Drones: A Range Management Tool

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Technology has advanced tremendously over the past century. And with this new technology comes new opportunities to improve range management. Satellites, drones, GPS trackers, and even certain apps on your phone can all help to better manage rangeland. Nebraska has 22,770,000 acres of rangeland[1]. This is a staggering number, but with all the new technology that has emerged, this rangeland can be managed much better now than one hundred years ago. Drones, in particular, have extreme potential in the areas of range management. Drones have advanced far beyond simple machines that could hover and fly in a limited radius. The first drone was invented in 1935, and was improved exceedingly during World War I.[2] There are different types of drones, the four main physical types of professional drones being multi-rotor, fixed wing, single-rotor helicopter, and fixed wing hybrid VTOL (Vertical Take Off and Landing).[3] These different drones can be used for different things, which will be explained later in this paper. Also, drones now have various cameras, GPS, various sensors, SD cards, and many other things. Because of all these accessories, drones have huge potential to influence how we manage our range. In this paper, we will explore the different drone types along with their possible attachments, how drones have already been integrated into range management, what drones could possibly be used for in the near future for range management, and finally which drones would be best for different areas of range management.

There are four main types of professional drones. These four are multi-rotor drones, fixed wing drones, single-rotor helicopter drones, and fixed wing hybrid VTOL drones. Drones that have multiple rotors and propellers were created for vertical takeoff and landing. The propellers are the small wings or blades on a drone that make it fly, like you see on a helicopter. Rotors are just the part that spins the propellers. Helicopters have just one single rotor, multi-rotor drones have many. They usually have four, six or eight rotors, four being the most common for small to regular sized drones.The purpose of having more than one rotor is to help give their operator better control over the drone's position in the sky. The more rotors it has, the more ways the drone can maneuver itself, but the controls can be a lot more complicated to learn on an 8-rotor drone rather than a 4-rotor one. Drones that have a lot of rotors can tend to be limited in their speed and duration of flight time because they're not nearly as efficient as other types of drones, such as a fixed-wing drone, which can fly for nearly 16 hours at a time. Some multi-rotor drones can only fly for 20 minutes before needing to recharge the battery, so large-scale surveying is out of the question. However, If you wanted to map a small area that

[1] agronomy.unl.edu
[2] consortiq.com
[3] Auav.com/Circuitstoday.com/Dronethusiast.com

had some tight fits for a drone, this drone would be handy to have, as its maneuverability is excellent for slipping through tight spaces.

Fixed Wing Drones, unlike the vertical takeoff capability of drone models that use rotors for flying, have a single long wing on either side of their body and need either a catapult or a runway to lift off the ground. They also have much more difficulty landing due to their inability to hover. Fixed-wing drones are sometimes used for surveillance, like in the military, but they aren't generally used for other types of aerial photography and drone flying. To get stable photos and videos, a drone would need to be able to hover and stay flying at certain angles. Fixed-wing drones are more commonly flown for the purpose of long-distance tasks or they're flown by hobbyists. They can stay airborne for 16 hours or more at a time and do not require the recharging of a battery unless other electronic equipment is attached to it. This type of drone requires quite a bit more drone flying experience and training, mainly with takeoff and landing. And while these drones might not help get pictures and video of rangeland, they can be used to check tanks, salt and mineral tubs, and complete other tasks as well.

Single-rotor helicopter drones come in a multitude of different sizes, from very small kid's toys to exceedingly large drones with a built-in camera, the price goes up with the size. Some single-rotor drones are sold for as little as $20 at the store, while others go for thousands of dollars online. Something unique to this type of professional drone is that it can run on gas instead of electricity, depending on the size. They are more efficient than multi-rotor drones, but not as efficient as fixed-wing ones. The single-rotor can sometimes be nearly as hard to fly like a fixed-wing drone, and both require a balancing act. There are not a lot of uses for single-rotor drones as there are for multi-rotors, but they can definitely carry a heavier payload. Typically, they're bought by people who are looking for a new hobby. These drones can go longer distances on a single battery/tank of fuel than multi-rotor drones, but can't go as far/long as fixed wing drones. These drones are not as maneuverable as multi-rotor drones are either.

The last main type of professional drone is a fixed wing hybrid VTOL drone. This drone basically merges multi-rotor drones and fixed wing drones into one drone. Merging the benefits of fixed-wing drones with the ability to hover is a new category of hybrids which can also take off and land vertically. There are various types under development, some of which are basically just existing fixed-wing designs with vertical lift motors bolted on. Others are 'tail sitter' aircraft which look like a regular plane but rest on their tails on the ground, pointing straight up for take off

before pitching over to fly normally, or ’tilt rotor’ types where the rotors or even the whole wing with propellers attached can swivel from pointing upwards for takeoff to pointing horizontally for forward flight. Many of these configurations were tried in the 1950s and 60s for manned aircraft, but they proved too complex and difficult to fly, with some disastrous results. With the arrival of modern technology, which includes autopilot, gyros and accelerometers, suddenly these whacky types are feasible because the autopilot can do all the hard work of keeping them stable, leaving the human pilot the easier task of guiding them around the sky. These drones, once perfected could affect range management enormously. With the ability to fly for 16 hours and the ability to hover, these drones have huge potential. You could map many acres in one day, without having to move from one location to another. There are a few of these on the market, but these types of drones are largely still in testing.

Drones have already been integrated into range management in several ways. Some have been used to monitor controlled burns, others have been used to map out small areas of rangeland. Firemen and State Patrolmen use drones on wildfires to find and track hotspots for potential flare ups. Drones can be used with GIS software, which enables their operator to map out rangeland in a small period of time. This makes it so that a range manager no longer has to walk all the fence lines in the area, or drive to every tank to get GPS coordinates. And while drones can’t take soil samples to detect soil types, they can be used to save time. Some private programs have started using drones in their range management programs. And while they don’t use them extensively, they have found that they can be useful and help save time. Some range management programs have also started using drones for various things, including but not limited to: Monitoring Red Cedar Tree growth, monitoring noxious weeds, monitoring erosion areas, and to monitor controlled burns. Various universities have conducted studies with drones in range management, and have proved that if used correctly, drones can help range management programs be more effective and efficient.

While drones have already been introduced to range management, there is still huge potential for them in the hopefully near future. Already, some experiments have been started with using drones for soil sampling. Multispectral remote sensing uses sophisticated imaging technology and unmanned aerial vehicles to perform soil and field analysis. To do this, they use drones affixed with remote sensing cameras that collect information on the electromagnetic spectrum of light reflected back from the land below. Different elements reflect unique wavelengths of light that can be used to identify them. Multispectral imaging sensors collect

reams of data on those wavelengths, powering advanced AI software that can pinpoint differences in elemental soil composition. Using advanced GIS mapping techniques and photogrammetry for landform identification, a detailed understanding of on-the-ground conditions can be produced for large amounts of land in a short amount of time. Of course, the more precise measurements needed for targeted growth yields may require traditional soil sampling. But multispectral imaging is valuable for producing a scaled map of range conditions.[4]

Finally, which drones are best for what areas of range management? As stated in the second paragraph, there are four main types of drones. These are Multi-rotor, fixed wing, single-rotor helicopter, and fixed wing hybrid VTOL. As a quick reminder of the pros and cons of these drones, multi-rotor drones are by far the most versatile, at the cost of very low battery life. Their price range is from $1,500 to $4,000 usually. Fixed wing drones have the longest battery life, but can't hover and require much more training to fly, mainly taking off and landing.Their price range can be from $55,000 to $500,000 depending on size, payload, range, and battery life. Single Rotor Helicopter Drones can be run on fuel or electricity, depending on the size. They are more maneuverable than fixed wing drones, but not as maneuverable as multi rotor drones. They have a longer battery life than multi rotor drones, but not nearly as long as a fixed wing drone. Their price range can be from $20 to thousands of dollars. Finally, we have the Fixed Wing Hybrid VTOL, which basically combines the multi-rotor drone and fixed wing drone into one drone, that is maneuverable, can go long distances, can hover, and has a good battery life. The downside to these is that they are still in development, and look like they are going to be extremely expensive. Now, if a range manager wanted to map a section of rangeland, then the multi rotor drone is probably the best drone for that, due to the fact that it is extremely maneuverable, has the ability to hover, and can take clearer photographs and videos than the others. This drone is also the best option for monitoring controlled burns due to the ability of its photographing and videoing. If a range manager wanted to map a large section of rangeland, specifically soil types, then a fixed wing drone with multispectral imaging is the best option. This drone has the ability to produce a scaled map of range conditions in a relatively short period of time. Also, If someone just wanted to see how the land lays, and if there are any major problem areas, then this drone would also be the best choice. If someone simply wanted to look at one very small area of rangeland occasionally, then the single rotor helicopter would be best, as it is the cheapest. Finally, If a range manager wanted to map a large piece of rangeland, but get detailed images and information, then a fixed wing hybrid VTOL drone would be best. This

[4] mapware.ai

drone is unique as it can hover, go long distances, carry a fairly heavy payload, and has a good battery life.

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