No. 58: AThe Revere Theory of Vacation Antennas

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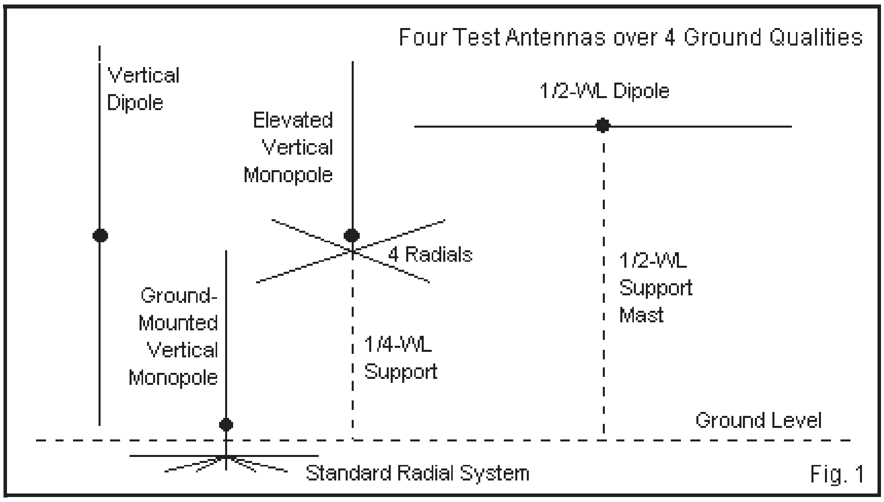
The theory is simple: Horizontal if by land and vertical if by sea, (And I on the opposite shore shall be). Of course, neither Paul Revere nor Henry Wadsworth Longfellow is responsible for the name of the theory. But the name is a catchy way of introducing you to why many contest and vacation operators on beaches or on boats use vertical antennas, while at home, they use horizontal antennas.

For 10 meters, vertical antennas are simpler to use on vacation. A central element and some radial wires (if we are using a •À½-wavelength monopole) are usually easier to pack than a pair of support masts to hold up a dipole. The dipole is somewhat directional, so a tubular version on a single support mast resolves the turning question, if only by hand. However, that system can be ungainly on some boats. Actually, the choice of a vertical antenna for contests and vacations near or on the ocean depends less on mechanical simplicity than it does on performance.

To see why verticals have once more become popular on or near salt water, let's perform a little exercise. Since I cannot afford a Caribbean vacation at the moment, we shall have to use modeling software. We shall look at four antennas, all simple ones, as shown in **Fig. 1**. The first is a center-fed vertical dipole with its bottom end 1' above ground. The second is a ground-mounted vertical monopole. The third antenna is simply the monopole raised •À½-wavelength above ground with 4 elevated radials. Finally comes the horizontal dipole that is •À½-wavelength above ground.



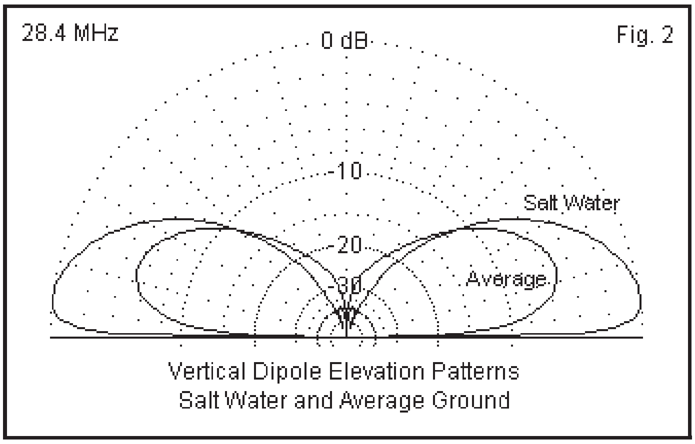
For each antenna, we shall select 4 ground environments. One must be salt water. The other three involve different levels of land-locked ground quality. The standard names are Very Good, Average, and Very Poor Ground. With 4 antennas and 4 ground quality levels, we have 16 tests to run.

1. The Vertical Dipole. Like all good vertical antennas (but not necessarily arrays of verticals), the vertical dipole has an omni-directional azimuth pattern. So we can confine ourselves to the elevation pattern properties. The vertical dipole uses a 1" diameter with its bottom tip only 1' above ground level. We normally bring the feed horizontally from the center point or run coax inside the element to ground level. In either case, we add a common mode current choke at the point where the coax emerges from the antenna. The following table lists the maximum gain and the elevation angle for the four types of ground.

Vertical Dipole 1' above Ground

Ground Quality	Salt Water	Very Good	Average	Very Poor
Gain dBi	5.64	0.69	0.55	0.15
Elevation Angle	8ï¿½	17ï¿½	18ï¿½	21ï¿½

The largest change occurs between salt water and dry land. **Fig. 2** compares elevation patterns for salt water and average soil. I omitted the other soil types, since they are relatively so close together that they would make a single fat line. The advantage of the salt-water ground is very clear in terms of both gain and a low elevation angle for good DX work.

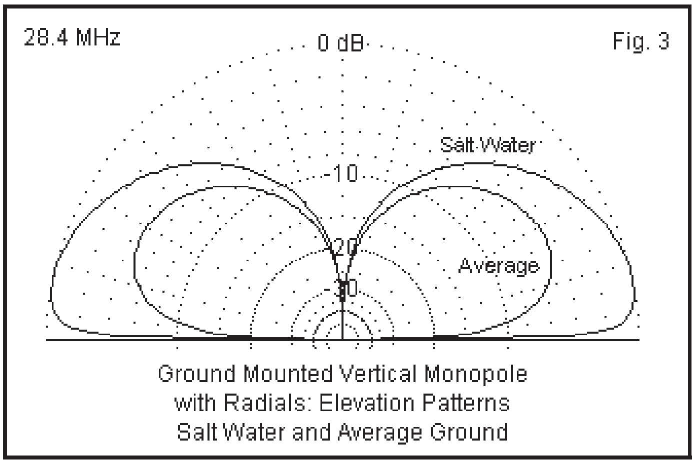


2. Ground-Mounted Vertical Monopole with Buried Radials. A vertical monopole at ground level is •À½-wavelength long and requires a field of radials. On salt water, the metal cladding of the keel or hull would normally substitute for the radial system, but on land, we need at least 32 buried radials for effectiveness. The table is based on a 32-radial field.

Vertical ï¿½-Wavelength Monopole with a Radial Field at Ground Level

Ground Quality	Salt Water	Very Good	Average	Very Poor
Gain dBi	4.27	-0.56	-0.31	-1.69
Elevation Angle	11ï¿½	24ï¿½	27ï¿½	29ï¿½

The shorter monopole is less effective than the vertical dipole, with higher elevation angles to accompany the lower gain. **Fig. 3** again contrasts just the salt-water pattern with the pattern over average soil. The overall height of the lobes, regardless of soil quality, is immediately apparent. Ground-mounted vertical monopoles find almost no land use on 10 meters, although they are common on ships and buoys.

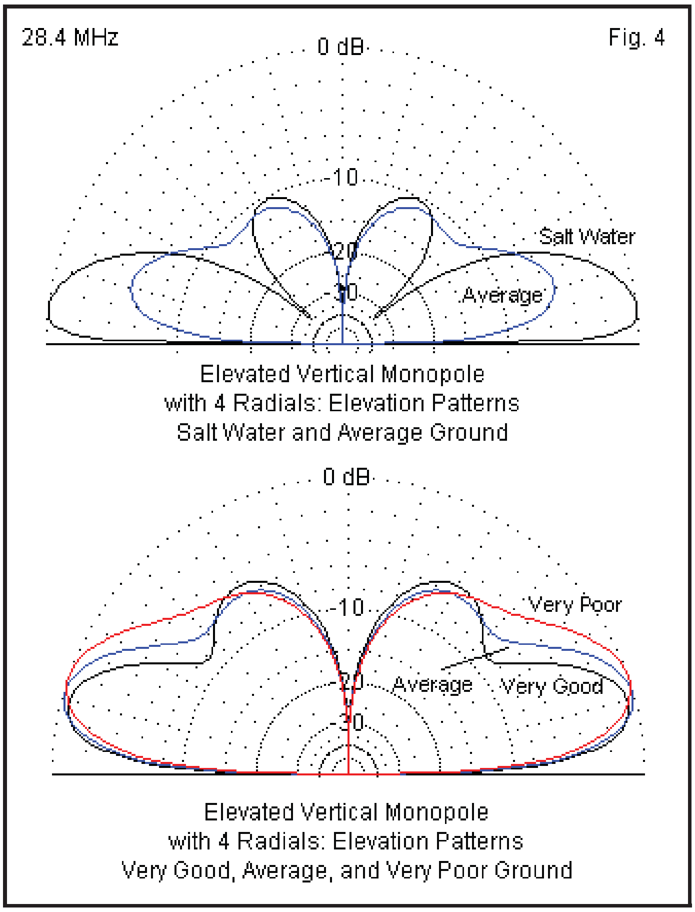


3. Elevated Vertical Monopole with 4 Radials. The vertical monopole works best on 10 meters when we elevated it. The test case uses a height of •À½ wavelength between ground and the base of the system. Above about 0.5 wavelength, the higher angle lobes tend to dominate, which is not good for DX communications. Once we place the antenna about 2 wavelength above ground, the lowest lobe again becomes the strongest, but this height is normally not practical for a boat or the beach.

Vertical ï¿½-Wavelength Monopole with a 4-Radial Field ï¿½ Wavelength above Ground Level

Ground Quality	**Salt Water**	**Very Good**	**Average**	**Very Poor**
Gain dBi	**6.31**	**0.82**	**1.15**	**1.24**
Elevation Angle	**7ï¿½**	**14ï¿½**	**16ï¿½**	**19ï¿½**

The salt-water gain improves by about 2 dB with the 8.7' elevation of the antenna. The top portion of Fig. 4 compares salt water to average ground for consistency with the preceding figures. The gain over dry land also improves, but presents a seeming anomaly. The gain actually decreases as the soil quality improves. However, as the table and the bottom of **Fig. 4** show, the elevation angle becomes (desirably) lower with improving ground quality. The operationally significant matter is the elevation angle rather than the small gain difference across the span of test grounds. Part of the reason for the seeming gain anomaly is the fact that as we improve the soil, the upper or second elevation lobe becomes more pronounced, although it is not problematical at the test height. The higher that we raise the base of this antenna system, the stronger that the second lobe will grow until it becomes the dominant lobe.



Elevated Vertical Monopole
with 4 Radials: Elevation Patterns
Salt Water and Average Ground

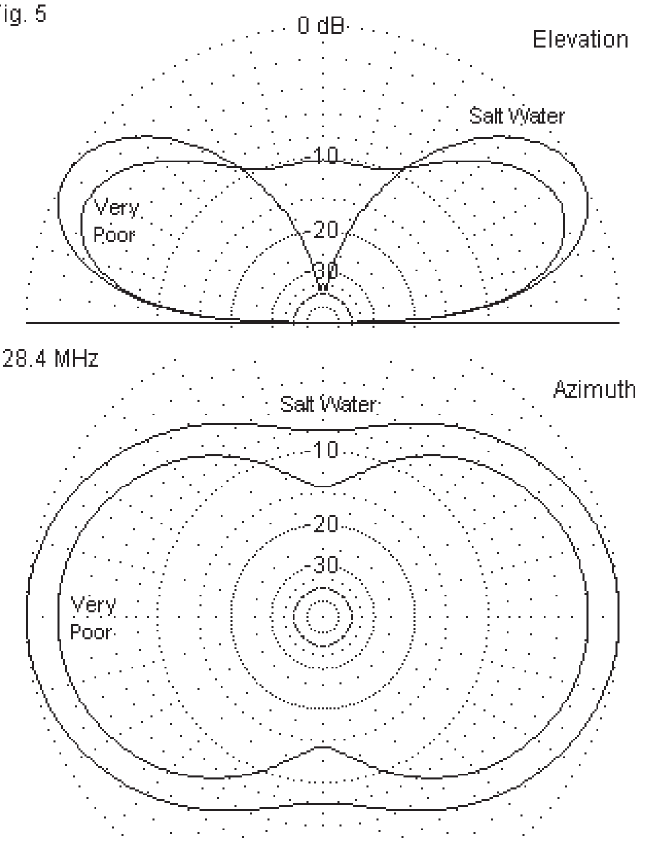
Elevated Vertical Monopole
with 4 Radials: Elevation Patterns
Very Good, Average, and Very Poor Ground

4. Horizontal •À½-Wavelength Dipole •À½ Wavelength above Ground. For each of our test vertical antennas, the gain over salt water has been about 5 dB stronger than the gain over the best of the dry-land ground qualities. By comparison, the differential among the dry-land grounds has been small. A half-wavelength horizontal dipole that is a half-wavelength above ground has been an old stand-by of vacationers and casual contesters for many decades. The table shows why land operators tend to prefer it to a vertical, while beach and boat operators lean toward vertical antennas.

Horizontal ï¿½-Wavelength Dipole ï¿½-Wavelength above Ground Level

Ground Quality	Salt Water	Very Good	Average	Very Poor
Gain dBi	8.36	7.73	7.24	6.48
Elevation Angle	29ï¿½	28ï¿½	28ï¿½	27ï¿½

We find less than 2-dB gain differential between salt water and very poor soil, compared to the 5-dB differential for the vertical antennas. **Fig. 5** provides both elevation and azimuth patterns for salt water and the worst soil quality. The dry-land elevation pattern shows where part of the missing 2 dB of energy goes: upward. The dry-land elevation beamwidths are wide enough to encompass the lower elevation angles for the vertical dipole and the elevated monopole, and they are about the same as for the ground-mounted vertical. For dry-land, then, the dipole provides considerably more gain than the vertical antenna and becomes the preferred antenna, even if we have to turn it broadside to our targets.



1/2-WL Horizontal Dipole 1/2 WL above Ground
Elevation and Azimuth Patterns
Salt Water and Very Poor Ground

The dipole, however, offers the beach and boat operator with very little gain advantage. The elevation angle increase tends to detract from DX signal strength more than the small gain increase helps it. Therefore, the best antenna for beach and boat operation--among simple antennas in these tests--is likely one of the verticals.

The modeling tests have used a uniform ground medium in all directions from the antenna. The ground reflection region extends for several wavelengths away from the antenna. On a boat, the ocean is everywhere. However, on a beach, we usually have only 180•À½ to 270•À½ of salt-water horizon, depending on whether we can find a point of beach-land for our antenna. Selecting a place on an island with ocean between you and the main communications targets is good planning.

However, coastal operations have benefited from verticals near the water's edge. Do not think about propagation as a single thin line between you and your target. RF refracts over a broad region. So a coastal path may actually consist of radio waves that go out over the water and return back to land at shallow angles relative to the straight-line bearing between the 2 points.

The next time you operate from a vacation island or boat, do not discount the simple vertical antenna as a highly effective way to make a lot of contacts (propagation permitting). However, over dry land, a horizontal dipole even as low as •À½ wavelength above ground may give you the stronger signal.