NZASE resource

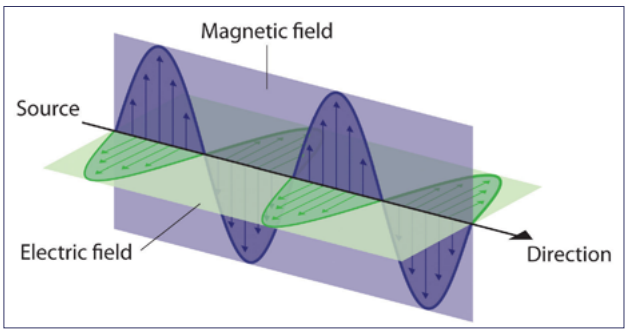
Tracking with radio

Radio waves are used to operate many devices around us. They allow us to detect signals from baby monitors, TV and radio broadcasts, emergency locator beacons, cell phones, and satellites; access internet by wifi; control garage door opening, and the movement of toy cars, boats, and planes.

How do radio waves work?

An electric current, a stream of electrons, passing through a wire will have around it an electric field, an area where an electric charge will be repelled or attracted. This electric current will also create a magnetic field around that wire – an area where a magnet will be repelled or attracted.

These two force fields are at right angles to each other and move outwards (radiate) at the speed of light (about 300,000 km/s). Together they are known as electromagnetic radiation, or EMR.



EMR consists of perpendicular oscillating electric and magnetic fields. Chemistry Libre texts: EMR.

Just as water waves transmit energy by moving water up and down (oscillating) at regular intervals, so energy can be transmitted by regular oscillations of electric and magnetic fields.

EMR can come in different forms that have different frequencies and wavelengths, with different amounts of energy. These include radio waves, microwaves, infrared light, visible light, ultraviolet light, x-rays, and gamma rays.

Radio waves have longer wavelengths (over 10mm) and lower frequency (0- 30 GHz) and transfer less energy than other forms. They can be emitted naturally, such as from the Sun, or from a transmitter like a radio station and detected by an antenna connected to a receiver. Because they carry information, radio waves are very useful for us, for example in locating kiwi.

Tracking kiwi with an antenna. From Meet the Locals - Wild tech. DoC, 2019.

Protecting kiwi

Our native birds are endangered, falling prey to introduced predators like stoats, ferrets, rats and dogs. Save the Kiwi works alongside iwi, conservation and community groups, and Te Papa Atawhai/ Department of Conservation (DoC) to manage known populations.

Since 1995 kiwi nests have been monitored. Eggs, once laid, are removed, incubated, hatched and raised in a secure predator-free site. Once it is big enough to fend for itself, at around 1kg, the bird is returned to the wild.

A kiwi will usually feed for about 12h each night and find a different nest to sleep in each day. But if it is incubating an egg, a kiwi will only feed for 4-5h a night. Knowing when incubation starts is key to predicting when the egg will hatch (about day 75), and so when the egg needs to be collected.

Monitoring nests used to involve a DoC worker tramping through bush for long hours every 2-3 weeks to find kiwi nests with trained sniffer dogs and taped kiwi calls, and checking nests for eggs - a very labour-intensive process. With the advent of radio tracking, not

only can the nest be found more quickly, more nests can be monitored and more kiwi saved.

Tracking kiwi

Since the mid 1980s, DoC has been using radio transmitters attached to kiwi legs to find their position during the day (when they usually nest). “The transmitter fitting is a good bit of kiwi ingenuity,” says DoC ranger Tim. “These days a hospital baby wrist band is wrapped around the leg and the handle of the transmitter, and then electrical tape is wrapped around that, being careful to align it nicely above the leg joint and keep feather dander off the sticky surfaces.” Usually, once a year, each tracked kiwi is caught to check its health and change the transmitter battery.

How kiwi radio transmitters work

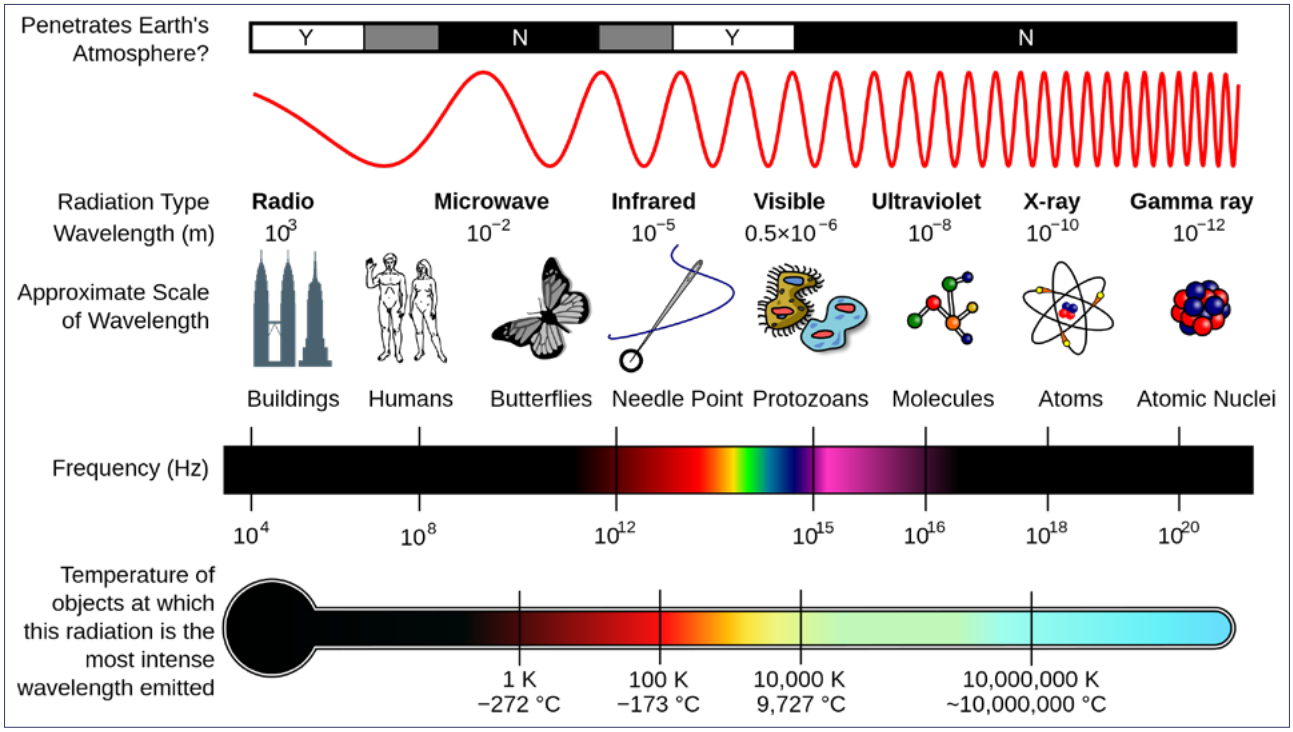
Each transmitter sends out a signal on a different frequency. At Whangarei Heads, a kiwi called Dallas nests in Taikura and its transmitter sends out a signal on channel 36. The receiver is ‘tuned’ or adjusted to match that specific frequency, so that Dallas’s signal is the one that is heard (just like selecting a specific station on the radio). In this way a receiver can be used to focus on one transmitter at a time.

The radio signals from each transmitter can

Above: Transmitters. Right: A brown transmitter held on kiwi’s leg by a white band. Photo: Sian Portier.

be detected by a foldable antenna which gathers the signal, and a receiver that converts that signal into audible beeps. As the operator swings the aerial from side to side, the volume and timbre of the beeps changes; the direction of the strongest signal indicates the direction of the kiwi being tracked. Barriers like rock walls can hide the signal or cause it to bounce around so operators need to move around to pinpoint a kiwi from several different directions.

Scientists Al Bramley and John Wilkes from Wild Tech developed a ‘smart’ transmitter, specifically designed for kiwi, so we can learn more about their breeding and behaviour. This device uses a mercury switch to count how often the kiwi moves its leg. Al describes it as a “tiny activity sensor buried inside a micro-chip. It’s like a cylinder with a ball bouncing around inside it. When the kiwi is asleep, having a rest,



The position of radio waves on the electromagnetic spectrum. By Inductive-load, Wiki-media Commons.

the ball is stationary. When it gets up to walk around and feed, the ball bounces around inside that cylinder and creates tiny electrical impulses that we interpret as 'the Kiwi out of bed'." Knowing exactly when this male bird starts incubating means Save the Kiwi knows approximately when it will need to remove the egg for hatching in captivity.

Sian Portier, operations leader at Taranaki Kiwi Trust, describes this in more detail. "The transmitter emits a radio signal which carries a lot of information. The number of beeps per minute tells how active the bird has been – 30 b/min for a healthy bird feeding for a full night, 48 b/min if feeding less, and therefore incubating, and 0 if the bird is dead or has lost its transmitter. Also, every 10 minutes or so, the transmitter sends a data stream, a series of eight codes, heard as faster beeps."

"This tells us in the last 24 h how long the bird sat on the egg, what time it emerged to feed, how long it fed for, as well as the average feeding time over the last four nights and the battery life of the transmitter." (See the image above).

The use of radio tracking has revolutionised how this endangered taonga is managed. It allows us to not only find kiwi and protect their young, but also to conduct detailed research on their way of life in a way not possible before the advent of this technology.

Student activities

- Find out about how radio waves are used in one of the other applications mentioned in this article.
- Compare and contrast radio waves and gamma waves.
- Find out about the journey for Māori to access their treaty rights in radio and television broadcast frequencies.

Sources

DoC, 2019, Video: *Meet the Locals - Wild Tech*.

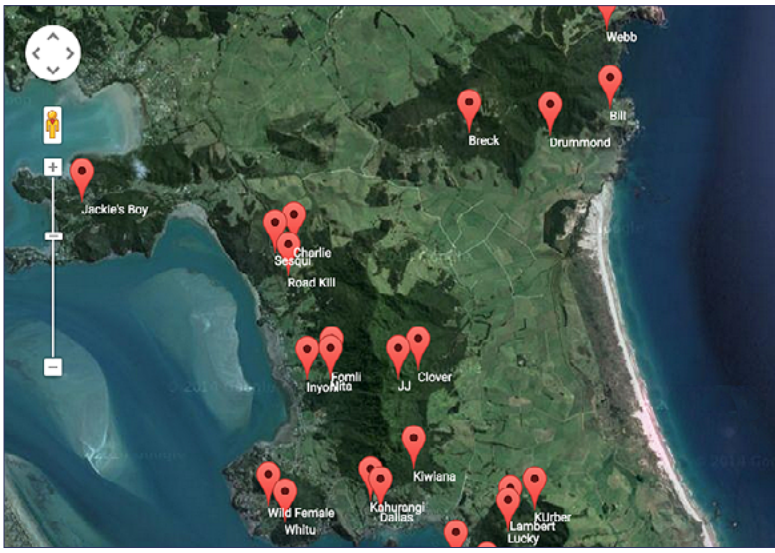
Whangarei Heads Landcare Forum, 2022, Backyard Kiwi.

Jim Lucas, 2022, What is electromagnetic radiation? *LiveScience*.

Data stream for Whitu at Reotahi at 10.15am on 23 March 2010	
30	Indicates the number of beeps per minute -- 30 is the signal for "alive but not nesting".
5.7	Indicates it was 35 days since Whitu's last nest (you subtract 2 from each number of beeps).
3.7	Indicates Whitu got up 15 hours previously, ie at 7.15pm.
6.9	Indicates 47 weeks of battery left in the tx.
8.2	Indicates 600 minutes of activity last night, ie 10 hours.
7.9	Indicates 570 minutes of activity 2 nights ago.
7.11	Indictates 590 minutes of activity average of the past 4 nights.

Above: Data stream for the Kiwi named Whitu. The 2 is subtracted to allow for a zero reading.

Below: A sample of the adult kiwi being tracked at Whangarei Heads.



Ngā Kupu

Aroturuki (~tia ~tanga) – Monitor
Auau (o te ngaru) – Frequency
Autōhiko – Electromagnetic
Awhi (~hia ~ nga) – Incubate, incubation
Roa o te ngaru – Wavelength
Ngaru irirangi – Radio wave
Pūrere tuku irirangi – Radio transmitter
Tūāwhiorangi autōhiko – Electromagnetic spectrum
Whaitua hiko – Electromagnetic field.

From *Paekupu*