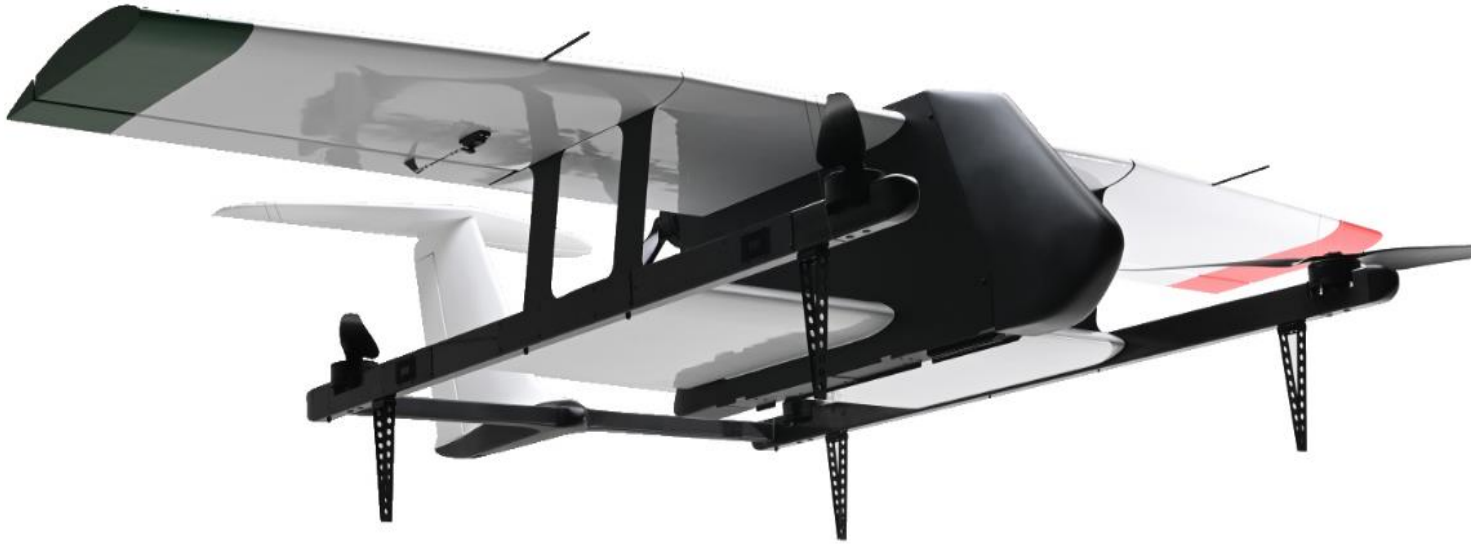
Progress in the development of a long-range flying VTOL-UAV ‘ASUKA’ and its application for cetacean research



Workshop of Basin Scale Events to Coastal Impacts (BECI)
13, 14th June, 2022 Tokyo

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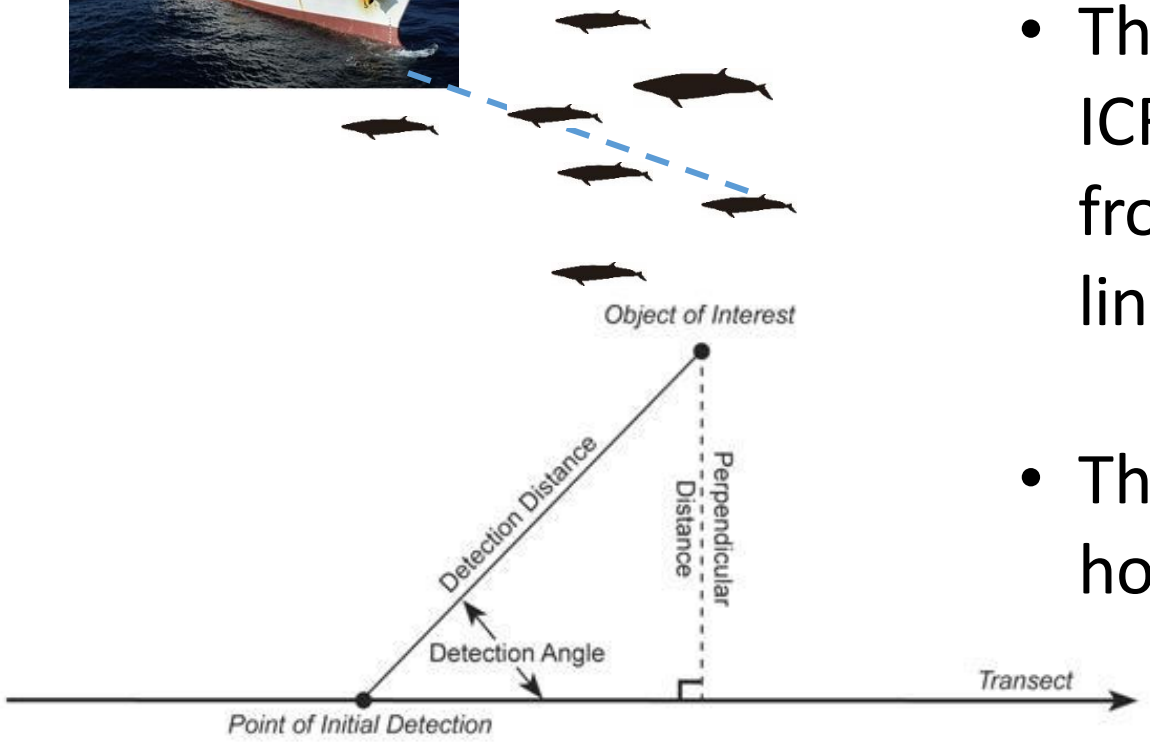
The Institute of Cetacean Research

Background



https://www.montana.edu/screel/teaching/bioe-440r-521/bioe-440-distance-sampling.html

Abundance estimates of whales

- Abundance estimates of whales is an essential information for the conservation and management of whale species.
- The abundance estimates of whales by the ICR is based mainly on sighting data collected from vessel-based sighting surveys, and the line transect method.
- This is a useful and standard method, however, it has some limitations.

Background

Limitations:

- In some cases, the surveys cannot cover all the area of the distribution of the whale species.
  e.g. Coastal areas surrounded by fishing gears.
  Pack-ice in the Antarctic.
  Area with high vessel traffic, etc.

- The implementation of the method requires of skilled observers, which require many years of training.

- The use of vessels involves a high cost.

Developing of an UAV to complement the process to estimate abundance from vessel-based sighting data – Requirements:

- Taking-off and landing from the vessel.
- Long flight time.
- Cameras installed to search for whales.
- Resistant to windy condition.

However, current commercial UAVs cannot cover for those requirements completely.

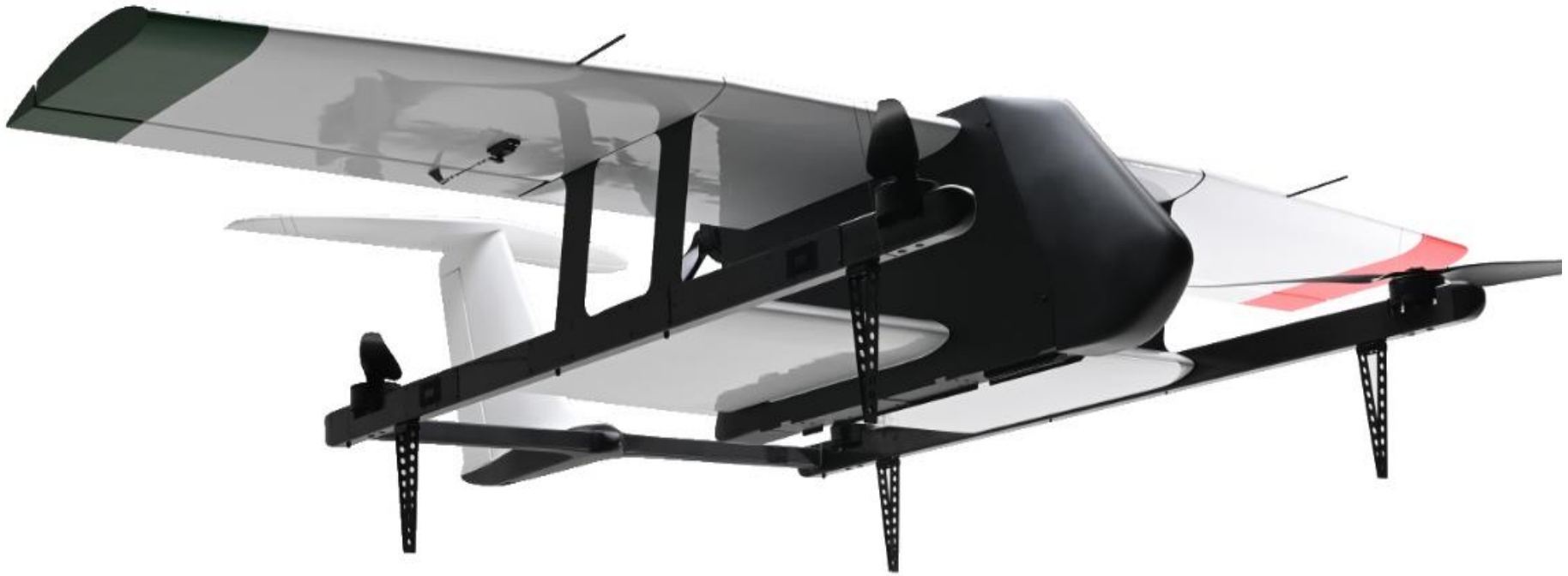
Characteristics of current commercial UAVs

Type	Launch locations	Flight time	Payload
Fixed wing	Require large, open area for launch and landing	Long flight time (more than an hour)	Light payload (less than 1 kilogram)
Multirotor	Open area for launch and landing not required	Short flight time (20 min)	Heavy payload (several kilograms) Can load multiple cameras

http://www.radicon1.com/item/Top-087B/

https://www.dslrpros.com/dji-matrice-210-rtk-g.html

Development of a new hybrid UAV (Asuka)



Length 1.92 m
Width 2.50 m
Height 0.62 m
Weight 12.44 kg

It combines the features of the fixed wing and multirotor UAVs.

- Take off and land from very narrow space in a vessel.
- Flight over 100km on the pre-determined track-line.
- Payload of up to 5kg.

Wind resistant and cost saving

‘Asuka’ is designed for surveys in offshore areas. Therefore, it is wind resistant, allowing optimal surveys of long distances at **wind speeds of 20 kts** (it can operate at maximum wind speeds of 40 kts).

It operate with a load of **Li-ion batteries**, which put weight on ‘Asuka’ making it wind-resistant and also allowing it for long-range flight.

Using rechargeable batteries **saves cost** and **prevent ocean pollution and fires** in the event of a crash.

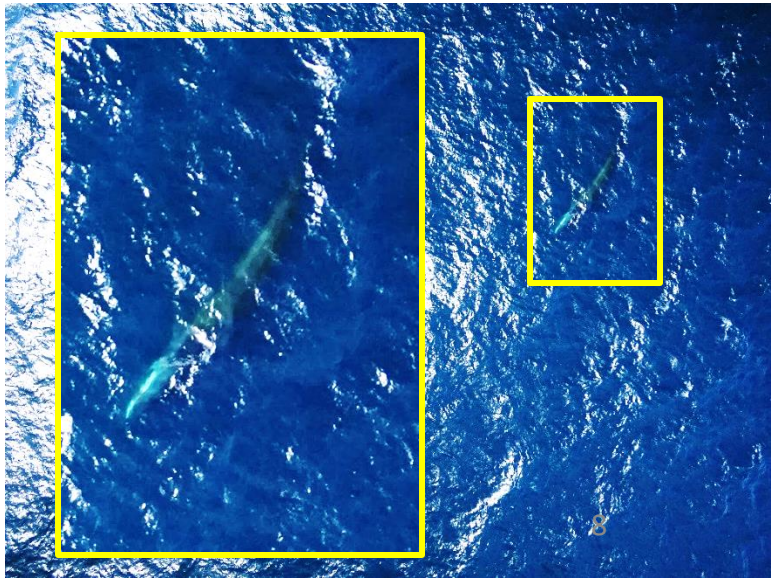
Field test

In 2021

- ✓Taking off and landing from the vessel (Mikawa Bay).
- ✓Autonomous flight covering a distance of 51 km (Mikawa Bay).

In 2022

- ✓Autonomous flight covering a distance of **104 km at one flight** (Sendai Bay).
- ✓Flight in conditions of around 20 knots wind speed (Abashiri).
- ✓Cameras succeeded in obtaining images of **fin whales** (Abashiri).

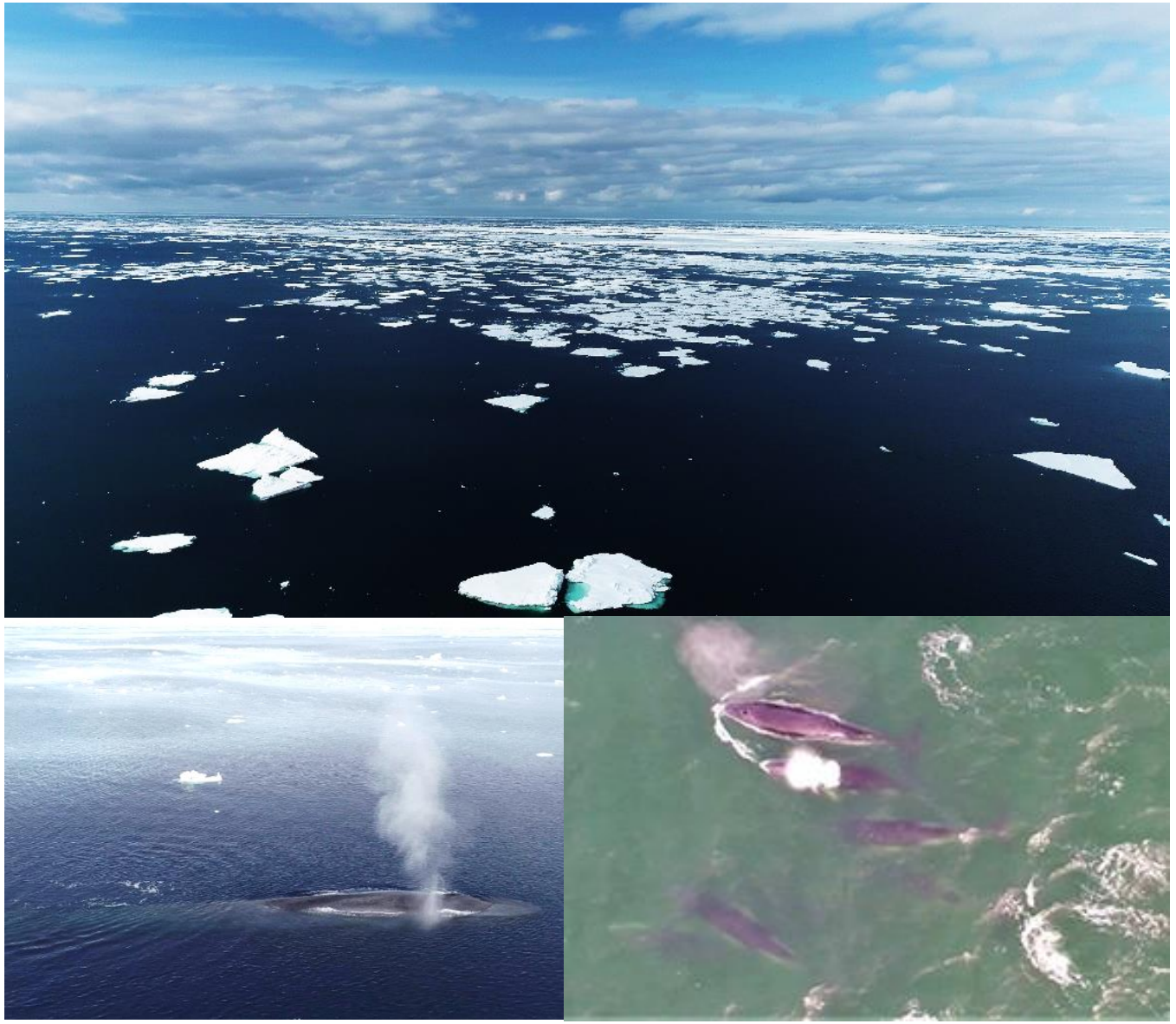


What is next

In the Antarctic:

Aerial line transect survey of whales in the pack-ice area.

Confirmation of species and school size during vessel-based sighting surveys.



What is next

Other potential usages:

Biology:

- Photogrammetric studies of whales.

Environmental data:

- Remote sensing loading sensers e.g. measurement SST with thermal sensor.

Study on species other than whales

- Animal tracking loading VHF receiver and antenna in the Inaccessible area.

The Institute of Cetacean Research