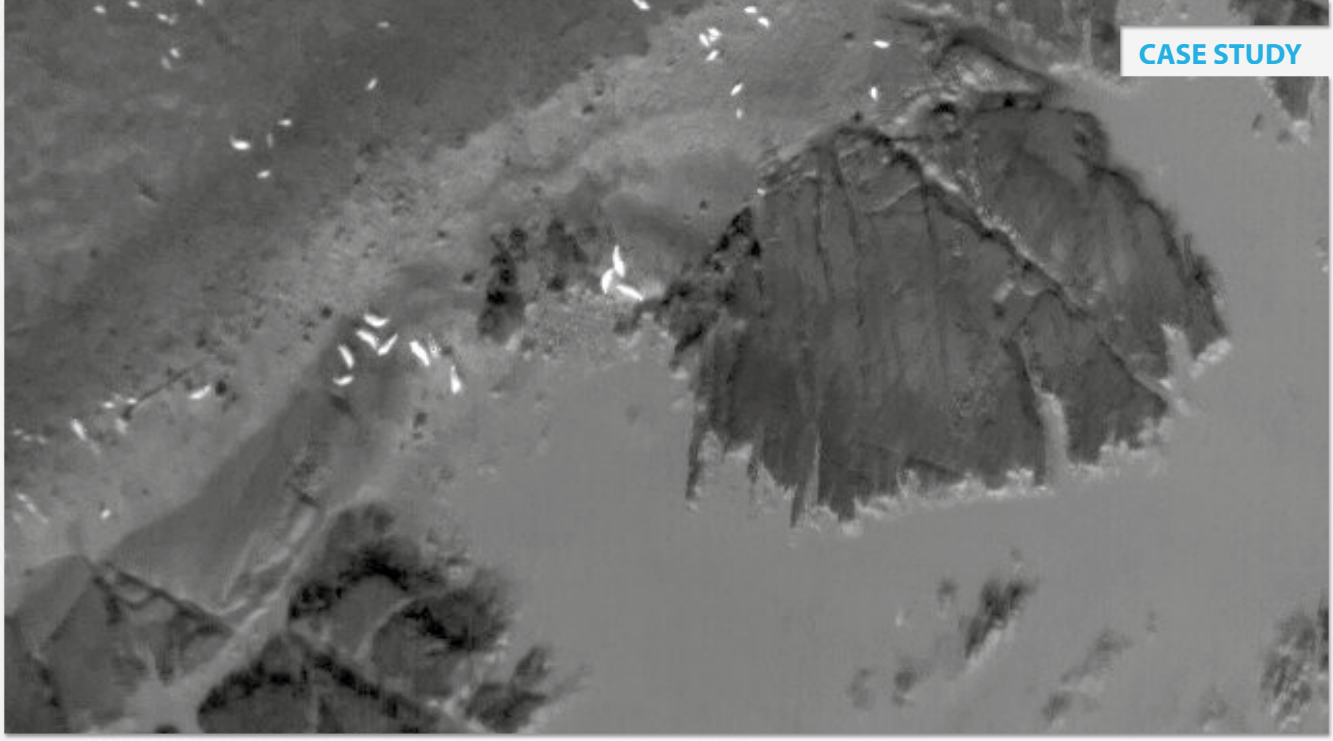


Cold spot – using a drone to count grey seals in Canada

When Duke University researchers wanted to try counting seals with a drone, they headed to Canada with two senseFly eBees and several types of camera. The project's results confirmed how UAV technology can help save time and money, highlighting in particular the promise of thermal imaging

David Johnston is an Assistant Professor at Duke University's Nicholas School of the Environment and one of America's leading marine conservation experts. He and his team are therefore well acquainted with the challenges of collecting data in some of the world's remotest spots, having worked in locations such as the Arctic, the Antarctic and the Northwestern Hawaiian Islands.

The sea wolves return

In early 2015, one of this team's focus species was seals. Specifically, grey seals and their pups. Seals have long been mistrusted by us humans, indeed the French refer to the seal as loup de mer or sea wolf—hardly the most positive moniker. This general animosity led to the massive depletion of seal populations in the 1800s, but since then their populations have been recovering. What's interesting to researchers such as Johnston is this: now that seals are back, how are they fitting in?

"Now we have healthy populations in some locations, we're interested in understanding how seals are assuming their role in today's ecosystems," Johnston explains. "Seals are predators, which we know are stabilisers in marine ecosystems, but we don't yet fully understand how they fit in and what that means for the other players in these environments."

A key starting point when assessing seal populations, indeed any group of target animals, is knowing how many animals exist in a specific location at a specific time. However, with the frustrating tendency of living things to keep moving around, counting them isn't necessarily a simple task.

senseFly
a Parrot company

Grey seals, whose populations have largely recovered since the 1800's, quickly abandon their pups, leaving them to survive together as a group (shown above, top left).

"Traditionally such surveys would be carried out via plane or helicopter, often using handheld cameras," Johnston says. "The photos captured would then often be assessed manually, counting the animals in each shot, or stitched together into a panorama. This approach can be incredibly inefficient, plus it is very expensive to hire the aircraft and pilots, and it would take us a lot of time to prepare the images after a flight."

> "Traditionally such surveys would be carried out via plane or helicopter, often using handheld cameras… This approach can be incredibly inefficient, plus it is very expensive to hire the aircraft and pilots"

The Nicholas School of the Environment already owns two senseFly eBee drones, which staff and students plan to use on several international projects including in the Antarctic and the Caribbean. However Johnston was keen to expand the use of this technology to animal counting, his hope being that it would provide a more efficient way of performing such population assessments.

"We wanted to use the eBee to try and improve how we work by generating orthomosaics [2D maps] of seal colonies from the drone's high-resolution images—quickly, easily and cost-effectively," Johnston explains. "At the same time we also wanted to see what the eBee's thermoMAP camera could do. We suspected a thermal sensor could help with the problem of counting animals that are hidden under vegetation—such as a seal lying under a tree or in the bushes—which can be a limitation with standard aerial RGB imagery."

As for why Johnston's department chose an eBee in the first place, he claims the system's integrated workflow was a big draw. "With the eBee we could start producing and using data quickly—flying, assessing the quality of our data and analysing this straight away. This ease of use and quick deployment is a real advantage in our line of work. It means that if we need to modify and repeat a survey, this can be done virtually instantly, which is crucial since we're only at each location for a short period of time," Johnston says.

Heading North

To get its seal-counting trial up and running, Johnston contacted Dr. Mike Hammill at Fisheries and Oceans Canada and requested permission to work at Saddle Island and Hay Island, home to some of the largest seal colonies in Eastern Canada.

Saddle Island (left pin) and Hay Island (right pin), the project's two sites, are situated off the northeast coast of Canada. (Image: Google Earth)

Since grey seals give birth around the start of the year, January was targeted as the perfect time to begin the assessment, since there would be both adults and pups around to count. After Fisheries and Oceans Canada approved the trip, flights were booked for two of Duke's research technicians; Julian Dale and Susan Heaslip.

These researchers headed North with two eBee mapping drones and four camera payloads: two RGB cameras (the eBee's supplied IXUS/ELPH RGB sensor and its alternative S110 RGB); a S110 near-infrared (NIR) camera; and the eBee's new thermoMAP sensor. "We wanted to map the island habitat as well as count the seals, so we took all the sensors we had in order to carry out as complete a mission as possible," Johnson says.

Since Saddle Island, unlike Hay, features small bushes and trees, this location would prove to be the key testing ground for the drone's thermal camera. As such, the team performed five flights on Saddle, compared to three on Hay.

UAV methodology

Having arrived in Canada, the team's first on-site calculation was to identify landing spots for the drone. "The landing point on Saddle Island was ideal, away from the colony to avoid disrupting the animals' behavior, while Hay Island required landing within the colony itself, so we chose a spot as far from the animals as possible," Johnston explains.

senseFly
a Parrot company

The trip's eight flights were completed over two days. In terms of climate, these were flown in temperatures of approximately -20 °C (-4 °F) and in winds of up to 20 knots or 23 mph (10.3 mps), with an average flight time of 20-30 minutes.

Using the drone's eMotion software, the team set the flights' required ground resolution to 2.5 cm per pixel for RGB and NIR flights (resulting in flight altitudes of 75 -95 metres), and 14 cm/pixel, the thermoMAP's default. Forward and lateral image overlap settings were kept at eMotion's default setting of 70%.

These parameters meant the drone captured between 200 and 300 images per RGB and NIR flight, and between 4,000 and 7,000 per flight with the higher frequency thermoMAP.

These images were first quality checked using the drone's Postflight Terra 3D software, before generating separate RGB, NIR and thermal orthomosaics of each island. It is these maps the team would use to analyse the ease of animal counting with the different sensors.

Inspiring results

"We learned a lot from the project, the thermal flights in particular. Our main discovery, which was huge, was just how well the seals 'pop' in the thermal images. You can't miss them. This imagery was especially useful for assessing whether or not seals were hidden in the scrub on Saddle Island," Johnston says.

Johnson predicts the thermal imaging approach will also bring a time-saving benefit. "Because the thermoMAP records temperatures, we can likely automate our post-flight counting by filtering our results by heat," says Johnston. "We know that on these islands there weren't any similar sized animals to the seals, and birds don't tend to congregate around seals, which means every object in the results that is warmer than ambient temperature—i.e. not rocks or ice—is most likely a seal. Therefore we can feed the drone's data into a GIS system to pluck out all of the objects that are a certain number of degrees warmer than the background. This automated approach could save us hours and hours of manual work in future."

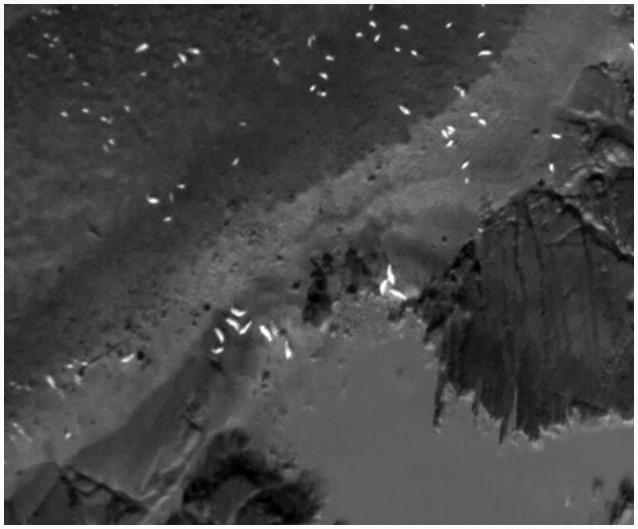
"We can also examine the size of each of these warmer objects, to separate out adult seals and their pups," he continues. "All these thermal benefits are very exciting. In future we should be able to greatly increase the speed we can go from collecting data to actually acting on this information."

> "All these thermal benefits are very exciting… in future we should be able to greatly increase the speed we can go from collecting data to actually acting on this information"

Another key learning concerned how to optimise the drone's flight plan prior to launch. "We discovered the best way of minimising the risk of miscounts was to make the drone's flight lines as short as possible," Johnston explains. "So for example, on Saddle Island, instead of setting flight lines along this thin strip of land, we ran surveys that had the drone flying up and down the island's shorter width. This minimised the time between the capture of adjacent, overlapping images, which gave the seals the least time possible to move between different photo locations and so mess up the count."

A section of the team's RGB orthomosaic of Saddle Island (the small elongated black shapes are seals).

A single RGB drone image showing adult seals with their pups.



Johnston's team was impressed by how easy it was to identify seals in the drone's thermal images.

senseFly
a Parrot company

Future fantastic

With the team's orthomosaics produced, and the eBee's reliability proven in another challenging location, Johnston's team returned from Canada enthused about the potential benefits of counting animals via UAV.

"I think we've established that using a UAS can be more efficient than taking shots manually from manned aircraft," Johnston states, "and from a price perspective, we realised that we could actually buy a full eBee system for what two aerial surveys would have cost us previously."

> "We could actually buy a full eBee system for what two aerial surveys would have cost us previously"

Looking ahead

The next test for Duke University's drones? Flying in the Antarctic. As part of the National Science Foundation-funded Long Term Ecological Research (LTER) project at Palmer research station, Duke and Oregon State University researchers will launch eBees there in Spring 2016.

"There's lots of change going on there that we're interested in monitoring, to better understand the Antarctic marine ecosystem along the western peninsula," Johnston says. "It's one of the fastest warming places on the planet, so we'll be looking at the vegetation changes that are occurring as more vascular plants start to appear. We'll also be studying land-based animals that rely on the marine environment, such as penguins, including how these are co-existing alongside seals—their new noisy neighbours who are moving into the Antarctic ecosystem for the first time."

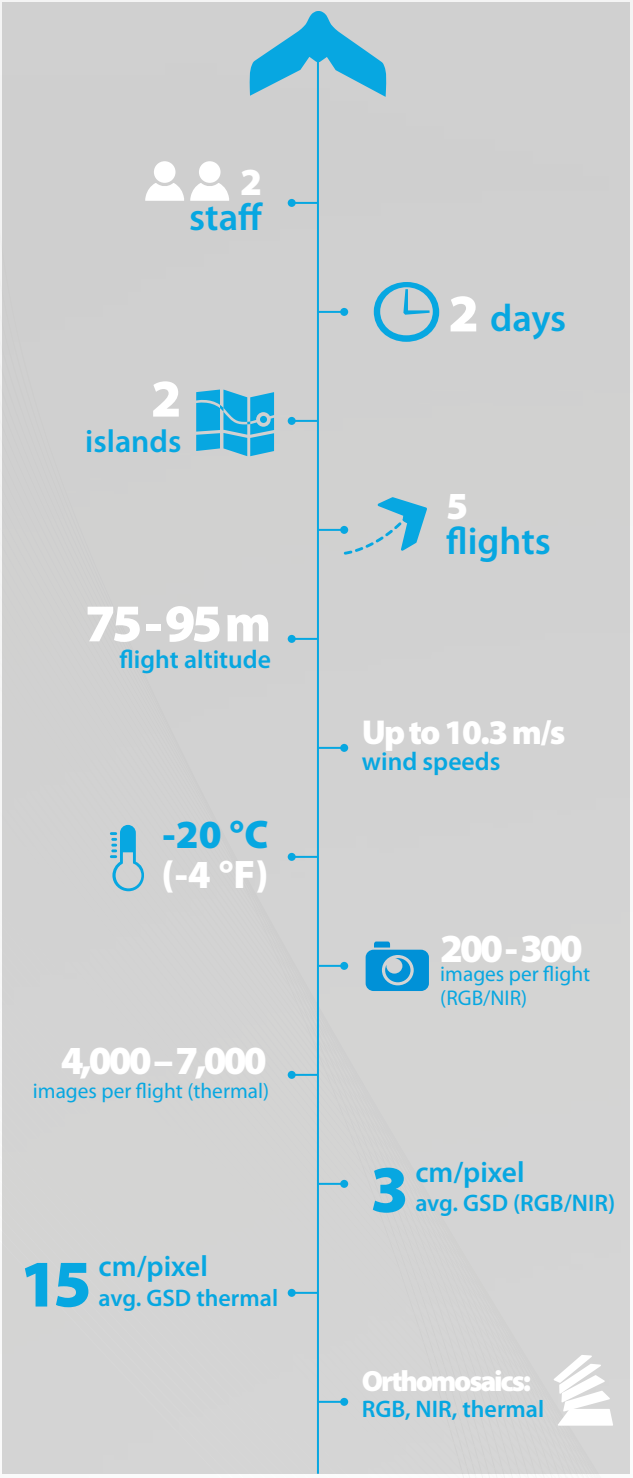
For now though, Johnston concludes the Canadian seal counting trial was a real success. "The tests we did will help us apply new techniques to other locations and they will definitely be useful for stock assessments in Canada. These were great results!"

Learn more

Read Dr. David Johnston's profile.

Learn more about Duke University's Nicholas School of the Environment.

PROJECT STATISTICS



Discover eBee:
Learn more at www.sensefly.com/drones/ebee.html

Get the newsletter:
Register for our regular email update at www.sensefly.com

senseFly
a Parrot company