HOTCHKISS, NEIL, and STEWART, ROBERT E. 1947. Vegetation of the Patuxent Research Refuge, Maryland. *Am. Midland Naturalist,* **38**(1): 1-75.
KENDEIGH, S. CHARLES. 1934. The role of environment in the life of birds. *Ecol. Monog.,* **4**: 299-417.
———. 1944. Measurement of bird populations. *Ecol. Monog.,* **14**(1): 69-106.
KLUIJVER, H. N. 1951. The population ecology of the Great Tit. *Ardea,* **39**: 1-135.
LOW, SETH H. 1957. Banding with mist nets. *Bird-Banding,* **28**(3): 115-128.
NICE, MARGARET M. Studies in the life history of the Song Sparrow, I. Trans. Linn. Soc. N. Y., **4**: I-VI; 1-247.
PARKER, R. A. 1955. A method for removing the effect of recruitment on Peterson-type population estimates. *J. Fish Res. Bd. Can.,* **12**(3): 447-450.
PETERSON, C. G. J. 1896. The yearly immigration of young plaice into the Limfjord from the German sea, etc. *Rept. Danish Biological Station* for 1895, **6**: 1-77.
SCOTT, F. R., and JULIAN K. POTTER. 1959. Middle Atlantic Coast Region. *Audubon Field Notes,* **13**(4): 358.
STEWART, ROBERT E., and CHANDLER S. ROBBINS. 1958. Birds of Maryland and the District of Columbia. U. S. Dept. of the Interior, Fish and Wildlife Service. N. Am. Fauna, No. 62, 401 pp.
WILLIAMS, A. B. 1936. The composition and dinamics of a Beech-Maple Climax Community *Ecol. Monog.,* **6**: 317-408.

Communicable Disease Center, U. S. Public Health Service, Montgomery, Ala.; Pennsylvania State University; and Patuxent Wildlife Research Center, Fish and Wildlife Service, Laurel, Md.

A METHOD OF MIST NETTING WOODCOCKS IN SUMMER*

By WILLIAM G. SHELDON

The purpose of this paper is to describe a technique of capturing American woodcocks *(Philohela minor)* with Japanese mist nets during the summer months in central Massachusetts. Low (1957) has thoroughly described mist netting techniques, mostly for passerines. Woodcocks present a unique netting problem requiring certain specific refinements of the technique heretofore described. It is possible that methods described here could be productive for other species as well.

Liscinsky and Bailey (1955) described a method of catching limited numbers of woodcocks in summer and fall by erecting funnel nets in favored summer feeding and resting areas. During the summers of 1953 and 1954, approximately 25 woodcocks were captured in similar traps set primarily for ruffed grouse by personnel of the Massachusetts Cooperative Wildlife Research Unit in central Massachusetts. Summer observations of evening behavior of woodcock led to the discovery of certain open fields where woodcocks light at dusk. The regularity and

*This is a contribution of the Massachusetts Cooperative Wildlife Research Unit supported by the University of Massachusetts, the Massachusetts Division of Fisheries and Game, the U. S. Fish and Wildlife Service and the Wildlife Management Institute.

pattern of these flights suggested the possibility of mist netting for the purposes of banding as well as for records of sex, weights, number of juveniles, and molt sequence. A further publication will describe this behavior and results in detail. Initial attempts at netting began in 1953 when only 10 birds were captured in mist nets. Experience in making 675 captures from 1953 to 1959 form the basis of this paper.

Nets:—

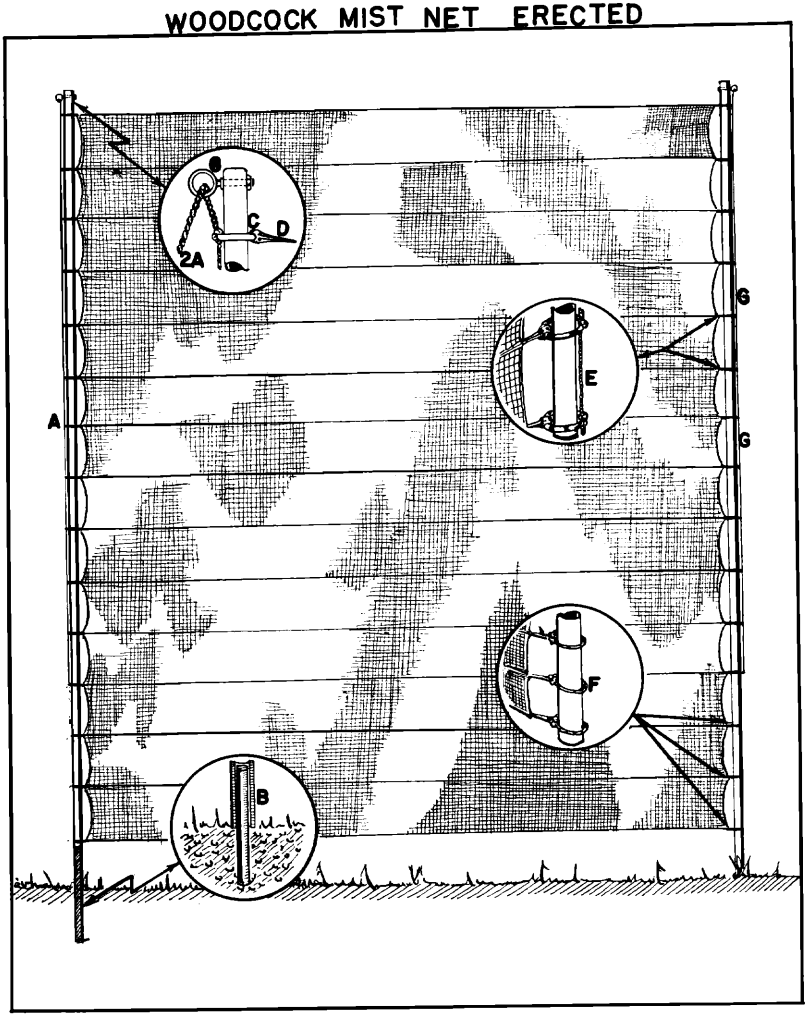
Three different types of nets were used. All have captured some birds. The highest quality silk thrush nets (1¼″ mesh) were most satisfactory. Nylon nets of approximately the same size were effective, but did not have as mush horizontal slack as the silk nets. Warbler nets were used in 1955. If set with sufficient slack, they successfully took woodcocks, but were too light to be durable. Shipments of silk nets from the same source in Japan varied in quality. These nets were ordered through E. A. Bergstrom from an agent in Japan contacted by Oliver Austin, Jr. Because nets used to capture woodcocks were on permanent sets and were exposed to all weather conditions from mid-June until mid-September, the test was very severe. During 1957, the nets received had relatively less twist in the threads, the dye faded quickly and the nets deteriorated in about six weeks. The best quality nets lasted from four to six months. In 1958, using the best quality silk nets, exact records were kept in one netting area of the number of birds hitting the nets and being captured. Of 91 woodcocks hitting the nets, 72 (79 per cent) were netted. The great majority of the escapes were birds hitting the edges of the nets. Some woodcocks which virtually hovered when coming in to light at a slow rate of speed escaped from the main body of the net. Almost all fast-flying birds were caught unless they hit edges.

Methods of erecting sets of nets:—

After experimenting with bamboo and hardwood poles, the most satisfactory type of pole proved to be aluminum television aerial poles which come in ten-foot sections 1″ inside diameter. They are light, sturdy, and do not rust or deteriorate for an indefinite period when exposed to weather. To be effective for woodcocks, the nets must be a minimum of 14′ or 15′ in height. We put two 10′ sections of television poles together so all our nets were 20′ in height. Four-foot ¾″ (outside diam.) pipes were driven 2′ in the ground at each pole site. Each pole was placed on a pipe (Figure 1B). No height was lost by having to drive a pole in the ground, and the poles were solid. Two 30′ sets of nets were erected experimentally, but were unsuccessful since these nets were backlighted by evening sky and visible to most woodcocks approaching the netting sites. In most cases, each 20′ pole required one guy line. Four or five sets of nets were often set in series so that one pole supported two sets of nets. Birds captured above our reach were taken out with an eight-foot stepladder, but we soon found it just as rapid to lower the nets to extract a bird.

Since it was necessary to cover a vertical area from about 2′ above the ground to 20′, at least three four-tier nets were used (Figure 1). To avoid gaps between these nets, which are inevitable in 12 meter nets even when the horizontal strings are taut, the top net was first tied to

FIGURE 1
WOODCOCK MIST NET ERECTED



the poles and the top tier of the next net was tied to overlap the bottom tier of the net above it.

The loops of each net were tied to heavy rubber bands which in turn were tied to rings of 2″ inside diameter which slipped up and down the poles (Figure IC and D). To catch woodcocks, the pockets must be deep enough to drop at least half the vertical depth of the tier immediately below. This vertical distance was positively controlled by the space between the rings. The latter were tied on one vertical string, each spaced a specific distance (depending on type of net) from the ring next to it (Figure 1E and G). A heavier string was tied to the top ring and run through an eye bolt or pulley at top of pole

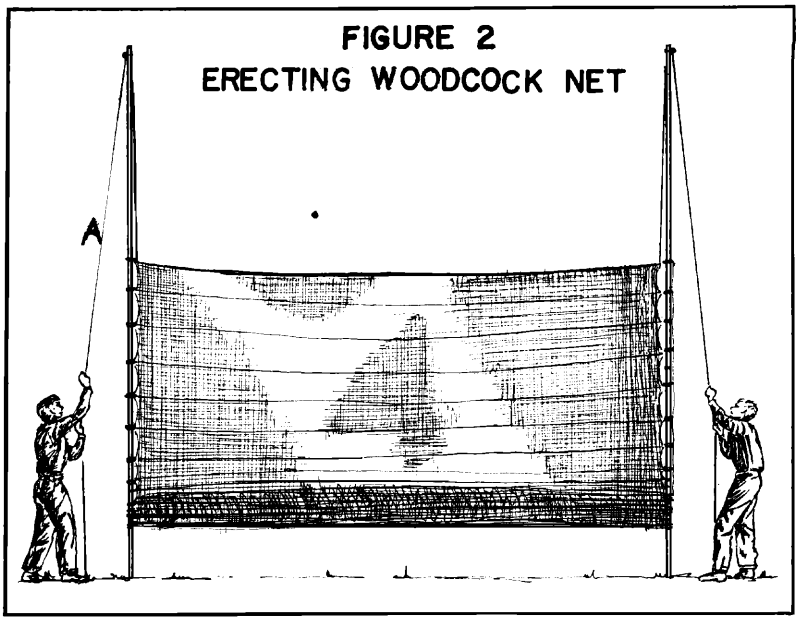


FIGURE 2
ERECTING WOODCOCK NET

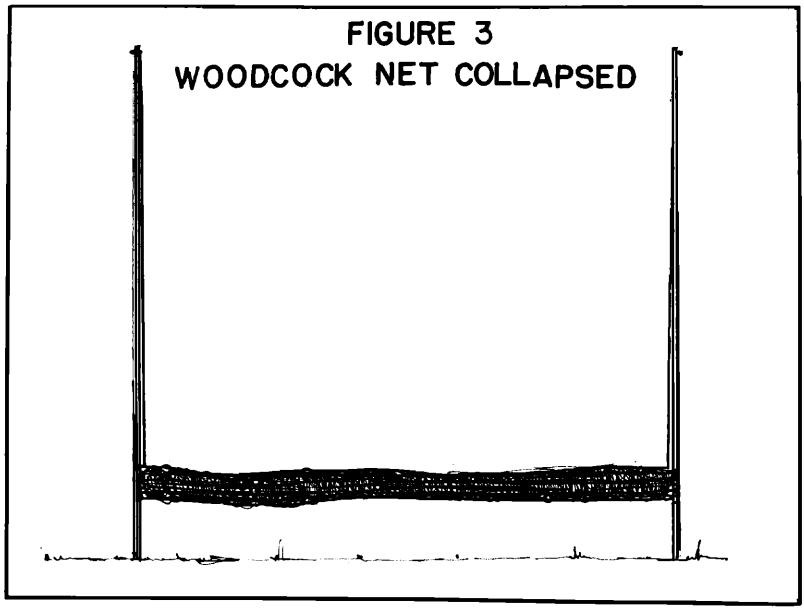


FIGURE 3
WOODCOCK NET COLLAPSED

and down to ground (Figure 1-2A and Figure 2A). The operator pulled the nets up much as one pulls a flag up a flagpole (Figure 2). The bottom three loops of the lowest net were attached directly to the poles by rubber bands (Figure 1F). After a netting period, these loops were pushed together vertically to bunch the net about 4′ above the ground. After completion of netting, the rings supporting the higher nets are run down and supported by the lowest net, thus leaving all nets collapsed (Figure 3).

Placement of nets:—

Three separate sites were netted. They varied in size from ½ acre to 2½ acres. Placement of the nets proved the key to successful captures. The smallest field (Area #1) of only ½ acre was ringed with nets so it was virtually impossible for a bird to come in and escape without hitting a net. The field was narrow and long. Nets ringed the perimeter and several were placed at right angles across the width of the field. Eight sets of nets sufficed to effectively cover the field. Area #2 was about two acres in size. Placement of nets was determined by observation of the flight paths of incoming birds. Four sets of nets were set in a solid bank across the width of the field, and separate sets covered the usual flight paths of the birds. Ten complete sets proved successful. Area #3 was about 2½ acres in size and was covered effectively by banks of nets set in a broad pattern. Eight sets were required. The open end was bordered by relatively tall plantation pines providing a high flight lane seldom used except by birds flying too high to hit the nets. Woodcocks which are netted usually fly into the field just over the tops of the trees or in any break between tree clumps. In some instances, the flight paths were channelized by cutting small trees on the field edge, thus creating a natural approach route.

Locating netting fields:—

All netting fields were near the center of spring breeding grounds, and all were used as singing grounds by males during the mating season. They varied widely in vegetation. Two were on high, dry hills, and the third in a relatively lower area. The ground was very dry, and trees immediately surrounding the perimeter were seldom more than 20′-30′ in height. Fields can only be found by constant evening observation.

Duration of netting:—

The most successful netting months were in June, immediately following the breeding season, until mid-July. Birds have been captured all summer and as late as October 10, but in late July, August and September, evening flights are erratic. Of the 675 birds netted, over 500 were captured before August 1.

Length of evening activity:—

Nets were erected half an hour after sunset on clear days and slightly earlier on overcast days. Woodcock activity begins at the same light intensity as spring courtship performances begin. From the time the first bird was seen, all activity ceased within a maximum of 15 minutes. Usually the duration of activity was slightly more than five minutes. Nets left all night until after dawn failed to capture birds.

Effect of weather:—

Windy evenings yielded few birds. There appeared to be less activity and often the birds detected the movement of the nets. Several years of weather records failed to reveal any positive correlation between weather conditions and bird activity. Cool evenings with temperatures between 55°-65° often yielded a good catch, and just as often were unproductive. Extremely hot days followed by late afternoon thundershowers and a windless, humid evening constituted consistently successful conditions.

Number of birds seen or captured per evening:—

Birds observed over the netting fields varied from one or two to over 20. Many passed over the field without attempting to light. After mid-June until mid-July, one of the best fields yielded an average of approximately three birds per trap night. Records of high catches include two instances of catching 10, three records of catching eight, three instances of catching seven, and several evenings when six were captured. After August 1, the catch dropped to under one bird per trap night.

Conclusions:—

The method of mist netting described above is unproductive as compared to netting records for many passerines. Sufficient woodcocks to yield significant scientific data on age and sex ratios, weights, molt pattern, etc., require netting every evening over at least six weeks of time. When help was available, we often ran three netting fields simultaneously.

Acknowledgments:—

A number of graduate students assisted from time to time in the field. Special acknowledgment is due Wendell Dodge, Raymond Gehling, Ethan Howard, Jr., and Gardner Hobart. Alfred Godin did the drawings of Figures 1-3.

Literature cited:—

Liscinsky, Stephen A., and William J. Bailey. 1955. A modified shorebird trap for capturing woodcock and grouse. *Jour. Wildl. Mgt.*, **22:** 310-312.

Low, Seth H. 1957. Banding with mist nets. *Bird-Banding*, **28**(3): 115-128.

Dept. of Forestry and Wildlife Management, University of Massachusetts, Amherst, Massachusetts.