

A METHOD FOR CONSTRUCTING AND ERECTING AERIAL-NETS IN A FOREST

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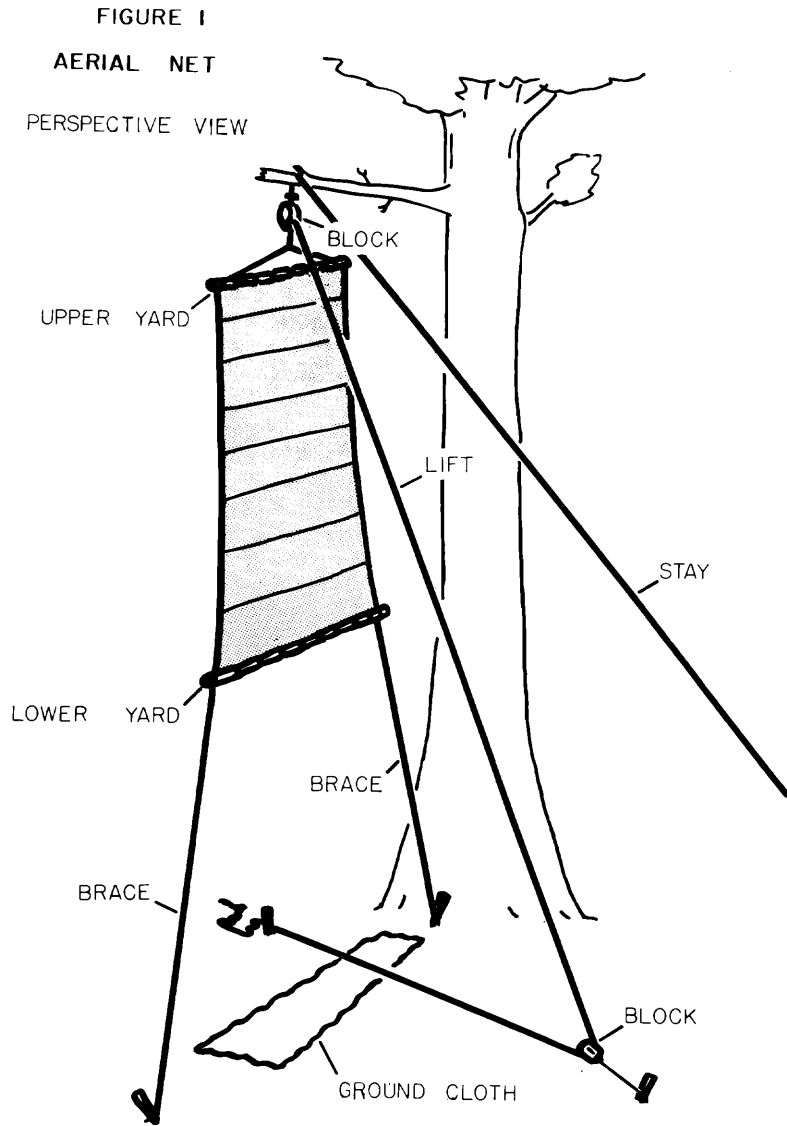
The Japanese mist-net was introduced to North American banders by O. L. Austin, Jr., in 1947. Nets have proved a versatile and invaluable aid in readily capturing a greater variety and a larger number of birds for banding than is possible with the various traps available. S. H. Low (1957) provided a detailed discussion of the operation of standard nets obtainable from distributors, and problems associated with their use. The versatility of mist-nets, and their apparent high non-selectivity in capturing birds, suggested their value as a means of sampling bird populations for estimating population size and studying population structure and dynamics. Stamm *et al.* (1960) described a method which they employed in studying wild bird populations with nets. The method is appealing since it can be used to standardize samples and provides information which can be treated statistically.

Slud (1960), conducting an investigation of an avian community in a tropical forest in Costa Rica, suggested that nets set in the standard manner (Low, *op. cit.*) will sample effectively only those species which commonly move in the strata near the ground. Preliminary data from ground nets used by the senior author in the forest on Barro Colorado Island, Canal Zone, Panama, confirmed Slud's warning. Species seen in the mid-forest and near the ground were the only ones taken.

Few attempts, if any, have been made to utilize aerial-nets in forested areas to compensate for the evident vertical bias of ground net-samples. Perhaps visions of tall steel towers and a costly budget (in terms of time and expense) prove discouraging. Worth (1964 and in litt.), studying the problem of birds acting as hosts to arboviruses, briefly described the use of two nets suspended from rather elaborate structures by his group at the Trinidad Regional Virus Laboratory.

Interest in extending the scope of the net as a tool in studying bird populations led us to consider an economical and versatile technique of constructing and erecting aerial nets. The development of a technique was initiated in the summer of 1963 as part of a continuing study of the avifauna of the William L. Hutcheson Memorial Forest, Somerset County, New Jersey (cf. Swinebroad, 1964). Our success in working with four aerial-nets has resulted in this communication. We hope that the method described below will be valuable to interested investigators, especially to those operating on a limited budget.

The criteria which have guided the development of the following technique are (1) that a number of nets could be erected and operated by one man with a minimum of effort and expense; (2) that the erection and operation of the nets could be sufficiently versatile



for use at non-permanent sites; and (3) that the nets could be erected with a minimum of disturbance to surrounding vegetation. Basically our problem resolved into finding or constructing a net suited to our purposes and discovering a simple way of anchoring a pulley and ropes on a support in the canopy or sub-canopy of a forest at a desired site.

CONSTRUCTING THE AERIAL-NET

Modifications. We have found it desirable to modify a standard 12-meter net for use as an aerial-net. The long horizontal axis of 6-, 10-, or 12-meter nets make them unwieldy and impractical as aerial-nets except where they can be used with elaborate set-ups. A more suitable net for intersecting a vertical cross-section of a forest, at least according to the criteria which we established, is a net with a long vertical axis and a short horizontal axis. We construct such a net by removing the shelf-strings of a 12-meter, 36 mm mesh net and restringing it so that the panels are aligned across its short axis; the horizontal axis of the standard net thus becomes the vertical axis of the aerial-net (see Figure 1). In addition, we reinforce the top and bottom lines of the net-frame (which becomes the sides or "leech" lines of the aerial-net) by weaving in extra lengths of heavy nylon fishline (80 lb. test). These modifications are relatively simple to do.

Any of the standard nets now available may be used for an aerial-net when modified as above. The net should be of the best grade. Strength and resistance to change in length with humidity are features of high quality nets. Reinforcement of the net frame (see above) with heavier line provides additional durability.

The amount of slack in the netting between shelf-strings is an important consideration in the aerial-net as well as in the ground net. The shelf-strings of the aerial-net cannot be raised or lowered readily to control the amount of "pocket", thus the slack (about 8-10 cm) should be made at the time the regular net is modified. This can be achieved by adjustments in the spacing of the shelf-strings and by shortening the shelf-strings of the aerial-net. Also, the shelf-strings should not be limp when the aerial-net is set or its effectiveness will be minimized.

Mounting the Aerial-Net. The aerial-net must be kept rigid when in use. This is accomplished by stretching the net between two 3 1/2 meter lengths of bamboo or aluminum television-antenna poles, termed upper and lower "yards" respectively. When set, the aerial-net resembles a vertically elongated rectangular sail.

ERECTING THE AERIAL-NET

Equipment. A simple method for suspending these aerial-nets at selected sites in the canopy of a forest enhances their versatility and usefulness. We shoot a light line over a desired support and use it to haul up the heavier cords, pulley, and the aerial-unit (net mounted as above). We use a recurved laminated bow (50 lb. pull), a bow reel attached to the front of the grip, and tiplless

fiber-glass fishing arrows. The reel is loaded with about 30 meters of fishing line and the end of this line is tied through the "eye" at the rear of an arrow. The arrows are sufficiently heavy to carry the line back to the ground, even through relatively dense vegetation, after they have been shot into the canopy.

Once the fish-line has been shot successfully over a selected branch, we tie it to 60 meters of heavy duty, wire-reinforced, plastic cord (the "stay") and draw it over the support. A plastic clothesline pulley (or block) is then attached to one end of the stay. Another 60 meters of cord (the "lift") is threaded over the pulley-wheel and the block and cord are drawn up against the support. The free end of the stay is tied back out of the way, usually to some nearby small shrub or tree. One end of the lift is tied to the upper yard of the aerial-unit. This cord is used to raise or lower the unit. The free end of the lift can be threaded through a second block a meter or so above the ground and two to three meters away to keep it free of the netting.

The end of the lift attached to the upper yard should be tied above the center of gravity of the aerial-unit to insure that it is properly balanced. To keep the frame of the net taut when it is set, and to minimize the effect of wind twisting the unit, we attach a 30-meter guy-line ("brace") on each end of the lower yard. After the aerial-unit is set at a given altitude, the braces are tightened down and tied. These lines are also used to control the net when it is raised or lowered. When the unit is properly balanced and tied down, it is surprisingly stable. Care must be taken, however, not to put too much tension on the net by the braces, since the twine frame (if not reinforced) may break when a gust of wind causes extreme upward motion by the supporting branch.

Windiness must be considered when operating aerial-nets. Such nets are more exposed than ground nets in a forest. Even light winds will cause motion which may influence their effectiveness.

Site Selection. One of the advantages of our method is that it requires relatively little disturbance of the surrounding vegetation. We locate a small natural opening (about 4 1/2 meters in diameter) in the subcanopy which provides a clear view of the canopy. We also look for a branch projecting over the opening. Branches of subcanopy trees or shrubs which might interfere with the net can either be trimmed or tied back out of the way. Low shrubs and loose litter directly below and in line with the net should be removed.

Removal of Birds. Raising or lowering the aerial-unit generally takes from a few seconds to two to three minutes, depending on the altitude at which it is set. Since only one line, the lift, is used to raise or lower the unit, it can be controlled easily by one man. When a bird is captured, the operator lowers the net onto a ground-cloth where it piles up. The ground-cloth, a piece of canvas about five meters by one meter, protects the net from debris on the ground. The net can be stopped at any desired height, e.g., if a bird is in the center panel, this can be arrested at chest height. When the net piles up on the ground-cloth, the netting above the cloth becomes

limp. So far at Hutcheson Forest, this has not proved disadvantageous to the retention of birds in the net as it is lowered. Some species, however, may take a little longer to remove than when in a taut net.

Storage of Net. If an aerial-net is used on several successive days, it may be stored overnight by leaving it piled up on the ground-cloth and folding the edges of the cloth over the net for protection. The net can be raised easily the next morning. If the operator is not using a net, it can be rolled up by rotating the lower yard until it lies adjacent to the upper yard. The two yards can then be tied together and rolled in the ground-cloth.

USE AT HUTCHESON FOREST

At present we have four aerial-nets (modified from 12-meter, 4-shelf, 36 mm mesh nets) which we have used intermittently during two and one-half summers. Much of our effort has been directed to developing the method.

During the summer of 1965, two of the nets were set up and run for four consecutive days by the senior author from June 30 to July 3 (0600 to 1500 EDT daily). One net was anchored so that the top panel could be raised about 21 meters above the ground; the top panel of the second net could be raised about 12 meters. Also, nearby ground nets were open to act as controls for a comparison of capture rate.

During the four days of operation, six birds were captured in the aerial-nets. Eight birds were captured in the two nearest ground nets. The species caught in the aerial-nets, and altitudes of capture to the nearest one-half meter, were: Tufted Titmouse (*Parus bicolor*), 3.0 m; Robin (*Turdus migratorius*), 1.5 m, 6.0 m, and 9.0 m; Scarlet Tanager (*Piranga olivacea*), 3.5 m; and Yellow-shafted Flicker (*Colaptes auratus*), 5.5 m.

These preliminary data indicate that the technique discussed above is a practicable one. Although we have employed a maximum of four nets, at least six to eight could be used easily by one operator. Also, several modified nets could be laced together vertically to make one long net which would intersect the profile of a forest from ground to canopy at one time. Such a net, however, may require more pruning of the vegetation and probably would involve two operators.

Aerial-nets could be useful in a number of types of investigations of forest avifaunas. First of all, such nets, if used properly, might provide a more complete sampling of a forest in studies of population size, structure, and dynamics. Ground nets give a good horizontal coverage, but little vertical coverage. This may prove to be an important bias in quantified studies. Also, aerial-nets might prove valuable in studying the daily activities of different species of birds in relation to the stratification of a forest. Consideration of species' activities as a function of volume rather than area is realistic in view of known relations of birds to the vertical structure of a forest (cf. MacArthur, 1958; and MacArthur and MacArthur, 1961.)

SUMMARY

A method is described for modifying standard size mist-nets into aerial-nets, and for erecting these nets in a broad-leaved forest. The method was developed at the William L. Hutcheson Memorial Forest, New Jersey, in conjunction with a continuing investigation of its avifauna. The long horizontal axis of a ground net is used as the vertical axis of the aerial-net. Shelf-strings of the standard net are removed and re-oriented so that the panels or shelves are aligned one above the other in the aerial-net. The net is mounted between two light poles. The pulley and rope is placed over a selected elevated support with a bow and fishing arrow to which a light line is attached. Aspects of site selection, removing birds, and storing the nets are discussed. Preliminary information from Hutcheson Forest show that the aerial-nets may be as effective as ground nets in capturing birds.

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