gray squirrel</td>
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<td>17</td>
</tr>
<tr>
<td>Black bear</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Unidentified</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Cameras were always employed with one of the two other techniques. In some cases predators identified with cameras were also determined with the other techniques. Thus, the total number of nests that were robbed by a particular species does not equal the sum of individuals that were identified.

References


Boag, D.A., Reebs, S.G. and M.A. Schroeder. 1983. Egg loss among spruce grouse inhabiting...


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