The AFMO Hi-Lo: Double Height Mist Net Utilizing a Pivoted Parallelogram Support System

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The "Hi-Lo" net support system described in this paper has operated successfully during the intense activity at the Allegheny Front Migratory Observatory (AFMO) for three years. The system is a radical departure from designs described by Mease and Mease (1980), Nixon (1972) and Chapin (1988). The Hi-Lo accommodates lowering of the upper net, for access to the captured birds, by moving the poles that support the nets. As the upper net is lowered, the lower net simultaneously raises to replace it.

Advantages of the Hi-Lo system include:

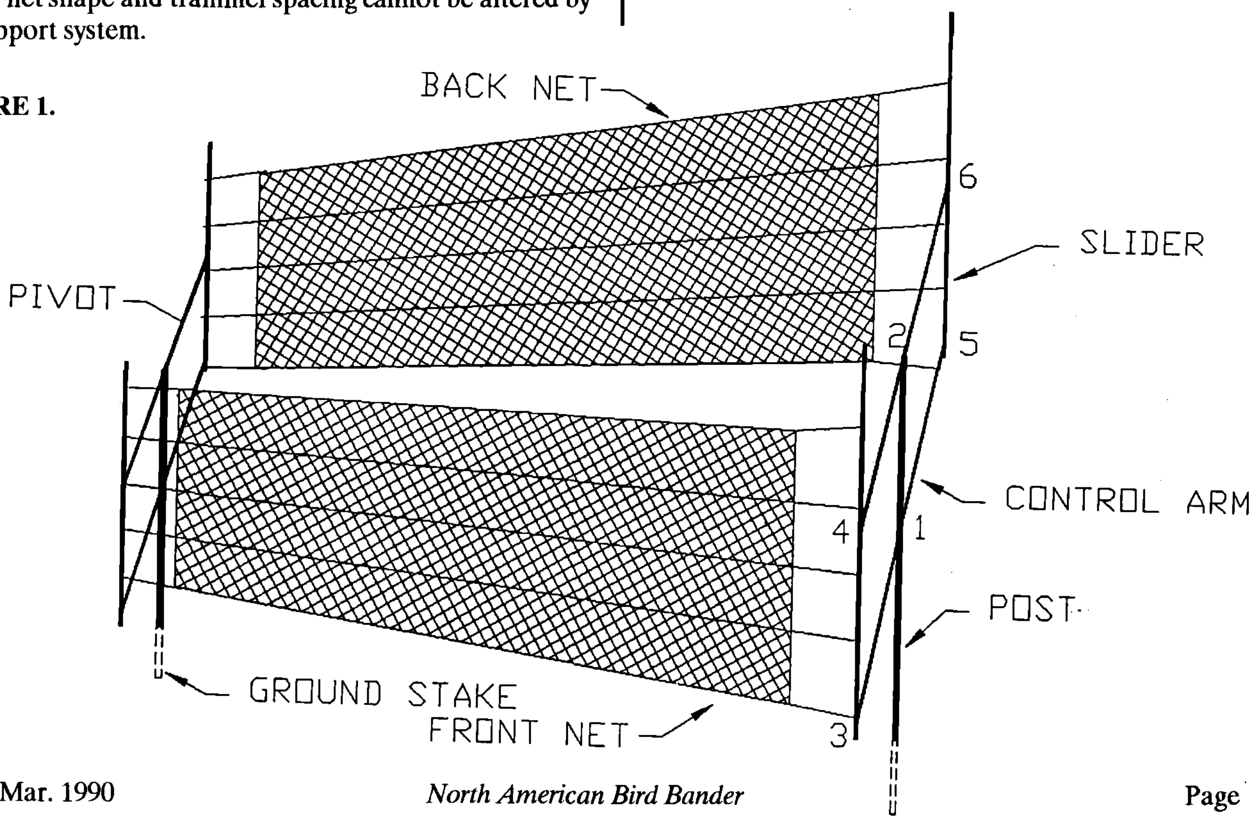
1) It can be operated by one person.
2) The upper net is lowered in less than five seconds.
3) The operator does not have to tie knots, secure lines, nor attach fasteners.
4) The flight path is obscured by two nets, one over the other, at all times except for the short period of operation, eliminating adjustments in net hours.
5) The net shape and trammel spacing cannot be altered by the support system.

Disadvantages of the system include:

1) Weight; the original weighs over 40 pounds.
2) Set-up time is longer than for two normal single height mist nets.
3) It requires a wide net lane, at least six feet, to prevent tangling the nets in adjacent brush.
4) The system is expensive if all components must be purchased.

Several lessons were learned during the trial years at AFMO which have altered the design concept. The basic structural design is described in this paper with a description of the original and suggested modifications. It is hoped that experimentation by others with this system will result in documentation of further improvements.

FIGURE 1.



BASIC STRUCTURE

The basic structure of the Hi-Lo consists of two identical end supports which support the two nets as shown in Figure 1. The support poles are fixed to the ground and guyed while all other components are free to move. The sliders, pivots and control arms form the pivoting parallelogram. They are connected at the numbered points with a stud welded to one of the pieces and passing through a hole drilled in another to form flexible joints. Studs welded to the net sliders pass through holes in the ends of the pivot and control arms. The pivot and control arms are connected to the support posts at points 1 and 2 in the same manner. The construction of one of the pivot joints (point 4) on the original is shown in Figure 2.

The assembly functions by rotating the control arm around pivot 1. Due to the form of the parallelogram, the pivot rotates in the same direction around point 2 and the two net sliders remain vertical as their elevations are changed. The key to successful operation of the structure is precision construction to maintain the distances between the pivot points. The spacing of points 1-2, 3-4, and 5-6 must be equal. The spacing of points 1-3, 1-5, 2-4, and 2-6 must all be equal to one-half the distance of 3-5.

Simultaneous rotation of the pivots and control arms at both ends of the nets is achieved by connecting cables that are run from the control arms through pulley blocks mounted at the base of the support poles. The cables are connected with springs to the control arms 12 inches from, and on each side of, point 1 as shown in Figure 3. The two cables cross between the support poles. The cable connected between points 1 and 3 on one end of the nets terminates at a

FIGURE 2.

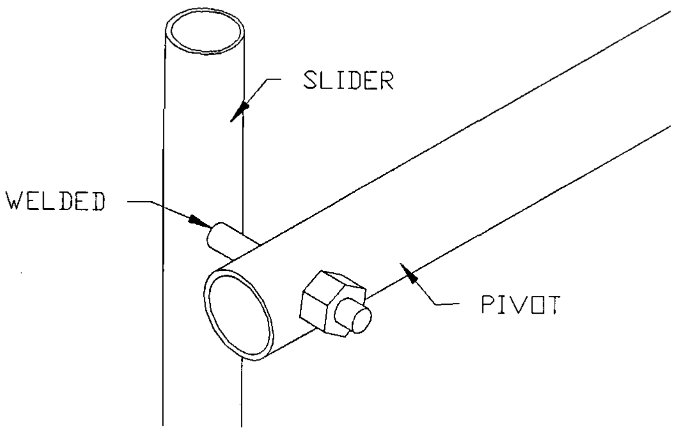
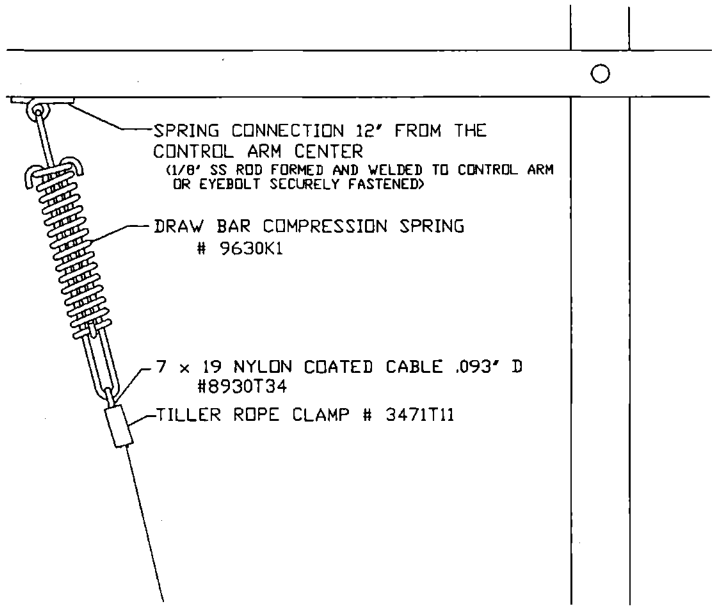


FIGURE 3.



connection between points 1 and 5 at the other end.

ERECTION

The ground stakes are installed in the ground four to six inches wider than for normal net poles. Prior to erection, the pivot arm is connected to the support pole at point 2. Each support pole is slipped over the ground stake and adjusted to achieve the proper height of pivot point 3 (or 5) above the ground--that height being slightly lower than the normal elevation of a bottom net trammel. The support pole is attached to the ground stake by through bolting. Pivot and control arms are mounted outside the assembly. The parallelogram is completed by assembling joints at 3, 4, 5, and 6 to connect the sliders inside the pivots and control arms.

Guy wires are connected to the support poles and the poles are plumbed. Pulley blocks for the control cables are installed using a through bolt passed through pulley block eye, the ground stake, and another pulley block eye immediately above the ground. The springs and control cables are connected to the control arm at one end of the nets. The cables are run through the pulley blocks at the base of the pole, crossed over between poles, run through pulley blocks, and brought to control arm connections at the opposite pole. The cables are then adjusted to maintain relative position of the assemblies with the springs compressed by approximately 1/4 inch. The assembly should be checked by rotating it once or twice without nets attached.

The installation of nets utilizes ties at the trammel ends to connect to the sliders. The two nets should be adjusted to maintain the same distance between sliders for both nets, thereby minimizing undesirable rotational forces on the ground stakes which will eventually loosen them.

OPERATION

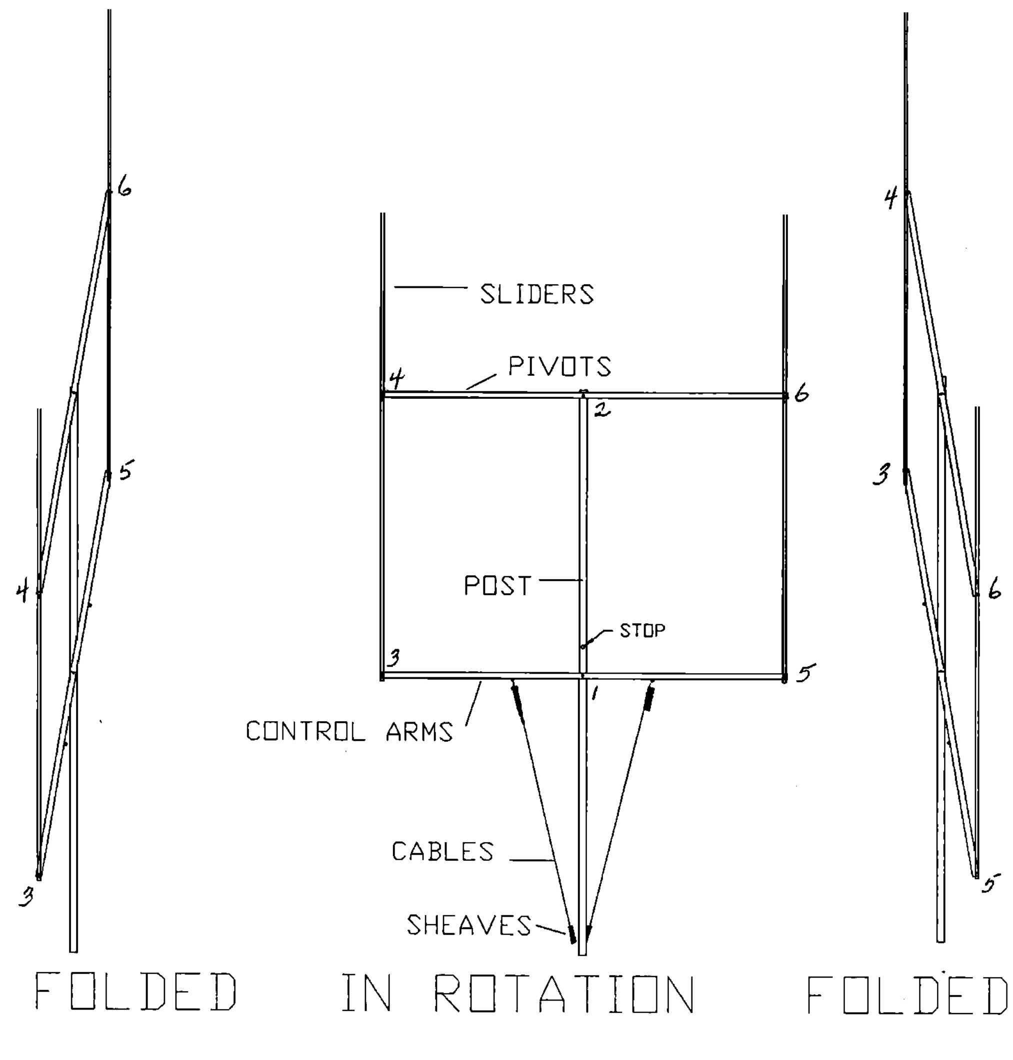
To gain access to the top net, the bander walks to either end, takes a hold of the control arm at either side of the support post, lifts up with one hand and presses down with the other to force the control arm to rotate. The control arm should not be released until rotation is complete. The top net is lowered to normal height while the bottom net rises to the higher elevation. Three stages of rotation are shown in Figure 4. The force required to rotate the assembly varies due to the change in angle of the cables. The maximum stress is required at the halfway point.

There is no need to secure the assembly in the two folded positions because any tendency to rotate results in a increase in spring tension. The design utilizes "the shortest distance between two points" to produce the two stable positions. A latch installed on the original was found to be unnecessary. The construction should produce a 12 to 18 inch horizontal separation between the two nets.

COMMENTARY ON MATERIALS AND CONSTRUCTION

The materials selected to build the Hi-Lo can be determined by your sources. Any type of metal tubing--fiberglass reinforced pipe or even wood--could serve for the support poles, pivots, control arms, and sliders. PVC pipe would have to be very large and heavy to withstand the bending forces. The original employed at AFMO was constructed of stainless steel tubing: 1/2 inch for sliders, 1 inch for pivots and control arms, 2 inches for support poles, with 1-1/4 inch pipe ground stakes. Several holes are drilled completely through the ground stake for connection of the support poles and pulleys and to allow for variances in soil conditions. With the exception of one slider that someone stepped on while it lay on the ground, the original Hi-Lo has withstood the high winds and frequent operations that accompany service at AFMO. Aluminum tubing of similar diameters (except sliders which should be larger diameter in aluminum) should serve at most other locations.

FIGURE 4.



The material lengths of the original are excessive. The length of the sliders and control arms can be less than 6'9", which permits cutting three pieces out of one standard 20' length of tubing. The support poles must be longer and are conveniently 10' or one-half of a standard 20' length. Transport restrictions would permit shortening the support poles to 8' or less with an adjustment of the 1-2 point dimension. Note that the net trammel connections would straddle the point 4 and point 6 connections, requiring tying the trammels of a closed net. Current recommended spacing is 66" between points 1 and 2 and 32" between points 1 and 3, with other dimensions conforming to the formula stated earlier.

The flexible joints in the original were formed by welding stainless steel rod to the sliders, pivots, and control arms then threading the ends. Locking nuts, with nylon inserts, were used to complete the connection as shown in Figure 2. Whatever method you use requires maximum strength of the pivot and control arms at their centers (points 1 and 2) because that is the location of maximum bending stress. The outside holes at the ends of the control arms and pivots were oversized recently to recess the nuts inside the tubing: an attempt to minimize problems with tangling the ends of the nets on the nuts.

The original Hi-Lo utilized tension springs from an old roll-out bed instead of those shown in Figure 3 (which are normally used for storm doors). Either type is acceptable, but the storm door type limits misalignment during operation. The springs may be unnecessary if the cables are replaced with appropriately tensioned nylon cordage.

Vinyl coated steel cable was used for the original control cables. Nylon cord might be substituted, at substantially lower cost, but would have to be stretched precisely to achieve proper operation. The control cables run along the ground between the two support assemblies and will be subject to foot traffic. Potential failure of nylon or similar cordage due to wear on the rocks at AFMO prompted the selection of the steel cable.

DOES IT IMPROVE CAPTURES?

Two nets, one above the other, in place of one net will more than double banding activity at the same net location. During the first season of operation at AFMO, the double height banding net captured 280 birds. One hundred were caught in the net located at normal height and 180 were caught in the top net. The assembly provided a 180% increase in banded birds for the same net location. With reduced bird counts in the second season, the increase was slightly more than 150%. The additional height may permit, or increase, the banding of birds that pass the banding station at higher elevations. The activity at AFMO prevented analysis but, according to observers, the top net caught more of the higher flying birds such as blue jays and grosbeaks. The assembly will be erected at Harford Glen in the spring of 1990 to develop information on captures in another habitat.

OPTIONAL EXTENSIONS

The design can be expanded to support mist nets at four times the normal height. Someone with a need for that height may wish to attempt it. Support of four nets might be used to provide a triple height assembly where two nets rest at normal height, for very active locations where more access is required for removal. Shorebird banders may use the support system to hold one net well above the water, thereby preventing drownings.

COST

The original construction has a material and labor cost substantially higher (actual value of approximately $500.) than track and slider designs. The resourceful bander should be able to construct this system for the $80 cost of the original prototype by utilizing less expensive material or (savings on the original) encouraging donations. The simplicity of operation and continuous exposure offered by the Hi-Lo system should make it worth the additional expense.

LITERATURE CITED

Chapin, R.E. 1988. Construction of poles for double-tiered mist nets. *North American Bird Bander* 13:108-109.

Mease, D. and E. Mease. 1980. Aerial net assembly. *North American Bird Bander* 5:138-139.

Nixon, G.A. 1972. A use of external marine sail tracking on mist net poles. *W. Bird Bander* 47: 53-55.