

competition for nest boxes was reduced by placing the boxes away from the shrubby areas wrens prefer, wrens were still a major cause of bluebird nest failure during all three years of the study. Because House Wrens are smaller than bluebirds, there is little that can be done to make a bluebird nest box "wren-proof" and still acceptable to bluebirds. Several hole designs and "wren guards" have been tried on bluebird boxes (Berner 1990, Berner 1991, Berner and Pleines 1993), and a wren guard designed by Pollock (1989) was tried on several of our boxes. Results of our tests and those of the others show that wrens were still able to gain access to nest boxes to build nests or destroy bluebird eggs.

The only effective way to reduce competition from House Wrens is by trial and error; e.g., relocating nest boxes used by wrens (usually to more open areas) until they find them unacceptable (Parren 1991).

Boxes placed in open areas should be monitored closely for Tree Swallow competition. If a second box is placed within 3 - 6 m of the contested box, the chances of having both species nest successfully will be increased.

The fact that raccoon-caused nest failures rose from 0% in 1989 to 10.7% in 1990 may represent learned behavior by the raccoons. By using several anti-predator management techniques (mounting houses on smooth metal poles, greasing the poles with white lithium grease, and attaching wire guards to the fronts of the boxes) overall egg loss due to raccoons was reduced to 4% the following year. It is safe to assume that eventually a raccoon will find and try to investigate any nest boxes in its

territory. Precautions taken to prevent them from successfully gaining access initially will save much time and effort later, as raccoons are very persistent once they have found a food source. Nest boxes should always be mounted at least 1.3 m above the ground on smooth round poles



*Eastern Bluebird fledgling. Photo by Victoria J. Byre.*

that have at least a 0.5 m wide, liberal coating of grease (carnuba car wax may be a less messy alternative (Davis 1993). In high risk areas, an anti-predator device should also be attached below or onto the front of the nest box. The Noel "cat 'n coon" guard (Noel 1991) appeared to work well in our application. The "bird guardian," a tube-like commercially available predator guard that fits over the entrance hole has not proved effective (Berner 1991, Berner and Pleines 1993).

Human-caused nest failures can best be prevented by strategic placement of the nest boxes (especially away from frequently used paths or roads) and informative signage and public education.

While a number of Eastern Bluebirds returned to their previous year's nesting areas the following year, a surprisingly large number of unbanded adult birds appeared each spring, despite the fact that all nestlings and most adult females (the

majority of which nested successfully) were banded at each study site during the previous years. This finding is somewhat contrary to a study done by Pinkowski (1979) in which the number of Eastern Bluebirds nesting in an area gradually increased after the initial provision of nest boxes, because young birds that were reared in the area were returning there to breed, and adults that were successful in the area were returning there for subsequent nestings. While our bluebird population also increased quite dramatically, many of the birds were "new" to each site each year, and took advantage of the abundance of nest boxes provided. This high turnover rate was surprising and certainly would not have been suspected had the banding study not been done.

Preliminary banding returns also indicate that a large number of nestlings from our study areas spent their first adult summer somewhere other than their hatching site, then returned to their hatching site during their second adult year to nest. Whether these two-year-olds nested somewhere else during their first summer is unknown.

Our banding returns also show that local bluebird populations do intermix. Areas of higher productivity, such as the Morton Arboretum site may provide a source of birds for areas of lower productivity such as the McKee Marsh and Fermilab sites. Likewise, areas of higher quality habitat may draw birds to them from less suitable areas.

Many factors are involved in the ultimate size and stability of a local Eastern Bluebird population. The availability of suitable nesting cavities is certainly a major factor, but food supply, predators and competitors, habitat characteristics, and local and regional weather conditions