

- fledged were produced by four double-brooded females. One double-brooded female produced at least six fledglings in 1957.
27. The species endures and overcomes high mortality of nests by virtue of its high breeding potential.
  28. Adult males sang full songs as late as August 6. Adults did not undergo postnuptial molt during nesting.
  29. Fledging occurred as late as August 17-18.
  30. Adults apparently migrate south from Oklahoma before molting. There are no September or later records of adults for the state. Juveniles have been recorded in September, female-like birds in October.
  31. Differences exist in the breeding behavior of the Indigo and Painted Buntings.

## ACKNOWLEDGMENT

This study was financed largely by a grant-in-aid from the National Science Foundation. Dr. Carl D. Riggs, Director of the University of Oklahoma Biological Station, provided transportation and both field and laboratory equipment, and helped me in every other possible way. Mr. W. M. Pulich of the University of Dallas, Irving, Texas, aided me in field observations. I am especially grateful to Dr. George M. Sutton and Mr. Donald H. Baepler of the University of Oklahoma Zoology Department for invaluable help afield and in the reading of the manuscript.

## BIBLIOGRAPHY

- ALLEN, A. A. 1933. The Indigo Bunting. *Bird-Lore*, **35**: 227-235.
- BAUMGARTNER, F. M. and HOWELL, J. C. 1947. The numerical and seasonal statuses of the birds of Payne County, Oklahoma. *Proceedings of the Oklahoma Academy of Science*, **27**: 45-59.
- BRADLEY, H. L. 1948. A life history study of the Indigo Bunting. *Jack-Pine Warbler*, **26**: 103-113.
- COMMITTEE OF THE AMERICAN ORNITHOLOGISTS' UNION. 1957. Check-List of North American birds. Fifth Edition. The Lord Baltimore Press, Inc., Baltimore, Maryland. Pages 1-691.
- FORBUSH, E. H. 1929. Birds of Massachusetts and other New England States. Volume 3. Massachusetts Department of Agriculture. Pages 1-466.
- NICE, M. M. 1931. The birds of Oklahoma. University of Oklahoma Press, Norman, Oklahoma. Pages 1-224.
- NORMAN, J. L. Unpublished notes at 2617 Elgin, Muskogee, Oklahoma.
- SPRUNT, ALEXANDER, JR., and CHAMBERLAIN, E. BURNHAM. 1949. South Carolina Bird Life. University of South Carolina Press, Columbia, S.C. Pages 1-585.
- SUTTON, G. M. Unpublished notes at Department of Zoology, University of Oklahoma, Norman, Oklahoma.
- Biology Department, Kansas State Teachers College, Emporia, Kansas.*

**THE BAL-CHATRI: A TRAP FOR THE BIRDS OF PREY**

By DANIEL D. BERGER AND HELMUT C. MUELLER

In spite of the abundance and variety of traps left to us by many generations of falconers, the raptors remain among the most difficult birds to trap. The device presented below is the best all-purpose trap we have encountered in nearly a decade of experimenting with the various techniques for capturing hawks. It has the advantages of being small, having no moving parts, and can be thrown into the vicinity of a hawk from a moving vehicle. As with most trapping techniques, the device is an adaptation of an ancient idea. For many years the east Indian falconers have taken hawks in horsehair nooses affixed to the exterior

of a cane cage which contained several live lure birds. MacPherson (1897) designates this trap as a "Shikra Trap." Craighead (1942) gives *bal-chatri* ("boy's umbrella") as the Indian name of this trap. The latter has become the accepted name. In our *bal-chatri* we have substituted hardware cloth and monofilament nylon for cane and horse-hair and changed the dimensions to enhance portability, but the basic idea remains unchanged.

#### TRAP DESCRIPTIONS

The *bal-chatri* is a hardware cloth cage covered with slip-nooses of monofilament nylon. Three types satisfy our present requirements although it is possible that none of these may be suitable for some of the many species of raptors with which we have not yet had experience. It is interesting that we have yet to catch a single one of the short-winged species for which the Indian *bal-chatri* was used.

*Type I.* The first of our two basic traps is in the shape of a cylinder six inches in diameter and two and one-half inches high constructed of one-third inch mesh hardware cloth. A door in the bottom permits the deposit and removal of bait. The top is uniformly covered with 40 one-inch-in-diameter nooses of four lb. test nylon. A metal strip is wired circumferentially to the bottom to bring the gross weight of the trap to eight ounces.

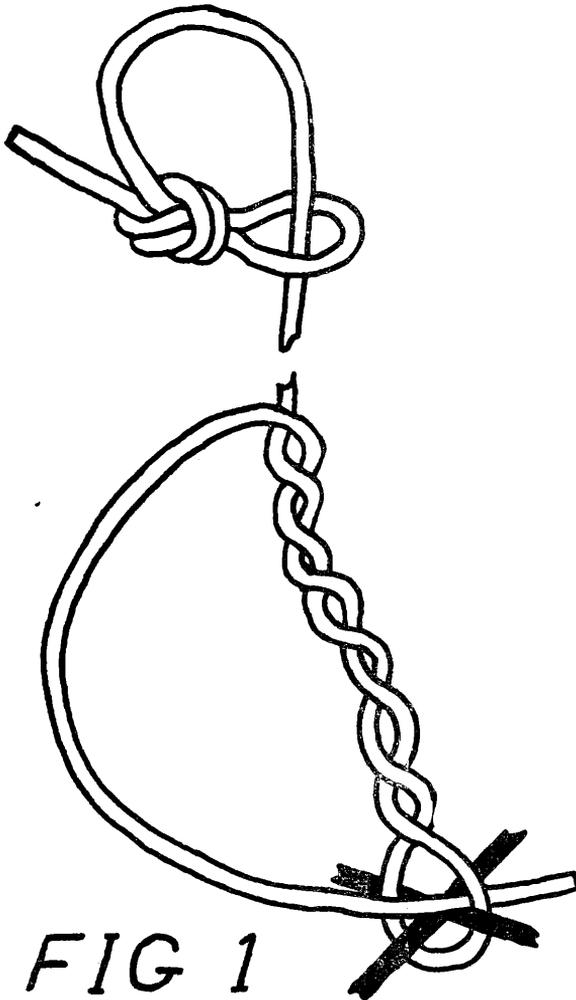
*Type II.* This trap differs from type I in having about 35 nooses of 15 lb. test nylon, each one and one-half inch in diameter. A somewhat heavier strip is attached to the bottom in the same manner as in type I so that the total weight of the *bal-chatri* is brought to twenty ounces.

*Type III.* This trap is hemicylindrical, or quonset shaped, twelve inches long, ten inches wide, and six high. The ends and top of this one-half inch mesh hardware cloth cage are covered with some one hundred nooses of twenty lb. test nylon. Each noose is one and one-half inch in diameter. Again, this trap should be weighted at the bottom sufficiently to cause it to land right-side-up, but the total weight should not exceed twenty-four ounces if possible. The door, as in all of our traps, is in the bottom. This *bal-chatri* was designed specifically for the trapping of Harris' Hawks (*Parabuteo unicinctus*) and is not necessarily particularly well suited for the capture of any other hawks except possibly other gregarious species.

Weighting our traps at the bottom with strips of lead or iron causes them to right themselves, even when rolling, after being dropped from a moving automobile. The weights are light enough so the hawk may drag the trap a short distance, but heavy enough to keep the bird from carrying it away. If the trap is too heavily weighted, the abrupt pull of the striking hawk may snap the nooses.

The efficiency of a *bal-chatri* is dependent on several things. First of all in order to attract the hawk an active lure is essential. Then after the hawk strikes the trap it is important to have properly tied nooses of optimum diameter and density. We have come to expect a catch of at least 95% of the Kestrels that actually strike the trap.

Nooses may be tied in several different ways. Our method is diagrammed in Figure 1. After each noose is attached to the trap as



shown in Figure 1 the attachment knot can be tightened by inserting a pencil through the noose and pulling away from the trap. Now the noose, which so far has been closed, should be spread open and adjusted so that it stands as nearly erect as possible. A drop of Duco cement at the point of attachment will secure the knot and keep the noose erect. A No. 13 crochet hook considerably increases the speed of the operation. This tool is also useful in reopening nooses after a hawk has been captured. We have experimented with several brands of monofilament nylon and have found the J. C. Higgins brand, sold by Sears, Roebuck and Co., to be very satisfactory and inexpensive. Limp nylon is the most desirable. A bal-chatri requires very little maintenance. One must simply see to it that nothing is left lying on

top of the nooses while the trap is not in use. Occasionally regluing or replacement of the nooses is necessary.

#### LURES

We have used, with varying success, several species of birds and mice for bait. House Mice (*Mus musculus*) are by far the most satisfactory of the rodents. Other species are erratic in their activity within the trap and often fail to attract the hawks' attention. However, Meadow Voles (*Microtus* sp.) can also be used with some success. Fitch (1950), Howard (1953), and Howell (1954) give descriptions of live traps for mice. Several commercial models are also available. Freshly-caught English Sparrows (*Passer domesticus*) can also be used but they soon learn to "freeze" upon sighting a hawk and will remain inactive, and thus unattractive for extended periods. Due to this disadvantage and also to the fact that sparrows are relatively difficult to keep, especially while travelling, we much prefer to use mice for trapping most species. Though we have had our greatest success with the House Mouse, we have also used, in order of desirability, Meadow Voles (*Microtus pennsylvanicus*), Deer Mice (*Peromyscus* sp.), and Pigmy Mice (*Baiomys taylori*). Of these only House Mice have proven to be consistently active enough for good lures. Their activity is not arrested by a hawk passing at them and they are easy to keep in captivity. The action of individual House Mice actually seems to improve with use contrary to all our experience with other species of mice and certainly with sparrows. For the large trap (Type III) we have found Starlings (*Sturnus vulgaris*) to be the most consistent performers. Two Starlings will produce an almost constant activity which is increased, instead of halted, when a hawk approaches. If birds are left in a bal-chatri for more than a few minutes they will often pull

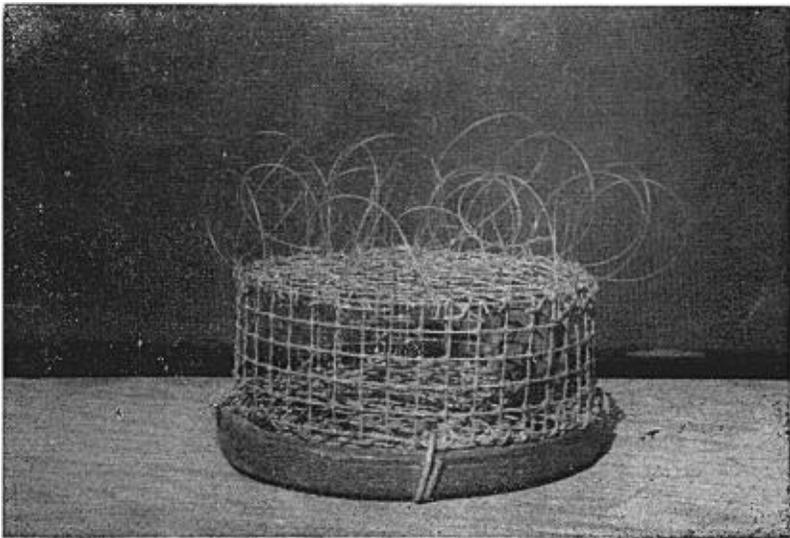


Fig. 2. Bal-chatri with mouse.

nooses through the hardware cloth and hang themselves. This is easily prevented by tying the mandibles together.

We have had good success in keeping most species of mice in one-pound metal tobacco cans with perforated covers. The can should be kept about two-thirds full of dry, shredded newspaper, and the mice supplied with grain or commercial mouse pellets and a little vegetable matter for moisture every two or three days.

We have kept Starlings successfully only after providing dark roosting boxes in the cage. We have found them to thrive when provided with dried dog food, and a copious supply of fresh water.

#### THE TRAPPING PROCEDURE

Although the bal-chatri can simply be left in a likely location and visited at intervals, it is most efficiently used when dropped from a moving vehicle as close as possible to a sitting hawk. We always carry traps and mice in our automobiles, and trap hawks as we encounter them. Hawks, especially Kestrels, are frequently found perched on utility poles or wires. Upon sighting a bird we generally pull off onto the shoulder of the road, slow down to ten miles per hour, and drop the trap as we go by. If at all possible we try to drop it off from the side of the car that is away from the bird. It is best to open the door wide enough to accommodate the dropping procedure somewhat in advance of the actual dropping and to hold that position until safely past the bird. Any swinging of the door or undue movement inside the car while close to the sitting hawk is apt to flush it—especially while driving slowly. In some circumstances, hawks will flush if the above technique is used and it is best then to approach the bird as closely as possible, drop the trap, and back up. In either case we generally

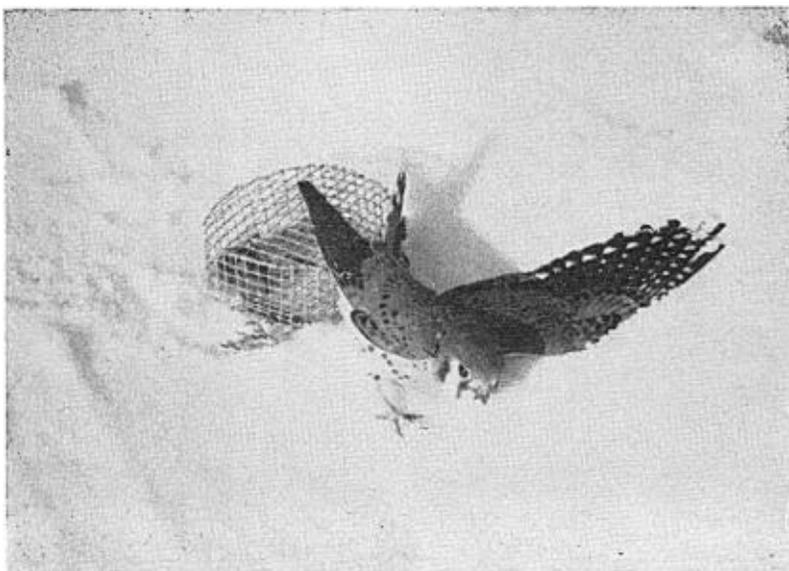


Fig. 3. American Kestrel caught on Type I bal-chatri.

park between two and three hundred feet from the bal-chatri while waiting for the hawk to come in. Often this is a matter of only several minutes and sometimes only a few seconds. Most of the Kestrels that come in to the trap land on the top and are quickly ensnared during their frenzied attempts to clutch the lure. It is not always evident just when the bird becomes entangled; however, if the road is well travelled the first passing car is likely to answer this question since the bird will probably panic. The work of resetting nooses can be considerably reduced by retrieving the hawk as soon as possible. We have found that while trapping in good country it is best, while driving from one bird to the next, to cover the bal-chatri with a cardboard box or metal container, taking care that the nooses do not become depressed. In this way the mouse can be kept in the trap in total darkness and yet is ready at a moment's notice. The result seems to be a more lively mouse when the trap is in use. When trapping is slow, we keep the bait animals in their cans or cages, and do not put them in the trap until a likely hawk has been sighted.

#### TRAPPING SUCCESS

##### *American Kestrels*

More than 90 percent of the birds of prey that we have caught using the bal-chatri have been American Kestrels. We have already caught 376 of these birds and as many as 22 in one day. During two banding trips to Texas and Mexico—the first lasting 13 days in January 1955, and the second 37 days in December 1955, and January 1956—we banded 227 Kestrels. Our efficiency during the first trip was 45.8 percent, and on the second was 57.8 percent. These figures were obtained by dividing the number of Kestrels trapped by the number of birds for which a trap was dropped, providing that the lure in the trap was seen by the hawk. In other words, we did not include cases in which the bird did not see the lure dropped for it. We feel that we can judge with considerable accuracy whether or not a hawk has spotted the lure.

A composite analysis of these two trips shows that we counted a total of 1,358 Kestrels of which we were able to catch 16.7 percent. Actually, however, trapping was attempted on less than a third of the total number observed which brings our percentage to 52.8. In summary, the fact that we were able to catch one of every two attempted Kestrels in a series of this size (430) is ample proof of the remarkable efficiency of this trap.

Our most outstanding success with the bal-chatri occurred while trapping Kestrels through the semi-arid country from Mission to Laredo, Texas, on January 7, 1955, where we attained a catch of 88 percent by trapping 22 of the 25 birds for which traps were dropped. Our relative trapping success in different parts of the country and at various times of the year seemed to fluctuate mainly with the availability of insect prey. Our lowest "no response" percentage occurred during the winter season in Wisconsin where insect prey was nonexistent. Up to the present time we have trapped Kestrels in Wisconsin, Texas,

Colorado, Wyoming, Illinois, Tennessee, Mississippi, Louisiana, and the Republic of Mexico. Nowhere have we experienced a catch of less than 50 percent.

In Wisconsin we have trapped and banded Kestrels during every month of the year. Although records of our Wisconsin trapping have not been consistently kept, we feel that our trapping percentage is not only relatively high, but surprisingly stable throughout the year. For example, during a one-month period beginning July 29, 1956, we caught 81 percent of 21 birds while 14.3 percent did not respond. Our winter trapping success varied only slightly from that of the summer. During the period December 1, 1956, to March 1, 1957, we caught 80 percent of 30 birds while only 6.7 percent did not respond.

In the summer of 1956 we made our first attempts at trapping family groups of Kestrels. Four groups were tried in or near Milwaukee, Wisconsin. Both adults were seen in 3 of the groups and neither adult in the fourth. All 6 adults were trapped. A total of 12 young birds was observed although probably more existed. Ten of these were trapped, but only one of the 2 that were not caught was classed as unresponsive. On September 4, 1956, along a 1 mile stretch of road in the Owl Canyon about 28 miles northwest of Fort Collins, Colorado, we encountered a group of 15 Kestrels. During the ensuing 70 minutes which were terminated by darkness we trapped 12 of these birds. We felt that with more time we could possibly have taken all of them. Ten of the trapped birds were juveniles.

### *Harris' Hawks*

During our January 1955, banding trip to Texas and Mexico we were very much encouraged by our unexpected success in trapping Harris' Hawks. Being a gregarious species these birds are frequently found in groups of three to six individuals. So we designed a bal-chatri capable of ensnaring more than one bird at a time. Although we had an appallingly inferior trap at that time we had as many as six Harris' Hawks surrounding the trap at one time.

During our 1955-1956 trip to Texas and Mexico we found only one area containing a rather dense population of this species. This was in Kenedy County, Texas, along U. S. route 77 which bisects the King Ranch. On December 29 we drove through this area rather late in the afternoon. At this time few of the 44 birds observed reacted to our lures and none was caught. On January 22, when we returned through the area, we encountered 38 birds. Of these we tried for 18, caught 8, and 2 more escaped after being temporarily caught. We made only 2 multiple catches. In one instance, in Mexico, both of a group of 2 birds were trapped at one time, and in the other, all of a group of 3 were taken. We encountered an extremely fast-reacting bird in the state of Nuevo Leon, in Mexico. We dropped the trap on a well-travelled highway only 20 feet from the bird which was perched low in a rather small tree. Our car was only 15 feet past the trap, which had hardly stopped sliding along the pavement, when the hawk was upon it.

*Red-tailed Hawks (Buteo jamaicensis)*

Red-tailed Hawks are generally quite difficult to trap with a bal-chatri. We caught our first one only recently on the Type II. Several more were caught on a Type III baited with a Starling. It seems likely, however, that the Type II baited with a mouse will ultimately be the more successful for trapping this species.

*Red-shouldered Hawks (Buteo lineatus)*

We have had even less success with Red-shouldered Hawks, but then we have made relatively few attempts to catch them. We caught one on a Type III baited with a Starling. Mr. David Seal (personal correspondence) caught a pair of these birds near Rockford, Illinois, on a mouse-baited Type II bal-chatri.

*Broad-winged Hawks (Buteo platypterus)*

In the spring of 1956 we tried the bal-chatri on transient Broad-winged Hawks. We were amazed by the high degree of success. We failed to catch only one of the six birds which we tried to trap.

*Other Birds of Prey*

We experimented with the Type III or Harris' Hawk trap on several other species mostly without success. In Texas we used it successfully on a Gray Hawk (*Buteo nitidus*) which was the only one we tried for. Of several Rough-legged Hawks (*Buteo lagopus*) that we tried to catch, one hovered ten feet above the trap for a short time, but this was the most encouraging response we obtained. A Great Horned Owl (*Bubo virginianus*) at dusk swooped low over the trap, but did not strike. We caught several Barred Owls (*Strix varia*) by leaving one of these traps in their hunting territories. For all of these a Starling was used as bait.

We have learned that others using traps similar to ours have had success with several other species viz., Sharp-shinned Hawk (*Accipiter striatus*), Marsh Hawk (*Circus cyaneus*), American Merlin (*Falco columbarius*), Peregrine Falcon (*Falco peregrinus*), Goshawk (*Accipiter gentilis*), and Screech Owl (*Otus asio*). Mrs. Frances Hamerstrom (personal correspondence) caught two Marsh Hawks on the Type III baited with a Starling. She also caught a Goshawk on the same trap baited only with the wings and a few feathers from one of the hawk's previous kills. Dr. Heinz Meng (personal correspondence) developed an ingenious trap of nylon netting over a wire framework instead of hardware cloth. Meng used 2 traps placed about 4 feet apart. The first, which was about 10 inches high and 18 inches square, and was baited with about 20 sparrows, seemed to serve remarkably well for attracting the hawks which would then swerve over and bind to the other smaller trap which contained only 2 sparrows. This smaller trap had sloping sides and was not over 4 inches in height. During several trapping trips on the East Coast during the fall of 1956 Meng trapped 8 Merlins, 2 Kestrels, 1 Sharp-shin, and 1 Peregrine. All of these birds were trapped during migration.

In addition to the birds of prey we have had some interesting experiences with several other species of birds. We have taken numerous

Shrikes (*Lanius ludovicianus* and *L. excubitor*), usually using a mouse lure. On one occasion in Texas shortly after a Kestrel had landed on our bal-chatri, a Roadrunner (*Geococcyx californianus*) darted out from the heavy roadside brush and attacked the caged House Mouse, but tore the nooses after being momentarily caught.

#### CONCLUSION

The bal-chatri is a comparatively simple yet extremely effective device for trapping several species of raptors and can probably be used with some success on most species. It is completely portable and requires little skill to use. There has been no mortality among more than 400 birds trapped. Due to the difficulty of recognizing negative results it is hard to ascertain just how successful we have been at re-trapping. We have, however, retrapped six Kestrels—five of them once and one twice. We consider the bal-chatri method of hawk trapping to be a most useful accessory to the bander.

#### SUMMARY

During the past two and one-half years we have trapped and banded more than 400 hawks and owls of 7 species, mostly American Kestrels, with a modified form of an old Indian trap called the bal-chatri. Others have had success with at least 6 more species. Several different types are used for the various species of raptors. House Mice have been found to be the best all-around lure. The trapping technique usually involves dropping the bal-chatri from a moving automobile in view of a perching hawk. Those that strike almost invariably become entangled within seconds in snares which cover the top of the trap.

#### ACKNOWLEDGMENT

We are indebted to Mrs. Frances Hamerstrom and to Dr. Frederick N. Hamerstrom for editorial assistance.

#### REFERENCES

- CADE, T. J. 1955. Experiments on Winter Territoriality of the American Kestrel, *Falco sparverius*. *Wilson Bulletin*, **67**(1): 5-17.
- CRAIGHEAD, F., and CRAIGHEAD, J. 1942. Life With An Indian Prince. *National Geographic*, **81**(2): 247.
- FITCH, H. S. 1950. A New Style Live Trap for Small Mammals. *Journal of Mammalogy*, **31**(3): 364-365.
- HOWARD, W. E. 1953. A Trigger Mechanism for Small Mammal Traps. *Journal of Mammalogy*, **34**(4): 513-514.
- HOWELL, J. C. 1954. Populations and Home Ranges of Small Mammals on an Overgrown Field. *Journal of Mammalogy*, **35**(2): 177-186.
- MACPHERSON, H. A. 1897. A History of Fowling. David Douglas, Edinburgh. Cedar Grove Ornithological Station, Cedar Grove, Wisconsin, and Department of Zoology, University of Wisconsin, Madison 6, Wisconsin.