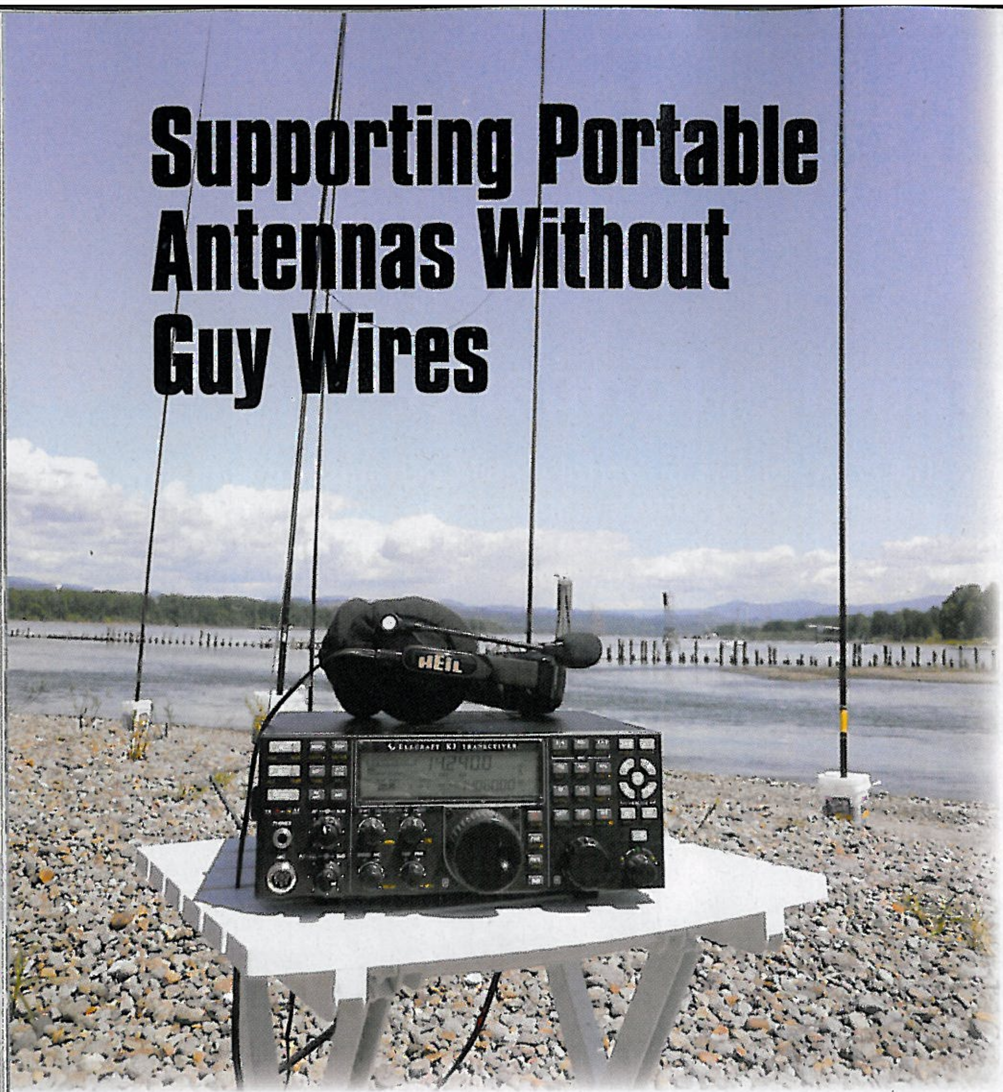
Supporting Portable Antennas Without Guy Wires

A handy antenna — perhaps just right for your Field Day station.

Dave Fisher, KGØD/7



Look Mom, No guy wires! There are plenty of papers on designing antennas. This is more about supporting those antennas — without guy wires. Helping the grandkids build sand castles with small buckets on the beach triggered the idea. The materials for construction are simple — 33 foot fiberglass poles, 5 gallon plastic buckets with snapping lids and sand. These components make it easy to build a four element 20 meter monoband Yagi vertical without those messy guy wires.

I've been operating portable for several years now. This was caused by my proximity to a 50 kW AM station compounded by electronic noise from the neighbors. My portable operating locations needed to be near trees for antenna supports. This limited my operating locations. Using guy wires for support avoided the need for trees but these were a hassle to install and move.

A Better Way

This easy to duplicate antenna solved all my problems at once. The configuration I chose offers a four element 20 meter vertical Yagi of half wave dimensions that can be readily steered in multiple directions. The same materials can be used to construct similar antennas for other bands (see Table 1 for dimensions), or base fed monopoles for lower bands. The base fed antennas require ground radials, making them more difficult to move, but they can still be effective choices if those are the bands you want to use.

The wire antenna elements are supported by 33 foot telescoping fiberglass poles that are available from a couple sources. The ones I use collapse to 45½ inches. Each weighs about 3⅓ pounds. The plastic buckets I use originally held cat litter. A nested stack of five buckets weighs 10 pounds and measures 27 × 12 × 10 inches — easy to manage. It is important to use buckets with lids that snap in place. There are many choices for buckets. Some large hardware stores sell them already empty. This is the best source. Others contain products such as soap, paint, swimming pool chlorine and cat litter that must be used first.

Figure 1 shows a bucket partially full of sand with the fiberglass pole in place. You can use sand, dirt or rocks dug from almost any operating location. These will make a bucket weigh 40 to 60 pounds depending on material density. Another option is bolting a PVC cap on the bucket's bottom. This will hold the bottom of your pole in place when you use water, rocks or snow/ice for wintertime operations. A 5 gallon bucket of water will weigh about 40 pounds. Two 20 pound bags of rice per bucket could also be used instead of sand. Long grain brown rice is said to lower the radiation angle and increase operating range. The lid snaps in place over the filled bucket and helps keep the pole stable.

The center fed driven element will be most effective if the coax to element transition is through a 1:1 balun or common mode choke. I used a commercial balun, but your favorite technique should be suitable. The coax should be routed as close to perpendicular to both the element and antenna axis as feasible. Figure 2 shows the details of the coax support system. At this point you have an effective 20 meter vertical dipole (see Figure 3).

Add Some Gain with a Little More Stuff

Now that the technique is proven, it is easy to make a top notch antenna array. I added a reflector and two directors resulting in a four element 20 meter vertical monoband Yagi. The configuration is shown in Figure 4. While somewhat stationary, it doesn't take much to pick up and move the parasitic elements to steer the antenna to other directions. If you will be in the same spot for a while, take the time to precompute and mark the bucket locations for directions you think you will want. Figure 5 shows the antenna looking north to Europe. Figure 6 is a side view.

The *EZNEC* predicted elevation and azimuth patterns are shown in Figures 7 and 8. This antenna provides a lot of gain for the investment.[1]

Table 1

Element Wire Lengths and Interelement Spacing (feet) for Five DX Bands

Frequency (MHz)	*Reflector (+5%)*	*Driver (468/MHz)*	*First Director (–5%)*	*Second Director (–10%)*	*Element Spacing*
14.18	34.7	33.0	31.4	29.8	9.2
18.10	27.1	25.9	24.6	23.3	7.2
21.30	23.1	22.0	20.9	19.8	6.2
24.91	19.7	18.8	17.8	17.0	5.3
28.85	17.0	16.2	15.4	14.6	4.5

Figure 1 — Antenna construction starts with the driven element.

Figure 2 — Detailed view of the antenna feed connections. Vinyl electrical tape is used to secure the wire, pole sections and commercial 1:1 balun.

Figure 3 — The coax support vertical is built next. It gets the coax away from the driven element's bottom section. The coax support vertical is built just like the driven element. Each section is raised in three foot increments, taping each section as they are extended, until both are at full height. At this point you have an omnidirectional half wave vertical dipole. This is a good time to hook up the radio and check the band to see where you want to aim the antenna.

Figure 5 — The cat was kind enough to empty several more buckets of litter so more elements can be added. Using 20 meter data from Table 1, I measured and cut the wires needed for a reflector and two directors. I've included additional data for other bands these verticals could support. Part of the 20 meter reflector wire is extended above the pole and the other couple inches hangs down toward the ground.

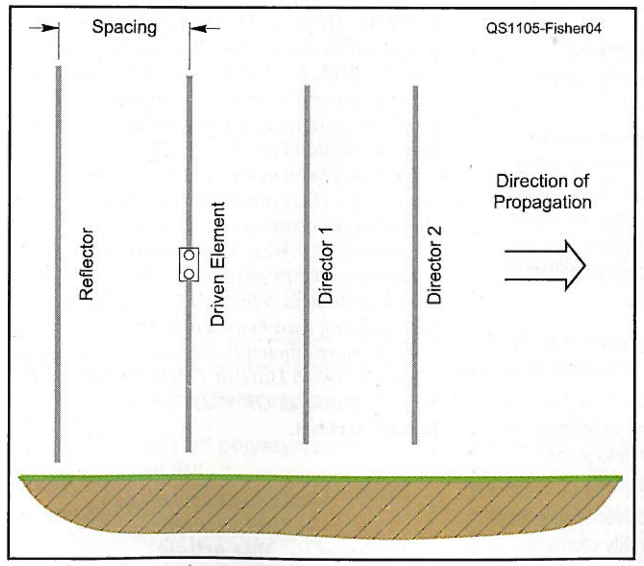


Figure 4 — Configuration of four element vertical Yagi. Dimensions are in Table 1.

[1] J. Devoldere, *ON4UN's Low-Band DXing: 25 Years of Low Band Success*, Fifth Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 8560. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop/; pubsales@arrl.org**. Data included with the provided CD includes many other multielement Yagi antennas with element quantity, length and spacing recipes.

Figure 6 — Side view of the four element 20 meter Yagi deployed on the beach on McGuire Island in the Columbia River.

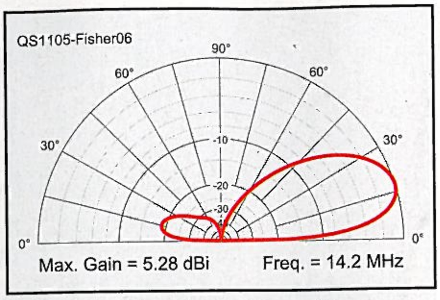


Figure 7 — Elevation pattern of the 20 meter vertical Yagi over typical ground. If you have a steady signal source, the design makes it easy to experiment with different spacings to see if the gain, or the front to back ratio can be improved. For reference the gain of a single element is –0.1 dBi.

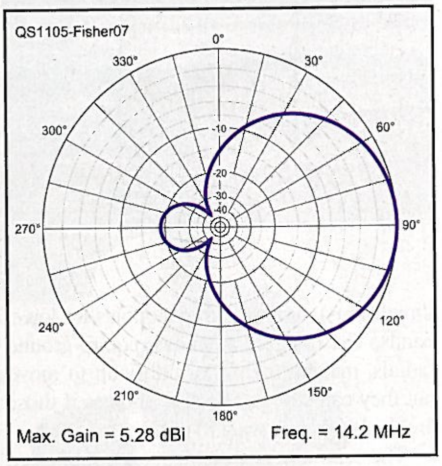


Figure 8 — Azimuth pattern of the 20 meter vertical Yagi at peak elevation angle of 17°.

Hamspeak

ARRL Field Day — Annual operating event, the fourth full weekend each June, in which US stations set up in portable, simulated emergency configurations and contact as many other such stations as possible. See **www.arrl.org/field-day** for details.

Azimuth plot — Graphical representation of signal strength from an antenna as a function of horizontal angle around the antenna center. It is made at a particular elevation angle, often the angle with the maximum response.

Director — One of the elements of a multielement parasitic directive antenna. The director receives energy from the driven element (attached to the feed line) and reradiates it to combine in the direction of the director. The director is usually shorter than ½ wavelength.

Elevation pattern — Graphical plot of the radiation intensity of an antenna at different elevation angles. For an omnidirectional antenna, the elevation pattern is the same at every azimuth angle. Other antennas will have elevation patterns that are different at each azimuth angle, so usually the plot at the most significant azimuth is shown. Elevation patterns with large signals near the horizon are generally preferred for line of site operations, such as in VHF mobile communication. Low elevation angles also provide for the longest distance communication via ionospheric propagation.

Guy wire — A set of wires used to hold a tower or other structure in position.

Radials — Portion of a usually vertical antenna, designed to provide an artificial ground or a connection to real ground. The multiple radials project radially from the antenna base in multiple directions.

Reflector — One of the elements of a multielement directive antenna. The reflector receives energy from the driven element (attached to the feed line) and reradiates it to combine in the direction away from the reflector. The reflector is usually longer than the driven element.

Yagi — Multielement directive antenna array in which one or more elements are driven by connection to a transmission line and the others are parasitically coupled. Yagis are generally characterized by high gain for their size accompanied by narrow operating frequency range.

ARRL member and Amateur Extra class operator Dave Fisher, KGØD, received his Novice class license in 1976 along with the call WN7EAL. He passed his General and Advanced class exams in 1977 and received the call KAØBYS. In 1980 he passed the Amateur Extra exam and received his current call. He has lived on a floating home on the Columbia River in Portland for the last 22 years.

Dave has been in the cold storage business since 1975. He is presently working for VersaCold Logistics as the Director of Engineering for West North America. He project manages new construction projects, designs custom ammonia refrigeration systems, maintains existing warehouses and develops ways to operate more efficiently for lower energy usage.

You can reach Dave at 17809 NE Marine Dr, Slip A5, Portland, OR 97230 or at **kg0d@arrl.net**.