

GPS TECHNOLOGY TO AID IN LIVESTOCK GUARDIAN DOG MANAGEMENT

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Global Positioning System (GPS) trackers can make using and locating livestock guardian dogs (LGDs) on a regular basis much easier. The trackers can also help you locate your livestock, as the dogs are generally nearby. GPS trackers can also help locate holes in your fences if an LGD is roaming onto a neighbor's property or if your livestock have left the pasture. By pulling up the travel path in the GPS tracker provider's software, you can find the exact location in a fence line where the dog or livestock got out.

There are many different types of GPS trackers that are available on the market today. They range in price, complexity of use, and most importantly, battery life. It is best to use lithium-ion batteries in your trackers to maximize battery life. GPS trackers specifically designed for domestic dog use often have very short battery lives, as the manufacturer assumes you will be able to catch the dog on a regular basis to exchange batteries. However, many LGDs are not well socialized, and catching them can be difficult—if not impossible—in large pastures or open ranges.

There are also a variety of GPS-based trackers used for scientific research that could be used for LGDs. The problem with most of these devices is that they are extremely expensive, and many require special software to download and analyze the data from the trackers. They also may not give location updates as often as needed for tracking LGDs. The devices discussed in this fact sheet are commercially available and easily accessible, allowing producers to acquire and receive customer support if needed. Most devices are easily attached to a dog's collar and require batteries that are commonly available in stores.

GPS TERMS

Two terms that producers should be familiar with when looking into GPS trackers are "pings" and "uploads."

Pings are generally taken in minutes of time, while uploads generally occur in hours of time. A ping refers to a GPS fix, or the location taken by the tracker at a time the user sets, typically logging every 15 to 30 minutes. Most trackers can store thousands of pings at a time before they are overwritten in the unit's memory. Pings generally do not use much battery life.

Uploads occur at set times during the day, usually every 2 to 4 hours, and refer to the ping data being sent to the tracking company's computer system. Uploads generally use the most battery life of a GPS tracker. By adjusting the upload time, you can conserve battery life while still being able to see where the dog has been. For example, a 15-minute ping with a 2-hour upload is a good setting to use for young LGDs under 2 years of age, as young dogs tend to roam and test the property boundaries more than older dogs. For dogs over 2 years of age, a 30-minute ping with a 4- to 6-hour upload is a good setting to monitor their daily activity. Mature dogs that are moved often or new to an area may need a more frequent ping and upload time to accurately track their movements to ensure they have not wandered off of the ranch. A geofence is also a good tool to use in the tracker's software to notify you if they have left.



Oyster 3 cellular GPS tracker
made by Digital Matters.
Picture courtesy of Digital Matters, 2022.

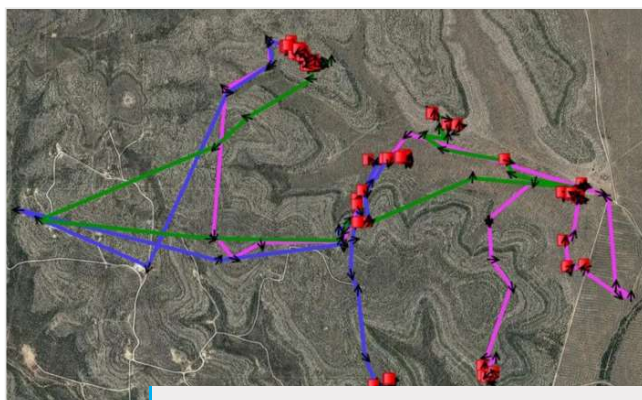
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TYPES OF GPS TRACKERS

There are two main types of GPS trackers available: passive tracking and active tracking. These terms refer to how the data is collected and reported by the tracker.

Passive trackers, or data loggers, collect the data but must be removed from the dog and have the information transferred to a computer to track its locations over time. The units often have internal batteries that must be recharged after downloading the stored data. These are generally much smaller than active trackers and have a longer battery life but do not offer live tracking of the dog. Data logger trackers are often used for research purposes, as they can store up to 65,000 pings or locations. For small producers with well-socialized LGDs, this type of tracker may be a good option as they are inexpensive but still track the dog's movements.

Active trackers send a signal either via cellular or satellite service to a provider. Active trackers require larger batteries than passive units and provide live tracking of the dog. However, their batteries must be replaced or charged on a regular basis. It is best to use lithium-ion batteries in your trackers to maximize battery life. Depending on the type of active tracker you purchase, you can expect anywhere from a few days to a few months of battery life. Many ranchers will find that active-tracking commercial GPS trackers for cargo containers and semi-trucks offer the best type of tracker for LGDs. These units are often waterproof with strong cases and have options to conserve battery life.



The paths three different LGDs traveled over a day in a large pasture in Iraan, Texas. Arrows indicate the direction of travel, and red boxes indicate locations where the dogs stopped.

Picture courtesy of DPL Telematics, 2021.

CELLULAR-BASED GPS TRACKERS

Cellular GPS trackers can often provide 5-minute updates on a dog's position. However, this comes at the price of battery life. GPS pings of 15 to 30 minutes are useful for most tracking purposes, with uploads every 1 to 4 hours. Uploading to the provider's server drains

most of a GPS tracker's battery life. The more often you have data sent, the shorter the battery life typically is. The cellular signal strength in an area also has a great impact on battery life. Areas with strong cellular signal will allow for much longer battery life than areas with poor signal because the GPS tracker will have a difficult time acquiring the signal and sending information. Some trackers on the market have features that help increase battery life by only allowing the tracker to send a signal a few times, then stopping if it does not receive a signal to send the data.

SATELLITE-BASED GPS TRACKERS

If the cellular signal is low in your area, then a satellite signal-based GPS tracker may be a good option.

Currently, the units are not as popular as the cellular-based trackers. However, the advantage of these units is that they will acquire a signal in almost any location—all they need is a view of the sky to send a signal of your dog's location. The battery-powered units have a similar life to the cellular-based units. New solar-powered units on the market look to be promising for LGD use as well. The solar-powered satellite trackers show great promise if manufacturers can reduce the size of the units so that they can be mounted on a dog's collar. These units, once placed on a dog, would

never have to be removed for battery replacement. However, the units currently available are a little too large to be placed on a dog's collar. Also, most of the units need direct sunlight to stay adequately charged to send a signal, which may require a harness on the dog. A new solar-powered ear tag tracker has just come out and is showing good early testing on LGDs. The unit can easily be attached to a dog collar.



Smart One C satellite-based GPS tracker.

Picture courtesy of Lone Star Tracking, 2021.



GsatSolar ear tag tracker.

Picture courtesy of Lone Star Tracking, 2023.

Table 1. GPS trackers used on LGDs at AgriLife Research Ranches.

Manufacturer	Unit	Coverage Type	Possible Data Transfer (ping/upload)	Power Source	Battery Life	Unit Cost	Service Cost/Unit
Digital Matters	Yabby 3 – Collar Ready	Cellular	15–30 minutes every hour	AA Battery	Fair	\$150	\$13/month
Digital Matters	Oyster 3	Cellular	15–30 minutes every hour	AA Battery	Good	\$150	\$13/month
Digital Matters	Oyster 3	LoRa – Cellular	Every 15 minutes	AA Battery	Excellent	\$115	\$7/month plus \$7/month tower fee
Globalstar	Smart One C	Satellite	2 hours, 4 hours, or 6 hours	AAA Battery	Good	\$199	\$30/month
Lone Star Tracking	GSat Ear Tag	Satellite	1 hour, 2 hours, or 6 hours	Solar	Fair	\$275 for 1 hour of data	Service cost included in price

LORA-BASED GPS TRACKERS

The newest type of GPS tracker to recently hit the market is the LoRa tracker. This system was originally designed for military applications and has recently been adapted for civilian use. It uses a tower to relay data from the GPS trackers to the cellular/satellite provider, eventually sending it to the tracking company's software. The LoRa system has several advantages, including lower unit costs, lower monthly fees, longer battery life, and constant pings/uploads. Most producers will find that a 15-minute ping/upload is more than adequate to track their LGDs.

The LoRa system does have some drawbacks. The main disadvantage of the LoRa system is that the tower's signal can only reach an approximate 4½-mile radius. For producers with large ranches, an additional tower would need to be installed to cover the entire ranch. There may also be a monthly fee for the tower service and an installation cost for the tower. Costs for the towers vary based on whether power and/or internet is available at the site.

GPS TRACKER FEATURES

All companies have online software that customers can use to access information and configure features for their specific GPS trackers. Many companies supplying GPS trackers to the public have apps for cellular phones. Phone apps vary in features and usability. In addition to the online software, it is important for producers to check out the provider's phone app to make sure that it provides the features they need and its ease of use. Some companies have software that sends speed alerts. These alerts can be helpful for young dogs, as producers get a notification that the dog is moving quickly, indicating they may be chasing livestock. A valuable feature offered by most software packages used by GPS trackers is the option for a geofence.



The blue area is a geofence set up around a pasture at the AgriLife Center in San Angelo. The red dot is an LGD.

Picture courtesy of DPL Telematics, 2021.

Geofences are imaginary lines drawn around a producer's ranch or pasture using satellite imagery in the software used by the tracking company. Producers can select how to get notifications, either via text message or email, if the GPS tracker leaves or enters a geofence. This is extremely helpful if a producer has an LGD that roams. It can also be helpful in instances of a neighbor's stock being harassed or killed and they suspect your LGD. Producers can use the tracking data and geofence alerts to show that they are not at fault for injured or killed animals on a neighbor's property.

COMMON PROBLEMS

It is important to remember that GPS trackers are not 100 percent foolproof and are subject to errors, just like any other equipment. They can send false alerts of geofence exits (see Fig. 1) and may stop tracking if the unit's software is not regularly updated. Most companies recommend using lithium-ion batteries. If these batteries are not used, service life can be severely shortened. Also, the rubber gaskets used in external units may fail, allowing water to enter and short-circuit the unit. Just like any equipment used in your operation, regular maintenance will give you the best experience with your tracker. Tracker units may need to have a multi-service sim card installed to maximize service abilities. It is best to check with your GPS tracker's service provider about this.

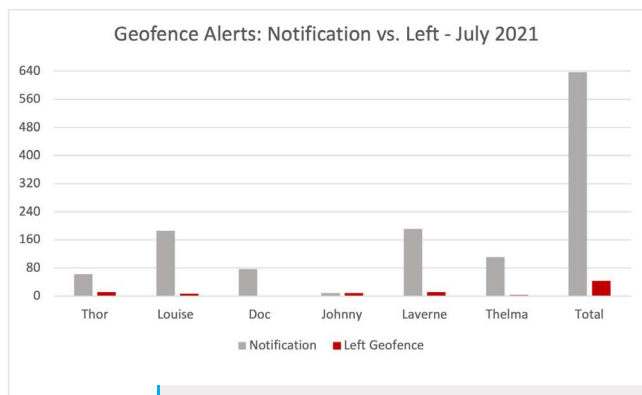


Figure 1. A chart showing geofence alert notifications versus actual times a dog left the AgriLife pasture for the month of July 2021.

ARE GPS TRACKERS NEEDED?

GPS trackers can be very helpful for new producers starting out with LGDs. Producers with young dogs may also find trackers helpful in monitoring LGD behaviors and patrolling patterns. If producers have issues with neighbors and roaming dogs, GPS trackers can be a great benefit for a rancher to know the location of their dogs. GPS data can be used to show whether a dog was on a neighbor's property should an issue arise. Trackers can also be helpful if a producer is snaring a certain area of the ranch to monitor if a dog has been caught. Tether-trained dogs will generally lay down for a while before pulling a snare. If a producer has a geofence alert set up in the software program, they will be alerted to a dog that is caught or trying to leave an area with snares.

Producers may not need GPS trackers if they have older dogs that do not move to new locations often, have adequate fencing, or maintain good relationships with their neighbors. Trackers can be an extra production cost that is not warranted in these cases, but they do provide peace of mind to many producers using LGDs.

TAKE-HOME POINTS

GPS trackers can be very helpful in locating LGDs and livestock from your phone or computer and are relatively inexpensive. However, battery life can be an issue, and false geofence alerts can create a lax attitude toward checking the dog's actual location. GPS trackers can be purchased from a variety of providers online. Most companies have a unit cost and monthly fee for the unit's service contract. Prices vary with a unit's abilities and warranty. Producers should research what each company provides and their service contract requirements before purchasing a tracker. GPS trackers, like all technology, are constantly changing and adding new features. Producers should try to purchase the newest units they can so the technology does not become outdated too quickly.



Oyster 3 GPS tracker attached to a 2 inch wide dog collar with electrical heat shrink and 3 zip ties.