Maternal size and body condition determine calf growth rates in Southern right whales: repeated individual sampling using unmanned aerial vehicles

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Reproduction in baleen whales

- Capital breeder
- Reproductive cycle tied to migratory cycle
- High offspring growth rates
- Energetically demanding (early lactation)
  - Sufficient energy stores critical
- Body condition important
  - Pregnancy rate (Williams et al. 2013)
  - Foetus growth (Christiansen et al. 2014)
  - Calf condition (Christiansen et al. 2016)
Aims

• Cost of reproduction?
• What factors influence maternal investment in the calf?
UAV Aerial Photogrammetry

• Aerial photogrammetry (Miller et al. 2012, *MEPS* 459:135-156)
• UAV photogrammetry (Christiansen et al. 2016a, *Ecosphere* 7:e01468)
• Cost effective
• Safe
• Remote locations

Repeated individual sampling of mother /calf pairs throughout breeding season
Study species and area
Study species and area

- Southern right whale (*Eubalaena australis*)
- Head of Bight breeding ground
- Population size: ~2500 (Australia)
- Fieldwork: June 24 – September 25 2016
• 878 flights
• 2,897 measurements
• 238 whales measured
  - 89 lactating cows
  - 89 calves
  - 60 unaccompanied adults

average 10 times (SD=5.7)
Body length

14.2m
Body width
Body width
Body volume

\[ V_s = \frac{1}{3} \pi h (r^2 + rR + R^2) \]
Body volume
Calf growth vs. maternal condition

Lactating female

μ = -0.126

Calf

μ = 0.081

Volume conversion efficiency = 68%
Calf growth

Body length

\[ \mu = 3.2 \text{ cm/day} \]

Relative width
Calf growth vs. maternal condition
What factors determine maternal investment in calf?

- Maternal body length
- Maternal body condition

Maternal volume at time of birth?

= Date of calf birth?
Body volume at day of birth

Step 1

Volume at birth: $1.6\text{m}^3$
Body volume at day of birth

Step 2

= Predicted date of birth for each calf

1.6 m$^3$
Body volume at day of birth

Step 2

Body volume at day of birth

Step 3

Body volume at date of birth

1.6m³

Predicted date of birth for each calf

Predicted maternal volume at date of birth
Body condition at time of birth

Total length (m)

Good condition!

Poor condition!
Gray whales in Laguna San Ignacio, Mexico

15 Jan – 15 April 2018:
- 452 flights
- 675 measurements
- 63 mother / calf pairs
- 254 single animals

16 Jan – 15 April 2019:
So far (16jan-02mar):
- 393 flights
- 285 measurements
- 24 mother / calf pairs
- 132 single animals
Thank you for listening!

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Gracias por su atención

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