

# **Practical radio-tracking**

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## Scope

This is an introduction to radio-tracking, which includes exercises to illustrate important characteristics of transmitting and receiving equipment.

### Radio-waves

Several aspects of the way radio-waves behave affect practical radio tracking. It is important to be aware of these before you start tracking.

#### 1) Attenuation.

Signal power is reduced (attenuated) by trees and dense vegetation. Signals are attenuated more severely, or lost completely, if the tag is behind buildings, ridges or hills. If the tag antenna touches salt water then the signal is lost completely.

#### 2) Reflection.

Radio waves can be reflected quite strongly by cliffs, hillsides, woods and buildings. This often confuses the tracker by giving a false impression of a tag's bearing.

#### 3) Diffraction.

This is useful, in that it allows radio-waves to be detected slightly off-line from the transmitter round the edge of an impenetrable object. However, it also gives rise to interference effects around tree trunks and thus makes it difficult to get accurate fixes in woodland. This effect, and reflection from the trees, also make it difficult to obtain accurate bearings for signals emerging from the wood into a 'Fresnel Zone' which extends for about 50 metres outside an abrupt woodland boundary.

#### 4) Polarisation.

When radio-waves reach your hand-held Yagi antenna they may be horizontally or vertically polarised, and for the best signal reception the elements on your Yagi should be in the same orientation. This is particularly important if you are searching for a lost tag, because a weak signal which is only just audible with the Yagi elements vertical, might not be heard at all if you held the elements horizontal.

## **Tracking**

Before starting to track fast-moving animals, you **MUST** get some experience finding stationary tags. You need to know the range your equipment has under particular conditions (such as different terrains and tag positions), and the procedures to follow when you start a search.

The following exercises demonstrate several important points about practical radio-tracking.

### **Exercise 1.** Characteristics of the directional 'Yagi' antenna

- 1) Place a tag in the middle of a large open space, preferably at the height and orientation it would be on the tagged bird, animal or model.
- 2) Take your receiving equipment about 50 paces away and hold the Yagi antenna with the elements vertical and the boom pointing towards the tag.
- 3) Turn the receiver on and set the gain so that the sound of the tag's signal is quiet, but can still be heard fairly easily. If you are tracking a powerful tag with a receiver with an attenuator switch, you need to switch on the attenuator (at the back of the receiver box) to get best directionality from the Yagi.
- 4) Keeping the Yagi elements vertical, slowly turn in a complete circle listening all the time to the loudness of the signal. Notice how the loudness drops off quite sharply as the antenna swings more than about 30° to the side, and then picks up again, but to a lesser extent, when you are pointing directly away from the tag (the 'back bearing').
- 5) Again point the Yagi, with its elements held vertical, towards the tag to get the loudest signal. Then turn the Yagi so that its elements are horizontal, and notice the difference in the loudness of the signal. In this situation, vertical elements will usually be best, but sometimes (e.g. when tracking in woodland) it may be horizontal. If you have lost radio contact with a bird or animal, you need to listen for it with the Yagi elements in each orientation in turn.

## **Exercise 2.** Signal strength meter function

Some radio-trackers prefer to use the signal strength meter to determine the direction of their tag, rather than trust their ears to judge when the signal is loudest. This can only be of use, however, if the signal is strong enough to swing the meter needle.

Follow the instructions in Exercise 1, but in step 3, set the gain to a level which swings the meter needle high on the scale. Notice the position to which the needle swings as you turn in a circle.

## **Exercise 3.** The effects of tag position and distance

After discovering how to determine the direction of a tag, it is worth investigating the effects of tag distance and position on the signal strength.

1) Note the gain required to just detect the signal where you are, and walk slowly towards the tag with the receiving antenna held for peak reception. The signal will increase in strength quite rapidly as you approach.

2) Walk round the tag, keeping at the same distance from it. If the tag antenna is horizontal, you will notice the signal strength change, reaching a peak when you are sideways-on it, and going through a minimum (null) when you are end-on. If the tag antenna is vertical, the signal will change little as you move around it.

3) Raise the height of the tag by a few metres (by putting it in a tree, or on a post).

Compare, at a distance of 20-30 paces, the strength of the signal from the tag in this position to that when it is in the same orientation on the ground. You will find that the signal is stronger when the tag is raised above ground.

The same effect occurs when you raise the height of the receiving antenna. Raising the height of either transmitter or receiver by only 4 metres will roughly double the signal range. Even raising the antenna above your head may help you find a missing tag.



#### **Exercise 4. Taking compass bearings**

In some situations you will find the tag by estimating the direction of the loudest signal, then walking towards it. However, this is not necessarily the best approach. Unless the tag is very close, it may be difficult to estimate just how far away it really is. Take, for example, a tag on a bird. Because of the effect of tag height on signal strength, the signal from a bird which is high in the air several kms away will sound as loud as one which is only a few hundred metres away on the ground. In this example, the true position of the bird may decide whether you approach it by foot or in a car. Similarly, for grounded tags, signal attenuation by woodland, ridges or other features of the landscape also makes it difficult to judge distances accurately from a single bearing. In these circumstances it would be better to take two (or more) compass bearings, and use triangulation to determine the position of the tag. You can take a compass bearing most accurately by following this procedure.

- 1) Find the peak signal position and turn down the gain until you can only just hear the tag.
- 2) Swing the antenna slowly to the side until the signal disappears, and then swing back until you can just hear it again, and note a landmark along the line of the antenna boom. Take a compass bearing towards this landmark.
- 3) Repeat this on the other side, and the tag bearing is the line that bisects the angle between these two directions.
- 4) Move 50-100 paces away in a direction roughly at right-angles to the line of the first bearing, then take a second bearing. If the two bearings are similar (say, 5-10 degrees apart) the tag must be quite distant. You should then move further away, at about 45 degrees to the second bearing (perhaps in a car) to take a third bearing. When the bearings differ by more than 30 degrees, you can use them to triangulate (the tag is near the point where the bearing lines cross on a map).

When you take bearings with a compass, hold it as far as you can from the receiver and headphones (preferably, take headphones off). This equipment itself creates magnetic fields which may affect the accuracy of your compass.

Of course, it will not be always necessary to take bearings with a compass. With practice, you will learn to judge the direction of the loudest signal by listening while you continually sweep the Yagi from side to side. If you walk at right-angles to the signal direction, still sweeping, you will be able to tell roughly how far away the tag might be, and decide whether you need to take a compass bearing or to drive/walk nearer to it.

## **Important Tips**

It is crucial that you practise finding a 'lost' tag (one that has been hidden by a friend) before you have to track one that is really lost ! When you start to use the equipment in real situations remember the following important points:

- Check your receiver, antenna and radio-tag before you use them, or at regular intervals (preferably daily) if the tag is in constant use.
- Carry a spare receiver battery.
- If you lose contact with a tag, gain height. The higher the place from where you are tracking, the greater will be the distance over which you can hear the tag. It will help even to raise the antenna above your head. If there is no high point where you are, it is often worthwhile going to the nearest highpoint, even though it may be some distance away.
- Listen for missing tags with the antenna elements held both vertically and horizontally. A signal which sounds very weak (or cannot be heard at all) may become quite loud if you change the orientation of the Yagi elements.
- Be sure that the direction from which you can hear the tag is the true bearing and not the back-bearing. The edges of woodland and sides of buildings are most often responsible for reflected signals appearing stronger than direct ones.
- Beware of attenuators ! An attenuator is very useful when tracking at close range, but it drastically reduces the maximum distance over which a tag can be heard. Always check that the attenuator is off before trying to find a lost tag.