

Beginner Foxhunting

Everything hams should know about this exciting radio direction-finding sport.

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Within amateur radio, *foxhunting* is the search for hidden transmitters with the help of radio equipment and direction-finding techniques. Many hams — and non-hams — of all backgrounds and skill levels find foxhunting enjoyable. Foxhunts can be carried out individually or as a club activity, and they are a great way to introduce unlicensed family and friends to amateur radio.

Foxhunting Equipment and Logistics

The hidden transmitter, or *fox*, can be something as simple as a fellow ham hiding in the bushes with a handheld, or as intricate as an automated transmitter disguised as a tree stump. Most foxhunts are conducted on the 2-meter or 70-centimeter bands. Therefore, a popular choice is to build a *fox box* that consists of an inexpensive handheld paired with an automated controller, a battery, and a small antenna built into a weather-proof container, such as a military surplus ammo box.

The most popular fox box controllers are pre-assembled units that use a pre-made cable, which plugs into the external speaker and microphone jacks of a handheld. This type of controller can be programmed by connecting it to a PC with a standard USB cable, then running programming software supplied by the manufacturer. For long-duration foxhunts, the controller can be configured to let hunters trigger the fox box by transmitting DTMF and/or CTCSS tones on a predetermined frequency. For timed hunts, the controller is commonly programmed to activate the transmitter and play tones or a short Morse code message at predetermined intervals.

Hunters can use various radios, antennas, and other equipment to search for a fox. A simple and effective foxhunting setup is a handheld, a directional antenna (such as a Yagi), and an in-line attenuator. A handheld used for foxhunting must have a signal strength meter that shows received signal strength with a bar graph display. Signal strength meters with the most segments offer the most usable measurement range between weak and strong signals, and are the best for foxhunting. Some handhelds lack signal strength



Foxhunts can be enjoyed by hams and non-hams of all ages. [Melinda Zielfelder, photo]

meters with enough range, so it is important to check for this feature before selecting a radio.

There are many directional antennas that work well for foxhunting. One of the most popular and inexpensive options is a homebrew tape measure Yagi. In one afternoon, a ham can construct this type of antenna for \$20 to \$30 with materials from a home improvement store. Other popular choices include commercially available collapsible Yagis, homebrew coat hanger Yagis, and loop antennas. Many hunters opt for a heavier, more rugged antenna to mount on a vehicle at the start of a hunt. Then they switch to a smaller handheld antenna when they're close enough to find the fox on foot.

An *attenuator* is a device inserted between the radio and antenna to reduce the strength of received signals, and is necessary when hunting near the fox. Step attenuators are popular among new foxhunters; they use a series of switches to turn on the resistor networks that weaken the signal picked up by the hunter's radio. This allows hunters to adjust the received signal strength of the fox by turning the switches on or off as needed. A more complicated — but possibly more effective — choice is an offset attenuator. Like a step attenuator, this device installs between the radio and antenna. It differs by using active circuitry to generate a carrier signal that mixes with the received signal from the fox. This creates a weaker secondary signal on another frequency, to which the hunter can tune their radio. The hunter can then use the weaker signal on the offset frequency to get a better reading on the radio's signal strength meter when close to the fox. Both options are available as fully assembled products or project kits. There are also homebrewing instructions for both attenuator types online.

Along with radio gear, hunters need equipment to navigate unfamiliar areas and determine which initial direction to travel. The direction of travel, or *heading*, is usually decided by orienting the hunting antenna with magnetic or true north on a map, and turning the antenna for maximum signal strength. For more information about magnetic north and true north, see the sidebar, "Magnetic North Versus True North." After this, the hunter can determine the heading by using a compass to measure the difference in degrees between magnetic or true north, and the direction in which the antenna is pointing. Once a hunter determines a heading, they can use a ruler to draw lines on a map toward areas of interest, such as a public park or recreation area.



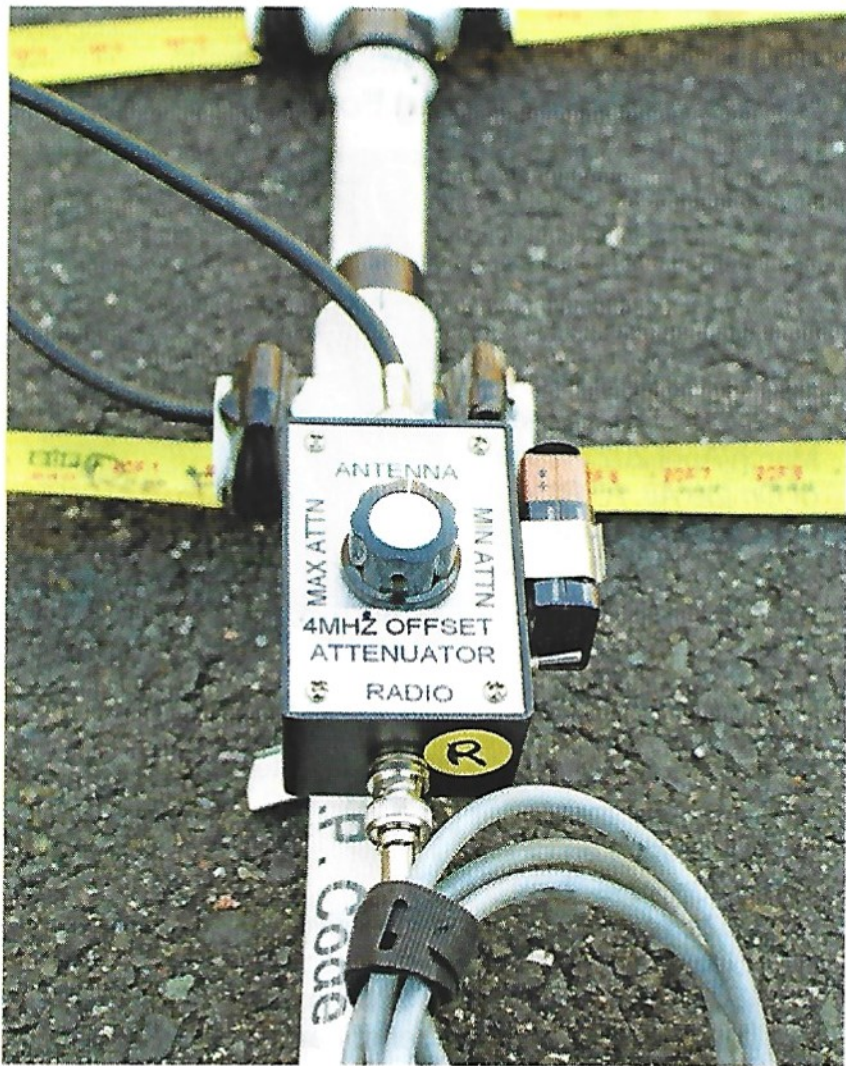
A typical fox box with accessories. [Bill Curlew, KC1JTS, photo]

The Hunt Begins

A typical hunt for an automated fox box begins with someone hiding a box out in the field, then notifying hunters that the fox is "loose." The fox owner will usually offer some basic information, such as the fox's transmit and receive frequencies, access codes for activating the fox box (if applicable), a general starting location, and a general search area. Most automated foxhunts don't have a strict time limit, but it's good practice for fox box owners to tell hunters how long the fox's battery should last. They should also mention any plans to move or retrieve the box after a period of time. For this type of hunt, the first person to find the fox box earns some bragging rights, but a winner isn't usually declared otherwise.

Magnetic North Versus True North

Modern maps are created with north referenced as the Earth's true north pole. However, compass needles always point toward the Earth's magnetic north pole, which is not in the same place as the true north pole. This difference is called *declination*, and it is important to know in order to establish accurate direction measurements during a foxhunt. The declination varies depending on where the hunter is on Earth, so hunters need to determine declination in their area by using a smartphone app or an online resource. Some maps will show the local declination in their legends. Once they know the declination, hunters must add or subtract this number from their compass readings to establish accurate headings.



An offset attenuator attached to a homebrew tape measure Yagi, courtesy of Bill Curlew, KC1JTS. [Melinda Zielfelder, photo]

When the fox is a live person operating a transmitter, a starting time and location for the hunt are given well in advance. Hunters will gather at the starting location, and the person acting as the fox will initiate the hunt at the specified time. They will begin transmitting on a designated frequency that can be heard at the starting location. Once the fox starts transmitting, the hunters can take signal strength readings, establish a heading, and begin hunting. At the first transmission, the fox will often give hunters a search radius and a time limit before transmitting at set intervals for the rest of the hunt. The fox may choose to vary power levels and antennas to throw hunters off the trail, or they may give helpful clues. The clues can be straightforward, like references to nearby landmarks, or they can be riddles. For example, the fox may state, "I can see a water tower from my location" or "The airport looks busy today." Or, to add more of a challenge, a fox might ask, "What can run but never walk, has a mouth but never talks, has a head but never weeps, and has a bed but never sleeps?" instead of simply saying, "I can see a river from where I'm located." Hunters may work alone or share their findings with the others as the hunt progresses. Gen-

erally, the first hunter to find the fox wins, but some hunts will factor in each hunter's mileage when determining a winner or settling a tie.

For either type of hunt, the first step is to establish a heading by finding the direction that the fox's signal is coming from. Hunters do this by tuning their radios to the frequency the fox is transmitting on. Then, they turn their directional antenna while watching the radio's signal strength meter for a maximum reading. Once they find the maximum signal strength, they note the direction toward which their antenna is pointing and use a compass and a map — or a smartphone app — to decide on a heading. For more information about smartphone mapping apps, see the "Smartphone Mapping Apps: Boon or Bane?" sidebar. It may also be possible to estimate how far away the fox is by the strength of the signal reading.

After choosing a heading, two strategies can be used to narrow the search area. One option is to follow the heading for some distance and take another signal strength reading later to verify that the heading was accurate. This method can be repeated with course corrections along the way until the hunter is close to the fox. The other strategy is triangulating the fox by moving to a new location perpendicular to the starting point. This allows the hunter to take another reading and plot a new heading on their map; the new and original headings should intersect at some point. Taking another reading from an equally distant location will yield a third heading, which should cross close to the intersection of the first two headings. The area around the three intersecting lines should be close to where the fox is hiding. This method, although potentially more accurate, can result in a longer search time.

As a hunter approaches the fox, the signal strength will continue to grow until it is no longer possible to see dips and peaks on the meter when turning the antenna. At that point, it will be necessary to cut the signal strength with an attenuator so that a heading can be determined. If using a step attenuator, stages can be turned on and off to achieve a usable signal at the receiver. If using an offset attenuator, the hunter will first need to tune the radio's receiver to the offset frequency, then adjust the attenuator for optimal signal strength.

The last leg of the hunt is usually carried out on foot with a handheld. But at this stage, the fox's signal may be too strong for attenuators and directional antennas to be effective. One technique for cutting

Smartphone Mapping Apps: Boon or Bane?

Smartphone mapping apps can be useful, but they can come with a learning curve and fail to work properly if cell phone service is interrupted. When using an app to plot headings over a large area, detail can also be hard to see, due to the small screen size. However, when the search area is small or when the hunter is close to the fox, a mapping app will often be more detailed than a paper map. Most apps can also help with plotting routes and alerting hunters to potential road hazards that may hinder progress during a hunt.

signal strength, known as *body fading*, is to remove the traditional antenna from the handheld and use something like a paper clip or bobby pin as an antenna instead. The hunter can then hold the handheld close to their chest while walking in a tight circle and looking for peaks and nulls on the signal strength meter. The makeshift antenna functions as an attenuator, and the hunter's body acts as a reflector on a directional antenna, which helps them find a heading. Another technique that is especially helpful for camouflaged foxes is tuning the receiver to the third harmonic frequency of the fox box. For example, if the fox is transmitting at 146.550 MHz, the hunter can tune their dual-band handheld to 439.650 MHz. If the hunter is close enough, they should be able to receive a weak signal from the transmitter, determine a final heading, and zero in on the fox.

Get Involved

Foxhunting is an enjoyable activity that helps build technical prowess and operating skill. Some hams even participate in competitive foxhunting and other amateur radio direction finding (ARDF) contests to earn awards and recognition. There are many ARDF organizations that promote this activity and sponsor sanctioned foxhunting events throughout the year.

Rob Zielfelder, N1NUG, has been a licensed amateur since 1992. In addition to foxhunting, he enjoys portable operating, collecting and preserving classic ham radio gear, and ragchewing with local hams. He is the secretary of the Natchaug Amateur Radio Club, based in Mansfield, Connecticut, and an active member of the BEARS of Manchester Amateur Radio Club. Rob works as a product validation engineer at Cadence Design Systems in Burlington, Massachusetts. When not working or operating, he enjoys outdoor activities like camping, biking, and kayaking with his wife and son.

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Check Out *On the Air* Magazine for More About Finding Foxes

If foxhunting sounds appealing and you want more information, read "Radio Orienteering: Using Sound to Find Your Way," by Charles E. Scharlau, NZØI, in the March/April 2023 issue of *On the Air*, ARRL's magazine for hams at beginner and intermediate skill levels.



The March/April 2023 issue of *On the Air*, featuring "Radio Orienteering: Using Sound to Find Your Way" by Charles Scharlau, NZØI.

Radio orienteering (aka, amateur radio direction finding, or ARDF) involves radios, maps, compasses, and navigating on foot outdoors — think of it as foxhunting's more competitive, athletic cousin. Participants use direction-finding receivers to seek out transmitters located within a forest or park, and winners are determined by the number of transmitters they find, and the time spent completing the course.



Gheorghe Fala and Norbert Linke wait for their 80-meter classic start times with receivers, maps, and compasses at the ready. [Photo courtesy of Imre Polik, KX4SO]

As is the case with foxhunting, no amateur radio license is required to participate in radio orienteering (because you're only receiving, and not transmitting), so this is an ideal activity for involving the non-hams in your life.

Radio orienteering brings together science, technology, nature, and sport. Its pace and level of challenge can be adapted to match the skills of the participants, regardless of age, physical fitness, or experience level. Read the article at www.arrl.org/ota and find out more at www.arrl.org/radio-orienteering.