# The "Hula Loop"

## A stationary bidirectional hybrid three-element delta loop.

by Dean Frazier NH6XK

Conventional wisdom preaches that directors and reflectors must be on opposite sides of a driven antenna element to achieve best performance in one direction; hence the advent of the rotating beam antenna (Yagi-Uda, Moore Quad, etc.). But by its very definition, "conventional" wisdom may only describe what has worked in the past. It does not allow that something else may work as well, or better; now, or in the future. Conventional wisdom may lack vision. It may be incomplete.

The rules of my QTH environment (a planned community in Hawaii) preclude my erecting a tower or rotatable beam of any kind, yet out here in the ocean, at (about) 21 degrees north latitude, 158 degrees west longitude, I like to propagate mainly to the NE/SW. For several years I have used a commercial half-wave vertical to do just that, but the declining solar cycle has forced me to seek a bit more gain than produced by said vertical, a bit less noise on receive . . . but how to do it with a low launch angle, in at least two directions simultaneously?

Many solutions are well-known, such as using two driven radiators separated one half-wave and fed in phase; or spaced one quarter-wave, fed 180 degrees out of phase. I wanted a simpler solution because I wanted to avoid two driven elements and the requirement for proper electrical phasing.

Any bidirectional antenna I might erect would have to have more gain than my half-wave vertical. It would have to be put up in the trees of the forest to the NE behind my back fence. It would have to be fixed in location and non-rotatable. It would have to have sufficient gain both to the NE (to the mainland US and Europe) and SW (to ZL-VK and Africa) to make up for feedline losses resulting from a roughly 300-foot run from shack to antenna. Virtually loss-less open wire feeder was out of the question due to "visual impact," and the antenna had to "blend" into the forest scenery. The vertical loop was the obvious choice fed by low-loss high quality coax, and the delta loop, apex down, high current region "up," was chosen so I could take advantage of the simplicity of available (and minimum) supports . . . the trees.

Gain would be easily enhanced in one direction with a reflector "behind" the driven element (à la conventional wisdom), but how to get some signal "out the back" at the same time? Electronic switching, grounding out elements, multi-driven elements, and pausing were ruled out preemptorily. This had to be a "no-fuss," simple antenna.

So I again considered conventional wisdom as I poured over my textbooks in search of a solution. Then I closed the books, and closed my mind to conventional wisdom . . . and the solution was obvious: Put a reflector (or reflectors) on the west side of the driven element for gain to the east toward the US mainland, and put a director (or directors) also on the west for a boost to the west, (e.g. VK-ZL).

So, after much trial and error, working with as many as two reflectors and four directors nested within the reflector(s), and varying their lengths (perimeters) and their spacing from the driven element, the Hula Loop evolved. It's not very fancy or sophisticated, but its simple form should not be underestimated.

The final configuration survived the skepticism of many fellow hams. It is explained below and shown in Figure 1. First, let me point out that prior to the utilization of the Hula Loop, the best I could do to the East Coast of America was 5/6 with the 3 dBd gain half-wave vertical, whereas now I consistently re-

*Photo A. The Hula Loop driven element at its feed point. Note the 1:1 balun.*

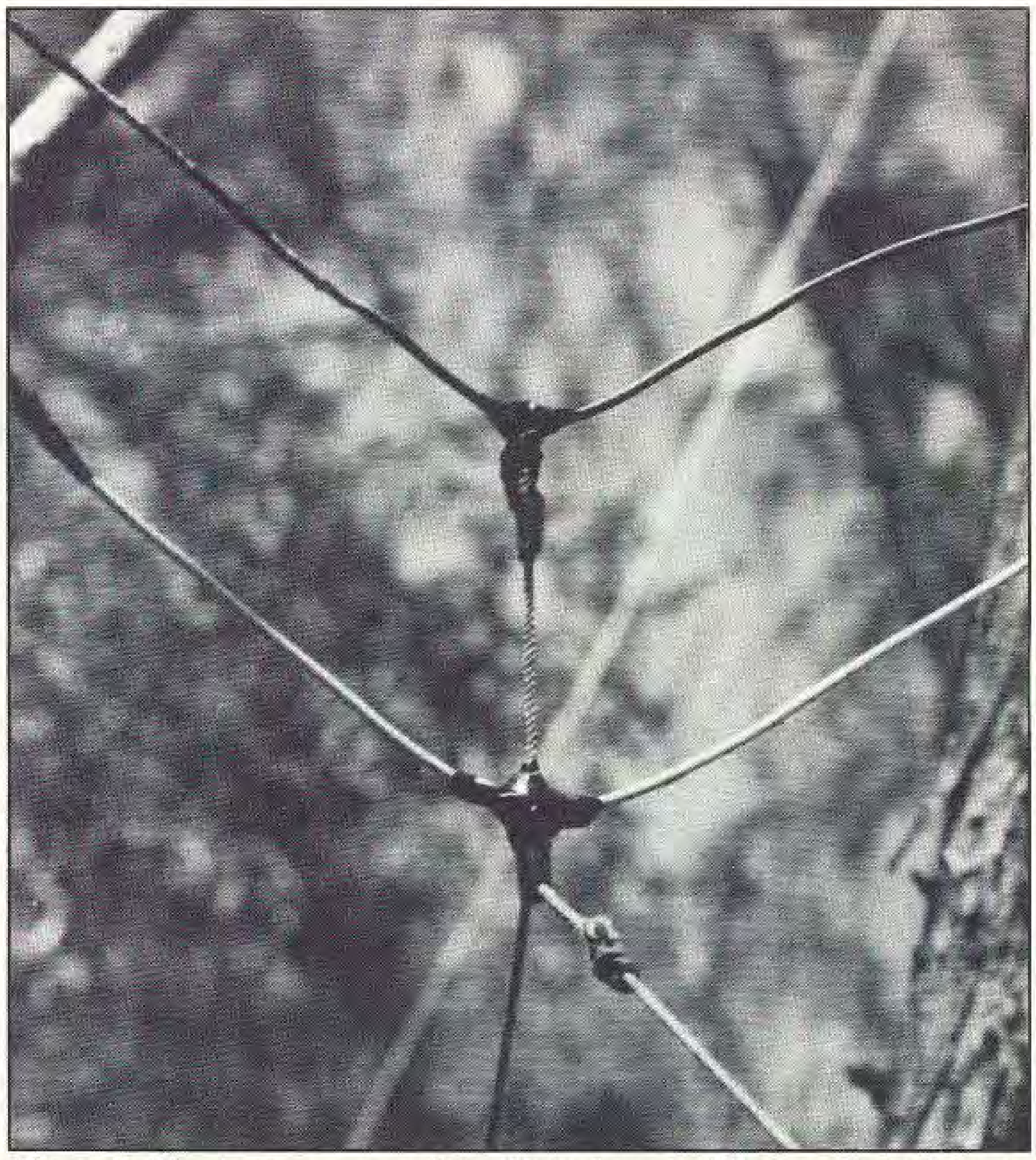

*Photo B. The bottom apex of the Hula Loop's diflector. Note that nylon cord is used to secure the antenna.*

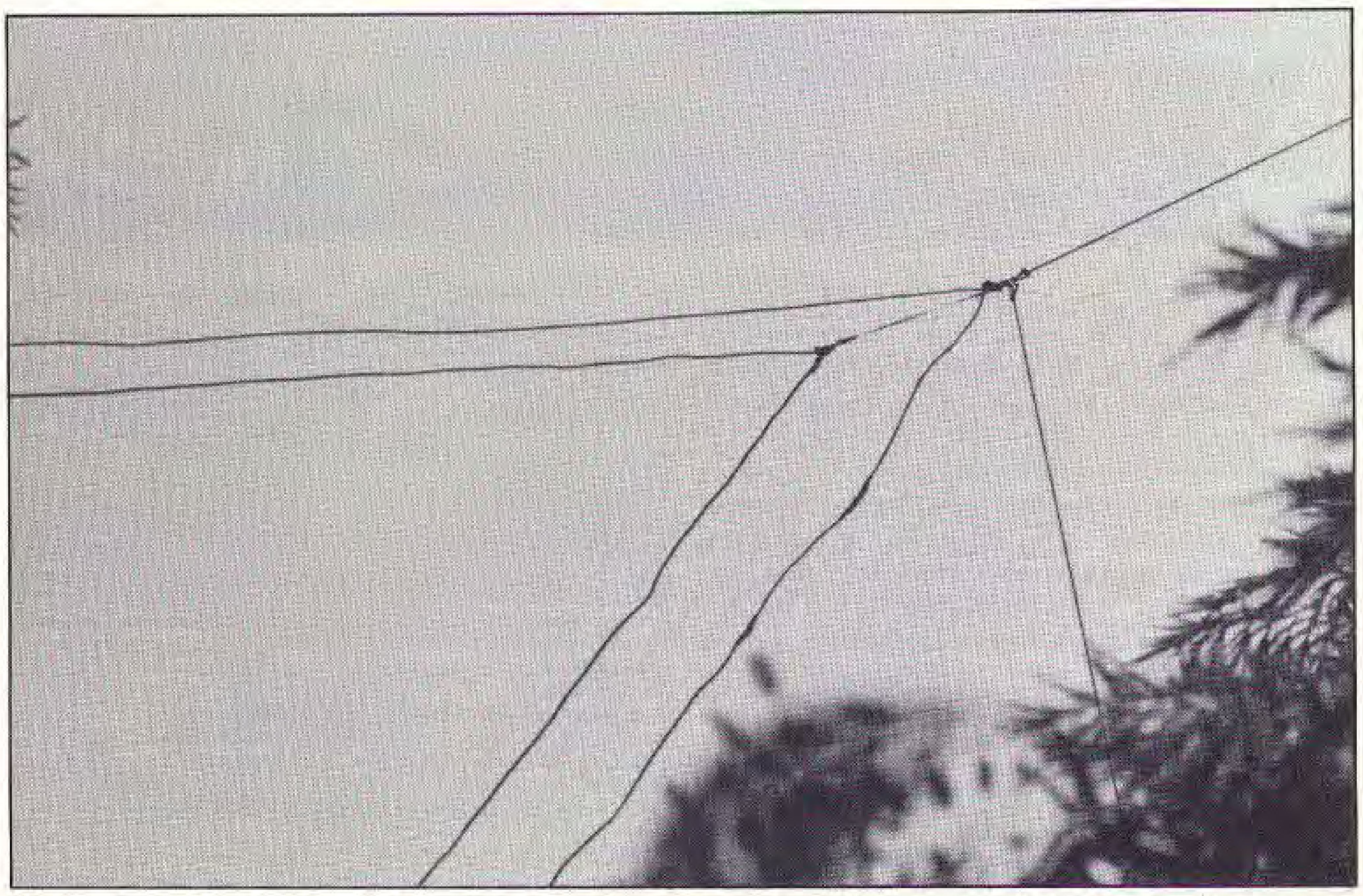

*Photo C. Another view of the Hula Loop's construction. The antenna blends into the scenery when viewed from a distance.*

ceive 5/9 or 5/9+ reports. To Australia and New Zealand, the vertical consistently beat my original single-element and eventual two-element delta loop, but now it's the other way around by 2 S-units. Short path to South Africa over Antarctica, I'd get 5/3 on the vertical and 5/2 on the conventional two-element delta loop, and now it's more like 5/7-5/8 on the three-element loop. To Europe over the North Pole, it used to be 5/5-5/6 with the vertical, and now it's 5/8-5/9-5/9+, even as the solar cycle declines, with the hybrid delta loop.

I can still communicate to Asia and South America with the vertical and a Loop Skywire, but not as well as the Hula Loop does to the northeast and southwest, from Hawaii.

### The Hula Loop's Design

The Hula Loop consists of a driven delta loop, apex down, behind which is a passive reflector 3% longer around than the driven, in which is nested a director cut 3% shorter than the driven. The reflector-director combination (which I call the Diflector) is spaced 0.16 wave (about 8'8" on 17 meters) from the driven element. This wide spacing results in the feed point impedance being in the 80-100 ohm range, as usual for a full-wave single-element loop, so feeding with 50 ohm coax (Belden 9913) terminating in an odd multiple of 75 ohm coax is appropriate ($\sqrt{50 \times 100}$ = 71 ohms). Moving the diflector towards the driven element would eventually bring down the feed point impedance to 50 ohms at some particular spacing, allowing a "straight in-feed" with 50 ohms, but the forest in which the loop is erected does not allow this luxury.

After cutting the driven element by using the formula (1005/f MHz = length in feet) and forming an equilateral triangle with the feed point at the bottom apex, and after having put the element "in situo," I then tuned this driven element to resonance, then measured its final length (or perimeter). Then I cut and placed the diflector by this formula: If the final tuned length of wire in the driven

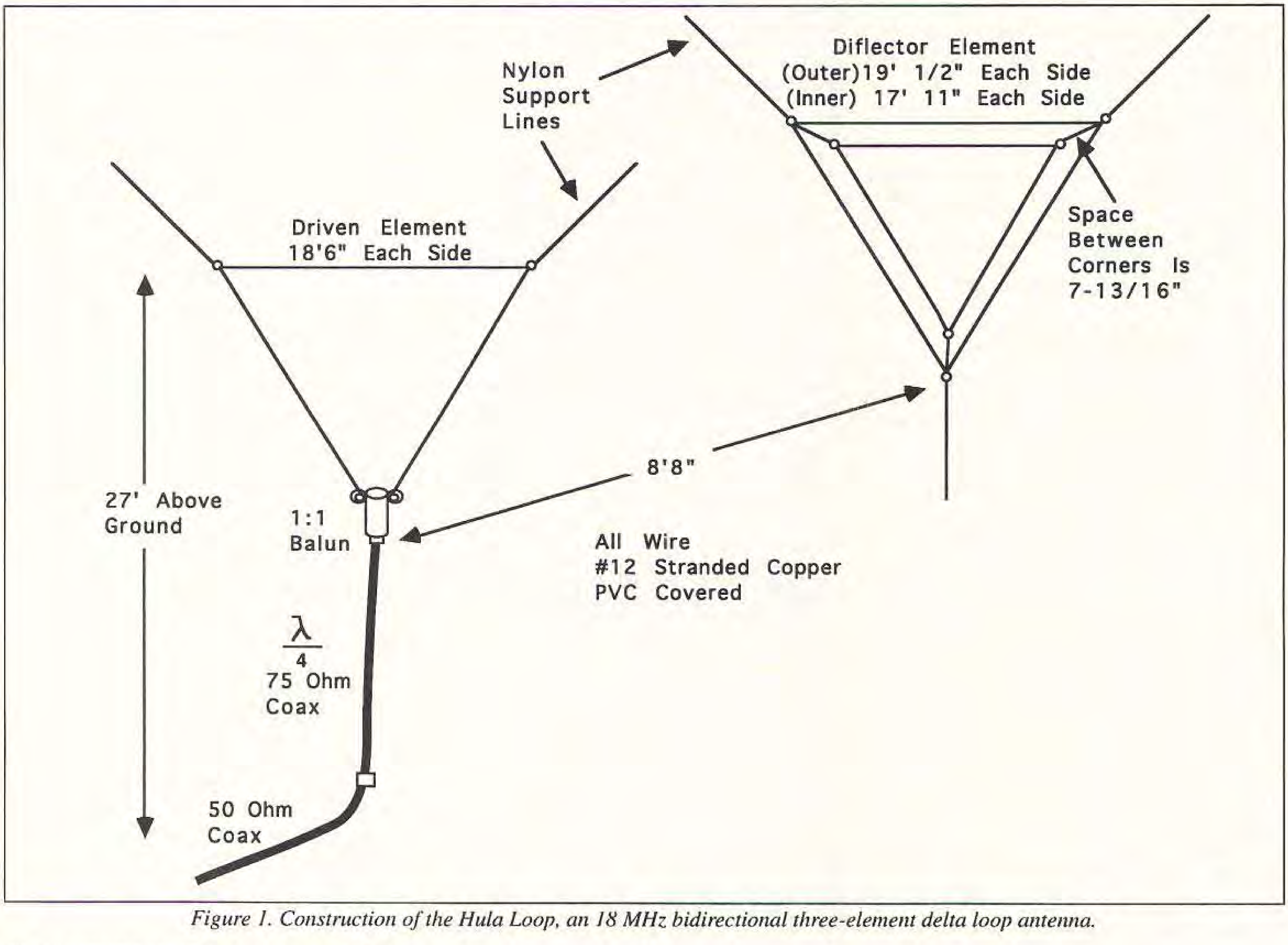

*Figure 1. Construction of the Hula Loop, an 18 MHz bidirectional three-element delta loop antenna.*

element comes out to be "L" feet, then cut the reflector according to 1.03 x L, and cut the director according to 0.97 x L. Both the reflector and director are then shaped into equilateral triangles, and the director is nested into the reflector using non-conductive material (nylon line) at the corners.

The reflector and director are closed parasitic loops; the driven element is open at its bottom. One end of the wire connects to one side of a 1:1 current balun, the other wire end to the other side of the balun. The quarter wave of 75 ohm coax then connects (screws) to the base of the balun, and its other end joins to 50 ohm coax (thence back to the shack) via a barrel connector. The balun is not a necessity, but if not used, I suggest that you wind and tape about six turns of coax (roughly six inches in diameter), directly at the feed point to act as an air-choke to RF. This will help to decouple the coax braid from the antenna to aid canceling RFI-TVI causing currents on the coax braid. Whatever method of putting power into the antenna is used, seal all exposed conductors from the elements. I use #12 stranded copper wire, PVC covered, for the driven element, director, and reflector. Be advised that the beginning length around the driven element (1005/f MHz = feet) probably won't work out quite right due to the detuning effects of not only the diflector (a small effect at 0.16-wave spacing), but primarily due to the particular final antenna environment . . . proximity to metal, wood, etc., and due to variation in length from the formula (1005/f) because of different wire gauges.

The driven element and the diflector are hung vertically, using nylon line attached to the upper corners. The driven feed point and the bottom apex of the diflector are prevented from swaying in the wind with light nylon line tied off to low bushes or ground stakes. As the figure shows, the Hula Loop is simply constructed.

## Results

On-the-air signal reports indicated the following: To the NE (US mainland and Europe) signal reports are about the same as when the loop was configured as a conventional two-element delta loop (driven and reflector), and 3 to 4 S-units stronger than the commercial half-wave vertical (very nearly the same coax line loss at 18.113 MHz, to both antennas). To the SW (VK-ZL and Africa), the conventional half-wave vertical beat the two-element delta loop by 1 to 1-1/2 S-units, but with the diflector in place, the three-element Hula Loop is better than the vertical by 2 S-units.

I suspect I may have "lost" 1/2 to 1 dB to the NE with the Hula Loop, compared to a two-element delta loop. I now have a narrower half-power beamwidth, but the gain "out the back" is startling.

In any event, with the Hula Loop I now put more signal both NE and SW than ever before with a 3 dBd half-wave vertical or with a conventional two-element delta loop.

All work was performed on the 17 meter band, at 350 watts.

I encourage others to experiment with directors nested within reflectors to see the effect on forward and rearward gain, compared to that of a conventional two-element loop antenna, keeping all antennas at the same height over the same ground. The flat-top of my Hula Loop is at 27 feet which puts the centroid of the triangles at about a third wave . . . raising the top to perhaps 35 feet would more nearly place the centroids near half-wave, with a resultant lowering of launch angle, but such may not be possible in the forest within which I work. In any experimentation with the diflector concept, however, as many variables must be eliminated from the problem. Conditions should be made the same for both the antenna under experimentation and with the control antenna, to allow any differences between the test and control antennas to become apparent.

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