NOFCA News

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Southern California Whippet Association
SSIH
Sierra Slopes Ibizan Hounds
SWCC
Southwest Coursing Club
THG
Tally-Ho Greyhounds
WBCC
Western Borzoi Coursing Club

In This Issue

Finding a lost dog (or falcon) with telemetry tracking equipment

It will soon be time to start conditioning our old dogs and training young dogs for next season. Our thanks to John Burchard for the following article about telemetry equipment.

The principle of telemetry tracking is simple. Attached to the animal is a transmitter which broadcasts a radio signal (a rhythmic beep tone) in all directions. The receiver used to detect this signal is equipped with a highly directional antenna. The signal in the receiver will be strongest when the antenna is pointed directly toward the source. By turning the receiving antenna, the user can find the direction from which the signal is coming. Since the receiver is portable (usually hand held), the user can then move toward the source of the signal, stopping at intervals to check the direction, until sight contact is made.

There are, however, some practical details which must be mastered in order to use the equipment effectively. The purpose of this article is to provide a simple account of those details. The discussion which follows is based partly on the technical specifications of Marshall telemetry equipment, because that is already in use in the coursing community, and because Marshall equipment is among the best available on the U.S. market. The principles described below apply, however, to all such equipment, and these instructions are therefore usable, with minor modification, for all modern telemetry gear.

Equipment

A basic telemetry system consists of four components: a transmitter, a transmitting antenna (attached to the transmitter), a receiver, and a directional receiving antenna (usually attached to the receiver, though vehicle based systems are also available using a much larger antenna mounted on a pole above the vehicle roof, and connected by coaxial cable to a receiver inside the vehicle). In practical use the transmitter and its antenna can be considered as one unit, and the receiver with its antenna as the other unit, but conceptually it is useful to consider the properties of each component separately.

The transmitters are either collar mounted, designed for use by scent hounds, or designed for attachment to falcons, where weight is especially critical. Falconry transmitters are miniaturized, weighing only a fraction of an ounce. Because their batteries must also be small and light, they don't transmit indefinitely. The signal from such a transmitter becomes weaker after a few days, and fades entirely within a week or so. Transmitters with larger, heavier batteries, mounted on a collar, can be used for scent hounds, which often operate in rugged mountainous country and therefore need a longer-lasting and more powerful signal. Small lightweight

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Transmitters continued

transmitters, similar to the falconry ones, are also available in a collar mount. Some users dislike having an unbreakable collar on a dog who may be trying to negotiate fences, etc., at speeds close to 40 mph. A shoulder mount attachment system has therefore been developed which allows the use of falconry-style transmitters.

The original shoulder mount was developed as a separate harness underneath the coursing blanket, by Ingrid Romanowski and Diane Divin. A modification, in which the transmitter is attached directly to the coursing blanket, was developed by Victoria and Warren Cook. Each version has its advocates.

Falconry transmitters come in two styles. "Leg mount" transmitters are fastened to a falcon's leg (or sometimes around its neck) by a lightweight flexible strap or thong. "Tail mount" transmitters have a spring clip which fits into a tiny metal tube, permanently attached at the base of a central tail feather. This is the best style for use with falcons, but the clip is superfluous when attaching a transmitter to a dog, so the less expensive leg mount style is preferable for this use. Marshall Radio currently makes two models in leg mount style, the Model BP at $125 and the Model RT Plus at $195. The BP is powered by two #399 wafer batteries, with a nominal battery life of five days. The RT Plus is powered by a single 1/3N lithium battery, with a nominal battery life of eight to ten days. It radiates a signal four times more powerful than the BP, so it can be detected at twice the distance. There is also a Power Max transmitter at $245, with four times the power (and therefore twice

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Please note: Treasurer Victoria Cook has a new e-mail address:
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NOFCA Meeting

July 17 at the home of Jo-Ann Van Arsdale

On the agenda:

Election of Officers

Vote on new rule proposals

(New proposals can be found on the web site)

It is NOFCA's policy not to print member addresses on the web site, please call for address and directions.

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E-mail: chubasco@vetdoc.com

the range) of the RT Plus. Its battery life is, however, only five days, and it is currently available in tail mount style only. Marshall also makes a small, lightweight collar-mounted transmitter.

Maximum range of the RT Plus is given as 15-30 miles line of sight, or 100 miles in the air. Effective range may vary considerably according to conditions of weather, terrain, vegetation etc.

The transmitting antenna, a rather stiff, stranded stainless steel wire protected by a plastic coating, is permanently attached to the transmitter. Its length is precisely tuned to the frequency of the particular transmitter to which it is attached, and should therefore not be changed. Cutting even a small amount off the end of the antenna may weaken the signal it transmits. An antenna will radiate its strongest signal when perpendicular to its "ground plane" which in this case is the body of the dog. That condition is met by an attachment style which seems to be gaining favor in the coursing community, i.e. mounting the transmitter on top of the dog's shoulders, using either an elastic harness underneath the coursing blanket, or a Velcro patch sewn directly to the blanket itself. In either case the transmitter body is held securely in a rubber baby-bottle nipple, and the antenna sticks straight upward. The strongest signal is radiated perpendicular to the axis of the antenna. In other words, with the above described shoulder mount, the strongest signal is radiated horizontally in all directions, which is ideal for locating it (almost no signal is radiated along the axis of the antenna, so it is hard to locate a transmitter whose antenna is pointing directly at the receiver).

The receiver has, like most radio receivers, an on-off-volume switch with which the playback volume of the received signal can be adjusted. There is a built-in loudspeaker, and also a jack for earphones. The receiver has a channel selector, so it can be set to receive signals on different frequencies within a particular waveband. There is a "Fine tune" knob to adjust the frequency within a particular channel, since individual transmitters vary somewhat in their properties (more of this below). There is a "Range" switch with "far" "medium" and "near" settings, and a "Filter" switch with "wide" and "narrow" settings. Both these features are used to improve directional reception of a particular signal. There is a "low battery" light indicating the batteries need replacing (the Marshall receiver uses two 9 volt alkaline batteries). Last but definitely not least is a large, illuminated signal strength meter, more accurate than the user's ear in determining the direction of the signal source.

The details of other receivers may vary, but they all function according to the same principles.

The receiving antenna is a "Yagi antenna" consisting of a central axis with two or more crossarms of precisely calibrated length and spacing along the axis. The basic design is familiar from old-style rooftop TV antennas. The Marshall receiver has a three-element Yagi antenna which folds ingeniously on top of the unit and deploys by spring action when released. The folded unit resembles a large pistol and can be carried in a belt holster. The Innotek antenna is also a three-element Yagi. The arms fold, but the axis does not telescope. It fits in a long tubular holster which can be carried over the shoulder.

Further details about Marshall Radio telemetry systems are available at http://www.marshallradio.com/. The Innotek system is described at http://www.innotek.com/.

Radio waves

Radio waves, like other waves, can be described in terms of their frequency (number of cycles per unit time) or their wavelength (the length of one wave). The unit of frequency, named in honor of one of the pioneers in the study of electromagnetic radiation, is the Hertz (Hz), equivalent to one cycle per second. The range of sound waves audible to the human ear, for example, is often given as 20 to 20,000 Hz. One thousand cycles per second is called a KiloHertz (KHz), one million a MegaHertz (MHz). Thus the upper limit of human hearing can also be given as 20 KHz (only young ears can hear sounds in that frequency range). The old "kilocycles" of AM radio are now called KHz, and the old "megacycles" of FM radio are now called MHz. One thousand MHz (a billion Hertz) are a GigaHertz (GHz), a frequency surpassed by recent generations of PC microprocessors. Visible light waves have frequencies on the order of 500 million GHz. X rays, for example, reach even higher frequencies.

Most telemetry tracking equipment operates at specific frequencies, assigned by the FCC, between 215 and 220 MHz. The Marshall units purchased by NOFCA and by the SCC operate in the 216 MHz band, with a channel spacing of 10 KHz, or 0.010 MHz. In that system Channel 1 = 216.005 MHz, Channel 2 = 216.015 MHz, Channel 3 = 216.025 MHz, etc., up to Channel 15 = 216.145 MHz. The channel numbers and frequency assignments are printed on the bottom of each receiver for reference. There is also a 217.7 MHz system and a 220 MHz system, each belonging to individual NOFCA participants. These are not compatible with the 216 MHz Marshall systems, so searches for those transmitters must be conducted using their own receivers.

Innotek, a name familiar to users of electronic training collars, manufactures a fully programmable telemetry system. Receivers and transmitters can be programmed to operate in the 216, 217, 219 or 220 MHz frequency bands,

and set to any of 16 channels in any of those bands. The channel spacing of the Innotek system is 50 KHz. Channel 1 is XXX.005 MHz, Channel 2 is XXX.055 MHz and so on up to Channel 16 at XXX.755 MHz. There is thus limited compatibility between the Innotek and the Marshall systems. In the 216 MHz frequency band, Innotek Channel 1 = Marshall Channel 1, Innotek Channel 2 = Marshall Channel 6 and Innotek Channel 3 = Marshall Channel 11.

Obviously, if you are using this equipment to look for a lost dog, it is essential to know on which channel the transmitter is broadcasting. That is, however, not sufficient. Individual transmitters on any given channel vary somewhat from one another in frequency. The transmission frequency of a transmitter also varies somewhat with the ambient temperature. The "Fine tune" knob allows the user to adjust the receiving frequency up or down by 5 KHz from the nominal channel frequency, thus scanning the whole channel width. If you are looking for a lost dog, you must therefore also know the correct fine tuning setting for that particular transmitter-receiver combination. That must be determined empirically beforehand, by listening to the transmitter and adjusting the fine tuning to obtain the strongest signal. At time of writing it remains to be determined whether the setting for a given transmitter is the same for both the currently available receivers. The NOFCA Secretary will obtain and compile all that information, and make it available in tabular form, but it is still incumbent on every user to know which transmitter they are using and make the relevant details known to the Field Clerk at the beginning of the day. A receiver may or may not be available for making such determinations on an ad hoc basis after arriving in the field, so the correct settings for a given transmitter must always be determined ahead of time. Receivers will, we hope, always be available in the area of a hunt, to be called upon at need, but at present there aren't enough to send one to each field.

It is also essential to realize that a 216 MHz Marshall receiver cannot be used to locate transmitters broadcasting, for example, in the 217 MHz band. The frequency band and channel assignments of transmitters and receiver must match. There are already at least three mutually incompatible tracking systems in use by the coursing community in California alone. We hope that further proliferation can be avoided, and that any future purchases are compatible with the existing 216 MHz equipment. The receivers, in particular, represent a considerable investment.

Frequency and wavelength are inversely related. Higher frequency waves have a shorter wavelength. Radio waves travel at the speed of light, nearly 300,000 km per second. The length of one wave at a given frequency is therefore 300,000 km (300 million meters) divided by the number of waves (cycles) per second. At 216 MHz (216 million cycles per second) the wavelength is 300/216 (since the millions cancel each other out) or 1.38 meters, a little less than five feet. That determines the size of antenna used. To receive or transmit efficiently, an antenna must have a length which is an exact multiple or fraction of the wavelength. A five foot antenna would be far too unwieldy on a dog, let alone a falcon. A 1/4 wave antenna is, however, in common use, and for 216 MHz would be a bit less than 14 inches long. It can be made shorter by putting a "loading coil" at its base (hidden inside the transmitter body in this case). I mention this only to emphasize again the importance of not changing the length of the antenna. It is precisely tuned for maximum output, and changing its length by even a few millimeters could cause a loss of signal strength.

Very short radio waves travel by line of sight. They don't bend around obstacles very much. That limits the range at which a dog, or a falcon on the ground, can be detected. If a falcon is flying high in the air it may be detectable at distances of 20 miles or more. On the ground the range of useful detection is, however, at most a few miles, depending on terrain and vegetation. That has implications for the search strategy (see below). In particular, you want to be as high as possible when scanning for a signal.

Practical considerations

When deploying a transmitter it is essential to record either the exact frequency (e.g. 216.037 MHz), or the frequency band (e.g. 216 MHz), channel (e.g. Channel 4, 216.035 MHz) and "Fine tune" setting (e.g. +2 KHz). Since in case of a problem the handler might very well be off somewhere looking for the dog when the decision is made to call for a receiver, that information should be on file with the Field Clerk so it will be available to the receiver operator without delay.

Another obvious point is to make sure the attachment of the transmitter to the dog is such that it will not easily be lost. Experience has shown that the "shoulder mount" arrangement is robust in that respect. If the dog dives under a fence the transmitter and antenna fold backward, and spring up again afterward. If a collar mount is used, the collar must be weighted so the antenna projects straight upward. Usually the relatively heavy battery case serves that function. For the very lightweight

Marshall collar mount, it is the buckle which serves as counterweight.

It is important, of course, that the transmitter have fresh, undepleted batteries. To conserve battery strength, it is advisable to switch the transmitter "off" whenever the dog wearing it is not in slips. It is vitally important, however, to make sure the transmitter is switched "on" before putting the dog in slips! Some transmitters are switched on by inserting their batteries; others by tightening a cap; and still others by passing a magnet over them, or removing a magnet. Make sure you understand the operation of the particular transmitter you are using. If at all possible, check the signal using a matching receiver. This is possible, of course, only if a receiver is available in the field at the time. An ultimate objective of this program is to have a receiver, and at least one knowledgeable operator, in every field. Because of the cost of the receivers, we may have to make do with less for the time being. In the meantime, however, a receiver will usually be available at the "draw" and transmitter testing can be done at that time.

Deploying a receiver requires some skill on the part of the operator. I hope to be able to give practical instruction to as many users as possible, since many things are more easily demonstrated than explained, and better remembered if you have experienced them at first hand. The broad outlines are, however, described below.

The batteries in the receiver should normally last quite a while, perhaps an entire season. It would be well, nevertheless, to have a spare set (of two conventional 9 volt alkaline cells) on hand.

Finding a lost dog

Using the receiver is straightforward: switch it on, set the appropriate channel (turn the knob clockwise only, please!) and fine tuning, deploy the antenna, set filter to "wide" and range to "far" and volume to a medium setting, and scan the horizon slowly a full 360 degrees to see if you pick up a signal. If you do, adjust the volume so the signal strength meter indicates about mid range, adjust the fine tuning to get the strongest possible signal, turn the filter to "narrow" and readjust the fine tuning, turn the range to "medium" and then to "near" and see if you can still get the signal (if not, turn it back one step) and then scan round the horizon to find the direction with the strongest signal. In general the signal will be strongest when the antenna axis is pointing straight at the source, and weakest when it is at right angles to the source. There will be a second, lesser signal peak in the opposite direction to the source. It may take some playing with range, filter and volume controls to distinguish clearly between the primary peak (toward the source) and the secondary one (away from the source) which should be weaker. The signal strength meter is more informative than your ear. The volume should be set so that the strongest signal causes the meter to indicate somewhere near the middle of its range; then the secondary peak should indicate a lower value. If the volume is too high you will not be able to distinguish primary and secondary peaks. You may need to pivot around several times to be sure of the direction of the source.

The "narrow" filter setting will give you the most accurate directional indication, but requires very precise setting of the fine tuning. The frequency of a transmitter varies somewhat depending on the ambient temperature. When looking for a signal, therefore, always set the filter to "wide" until you have picked up a signal from the missing dog. Then adjust the fine tuning to get the clearest possible signal. Only then try the "narrow" filter setting and readjust the fine tuning. If you lose the signal, go back to "wide."

Beware of interference from much closer transmitters on other dogs, even on other channels. There may be some "crosstalk" if the signal is very strong, so move away from other transmitters, or turn them off, while searching.

If you have difficulty picking up a signal, try rotating the plane of the antenna (around its axis, without changing the direction in which it is pointing). You should get the strongest signal (assuming the axis is pointing straight toward the source) when the plane of the Yagi antenna elements is parallel to the dog's antenna. With falcons that often tells us what a bird is doing. If it is perched, the antenna (tail mounted) hangs down, while if it is flying the antenna is horizontal, and so on. With a dog that might be less informative, because we hope the antenna will stick straight up most of the time; but at least you will know if it is rolling in a dead sheep! By monitoring the signal for a few minutes, after you have established the direction, you may be able to tell whether the dog is moving or stationary. If it is moving, the signal may vary in strength as the dog passes behind various obstacles.

Once you have a direction, the obvious thing to do is head toward the dog. It is, however, usually preferable to move at an angle to the direction of the signal, in order by triangulation to form an estimate of how far away the dog

is. Our coursing terrain is unfortunately well supplied with obstacles, such as highways or irrigation canals, that cannot be crossed except at specific points. You may therefore wish to know whether the dog is on this side or the other side of the California Aqueduct, or of a major highway, before setting off in that direction! In any case, by approaching the dog in a zigzag or spiral path rather than directly, the resulting triangulation effect will give you a good idea of its exact location before you reach the spot. That may be useful if, for instance, the dog is hidden in heavy brush. The drawback of a straight-line approach is that you are never sure how far away you are from your target.

After proceeding some distance (say half a mile) in the direction of the dog, make another scan to confirm the direction. The signal should be noticeably stronger. If not, double check that you are going in the right direction rather than the wrong one. It is sometimes, particularly in the neighborhood of reflecting objects, not easy to distinguish the primary from the secondary peak. Massive reflections, such as may occur in a mountain valley or among buildings, can be completely deceiving as to the actual direction of the signal source. Avoid the vicinity of high voltage power lines or transformers. They will distort the signal, and you may even receive an electric shock from touching the receiver.

The initial scan will usually be conducted near the location from which the dog started on its course, and preferably from the nearest convenient high point. If no signal is detectable, try increasing the volume setting. Try rotating the antenna about its axis - the signal will be strongest when the plane of the Yagi antenna elements is parallel to the transmitter's antenna, which as noted above is likely to be more or less vertical. Use earphones if possible. Try the highest nearby location you can reach. If you still can't get a signal, a search strategy is essential. The core of it is to hit the highest points along the dog's probable route, at about one mile intervals, and do a careful 360 degree scan from each. If ten miles of that hasn't produced any signal, it is probably time to think of broadening the search sideways. The details will obviously depend on the particular terrain, so local knowledge is very important. The best reception will be obtained from high points. Dense stands of trees will absorb the signal, so you might want to use a half mile interval in an orchard (but it might also be better to get out of the orchard and seek high ground). Because large metal objects reflect radio waves, avoid the immediate vicinity of buildings, parked vehicles and the like. Standing atop a vehicle, away from other vehicles, should be OK. Obviously, you won't get good reception from inside a vehicle.

Those are the barest essentials. I hope we will be able to arrange practical demonstrations.

John E. Burchard
12/29/2003

Summary of available equipment

The following summary will be updated as further information becomes available ...

NOFCA owns a 15 channel, 216 MHz Marshall receiver. Several individual participants own transmitters compatible with this receiver (and of course the SCC one, see next).

SCC owns a 15 channel, 216 MHz Marshall receiver. SCC also owns two model BP shoulder mount transmitters, Channel 4 and Channel 6, as well as one RT Plus shoulder mount transmitter, Channel 6.

SCC also owns a Tracker 220 MHz system, consisting of one receiver and four collar mounted transmitters on separate channels (details pending).

Ingrid Romanowski & Diane Divin own a 5 channel, 216 MHz Marshall receiver (Channels 6-10) as well as two RT Plus transmitters (channels not specified).

Vicky Clarke owns a 217.7 MHz system, consisting of one 10 channel AF Antronics MN-10 receiver and five LD-3 collar mounted transmitters at 217.707, 217.736, 217.746, 217.759 and 217.775 MHz.

Steve Hill owns a fully programmable Innotek RD-400 system, consisting of one receiver and two collar mounted transmitters (lighter in weight than the above mentioned) as well as one Marshall collar mounted transmitter on Channel 1, compatible with both systems.