# SnotBot: Developing an aerial platform for cetacean research

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## DEVELOPMENT

As sUAS are already being flown in close proximity to cetaceans, working with our partners at Olin College of Engineering we wanted to evaluate the potential impacts of sUAS flights over whales & develop a new benign research tool.

Olin students created 'SnotShot,' a whale blow simulator, even using 3D-printed blow-holes of different species.

After tests on land and in the pool, SnotShot was put onto SnotYacht, our mechanical whale surrogate. SnotYacht was equipped with an array of sensors including anemometers & hydrophones (above & below water) to help us measure effects of sUAS over flights.

**At a height of 2 metres the downwash created by sUAS was equivalent to that of a mild ocean breeze (3m/s or 6.7mph).**

The sound created was well within the parameters of ambient ocean noise. Current knowledge of cetacean hearing suggests few species have a hearing range which could even detect our sUAS (see TePRA reference below).

## PHOTOGRAMMETRY

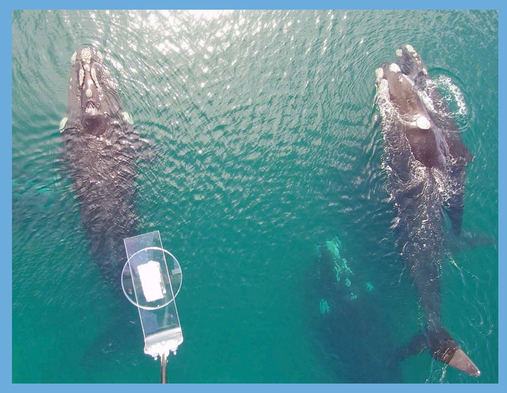
In Patagonia we also flew an APH-22 Hexacopter belonging to Drs Moore & Durban. They are using the APH-22 to assess size and body condition of whales using photogrammetry.

## INTRODUCTION

Ocean Alliance has always held the belief that it is not necessary to harm a whale in order to study it. Advancements in the field of small Unmanned Aerial Systems, (sUAS) has allowed us to hold true to that belief while allowing us to think outside of the research box.

With the aid of our partners at Olin College of Engineering, designers and oceanographers, the SnotBot™ concept was born.

This platform provides us with a low-cost, safe, and non-invasive method of obtaining physical data from large whale species.



The development of SnotBot™ went through many stages of design & testing to demonstrate that the presence of a sUAS would have minimal to no adverse effects upon the study subject.

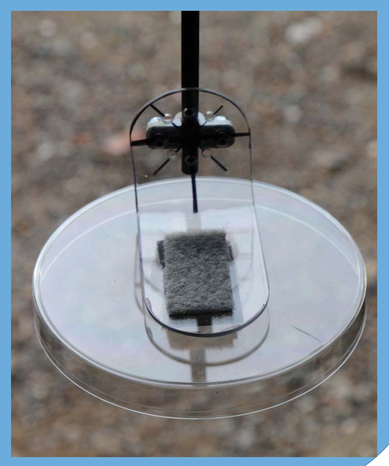
Our hard work and testing paid off when in September 2015 we received a research permit from the Argentine government. This permit gave us the opportunity to collect data from southern right whales and demonstrate the value & effectiveness of this scientific platform.

## EBC (EXHALED BREATH CONDENSATE) COLLECTION

**EBC Collection Protocol**

- Collection devices: Off-the-shelf models: Yuneec Typhoon/Tornado sUAS equipped with a collection arm holding 160mm & 100mm sterile Petri dishes and sterile glass wool.
- 3 or 4 person crew, 3 ideally for EBC collection (pilot, launch/retrieval, sample processor) & boat driver.
- Unit wiped down with alcohol, scientist & launcher wearing masks & gloves.
- sUAS launched and recovered by hand, from both a research vessel, a 4.1 m inflatable and the beach.
- Flight data/video shown on pilot's screen during flight (height above water/distance from pilot/ direction of sUAS/flight time remaining).
- Flight time restricted (conservatively) to 20 minutes.
- On retrieval, EBC either pipetted using sterile filter pipette tips and/or Petri dish wiped with sterile supor filter.
- Samples frozen in liquid nitrogen or transported in cooler to be processed on land & then frozen.
- Water & air samples collected as control samples.

Data collection on large whale physiology can be compounded by small, unpredictable sample sizes (sloughed skin/faecal matter), invasive (biopsy/close approach) procedures and expensive and/or dangerous methodology (aerial surveys).



We met our goals and demonstrated that drones like SnotBot™ are an important emerging tool in marine mammal research.

## sUAS/DRONES - Used

- **APH-22 Hexacopter**. Designed and built by Aerial Imaging Solutions. Weight=4lbs, Measurements=32''. Max. flight time=35mins.
- **Tornado H920**. Developed by Yuneec. Weight=5.48lbs. Measurements=36.2''. Max. flight time=38mins. Max. horizontal speed=21m/s.
- **Typhoon Q500 4K.** Developed by Yuneec. Weight=2.5lbs. Measurements=22.2''. Max. flight time=20mins. Max. horizontal speed=8m/s.

## RESULTS

- **We collected 22 EBC samples & 1,220 photographs of 57 whales.**
- Whilst focused on blow collection, we learned a lot about our protocols & machines.
- With that knowledge we are continuing to refine our methodologies & upgrade our equipment.

| | APH-22 flights | Typhoon flights | Tornado flights | Photogrammetry images | Breath Samples |
|---|---|---|---|---|---|
| Day 1 | 2 | 0 | 0 | 10 | 0 |
| Day 2 | 2 | 0 | 0 | 83 | 0 |
| Day 3 | 7 | 4 | 0 | 313 | 0 |
| Day 4* | 0 | 6 | 0 | 0 | 3 |
| Day 5 | 5 | 4 | 1 | 213 | 3 |
| Day 6 | 6 | 7 | 0 | 258 | 4 |
| Day 7* | 0 | 0 | 2 | 0 | 0 |
| Day 8 | 8 | 14 | 0 | 343 | 7 |
| Day 9* | 0 | 0 | 2 | 0 | 0 |
| Day 10 | 0 | 8 | 0 | 0 | 5 |
| Total | 30 | 43 | 5 | 1220 | 22 |

***= Limited effort due to 15 to 25 knot winds**

## DISCUSSION POINTS

This is a new field using an emerging & rapidly evolving technology, & the most effective ways of adapting sUAS have yet to be fully determined.

- Trade-off between sUAS stability & quantity of blow collected: angling the rotors outwards makes the drone more stable, while horizontal rotors blow more EBC on to the top collection plate.
- Surprising variability in the angle of the whale's blow meant that, in calm conditions, potential samples were sometimes lost. In windier conditions, by hovering the sUAS slightly downwind from the blowhole, our success rate increased.
- Waterproof sUAS were tested. They were found to be heavier, less adaptable & created more downwash (a potential irritant to whales). Their advantages were nullified by surprising stability of lighter units & features such as height lock, prohibiting them from descending beneath a pre-set height.

## THE FUTURE

The potential future applications of sUAS are both diverse and exciting; avenues we are currently exploring include:

- Applications relating to detecting/tracking & observing cetaceans. sUAS could significantly improve data sets whilst dropping costs. Potential applications in studying movement/spatial distribution/population/foraging ecology/ behaviour/predator-prey interaction etc.
- Infrared cameras, giving us the opportunity to study cetaceans at night. Infrared could also be used to detect & estimate the severity of infections/wounds on individual animals.
- Rapid and cost-effective support for whale disentanglement events.
- Opportunities to collaborate utilizing live-streaming video footage. Researchers and institutions worldwide could monitor a live-feed and communicate/direct the on-site pilot and researchers.

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