

Plastic pollution in Monterey Bay: from water to whales

Matthew Savoca, Ph.D.

Hopkins Marine Station of Stanford University

Lauren Kashiwabara, M.S.

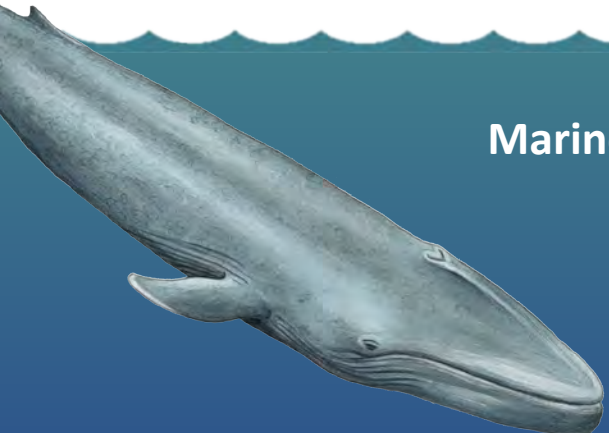
University of the Pacific



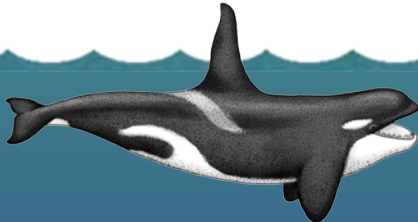
Plastic in the Monterey Bay pelagic food web



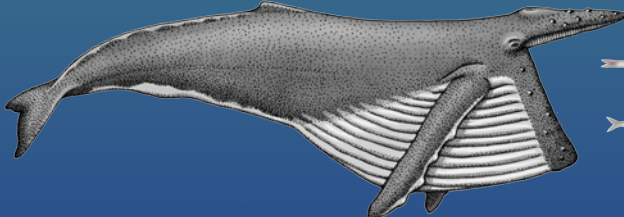
Seabirds



Marine mammals



Predatory fish



Forage fish



Sea turtles

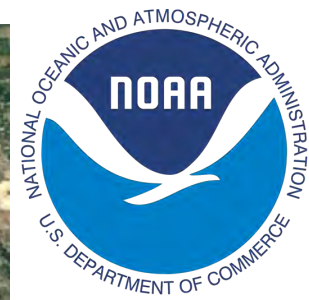
Zooplankton

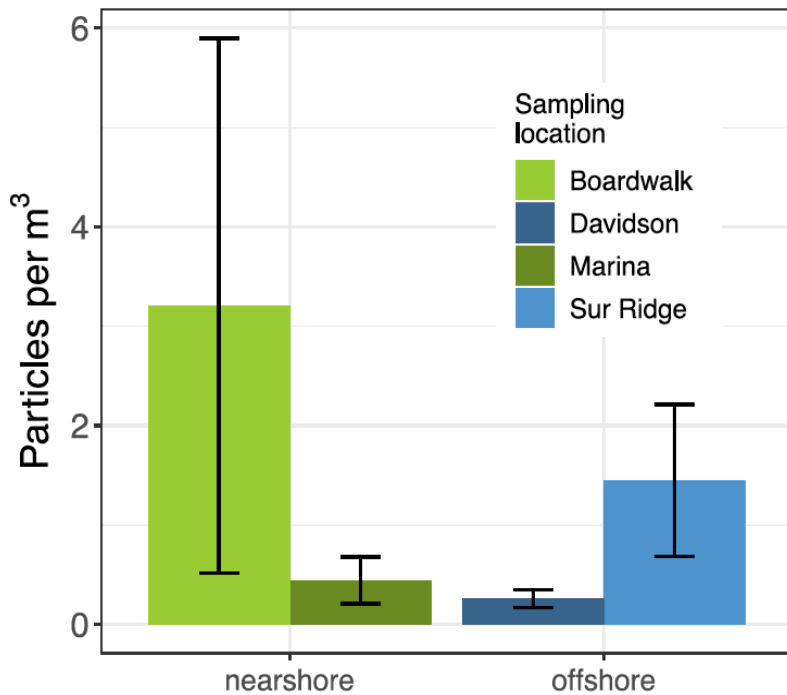
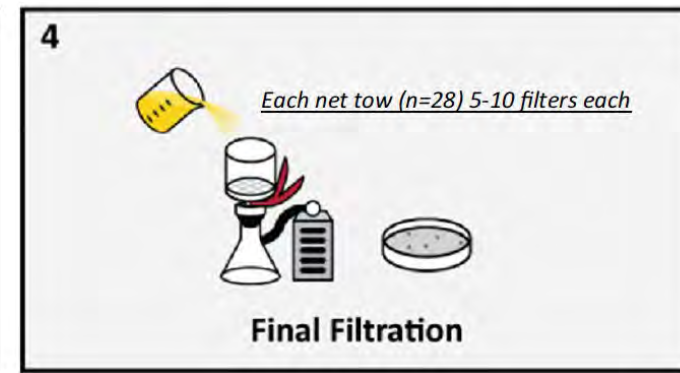
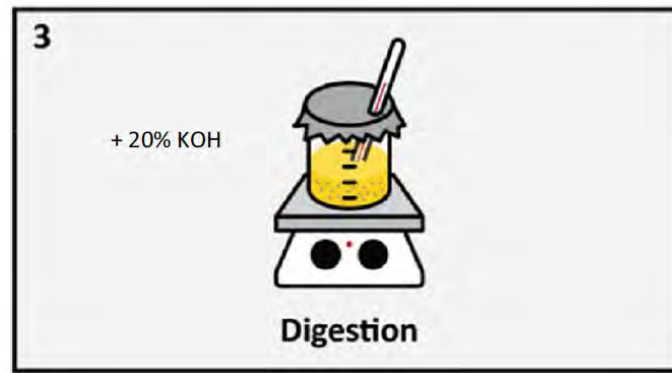
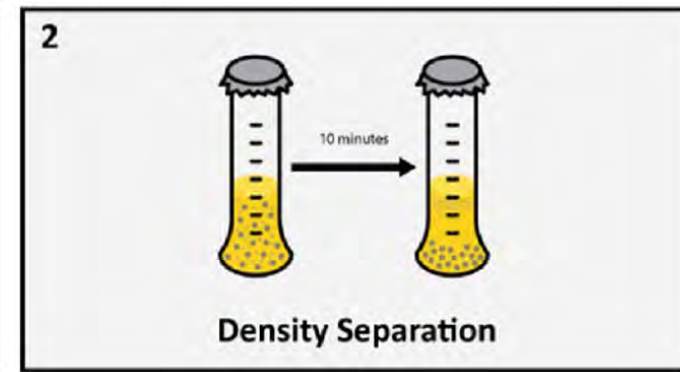
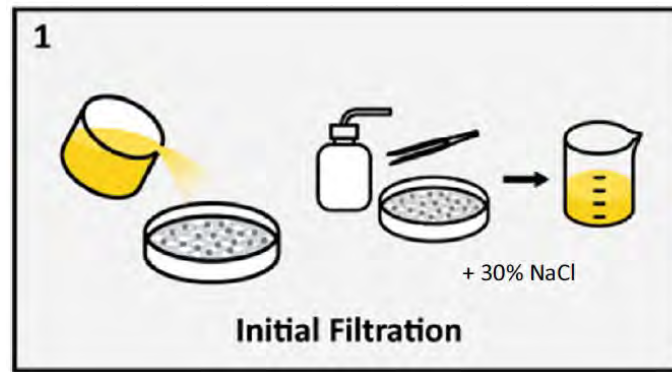


Deep-sea fauna



Seafloor





Marine Pollution Bulletin 165 (2021) 112148

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul




Note

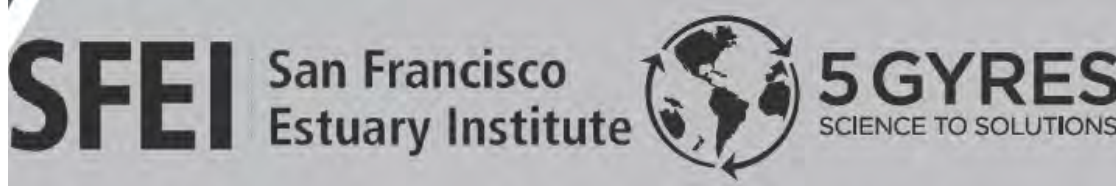
Microplastics and microfibers in surface waters of Monterey Bay National Marine Sanctuary, California

Lauren M. Kashiwabara ^{a,*}, Shirel R. Kahane-Rapport ^b, Chad King ^c, Marissa DeVogelaere ^d, Jeremy A. Goldbogen ^b, Matthew S. Savoca ^{b,*}



UNDERSTANDING MICROPLASTIC LEVELS, PATHWAYS, AND TRANSPORT

in the San Francisco Bay Region



Cordell Bank and Greater Farallones National Marine Sanctuaries:
1.12 particles/m³

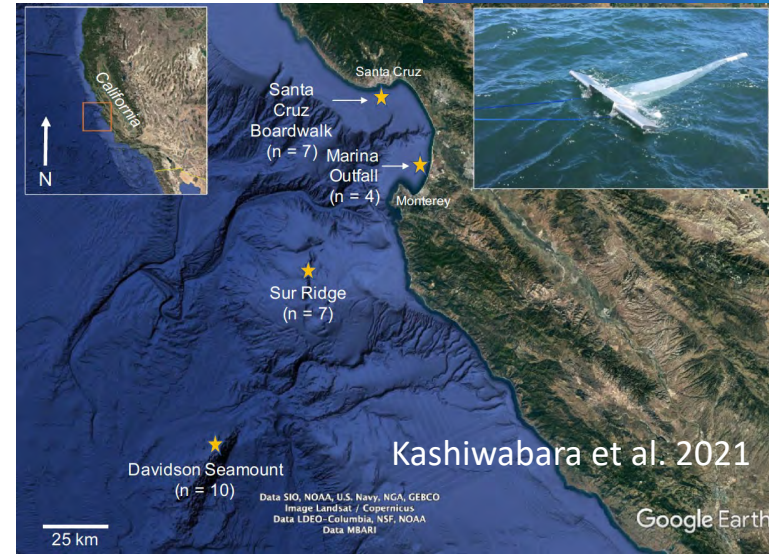
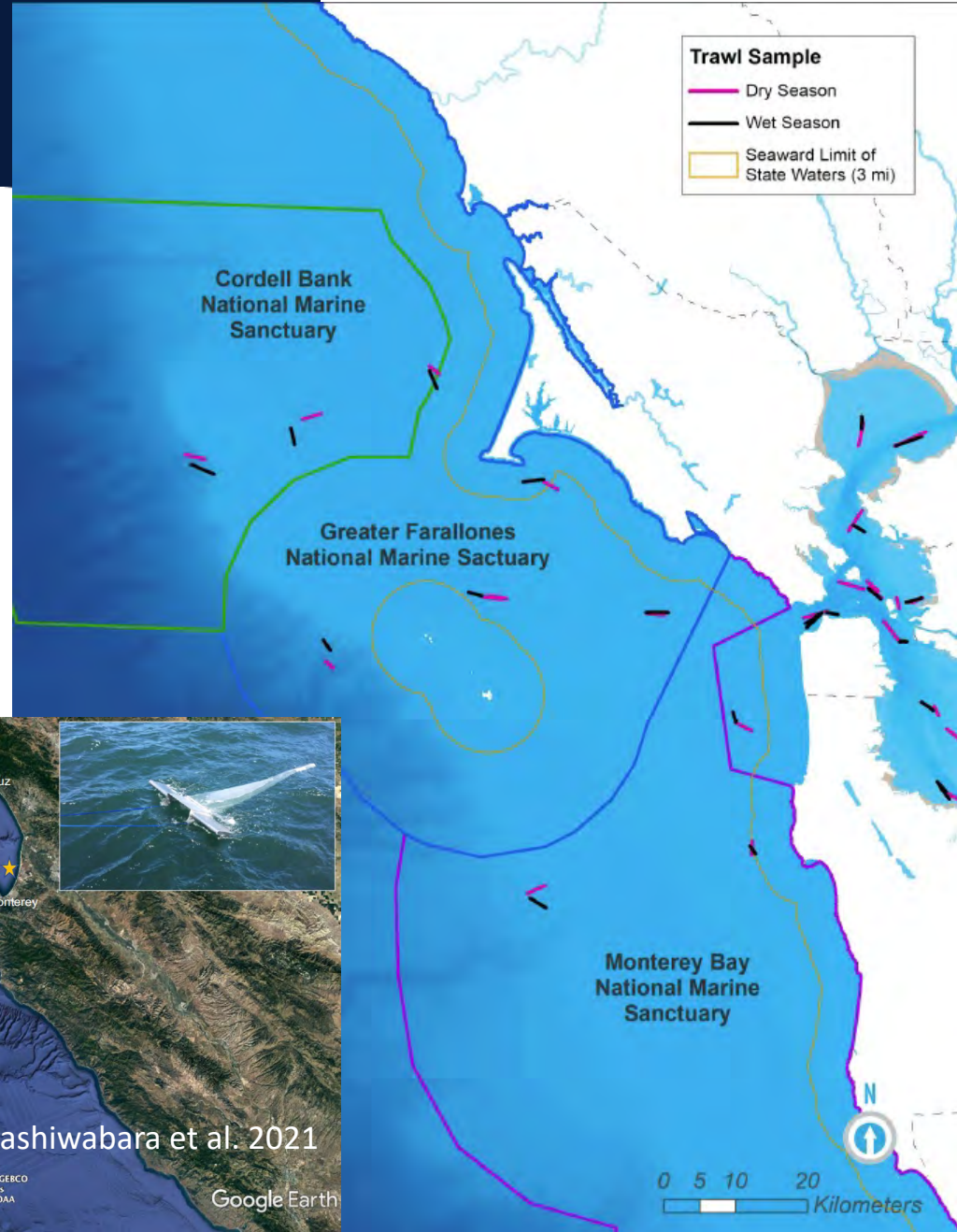
Monterey Bay National Marine Sanctuary:
1.32 particles/m³

San Francisco Bay:
4.11 particles/m³

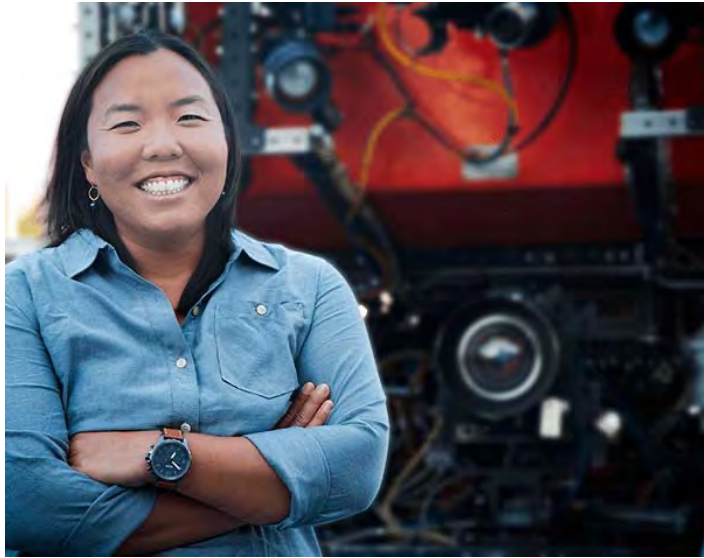
Santa Cruz Boardwalk:
3.21 particles/m³



Carolynn Box



What about deep water?



Anela Choy

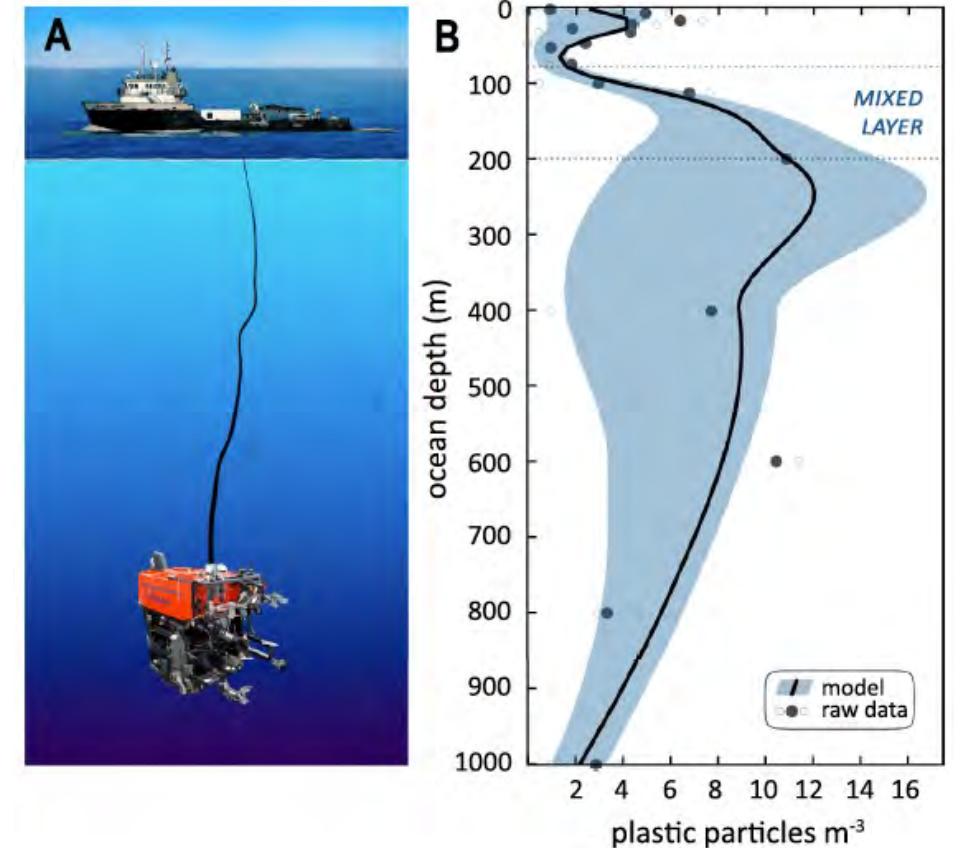


Monterey Bay
Aquarium®

SCIENTIFIC REPORTS

The vertical distribution and biological transport of marine microplastics across the epipelagic and mesopelagic water column

C. Anela Choy^{1,5}, Bruce H. Robison¹, Tyler O. Gagne², Benjamin Erwin¹, Evan Firl², Rolf U. Halden³, J. Andrew Hamilton¹, Kakani Katija¹, Susan E. Lisin², Charles Rolsky³ & Kyle S. Van Houtan^{2,4}



Plastic ingestion by baleen whales

Trends in Ecology & Evolution

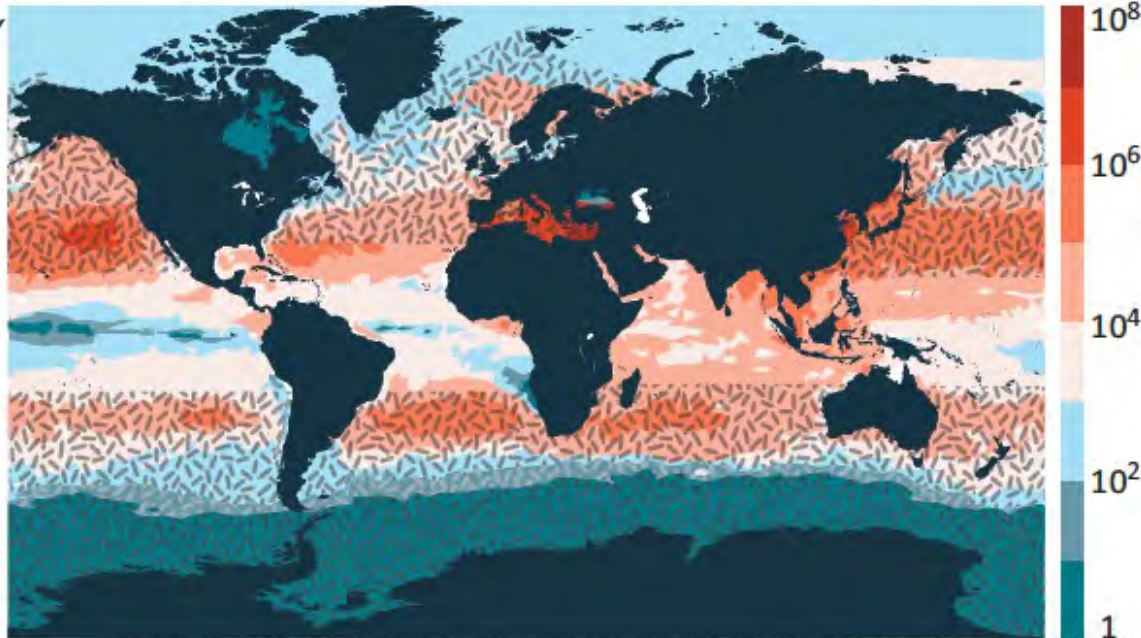
Volume 33, Issue 4, April 2018, Pages 227-232



Science & Society

Microplastics: No Small Problem for Filter-Feeding Megafauna

Elitza S. Germanov^{1, 2}, Andrea D. Marshall², Lars Bejder^{3, 4}, Maria Cristina Fossi⁵, Neil R. Loneragan¹



Trends in Ecology & Evolution

Marine Pollution Bulletin

Volume 95, Issue 1, 15 June 2015, Pages 248-252



Microplastic in a macro filter feeder: Humpback whale *Megaptera novaeangliae*

E. Besseling^{a, b}, E.M. Foekema^b, J.A. Van Franeker^b, M.F. Leopold^b, S. Kühn^b, E.L. Bravo Rebolledo^b, E. Heße^b, L. Mielke^b, J. IJzer^c, P. Kamminga^d, A.A. Koelmans^{a, b}



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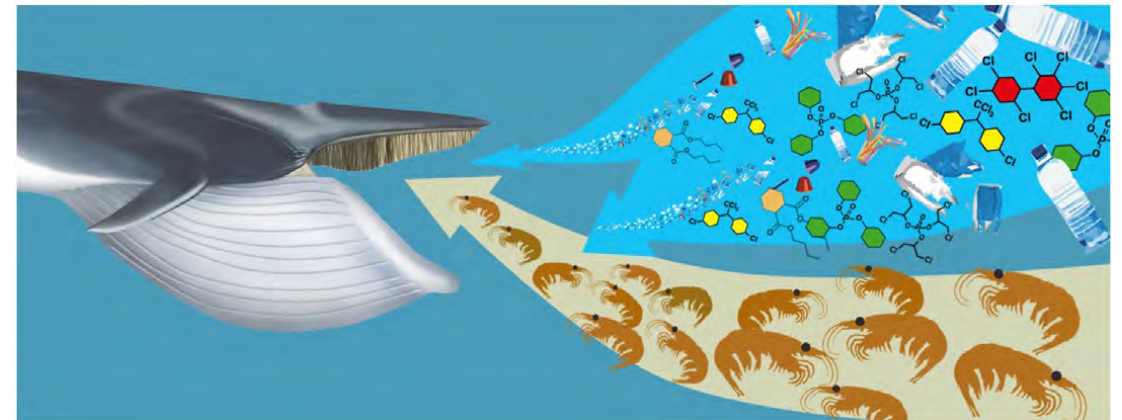
Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere



Ingestion of synthetic particles by fin whales feeding off western Iceland in summer

Odei Garcia-Garin^a, Alex Aguilar^a, Morgana Vighi^a, Gísli A. Víkingsson^b, Valérie Chosson^b, Asunción Borrell^{a, *}



Plastic ingestion by baleen whales

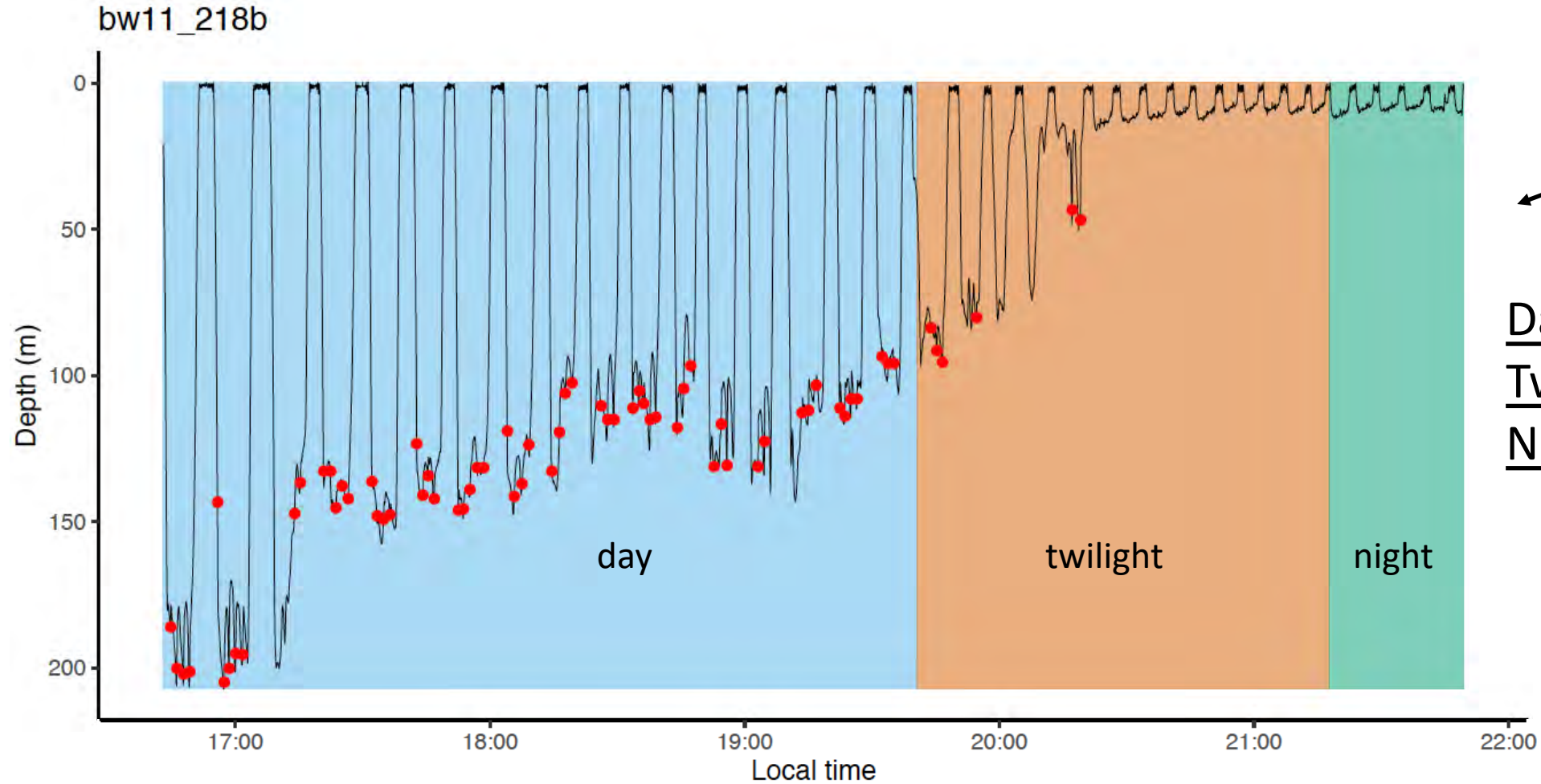
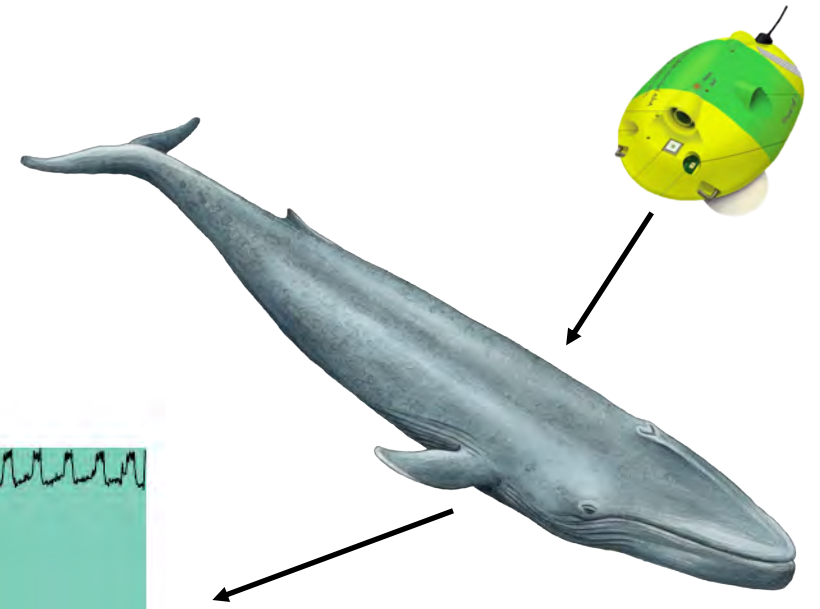


Video courtesy of: Monterey Bay Whale Watch



Video courtesy of:
Goldbogen Laboratory
NMFS permit #16111

Plastic ingestion by baleen whales



Day rate: 21 lunges h⁻¹
Twilight rate: 4 lunges h⁻¹
Night rate: 0 lunges h⁻¹

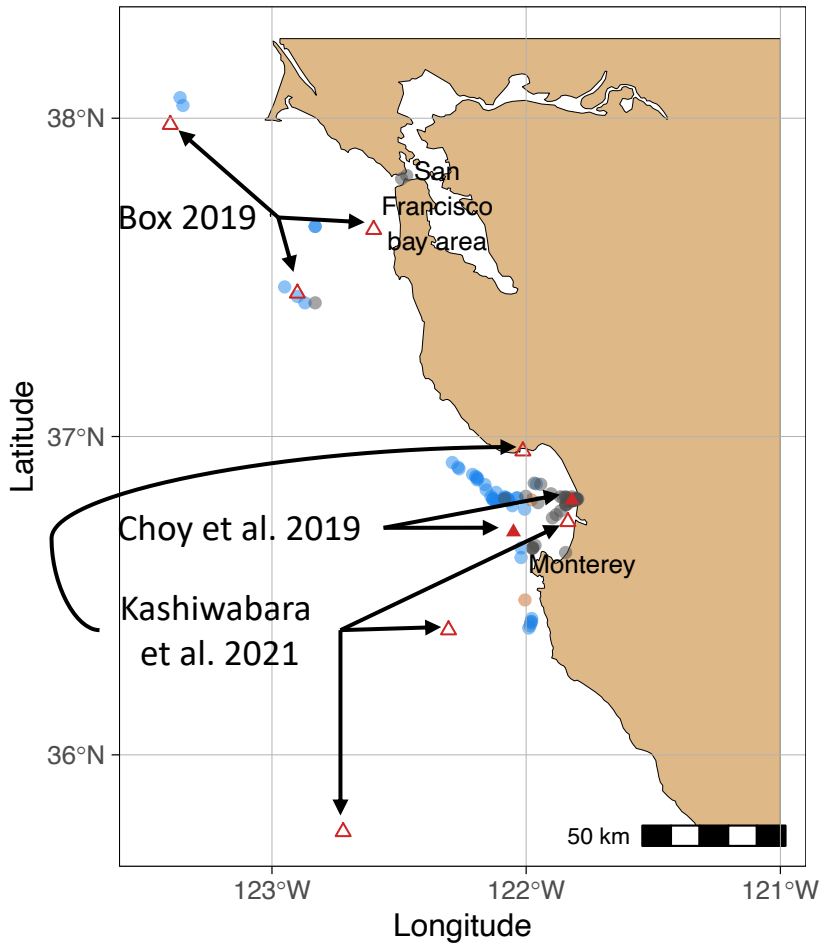
Plastic ingestion by baleen whales



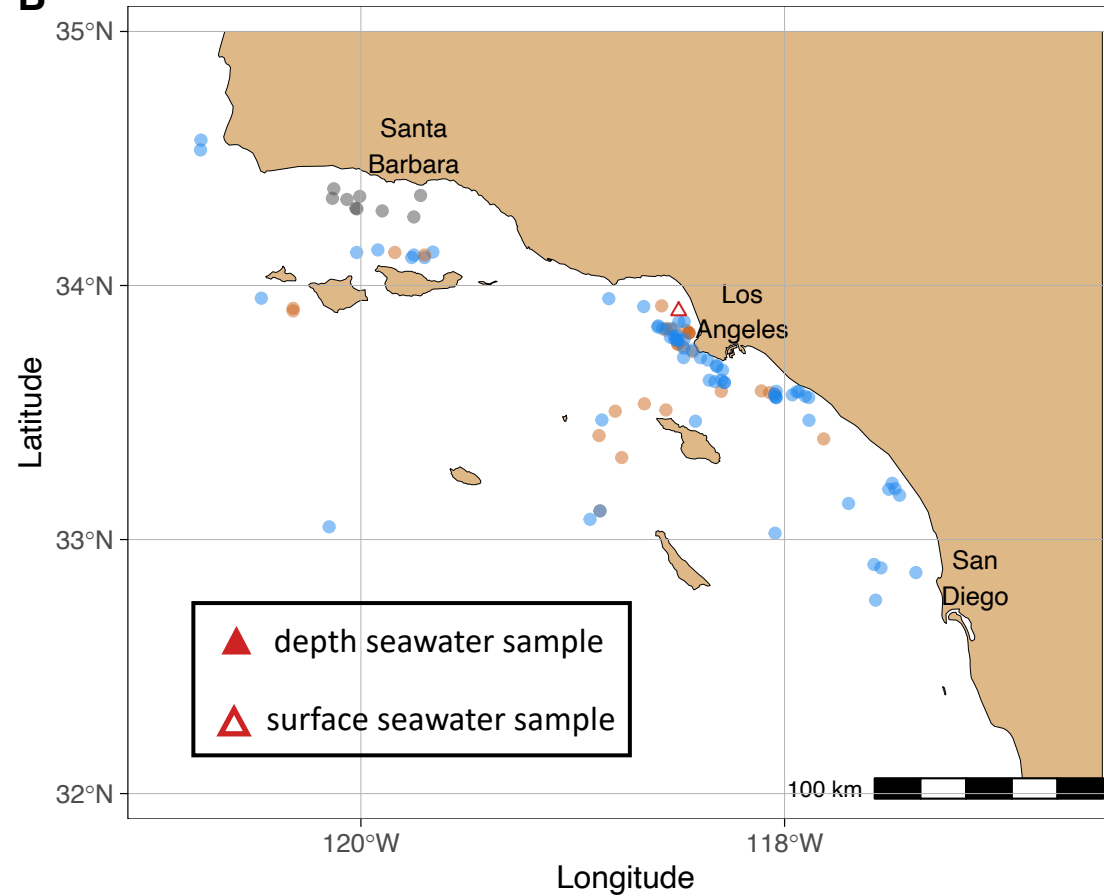
Species ● *B. musculus* ● *B. physalus* ● *M. novaeangliae*



A



B



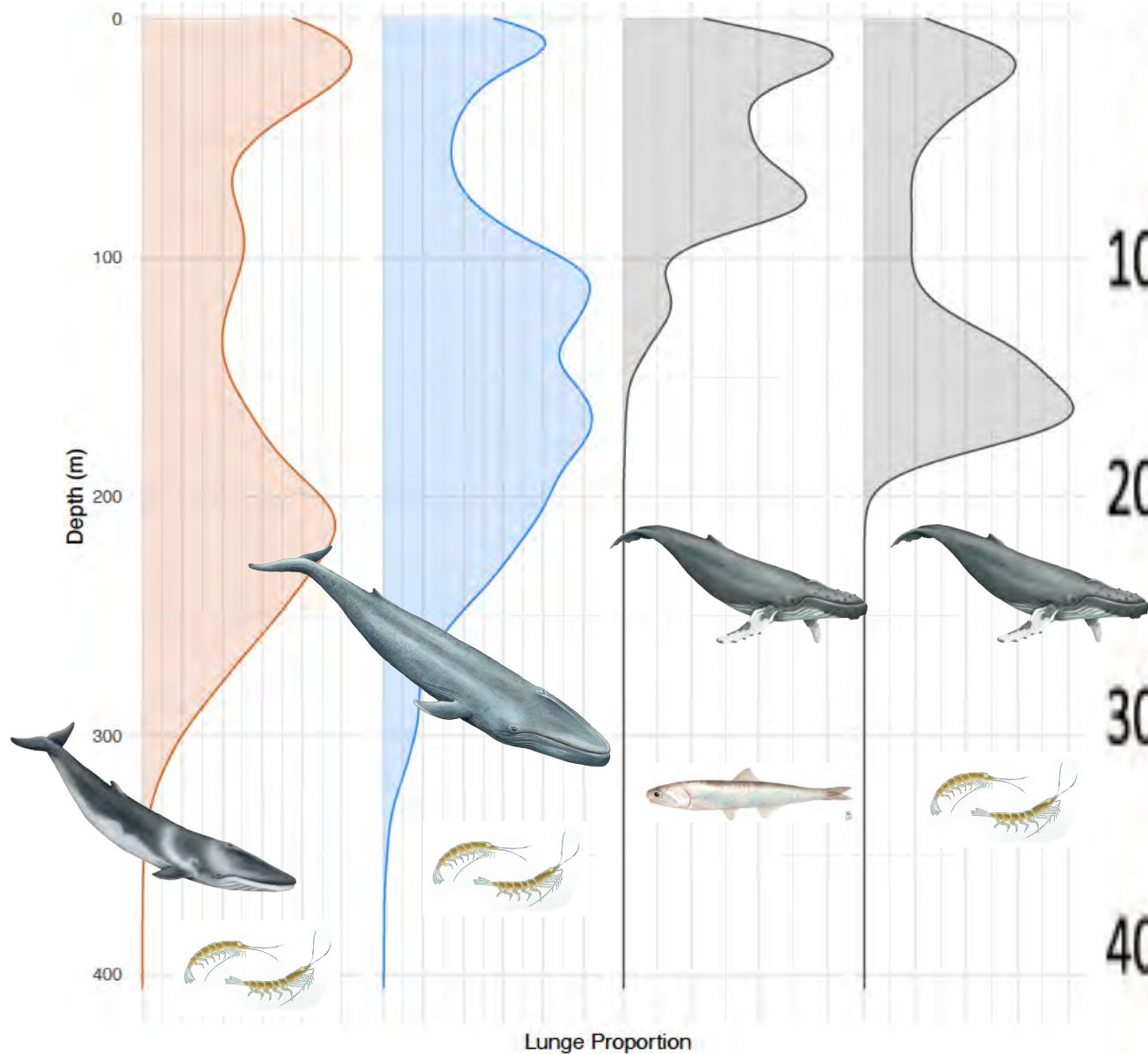
Shirel Kahane-Rapport

Kahane-Rapport et al. *In review*

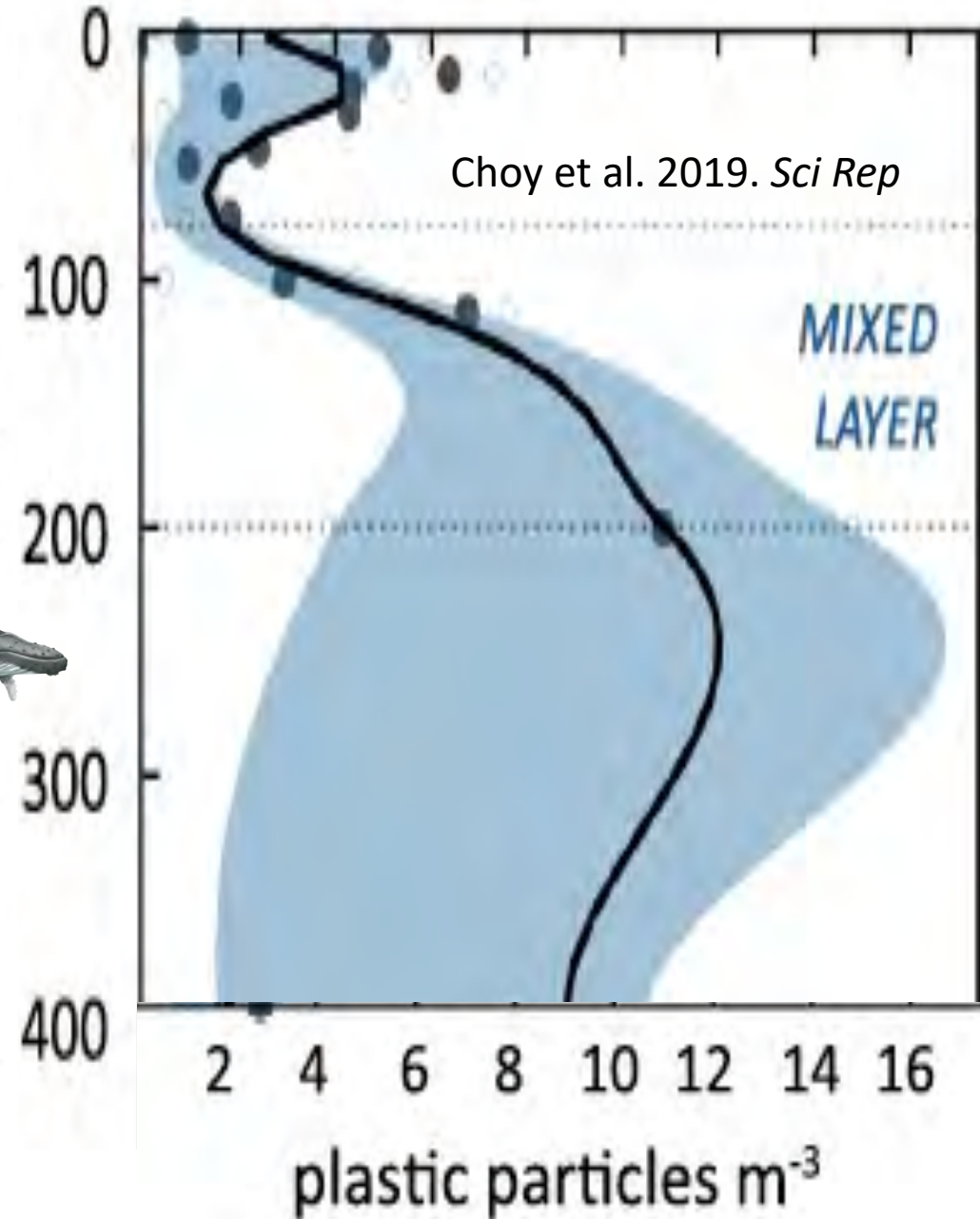


No photos please!

Plastic ingestion by baleen whales

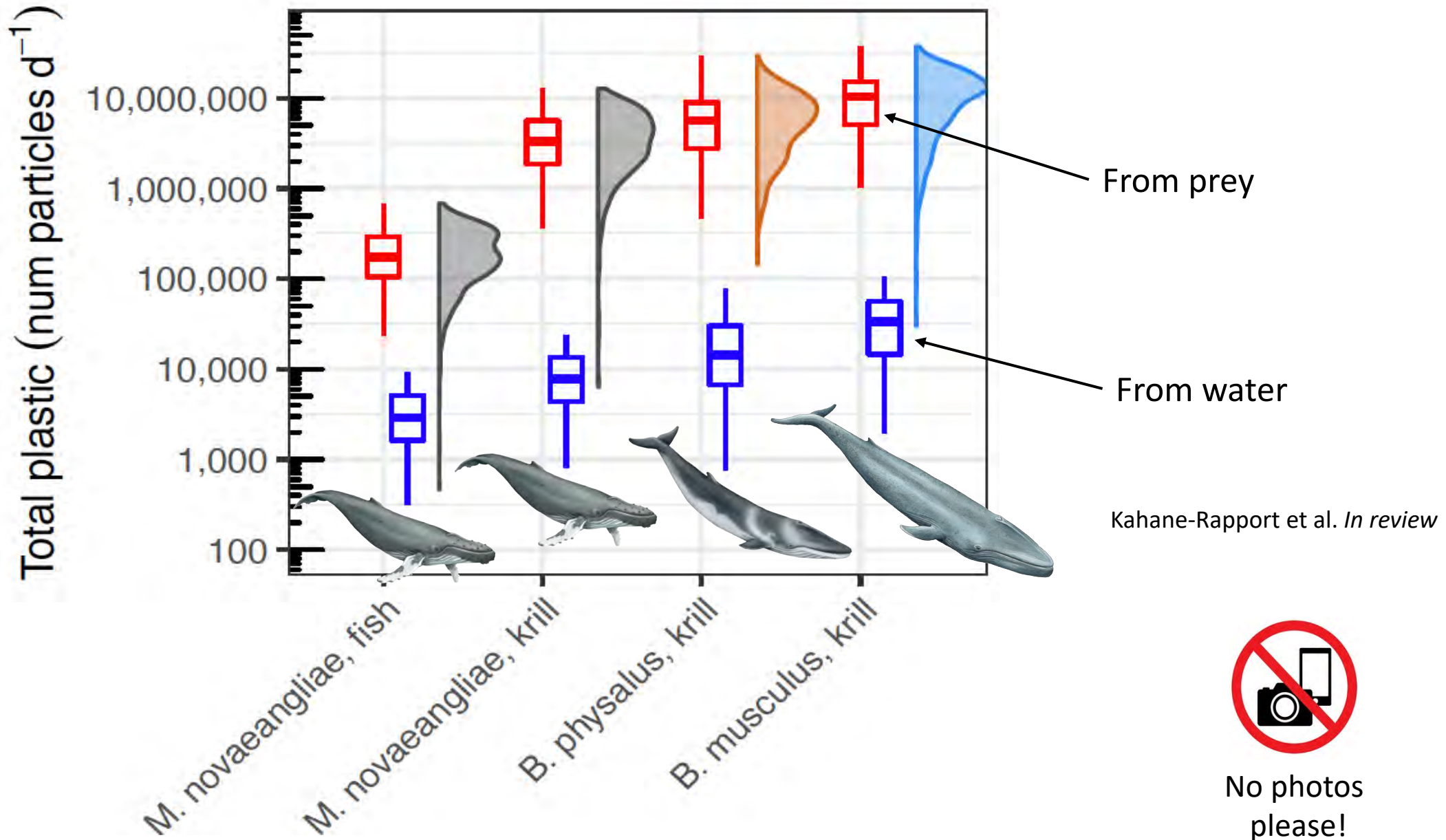


Kahane-Rapport et al. *In review*



No photos please!

Plastic ingestion by baleen whales



No photos please!

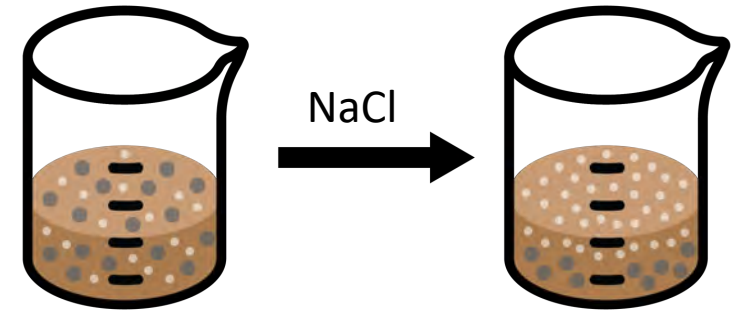


Microplastic Isolations

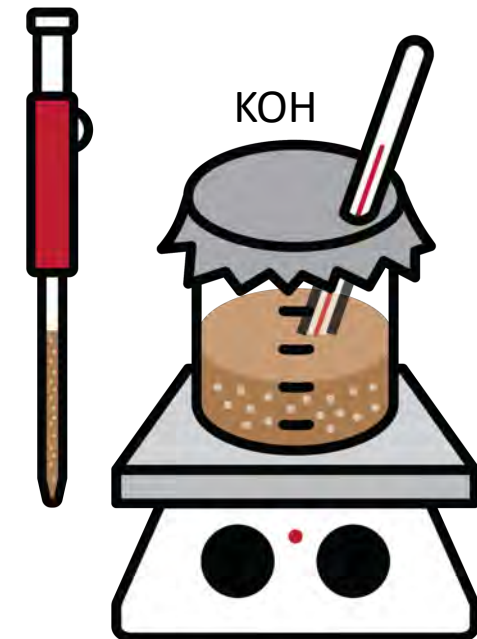
- n=8 scat ANNU
n=3 scat PORE
- Sand blanks
- Spring/summer haulout



Subsamples (9-12g)
Density separation

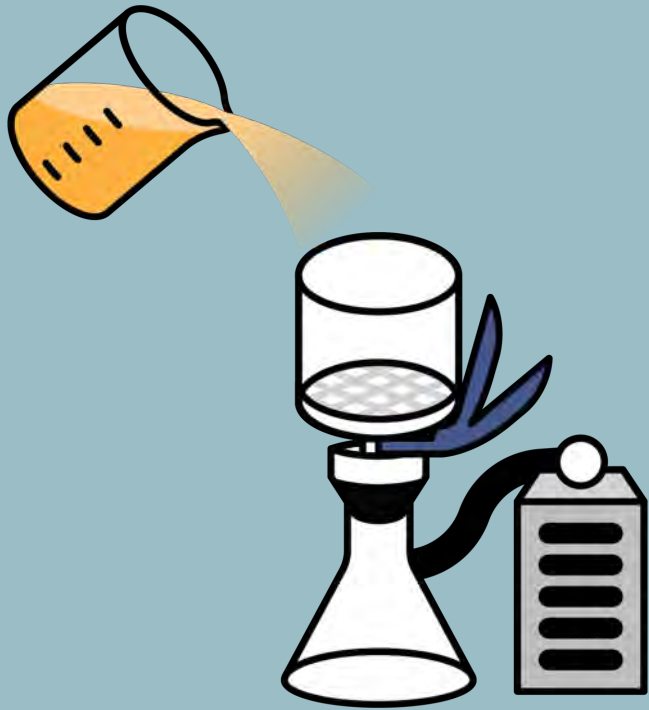


Chemical digestion
of organic material



Microplastic Isolations

Vacuum filtration



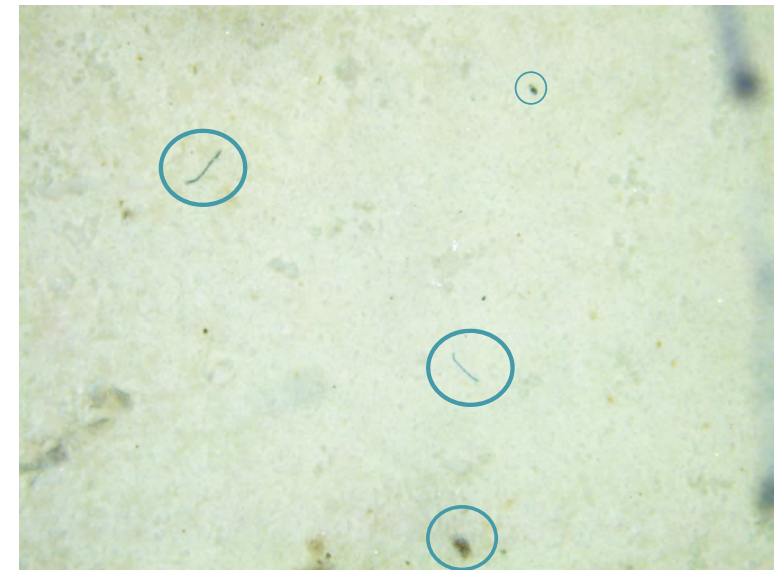
100 filters!



1 μm



Image credit: Danielle Dube



Año Nuevo sample

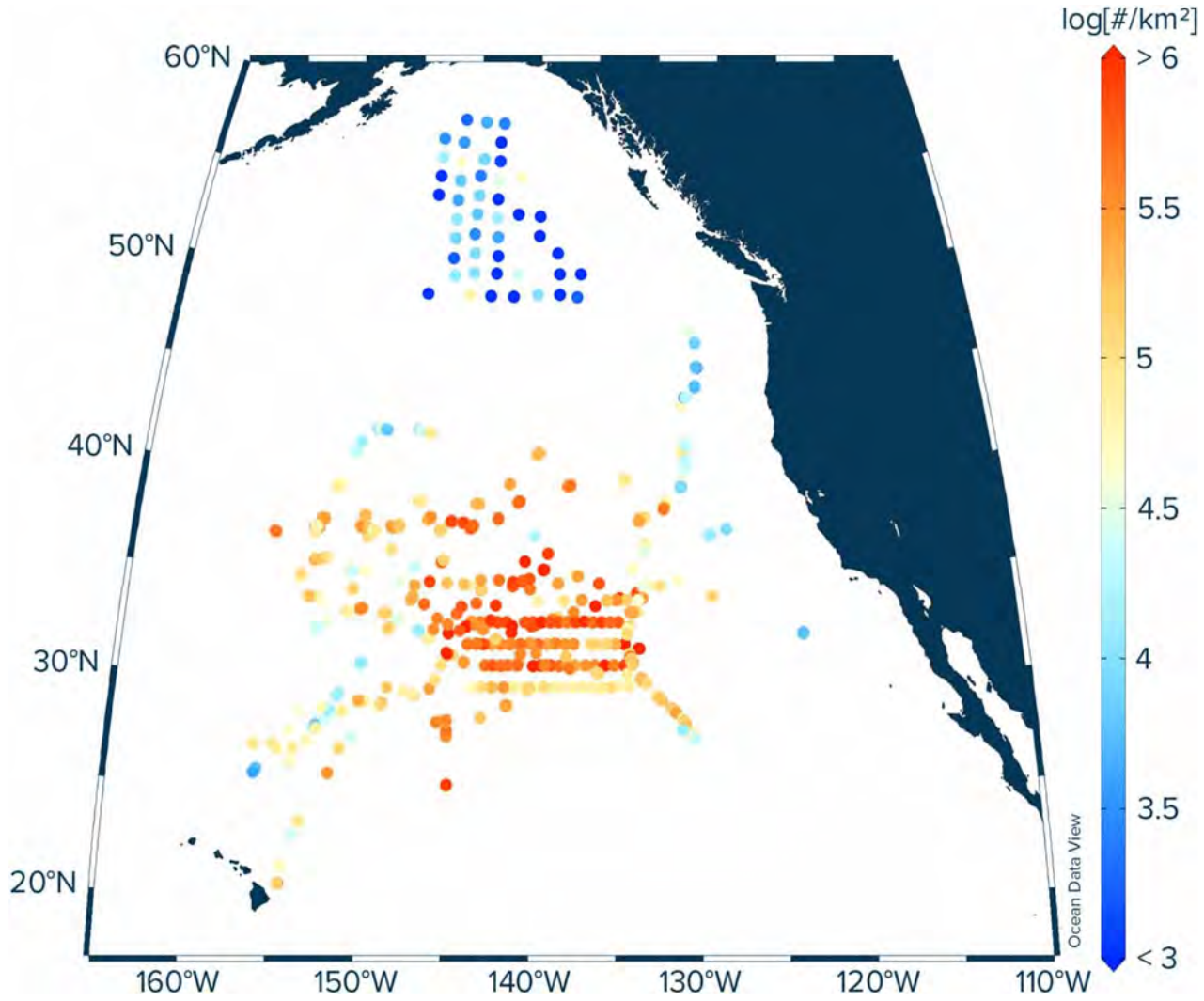
Are northern elephant seals consuming plastics?



Type	Mean +/- s.d.
Scat	0.68 particles per gram ± 1.28
Blanks	0.09 ± 0.12

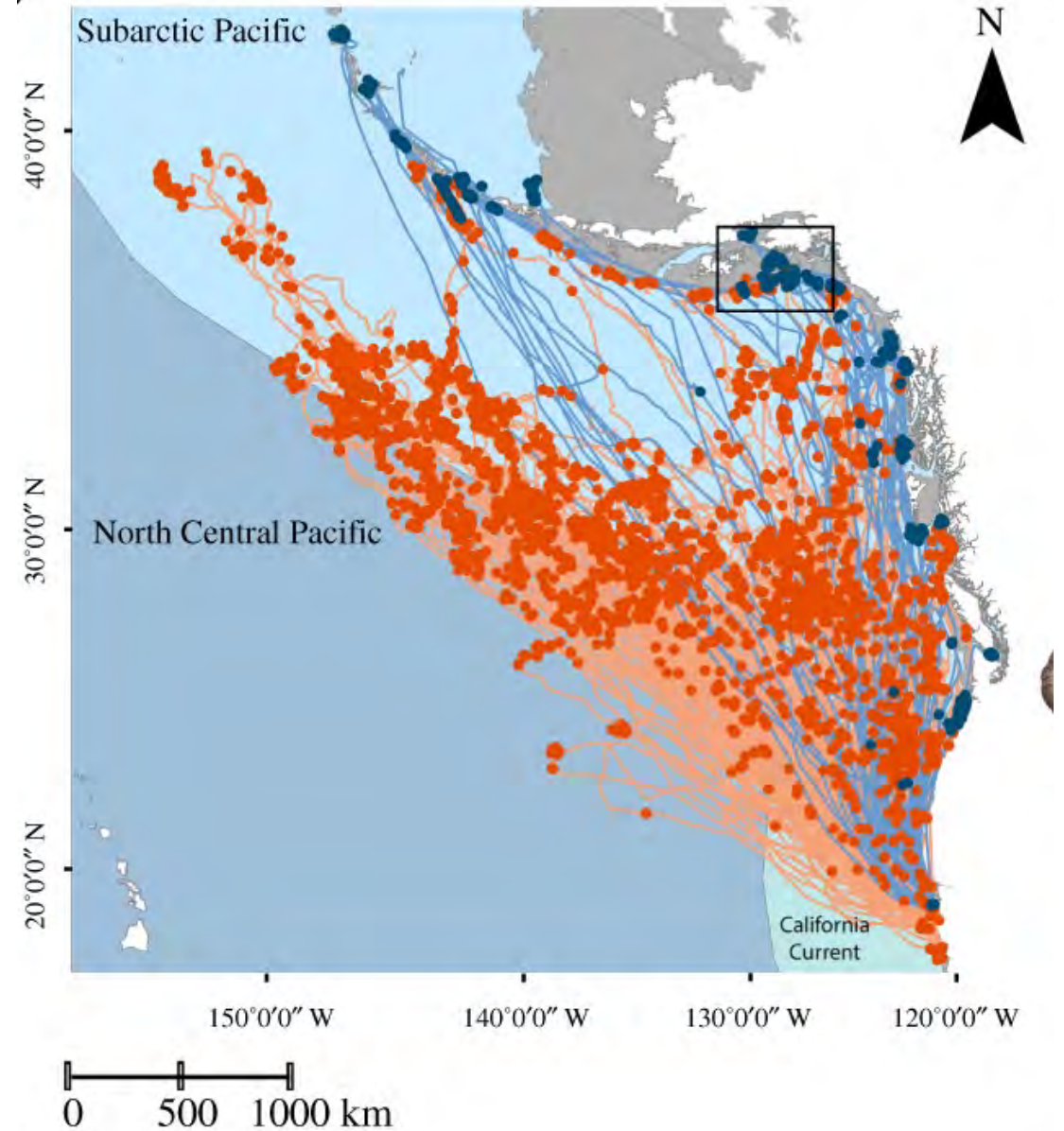
W = 2169, p-value <0.001

Surface water microplastic concentrations



Egger et al., 2020

Female & male foraging tracks

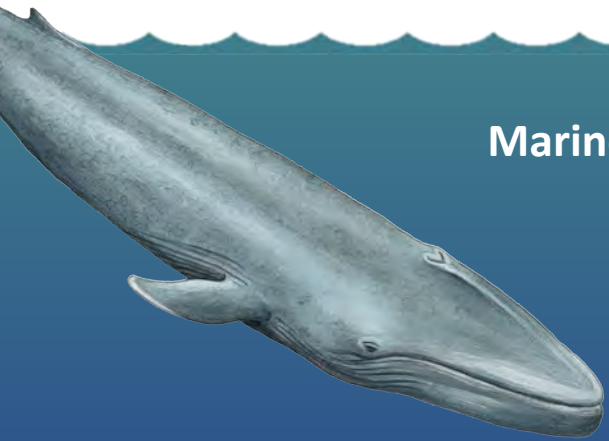


Kienle et al., 2022

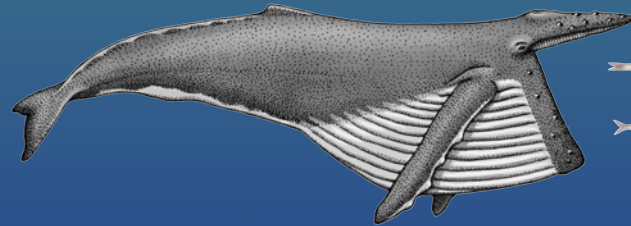
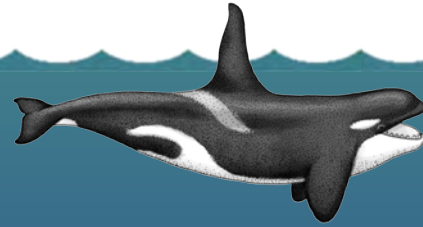
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