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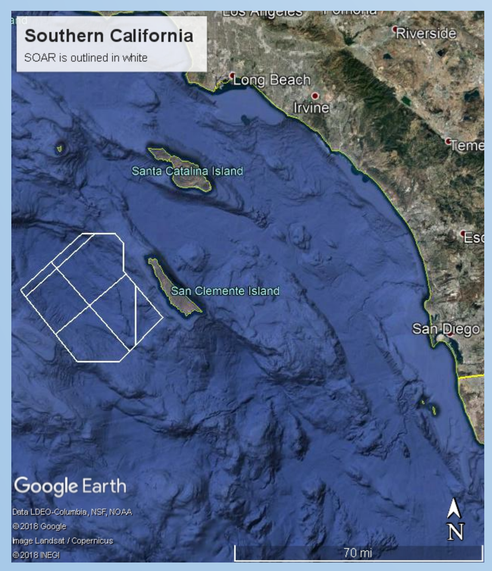
# Preliminary estimates of vital rates from Cuvier's beaked whales on a military training range

Erin Falcone[1], Erin Keene[1], Gregory Schorr[1], Brenda Rone[1], and Stephanie Watwood[2]

1. *Marine Ecology & Telemetry Research*, Seabeck, WA, USA efalcone@marecotel.org 2. *Naval Undersea Warfare Center*, Newport, RI, USA

## Background

**Vital rates are key inputs to Population Consequences of Disturbance (PCoD) models used to estimate impacts of sub-lethal stressors that may reduce fitness over time.** However, they are difficult to assess for cryptic species, like beaked whales, with low encounter rates. We are using data from an ongoing photo-ID study to estimate demographic and vital rates for Cuvier's beaked whales in and around the Southern California Antisubmarine Warfare Range (SOAR)- a population frequently exposed to military sonar.




Genetics

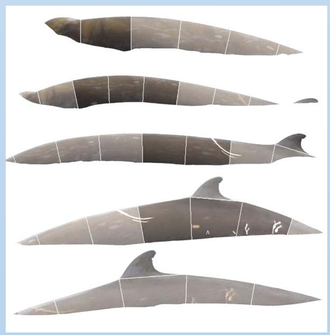
Life history

Dentition

Ovals on melon

Crescents

Differentiation and extent of cape



Standardized linear scarring density data

## Methods

**Each whale was classified to age and sex each day it was photographed using a combination of genetic, life history, and visible trait data.** Adult males are distinct, but adult females, subadults, and juveniles can be challenging to differentiate. We adapted published methods [(1,2)] for aging and sexing whales by appearance for use with sub-optimal photo sequences to age-sex classify as many whales in the study as possible.

**Adult female**: ***ovals, pale cape, crescents, little or no scarring***

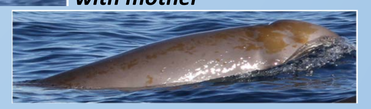
**Adult male**: ***extensive sharp cape, crescents, teeth, moderate-heavy scarring***

**Subadult female**: ***paling cape, faint ovals, faint crescents, little or no scarring***

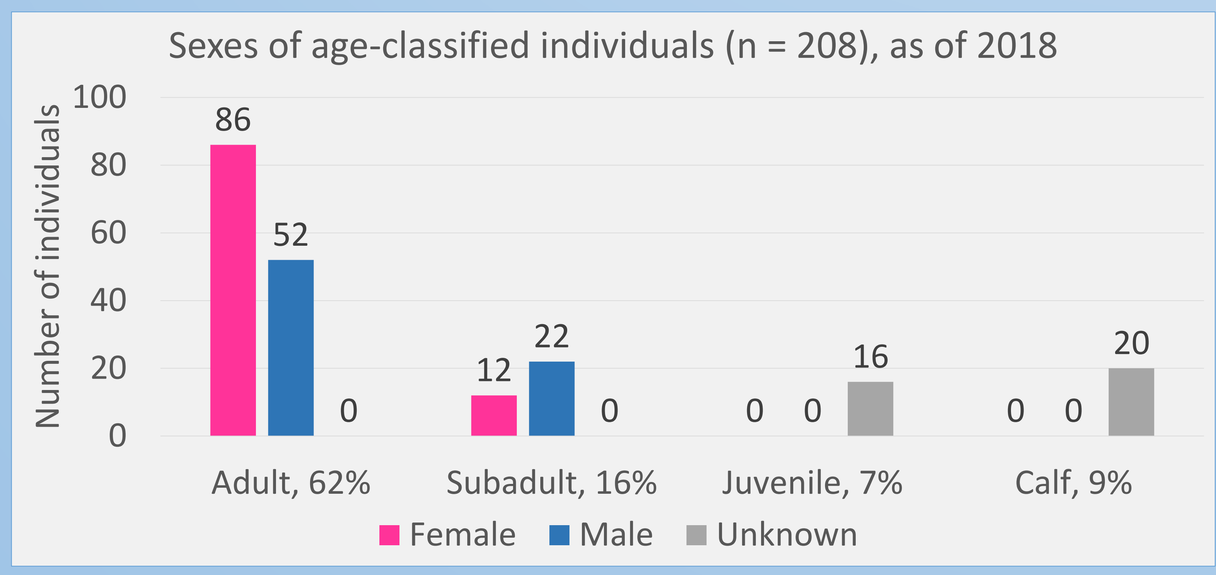
**Subadult male**: ***paling cape, faint crescents, low-moderate scarring, no teeth***

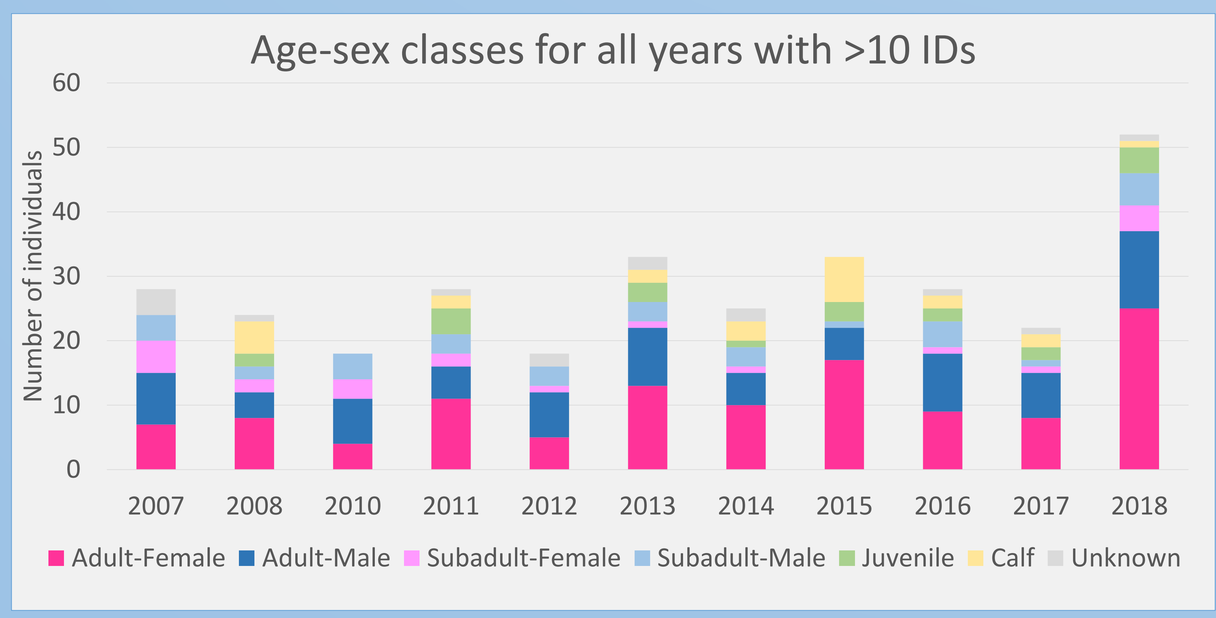
**Juvenile**: ***small size, gray cape, loose or no assoc. with mother***

**Calf**: ***small size, brownish-gray cape, closely associated with mother***



## Results




**The annual ratio of Females:Males identified varied by age class** (n = 11 years)

- Adults: female-biased
- Subadults: male-biased

| | Adult | Subadult |
|---|---|---|
| **Mean** | **1.58:1** | **0.61:1** |
| Med | 1.44:1 | 0.67:1 |
| Min | 0.57:1 | 0.00:1 |
| Max | 3.40:1 | 1.25:1 |

**Calving and weaning rates**

- 23/86 (27%) adult females were sighted with a calf
  - 2 had two calves during study
- 7 mother-calf pairs were sighted together in more than one month
  - Joint mother-calf sighting histories ranged from 0.23 – 2.61 years in length
- **Annual ratio calves:adult females highly variable**
  - Average 0.20 (range 0 – 0.63)
- **Estimated calving interval: ~ 4 years**
- **Estimated time to weaning: ~2-3 years**

**Maturation rates**

- **16 whales transitioned to next age class**
  - 2 calf → juvenile
  - 1 juvenile → subadult
  - 13 subadult → adult
- **Estimated ages by class**
  - **Calf: <2 years**
  - **Juvenile: 2-7 years**
  - **Subadult: 7-10 years**
  - **Adult: >10 years**

**Potential Sources of Bias**

- **Social structure**
  - Groups of 1-4 account for 77% of sightings, and consist primarily of adult females with calves/juveniles
  - Groups of 5+ are uncommon, but typically contain more males than females and few calves
- **Incorrect age classification, especially of females**
  - Differences in adult and subadult females subtle
  - Failed matches also more likely among females

## Conclusions

- **Data remain sparse, estimates uncertain, despite more than a decade of effort.**
  - *When vital rate are needed for management of slow reproducing species with low encounter rates, start early!*
- **Comparable data from regions without sonar needed to assess whether these values warrant concern**
  - *Importance of adopting similar age-sex classification methods between studies*

## Acknowledgements

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*1. Rosso, M., Ballardini, M., Moulins, A., Würtz, M., 2011. Natural markings of Cuvier's beaked whale Ziphius cavirostris in the Mediterranean Sea. Afr. J. Mar. Sci. 33, 45–57. 2. Coomber, F., Moulins, A., Tepsich, P., Rosso, M., 2016. Sexing free-ranging adult Cuvier's beaked whales ( Ziphius cavirostris ) using natural marking thresholds and pigmentation patterns. J. Mammal. 97, 879–890.*