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EVALUATION OF THREE ELEVATED MIST-NET SYSTEMS FOR SAMPLING BIRDS

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Abstract.—Three light-weight, low-canopy mist-net systems were developed and tested in dry tropical scrub, mangrove and forest habitats. One plastic (polyvinyl chloride) and two aluminum pole systems (with and without pulleys) were used to support mist nets to heights of up to 7.3 m. Although the aluminum telescoping-pole system (without pulleys) was expensive initially ($79–141/unit [US]), its use reduced capture of nontarget species and may have increased capture of target species when compared with ground-level netting. In one year, its use also reduced labor costs by $756, which completely offset the higher cost of the aluminum telescoping-pole system when compared to the plastic-pole system ($19/unit). Unlike the plastic-pole system, the aluminum telescoping-pole system was adjustable to any height within its range of 1.8 to 7.3 m, was 1.5 m higher, was more efficient to operate in the field, and was easily moved to new locations. For capture of psittacines, the pulleys of the aluminum telescoping-pole system were not necessary, but their use may assist in efficiently retrieving large numbers of birds from the nets. The aluminum telescoping-pole system was efficient in capturing psittacines, columbids, passerines and possibly chiropterans in habitats with canopies <10 m or in the forest subcanopy.

EVALUACIÓN DE TRES SISTEMAS DE REDES ORNITOLÓGICAS ELEVADAS PARA MUESTREAR AVES

Sinopsis.—Se desarrollaron tres sistemas livianos para el uso de redes ornitológicas a nivel del dosel. Éstos fueron probados en bosques de matorral seco, manglar y habitáculo arboreo tropical. Los sistemas permiten que se eleven ls redes hasta una altura de 7.3 m. Uno de los sistemas está compuesto únicamente de tubos plásticos (polivinyl cloride) mientras que los otros dos sistemas consisten en tubos telescópicos de aluminio (con o sin poleas). A pesar que el sistema de tubos telescópicos de aluminio (sin poleas) inicialmente fue más costoso ($79–141/unidad [US]), su uso redujo la captura de especies no deseadas y puede haber aumentado la captura de las especies deseadas, cuando se compara este sistema con los terrestres. En un año, el uso de estos sistemas permitió una reducción de $756 en gastos de labor, lo que minimiza el alto costo de los tubos telescópicos comparado con el sistema de tubos plásticos ($19/unidad). A diferencia de los tubos plásticos, el sistema de tubos telescópicos de aluminio es ajustable a cualquier altura dentro de su margen de 1.8 a 7.3 m, fue 1.5 m más alto, es más eficiente de operar y fue más fácil de mover a una nueva localidad. Para la captura de psittácidos, el uso de poleas con los tubos telescópicos no fue necesario, pero puede ser eficiente al remover cantidades grandes de aves. El sistema de tubos telescópicos (sin poleas) fue eficiente en la captura de psittácidos, colúmbidos, pasarinos y posiblemente chiropterados en habitáculos con doseles <10 m o en el subdosel del bosque.

Mist-netting has been proven an effective method for the capture of birds since it was first introduced from Japan by Austin (1947). Although originally thought to be nonselective (Austin 1947, Low 1957), slight changes in net mesh size affect the efficiency with which certain species and sizes of birds are captured (Heimerdinger and Leberman 1966, Pardieck and Waide 1992). Net placement within the habitat is also important in determining which species and how many individuals are captured (Stamm et al. 1960).

Positioning nets in the canopy is sometimes necessary to sample and capture forest birds, especially in tropical forests (Greenlaw and Swinebroad 1967, Humphrey et al. 1968, Munn 1991, Paton et al. 1991, Whitaker 1972). Biologists have proposed various methods of erecting nets at heights of 3–9 m to capture a representative sample of the avian community or a specific bird species (Chapin 1988, Heselton 1990, Karr 1979, Sheldon 1960). None of the existing canopy mist-net methods was satisfactory for our purposes. These methods required one or more of the following conditions: tall trees nearby, more than two persons to operate because the system was heavy and difficult to move, or skilled builders because the system was complicated.

We developed and tested lightweight, elevated mist-net systems for use in rugged montane rain forests, mangrove swamps and scrub. These systems were tested for capturing psittacines. We discovered that one system was superior and was also useful for capturing other birds, especially passerines and columbids, and possibly chiropterans. We propose herein three methods to capture birds from 2.6 to 7.3 m above ground and provide data to substantiate our recommendation for use of the most efficient method.

METHODS

We used polyvinyl chloride (PVC) pipes and aluminum poles for structural support of the mist-net systems. We built a 5.8-m high pole system from 20- and 40-gauge PVC pipes of 21 and 33 mm outside diameter (o.d.). We used aluminum alloy telescoping poles, Propole Model No. 3424 (Mr. Longarm, Inc., Greenwood, Missouri). [Use of brand names does not constitute government endorsement.] These poles extend up to 7.3 m and are threaded at the top for attachment of a paint-roller handle.

Construction of plastic-pole system.—To build the system we cut a 3.0-m length of 40-gauge PVC pipe (33 mm o.d.) in half and used it to support the bottom of the pole (Fig. 1). The halves were then attached with the preformed couple found at one end of the pipe (bottom section). Another 1.5-m section of the same type PVC pipe was used to make the top support piece. A 1.5-m length of 20-gauge PVC pipe was placed inside the larger PVC pipe to make the top section (Fig. 1). Holes were drilled through both pipes when extended to 2.8 m and the pipes were marked at the point where they intersected so that the holes could be realigned easily. Holes were also drilled through both pipes unextended to secure them for storage and transport. These two pipes (top section) were locked by placing a 6-mm-diameter hexhead bolt through the holes, and were secured with a nut. We attached the bottom and top sections with the preformed couple on the pipe to make a 5.8-m pole. The poles were

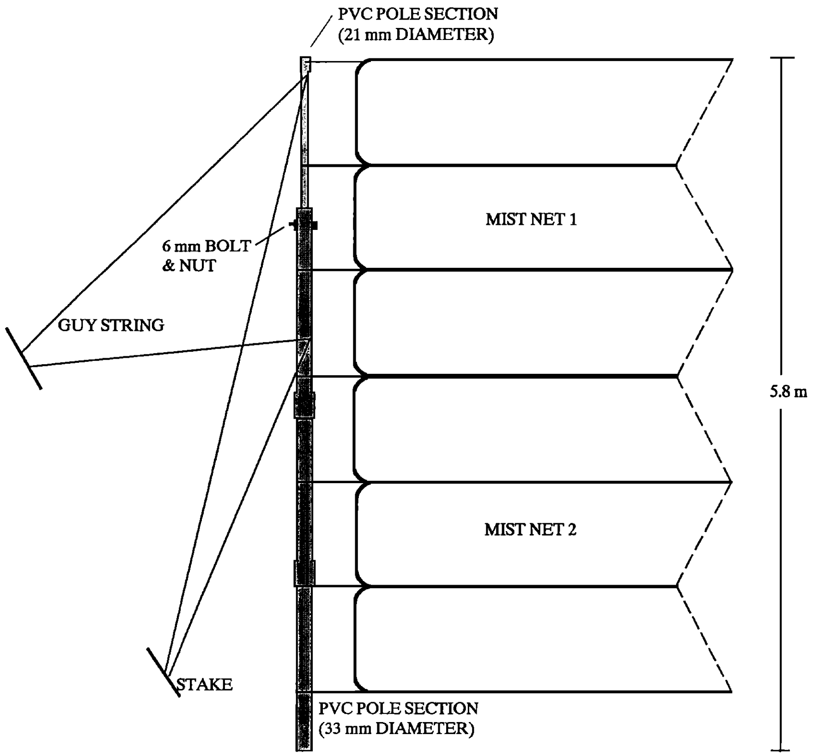

FIGURE 1. Plastic-pole (PVC) mist-net system without pulleys for raising nets to 5.8-m height.

spray-painted green. Net loops were attached directly to the poles, which were guyed at the top and mid-point with nylon twine (115-kg test) that was dyed black. We anchored the poles with reinforcing iron bars (60 cm long) driven halfway into the ground.

Construction of aluminum-pole system.—Each aluminum-telescoping pole had four 1.8-m sections that lock in place with a twisting friction collar. We fitted the top of the aluminum-telescoping poles with paint-roller handles, for which they are designed. The paint-roller handle was bent to accommodate a pulley and rope system (Fig. 2). We used 20 m of braided nylon line (6-mm diameter, 400-kg test) dyed green for the pulley rope. To reduce setup time, the rope was wrapped around the paint-roller handle for storage when not in use. The aluminum poles were spray-painted with flat black enamel. The poles were guyed with nylon twine (115-kg test), that was dyed black and were anchored with reinforcing iron bars (60 cm long) that were driven halfway into the ground. Small aluminum tent poles (Karr 1979) or lengths of bamboo were attached to the rope to raise and secure the net system (Fig. 2). These small

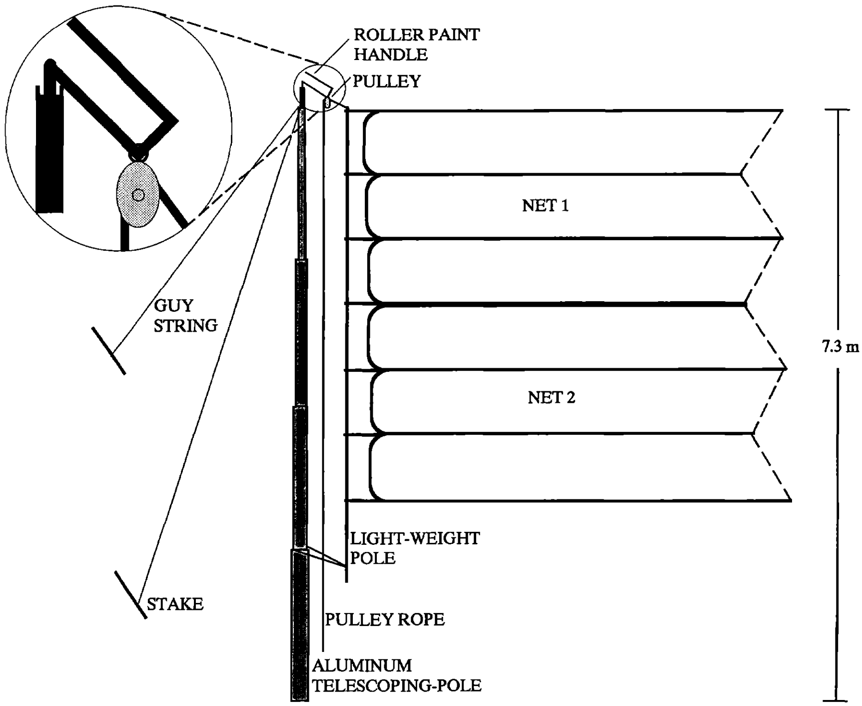

FIGURE 2. Aluminum telescoping-pole mist-net system with pulleys for raising nets to 7.3-m height.

poles were tethered at the bottom. We also erected this net system without pulleys by attaching the net loops directly to the telescoping poles (Fig. 3). The pulley rope was attached to the top of the pole and used as a guy line in this situation.

Sampling and analysis.—During 1991 and 1992, we tested both net systems for capture of psittacines (n = 8 samples for plastic-pole system and n = 27 samples for aluminum-pole system) at three locations: Cabeza de San Juan, Central Aguirre and Mayagüez, Puerto Rico. Each sampling period was 2–3 h in duration. We recorded species captured and total net-hours (net-h). We also recorded the time to erect, open, close, raise, lower and dismantle each net system under controlled conditions. The net systems were erected in dry forest-scrub with a canopy height of 4–9 m and emergent trees to 15 m, in an arboretum with trees up to 30 m tall, and in mangrove forest with a canopy height of 9–10 m. Mist-netting was conducted after sunrise at approximately 0600–0900 hours and at 1600–1830 hours before sunset.

We compared capture rates of 61-mm-mesh canopy nets to rates for ground-level nets using analysis of variance. Differences were considered significant at $P < 0.10$.

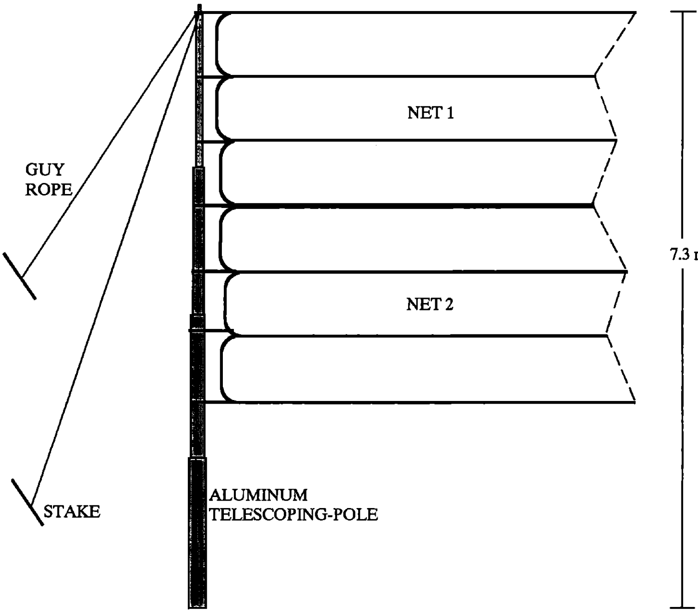

FIGURE 3. Aluminum telescoping-pole mist-net system without pulleys for raising nets to 7.3-m height.

RESULTS

Operation of plastic-pole system.—The system weighed 2.65 kg/unit (two poles, 5.8-m high and guy lines), cost $19 (US), and took <2 h to build. Two persons could erect a 5.8-m high stacked mist net (5.2 × 12 m) in 0.32 h (Fig. 1). It took 0.04 h for one person to lower and raise the nets to release a bird from the top shelf, not including time to remove a bird. We lowered the net by removing sections of the PVC pipes temporarily to make the height <3 m for removal of birds from the top shelves. This lowering could be done by one or two persons. Two persons could close two stacked mist nets in 0.12 h, open the nets in 0.05 h, and dismantle the plastic-pole net system in 0.10 h.

Operation of the aluminum-pole system.—The system weighed 2.35 kg/unit (two poles, pulleys, ropes and hardware), cost $79–141 depending on the vendor, and took only a few minutes to build. Two persons could erect a 7.3-m high stacked mist-net system in 0.25 h with the pulley system and in 0.15 h without the pulleys (Figs. 2 and 3). It took one person 0.02 h to lower and raise the nets (i.e., to remove a bird from the top shelf) using the pulley system and 0.04 h without the pulley system. Two persons could close the stacked mist nets with the pulley system in 0.06 h, open the nets in 0.05 h, and dismantle the pulleys and aluminum telescoping-pole system in 0.13 h. A net lane 2–3 m wide was required

TABLE 1. Comparison of three canopy mist-net systems for time (person-h) to erect, open, close, operate, and dismantle six units for four sampling periods (2–3 h) in 2 d.

Task	Plastic-pole	Aluminum telescoping-pole (with pulleys)	Aluminum telescoping-pole (without pulleys)
Erect	3.9	3.0	1.8
Open three times	1.7	1.9	1.1
Close three times	4.4	2.0	1.1
Operate (lower and raise five times)	0.2	0.2	0.6
Dismantle	1.2	1.6	1.0
Total	11.4	8.7	5.1

to lower two stacked nets to prevent entanglement with vegetation. Removing birds was easier when two persons worked together. Without the pulley system, two persons could close two stacked nets in 0.03 h, open the nets in 0.03 h, and dismantle the aluminum telescoping-pole system in 0.08 h.

Capture and net-system efficiency.—We captured 76 individuals of 18 bird species in canopy nets using 61-mm (63 individuals in 50 net-h) and 121-mm (13 individuals in 505 net-h) mesh sizes with the aluminum telescoping-pole system. Only one individual was captured in the plastic-pole system using 102-mm and 121-mm mesh nets (133 net-h). Six chiropterans were also captured in the 121-mm-mesh canopy nets with the aluminum telescoping-pole system during the first 90 net-h. We avoided capture of chiropterans thereafter by opening the nets later, at sunrise.

During netting over an entire year (10 2-d sessions with four samples/session) we saved 63 person-h using the aluminum telescoping-pole system (without pulleys) compared with the plastic-pole system (Table 1). We saved considerable time opening and closing the nets with the telescoping-pole system.

The aluminum telescoping-pole system has a height adjustment that allowed us to erect nets easily at any desired height from 2.6 up to 7.3 m. In a dry scrub-forest, we reduced capture rates ($P = 0.087$) for non-target birds by raising 61-mm-mesh nets from a 2.7- to a 5.3-m height. Adjusting these nets to sample the top edge of the adjacent canopy may have increased our capture rate for our target species (0.067–0.523 parakeets/net-h, $P = 0.367$). Our small sample for ground-level mist-netting ($n = 2$) prevented us from determining if this increase was significant. Nets erected at 7.3 m were more efficient in capturing *Amazona* spp. than mist nets erected at 5.8 m. We captured 46 *Aratinga canicularis* and eight *Amazona* (three species) in a variety of habitats with the aluminum telescoping-pole system.

DISCUSSION

The aluminum telescoping-pole net was a relatively light, compact and versatile system that could be transported in rugged terrain such as the wet tropical forests of Puerto Rico. The plastic-pole system was lightweight and less expensive, but required more than twice as long to erect and was cumbersome to move. The aluminum telescoping-pole system was also more efficient in capturing target species compared with ground-level netting.

Time saved in erecting the aluminum telescoping-pole net system will significantly reduce its cost compared with the plastic-pole system or other canopy netting systems (Chapin 1988, Heselton 1990, Sheldon 1960). We saved $756 in labor at $12/h, erecting the aluminum telescoping-pole system compared with the time needed to erect the plastic-pole system. This saving was enough in 1 yr to offset completely the high initial cost of the aluminum telescoping-pole system.

Unlike other canopy net systems the telescoping-pole system did not require climbing trees (Paton et al. 1991, Whitaker 1972) or tree limbs nearby to erect the nets in a desirable location (Dejonghe and Cornuet 1983, Greenlaw and Swinebroad 1967, Humphrey et al. 1968, Munn 1991). Our system, however, is limited in height compared with systems designed for use in trees of 30–40 m height.

We recommend that the pulley system be used only for mist-netting with smaller mesh sizes (30 and 36 mm) if the capture rates are high. Capture rates were low for larger mesh sizes (121 mm) and the pulleys were not necessary. The time saved erecting this system without pulleys is substantial and birds can be lowered quickly for release with the telescoping-pole system.

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