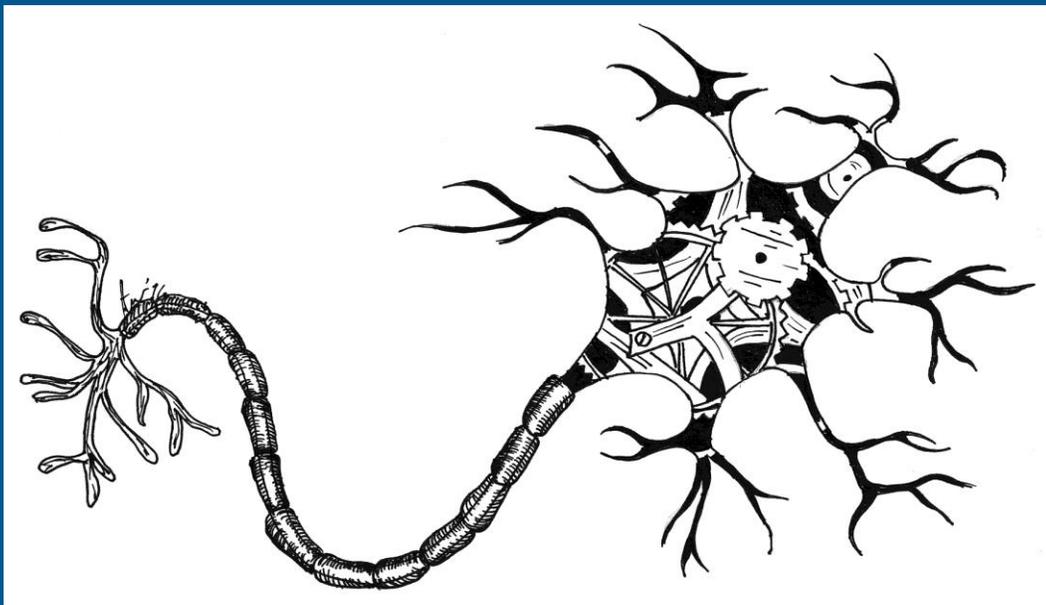


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Drones in Conservation

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Final Research Paper

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There has been a lot of degradation to Earth's ecosystems. Some of this destruction includes loss of species (Andrews' 2014) and pollution (Capolupo, 2015). However, with the introduction of new technologies, such as drones, these problems have started on a path toward being remedied (Sandbrook, 2015).

Chris Sandbrook defines drones as unmanned aircraft, either controlled remotely from the ground, or autonomously by following pre-programmed directions. They are most often categorized by the way they fly. Drones can either have fixed wings like a plane, or have rotary wings like a helicopter. Fixed wing drones are typically used for covering longer distances and carrying heavy loads while rotary wing drones are more often used for high maneuverability and hovering. Fixed wing drones tend to need a landing strip much like full sized planes do, if they do not have a built in landing parachute. Rotary winged drones on the other hand are able to take off and land almost anywhere (Sandbrook, 2015). Drones were originally designed by the military to reduce the amount of human casualties during war times. This includes identifying and neutralizing hostile targets, and assessing battle damage (Smith, 2001). However, drones have since become more accessible to more people and have been adapted for many other uses (Sandbrook, 2015).

Thanks to their wide variety of uses now, as well as recently becoming much cheaper to acquire, environmental scientists have adapted the technology to assist in conservation (Jones,

2016). Several new applications stand out as the most immediately promising ways of protecting both animals and their habitats from the depredations of humans. These include using drones to protect critically endangered species from poaching in remote areas and to detect concentrations of pollutants in wetlands.

Poaching Prevention. The first of these uses is one of the most critical areas where drones are making an impact: the preservation of endangered species. As Andrews' (2014) points out, right now drones are being used for surveying wildlife reserves in search of poachers that have not been detectable with traditional methods. Using infrared and GPS, these drones have been able to find poachers even when it is too dark or the forest is too dense for humans to see them. According to Ornes, poachers kill 1,000 rhinos a year in South Africa, which translates to 1 every 9 hours. This makes illegal hunting the largest threat to these critically-endangered animals (Ornes, 2014). Anti-poaching forces have been established all through the rhinos' habitat, but even they have not been able to put a stop to poaching. Before drones were used, rangers had to walk through dense jungle and use flashlights to try and find the poachers on foot. This was a very ineffective way to find the poachers since they would not be able to search the whole jungle and the poachers would often hear the rangers coming and could escape before they were caught (Pandolfi, 2014). Poaching of elephants and rhinos has also gone up dramatically since 2008 and is being performed by organized crime syndicates, equipped with highly advanced technology to track the animals. These crime syndicates are so well organized that it is impossible for law enforcement to keep up and they often come to a crime scene long after the animal has already been killed (Montesh, 2013). If this keeps up most large mammals in South Africa could be extinct within the decade (O'Donoghue and Rutz 2014).

On May of 2013, a team of researchers launched a small aircraft over a South African jungle right after sunset. The drone had a 2.4meter (8foot) wingspan and was impossible to hear from people on the ground. It was deployed at night to allow the onboard infrared camera to pick up heat from animals, humans and vehicles much better than it could in the day time, because the surrounding ground was much cooler. Using a mathematical algorithm to predict where herds of animals would be and employing the onboard GPS to find the predicted areas, the drone was able to triangulate with a very high percent of accuracy the location of the poachers and how close they were to the animals they were hunting. With this information, rangers were able to intercept the poachers before they were able to make any kills. During the entire time the drone was used, not a single animal was killed (Ornes, 2014).

Pollutant Detection. Drones are also now being employed to combat soil contamination. An example is the way drones recently have been used to track pollutants that have accumulated in the soil of the Campania Region of Southern Italy. This location has a longstanding problem with in-ground pollutants such as copper and other heavy metals. Contamination has been caused by many factors, but most of it stems from agriculture using inorganic pesticides and chemical fertilizers, and from motor vehicle use. Due to the high cancer risk and other damages these pollutants have caused, many attempts to track the pollutants have been undertaken with little success. Because of the nature of the soil and how it interacts with the heavy metals, tracking contaminants with any consistency has proven to be difficult. While it is known that these pollutants tend to accumulate in wetlands, it has been difficult to determine with accuracy where in the wetlands the contaminants tend to concentrate. However, by using a combination of low altitude aerial photos taken by drones and existing wetland models, researchers were able to predict where heavy metals would accumulate with a much higher degree of accuracy than has

been achievable before. The results from the study are pictured in in Figure 1 and Figure 2 (Capolupo, 2015).

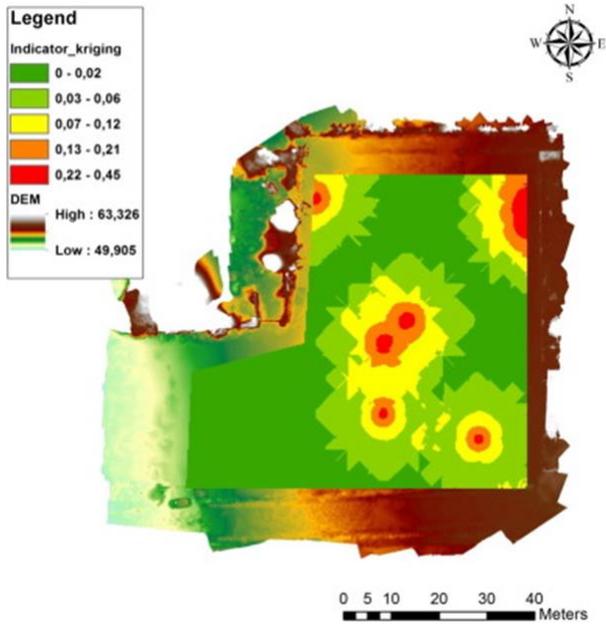


Figure 1: Map of the 4500 m² study area with concentration levels of copper. The closer the color on the map is to red the higher the concentration (Figure from Capolupo, 2015).

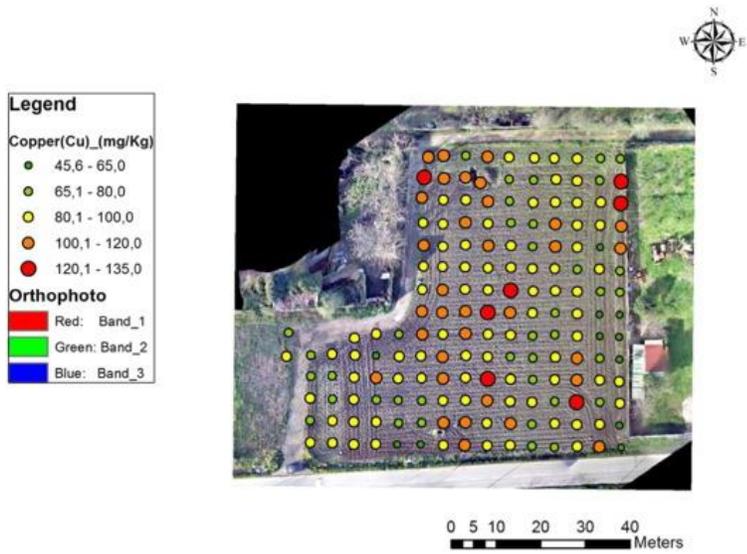


Figure 2: Map of the 4500 m² study area with predicted concentration levels of copper. The large red dots indicate where the highest concentrations are thought to be (Figure from Capolupo, 2015).

Drones have done remarkable things for the environment that environmental scientists would not have been able to do without the technology. After integrating it into the research projects around the world such as using drones to stop poachers (Andrews, 2014), tracking pollution (Capolupo, 2015) it is hard to imagine these conservation efforts without drones involved. However, as much good as drones have done for the environment there is still much more they can do in the future (Floreano, 2016).

Scientists at Bio Inspired Technologies of Boise, Idaho, are working on drones that have the capability to solve problems and think on their own (Jo, 2010). At the moment laws prevent drones from going too far outside the visual range of a human operator because of the risk of collision with other objects (Sandbrook, 2015). Currently, computers that would give real time information and calculate paths fast enough to avoid other objects are too power-consuming for drones but this could be fixed with a new kind of resistor. Scientists are mimicking how human brains work in order to develop a resistor that has a memory, or memristor. Similar to the synapse in a brain, the memristor changes when impulses pass through it; more importantly, it is able to retrieve these impulses after they have stopped. So not only will the drone be able to recognize obstacles and how to get around them but also be able to adjust if the obstacle changes in any way. With self-regulating guidance systems like this a drone will be able to detect an obstacle and plot a course to avoid it without human intervention. Eventually it is hoped that this

kind of technology will be used as a way of tracking wild life through dense trees and other difficult to navigate terrain (Jo, 2010).

Drones are a remarkable piece of technology that will be part of environmental conservation for a very long time. Right now, in the capacity to locate poachers, to accurately predict where pollutants accumulate, and to reach habitats beyond human reach, drones have made conservation much more efficient and have saved millions of dollars in the costs of such work. With new advancements, such as drones being able to plot out paths to avoid obstacles on their own (Jo, 2010), drones are proving to be one of the greatest advances in successful conservation in our time.

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I have abided by the Wheaton College honor code in this work.

-Paige E. F. Adams