Wild Cetaceans Used for Scientific Purposes: Replacement, Reduction and Refinement For Tagging And Biopsy Techniques as Well as Behavior And Data Validity.



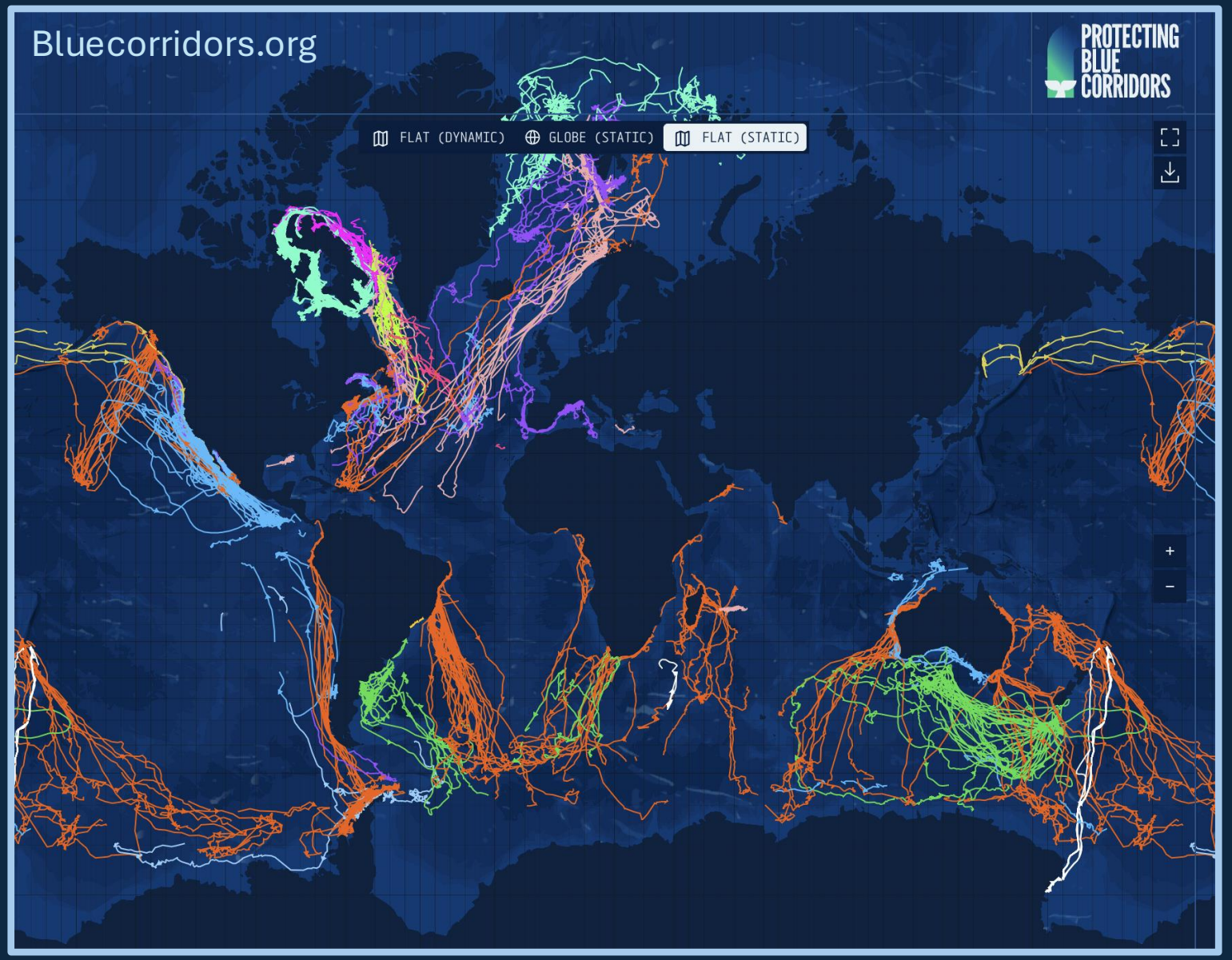
Alexandre Zerbini

CICOES/University of Washington, NOAA & Marine Ecology and Telemetry Research

BIOPSY AND TAGGING: WHY DOES IT MATTER?

Key data for conservation:

- Population structure.
- Population connectivity.
- Demographic parameters.
- Critical habitats (e.g., foraging; migration, reproduction).
- Overlap and exposure to human threats.



CETACEAN BIOPSY SAMPLING



https://wwhandbook.iwc.int/en/industry-support/social-cost



Hunt et al. 2012 – Conservation Physiology

CETACEAN TAGGING

- Location data.
- Behavior (e.g., movements and migration; diving).
- Foraging.
- Physiology.

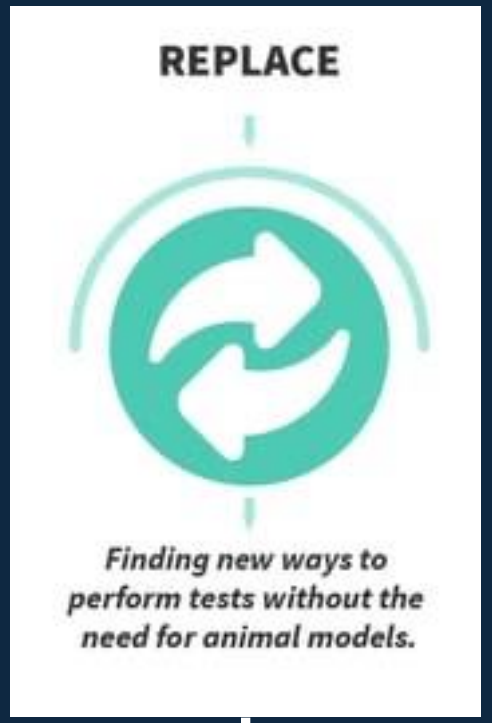


Andrews et. al., 2019

HOW IS BIOPSY SAMPLING AND TAGGING DONE?



The 3 Rs



Difficult for cetaceans. Specific biological questions require studying species in their natural environment



More efficient analysis of existing data to reduce number of individuals sampled



Improvements in sampling devices and methods to minimize impact to individuals

Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.









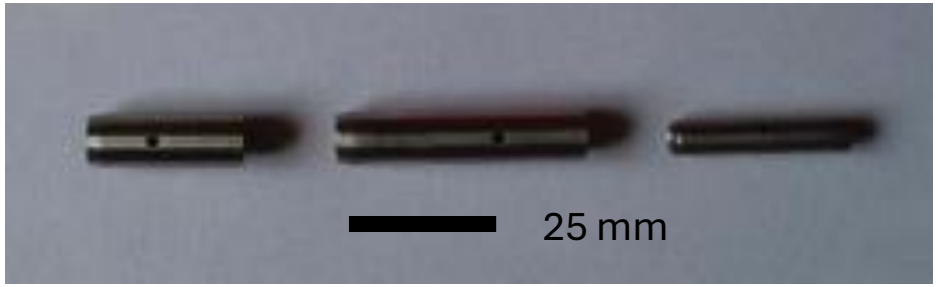
Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.
  - Pole sampling.



Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.
  - Pole sampling.
  - Miniaturized tips (for certain applications).





Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.
  - Pole sampling.
  - Miniaturized tips (for certain applications).
  - Collection of sloughed


© E. Hazen/NOAA


© thesaltyskipper



AI generated image

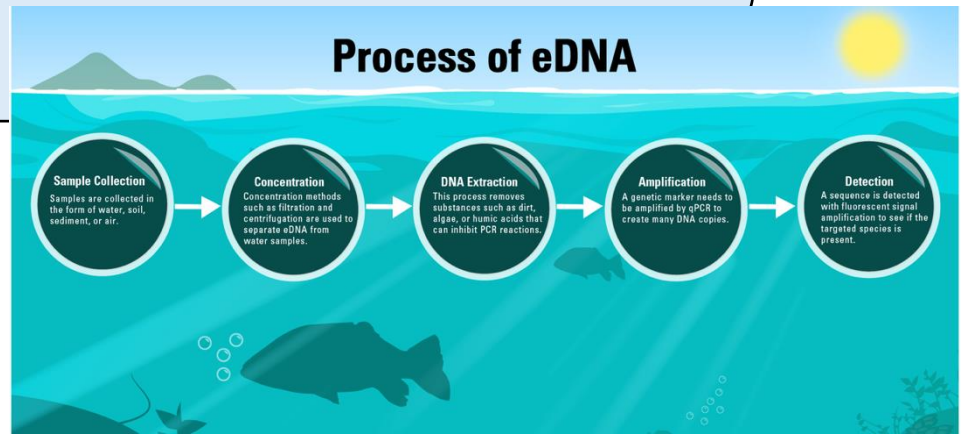
Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.
  - Pole sampling.
  - Miniaturized tips (for certain applications).
  - Collection of sloughed skin.
  - eDNA samples.







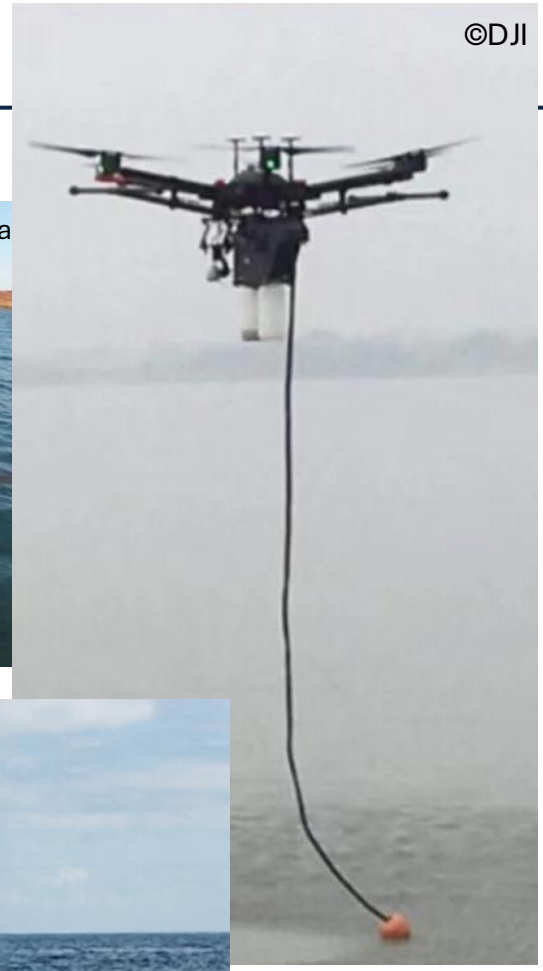


Refinement in biopsy sampling

- Sampling methods.
  - Crossbow versus rifles.
  - Pole sampling.
  - Miniaturized tips (for certain applications).
  - Collection of sloughed skin.
  - eDNA samples.
  - UAVs.







Marine Mammal Science

MARINE MAMMAL SCIENCE, 28(1): 154–199 (January 2012)
2011 by the Society for Marine Mammalogy
Published 2011. This article is a US Government work and is in the public domain in the USA.
DOI: 10.1111/j.1748-7692.2011.00469.x

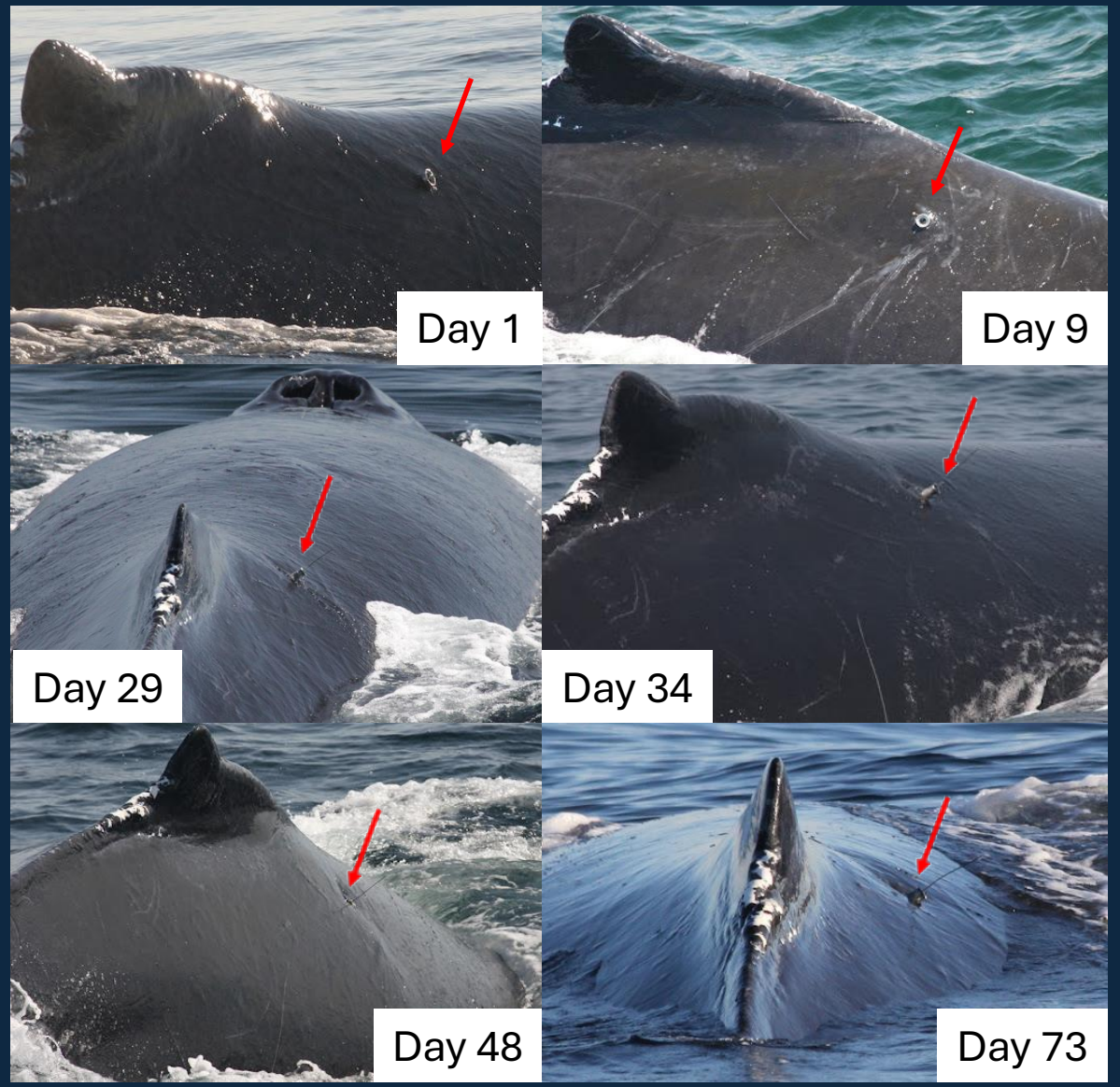
Review of cetacean biopsy techniques: Factors contributing to successful sample collection and physiological and behavioral impacts

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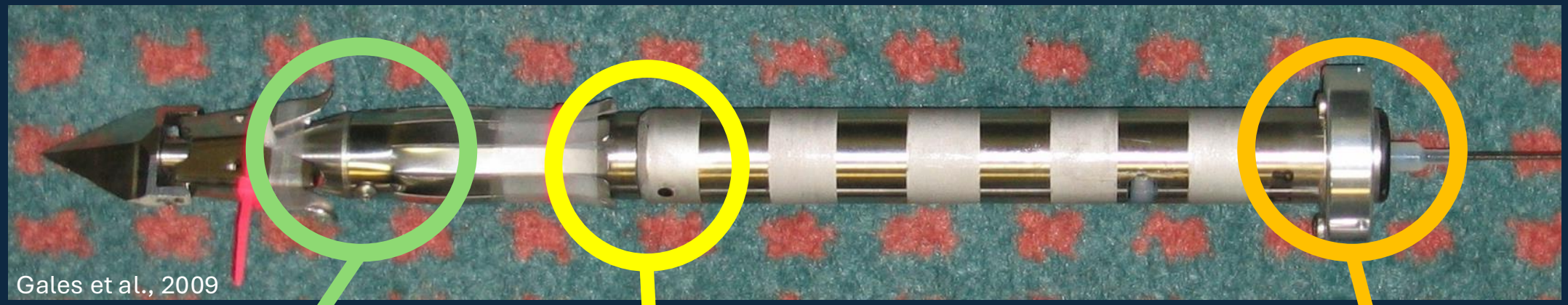
Refinement in tracking methods

- Development of robust devices
  - Follow-up studies.
  - Laboratory testing.





Refinement in tracking methods: discovery of design vulnerabilities

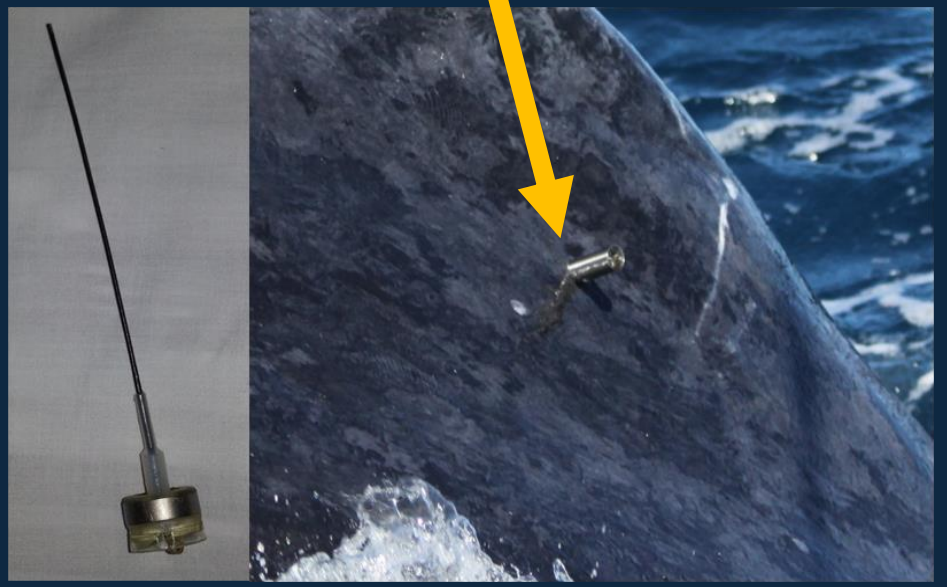




ANCHOR ARTICULATION



ANCHOR/TRANSMITTER INTERFACE

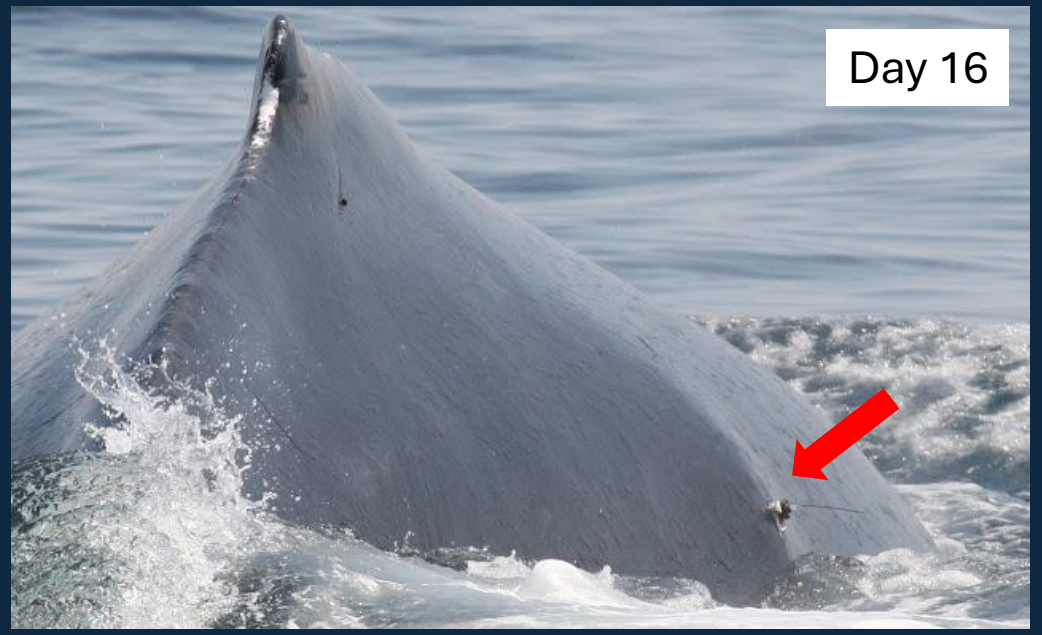


"EPOXY BULB"

Refinement in tracking methods: discovery of design vulnerabilities

Design vulnerability	No. observed	No. of deployments	%
Articulation failure	8	19	42%
Anchor/transmitter interface failure	5	16	31%
Damage of the tag's posterior end	1	35	3%

- Some of these vulnerabilities may have been present for ~20 years but were not detected or quantitatively evaluated due to a lack of follow-up studies.
- Breakages were linked to demographic, health and behavioral effects.





Refinement in tracking methods: development of robust tags









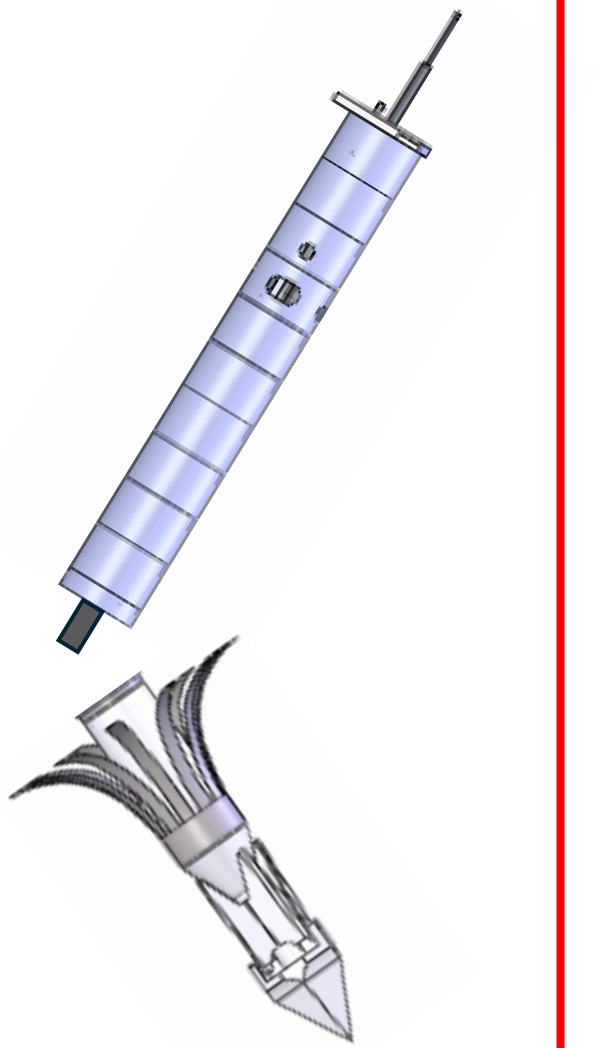




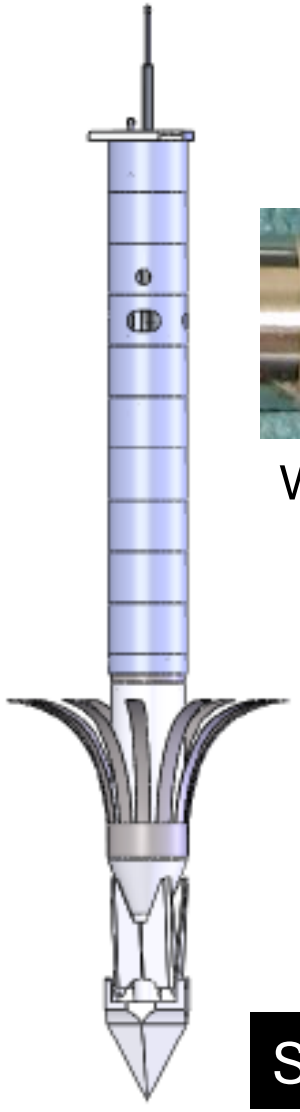


Refinement in tracking methods: development of robust tags

“NON-INTEGRATED”

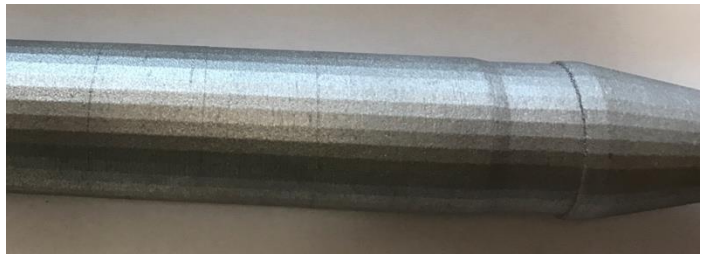


“INTEGRATED”

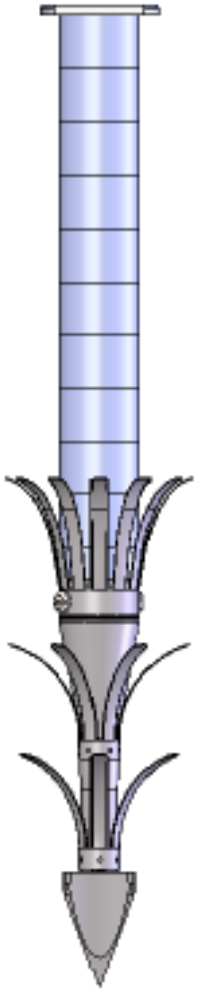




WELDED



DMLS/3-D PRINTED

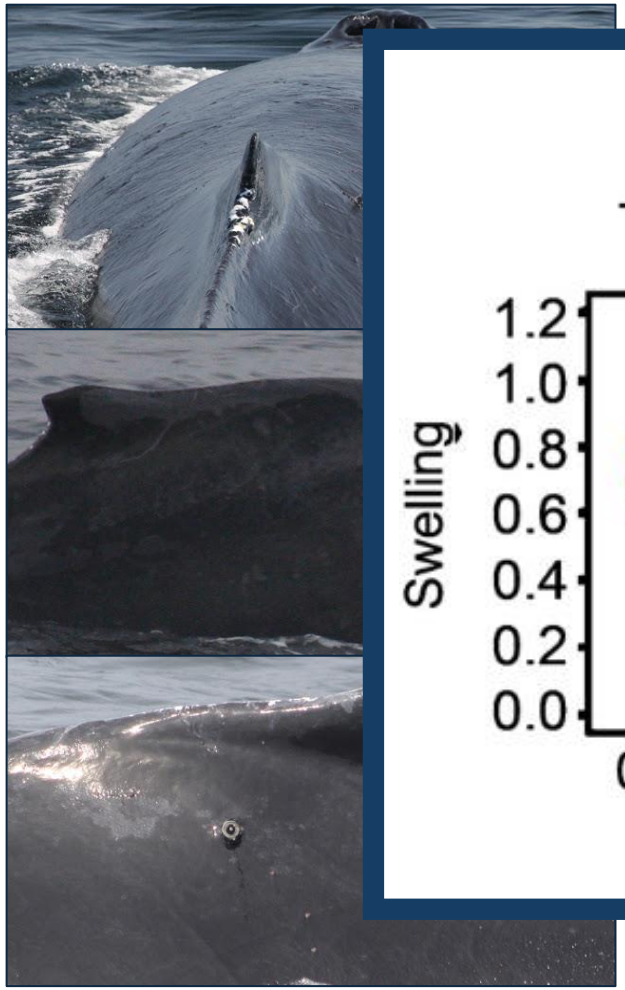


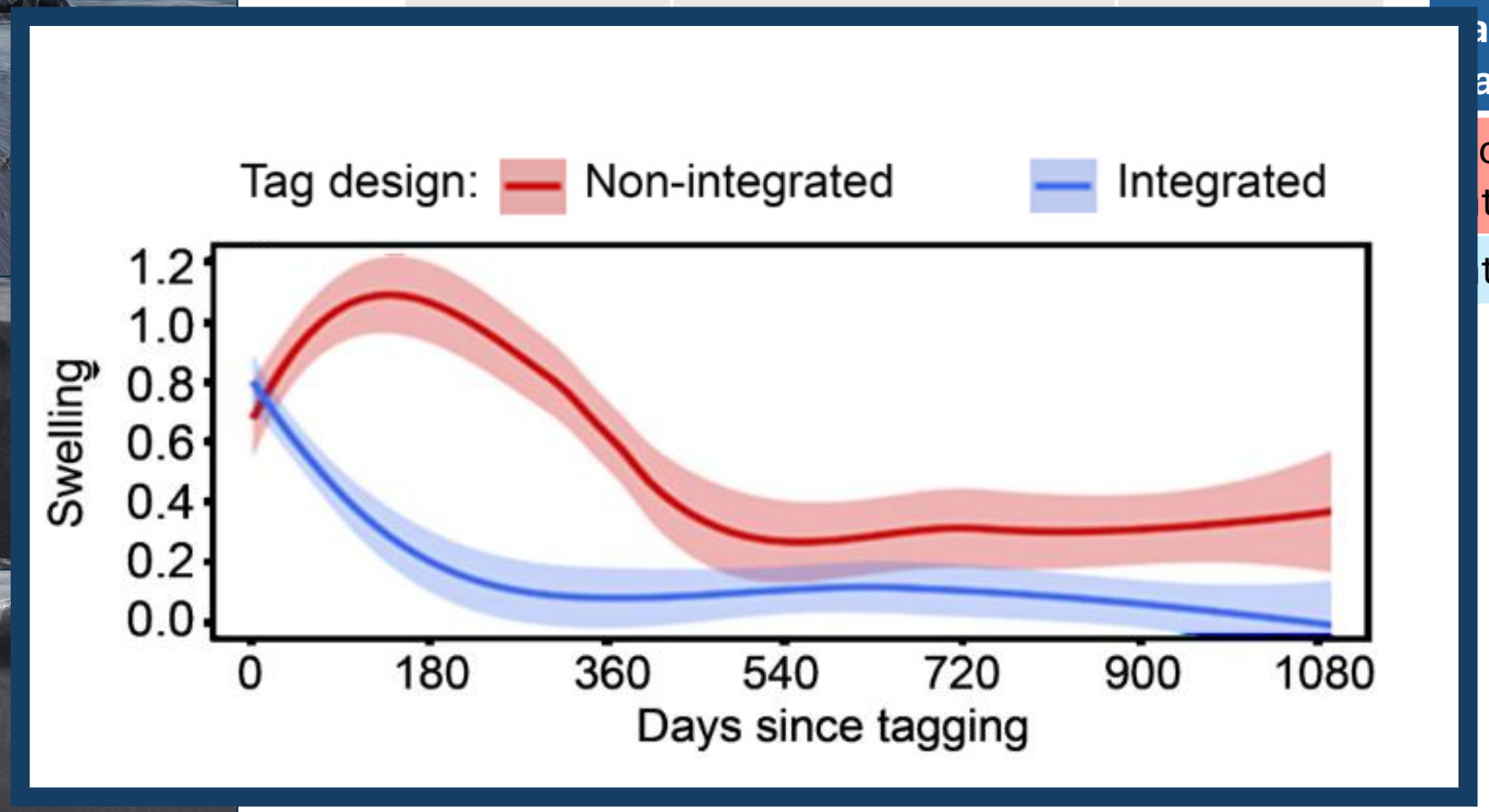
SPOT-303

SPOT-372

WILDLIFE COMPUTERS

Refinement in tracking methods: development of robust tags.





ag ategory	Mean duration
on- tegrated	28.8 d
tegrated	47.5 d

p = 0.003

+85%

TRANSMISSION DURATION

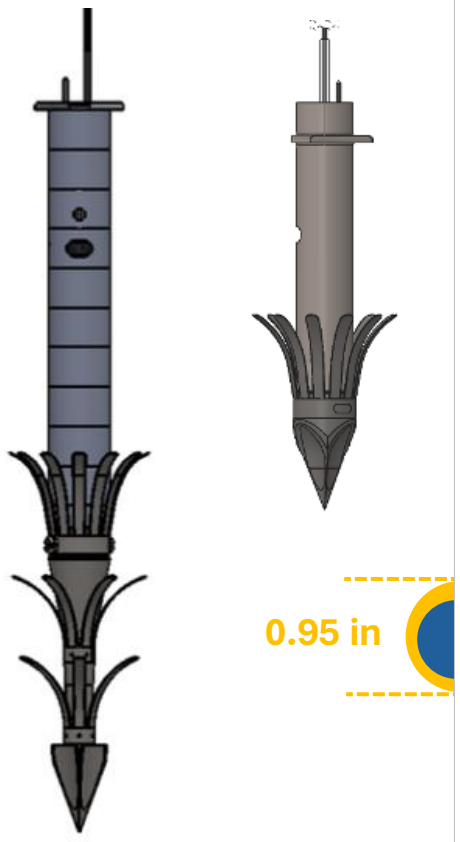
Non-Integrated (n = 31)

Integrated (n = 42)

Refinement in tracking methods: miniaturization

CURRENT

SPOT-372 **SPOT-177S**



Zerbini et al., 2025; 2026

WILDLIFE COMPUTERS

	SPOT-372	SPOT-177
Length (mm)	297	125
Weight (g)	390	180





FOOTPRINT REDUCED BY 50-70%

Refinement in tracking methods: references

J. CETACEAN RES. MANAGE. 20: 27–66, 2019

Best practice guidelines for cetacean tagging

RUSSEL D. ANDREWS[1], ROBIN W. BAIRD[2], JOHN CALAMBOKIDIS[2], CAROLINE E.C. GOERTZ[3], FRANCES M.D. GULLAND[4], MADS PETER HEIDE-JØRGENSEN[5], SASCHA K. HOOKER[6], MARK JOHNSON[6], BRUCE MATE[7], YOKO MITANI[8], DOUGLAS P. NOWACEK[9], KYLIE OWEN[10], LORI T. QUAKENBUSH[11], STEPHEN RAVERTY[12], JOOKE ROBBINS[13], GREGORY S. SC
OLGA V. SHPAK[14], FORREST I. TOWNSEND, JR.[15], MARCELA UHART[4,16], RANDALL S. WELLS[17] AND ALEXANDRE N. ZERBINI[1]

Contact e-mail: russ@marecotel.org

IWC | *J. Cetacean Res. Manage.* Special Issue 5 (2024) | 1

Effects of satellite-linked telemetry tags on humpback whales in the Gulf of Maine: Photographic assessment of tag sites

FRANCES M.D. GULLAND[1], JOOKE ROBBINS[2], ALEXANDRE N. ZERBINI[3,4,5,6], VIRGINIA ANDREWS-GOFF[7], MARTINE BÉRUBÉ[2], PHILLIP J. CLAPHAM[8,9], MICHAEL DOUBLE[7], NICHOLAS GALES[7], AMY S. KENNEDY[3], SCOTT LANDRY[2], DAVID K. MATTILA[2], DOUG SANDILANDS[2], JENNIFER E. TACKABERRY[2], MARCELA UHART[1] AND RALPH E.T. VANSTREELS[1]

https://doi.org/10.47536/jcrm.v5i1.1091 IWC | *J. Cetacean Res. Manage.* Special Issue 5 (2024–25) | 91

Developing robust large whale satellite tags through follow-up studies

ALEXANDRE N. ZERBINI[1,2,3,4], JOOKE ROBBINS[5], VIRGINIA ANDREWS-GOFF[6], MARK BAUMGARTNER[7], PHILLIP J. CLAPHAM[8], MICHAEL DOUBLE[7], NICK GALES[7], SCOTT LANDRY[5], FRANCES M.D. GULLAND[9], TERRY HAMMAR[7], MELINDA HOLLAND[10], AMY S. KENNEDY[3], ANDY LEASK[10], DAVID K. MATTILA[5], DOUG SANDILANDS[5] AND GREGORY S. SCHORR[3]

Marine Mammal Science

Development of a Short, Integrated, Consolidated Satellite Tag Designed to Anchor in the Blubber of Right Whales (*Eubalaena* spp.)

Alexandre N. Zerbini[1,2,3,4] | Santiago Fernández[5,6] | Solange Fermepin[7] | Melinda Holland[8] | Amy Kennedy[1] | Andy Leask[8] | Rupak Rajachar[9] | Mariano Sironi[10,11] | Ariana Smies[12] | Federico Sucunza[4,13] | Marcela M. Uhart[11,14]

Summary

- Development of modern techniques and sampling procedures have improved over time.
- Development has helped with “**R**efinement” of devices and sampling methods (addressing animal care questions/concerns).
- More reliable instruments/methods result in better data, indirectly addressing with “**R**eduction”.
- “**R**eplacement” remains a difficult task for marine mammal surveys.



People and Organizations

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Marcela Uhart (UC Davis)

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THANK YOU!



Mariano Sironi, ICB