

Evidence of fisheries interactions with Hawaiian insular odontocetes



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Cascadia Research Collective

Marine Mammal Commission, May 22, 2019

Hawaiian insular odontocetes

- Up to three independent lines of evidence for insular populations: genetics (7 species), long-term re-sightings (10 species), satellite tag data (9 species)
- 11 species with evidence of insular populations:

Three lines	Two lines	One line
False killer whale	Spinner dolphin	Dwarf sperm whale
Short-finned pilot whale	Pygmy killer whale	
Bottlenose dolphin	Pantropical spotted dolphin	
Rough-toothed dolphin	Cuvier's beaked whale	
Melon-headed whale	Blainville's beaked whale	

Insular stocks in NOAA SARs for 5 of 11 species

Diet of main Hawaiian Islands insular false killer whales



- Ahi/yellowfin tuna (S/O)
- Ahi palaha/albacore tuna (O)
- Aku/skipjack tuna (O)
- A'u ku/broadbill swordfish (O)
- Hebi/shortbill spearfish (O)
- A'u/marlin (S)
- Opah/moonfish (O)
- Mahimahi (S/O)
- Ono/wahoo (O)
- Monchong/pomfret (O)
- Kagami ulua/threadfin jack (O)
- Kāhala/amberjack (O)
- Ulua aukea/giant trevally (O)
- Loulu/scrawled filefish (O)
- Oio/bonfish (S/O)
- Squid (S)

S=Stranding (data from Kristi West)

O=Observations (CRC & citizen science)



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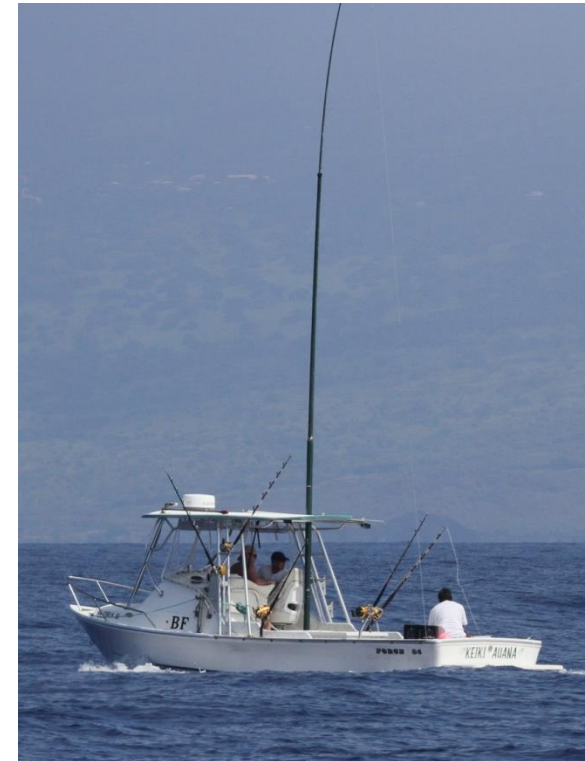
Non-longline pelagic fisheries

~ 3,000 – 3,200 Commercial Marine License holders in Hawai'i (2015)

Retained commercial catch of pelagics ~4-5 million pounds

Recreational catch ~11-17 million pounds; no registration/licensing

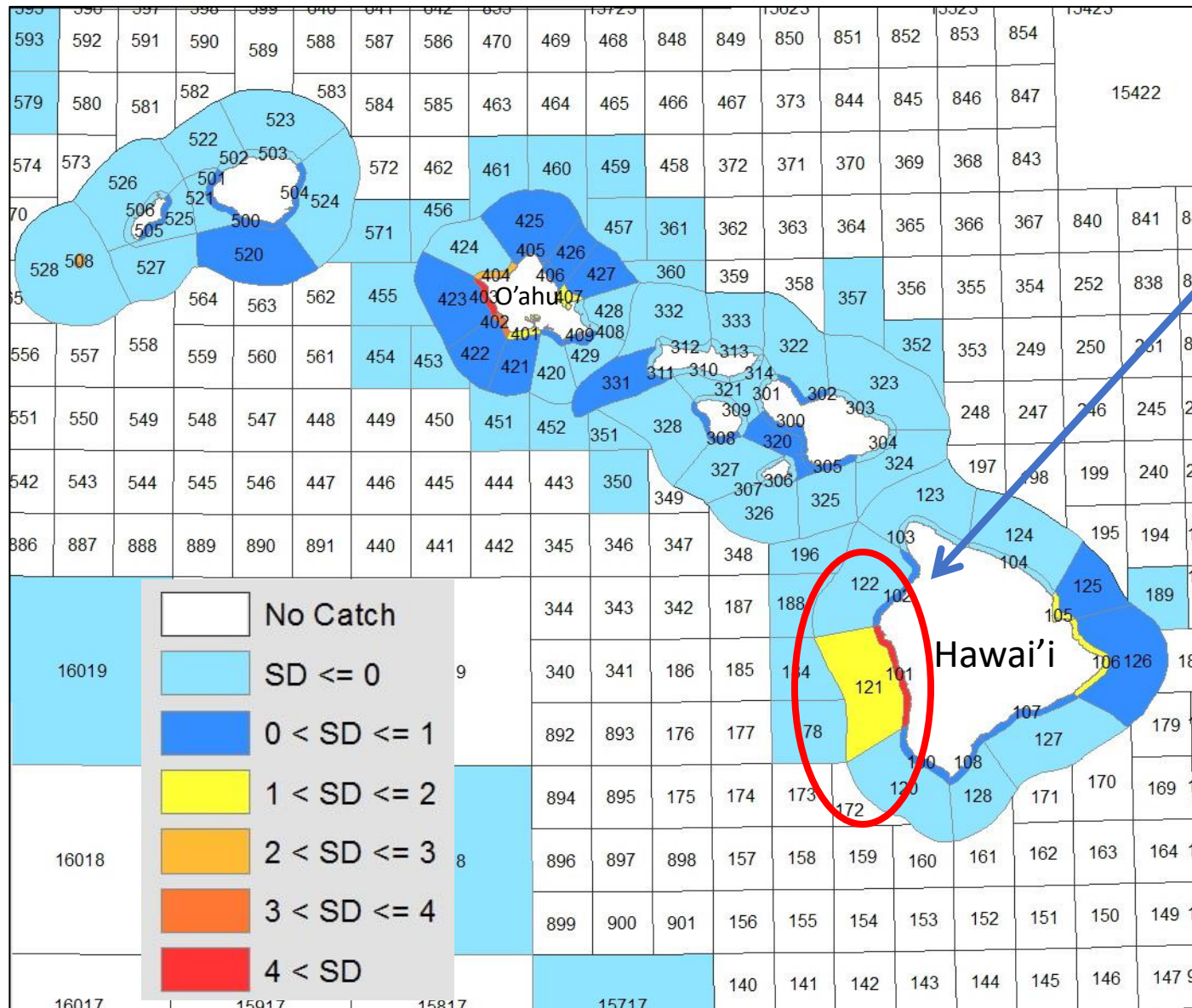
Fishery*	Estimated # vessels/ persons
trolling, rod and reel (includes green stick)	1,560
MHI deep-sea bottomfish handline	567
tuna handline (includes ika-shibi & palu-ahi)	459
HI charter vessel	114



*Self-declared primary fishing method, often use multiple methods

Fishing effort varies by area (data from 1994-2014)

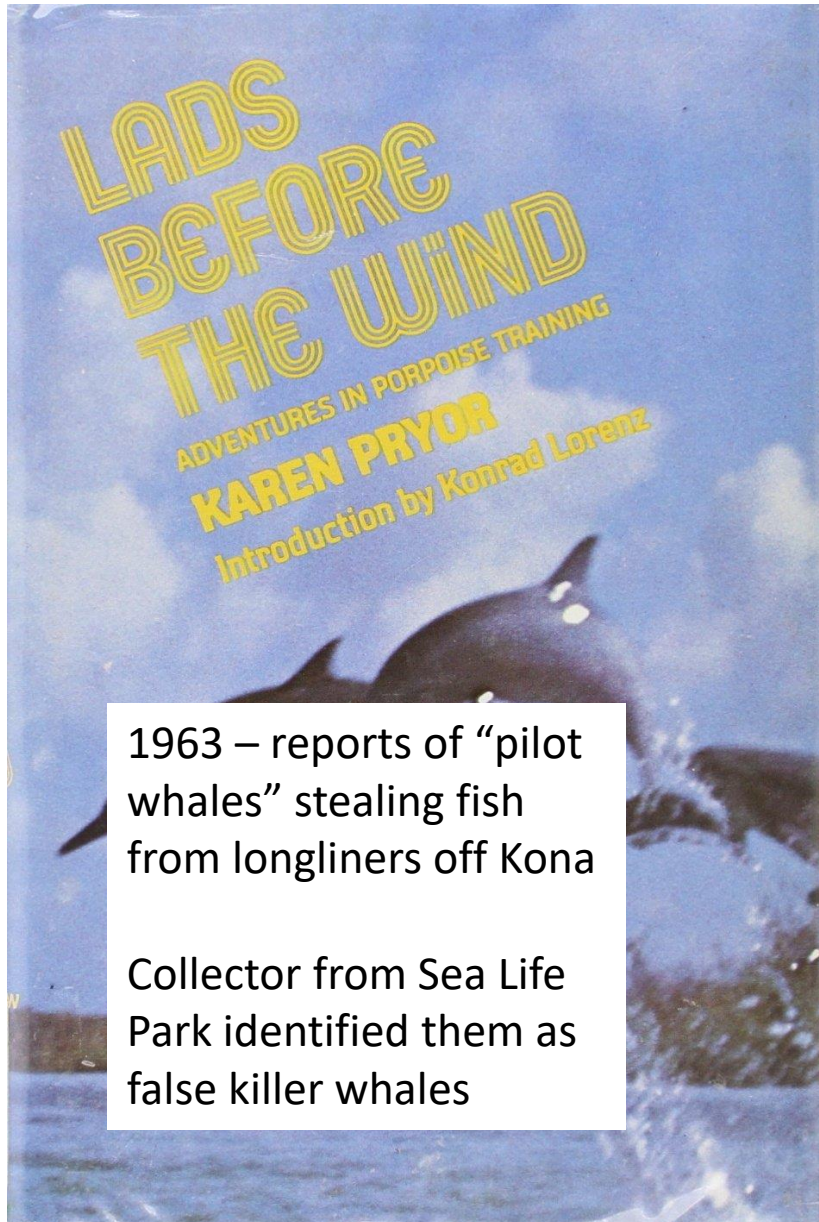
catch data from State fisheries through PIFSC Fishery Ecosystem Assessment Tool



Highest levels
of effort (>3
nm from shore)
off Hawai'i
Island

Sources of evidence for fisheries interactions

Historical reports



1963 – reports of “pilot whales” stealing fish from longliners off Kona

Collector from Sea Life Park identified them as false killer whales

Report No. MMC-77/23

THE STATUS OF HAWAIIAN CETACEANS

Edward W. Shallenberger, Ph.D.

Manta Corporation
272 S. Kalaheo
Kailua, Hawaii 96734

Published September 1981

“Pseudorca in several areas steal several species of fish from fishermen. This behavior is very common in Hawaii where Pseudorca frequently steal tuna of up to 70 lbs., and sometimes take much larger fish”

Sources of evidence for fisheries interactions

Historical reports

“Larger animals were so experienced that they did not damage gear, however the smaller ones broke the lines”

“porpoise fishery interactions have increased greatly in the past two years”

WILSON, J. L. FISHERIES INTERACTIONS
WITHIN THE HAWAIIAN ISLANDS

BARBARA A. KULJIS
49-139 Kam Hwy
Kaneohe, Hawaii 96744

Not for Publication

ADMINISTRATIVE REPORT H-83-19C

Thieving dolphins A growing problem in Hawaii's fisheries

by JAMES F. SCHLAIS

SOME OF THE BEST fishing grounds in Hawaii's main island chain lie off the Kona Coast of the Big Island. The large lee formed by the highest mountains in the state allows fishermen in 18- and 20-foot skiffs to troll, bottom fish for snappers, and hand-line for yellowfin tuna up to 20 miles offshore. Kona Coast waters are famous for marlin, and international tournaments attract millions of dollars annually to the local and state economies.

Among has also thieving porpoises unusual give up dozen or

per) and boating only the heads. A troller fisherman may have to switch to less effective lures because his live baits (skipjack tuna) are removed from his line as soon as he lets it out. By midmorning, fishermen hand-lining for yellowfin tuna may head for shore, their baits repeatedly stolen and any catch so badly damaged that it is unmarketable. Dolphin theft may not occur every day, but it does occur often enough to make a fisherman's

life a discouraging lot, and to drive a few to jobs ashore.

Over the past five or six years, the theft of bait and catch by dolphins has

A MILLION-DOLLAR LOSS yearly in the Hawaiian fishing industry results from dolphin theft of bait and catch. Mammalogist/fisherman Ed Shallenberger is among those trying to find a way to humanely thwart the antics of the thieves.

James F. Schlais

“it apparently began 35 years ago with a single [] bottlenose dolphin”



18 and 20 feet=5.5 and 6.1 meters
20 miles=32 kilometers

October 1984

309

Sources of evidence for fisheries interactions

Recent reports from fishermen

Rough-toothed dolphins aka Steno



(c) Robin W. Baird/Cascadia Research



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Sources of evidence for fisheries interactions

Stranded animals

HIPc164



Estimated % of animals that die that
are necropsied:

Monk seals in main Hawaiian
Islands ~43%

HIPc162



Main Hawaiian Islands false killer
whales ~4%

Sources of evidence for fisheries interactions

Stranded animals

HIPc164



Hooks in stomach of two of five stranded false killer whales (2 of 2 males)
(K. West et al. in prep)



HIPc162



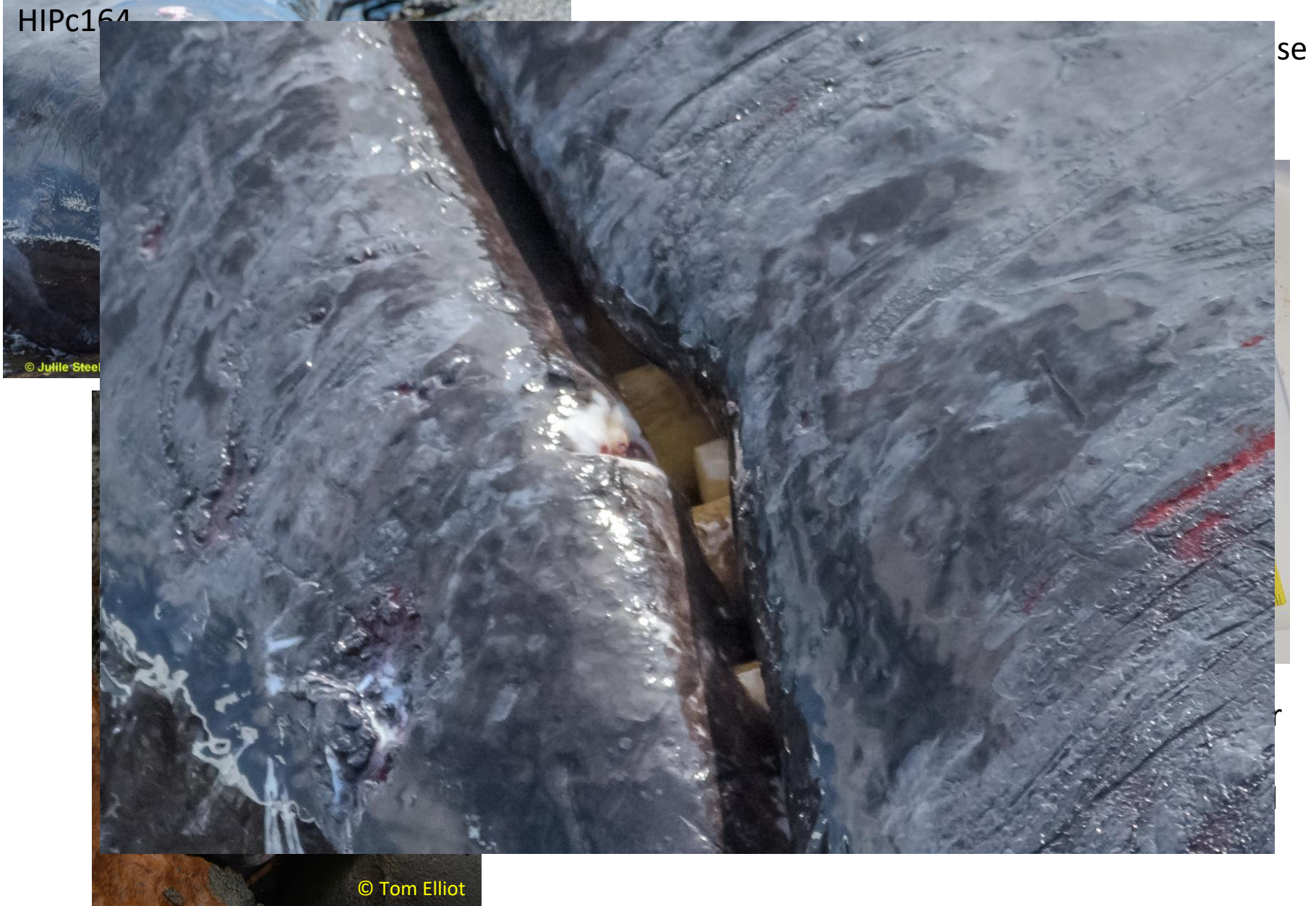
Hooking injuries in the mouth (pygmy killer whale) or mouthline (false killer whale, short-finned pilot whale, pantropical spotted dolphin), often associated with broken teeth

© Tom Elliot

Sources of evidence for fisheries interactions

Stranded animals

HIPc164



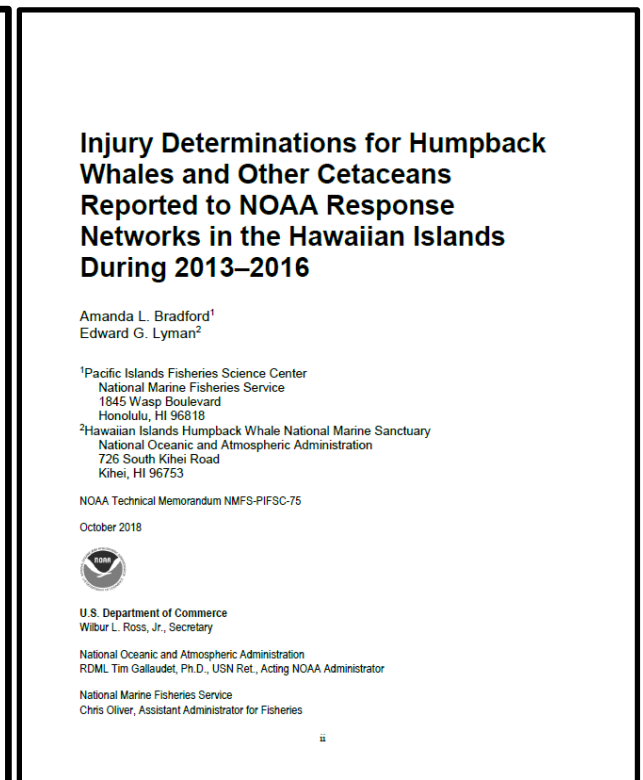
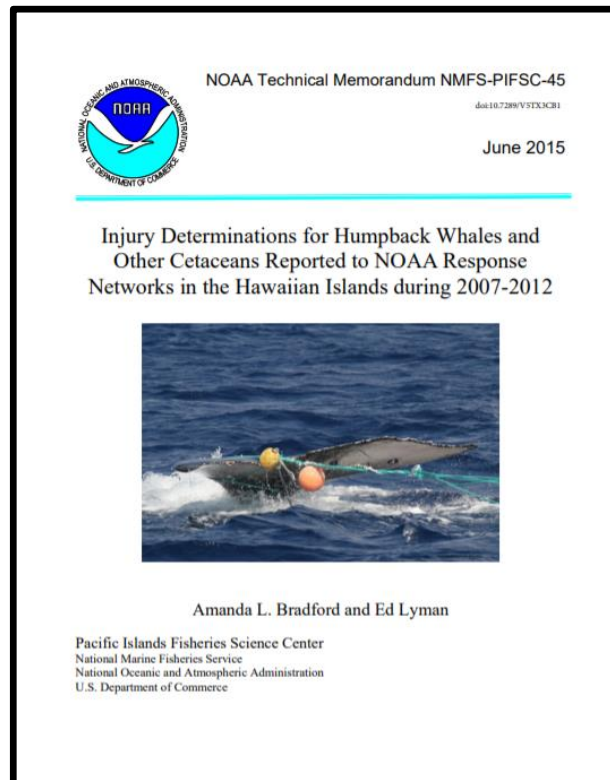
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Sources of evidence for fisheries interactions

Live animals with gear

Hooked spinner, spotted, rough-toothed and bottlenose dolphins (Hawai'i, Maui Nui)

Trailing lines or wraps on spinner, spotted, and rough-toothed dolphins, short-finned pilot whales (Hawai'i, Maui Nui)



Sources of evidence for fisheries interactions

Live animals with injuries consistent with fishery interactions

9% of MHI false killer whales with line injuries on dorsal fins*



Marine Mammal Science



MARINE MAMMAL SCIENCE, **(*): ***_*** (** 2014)

Published 2014. This article is a U.S. Government work and is in the public domain in the USA.

DOI: 10.1111/mms.12177

False killer whales and fisheries interactions in Hawaiian waters: Evidence for sex bias and variation among populations and social groups

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Sex known (8) or inferred (3) for 11 of 16 MHI individuals with fin injuries consistent with fishery interactions

**10 of 11 were females
(Sign test, $p = 0.0117$)**

*Baird et al. 2017 PSRG-2017-16

Sources of evidence for fisheries interactions

Live animals with injuries

~1/4 (23.3%) of MHI false killer whales have mouthline injuries
consistent with hooking

Median proportion of mouthline visible for those with injuries = 75% (without injuries = 53%), therefore
under-representative of actual injury rates



(Beach et al. 2015, Baird et al. 2017 PSRG)

Sources of evidence for fisheries interactions

Live animals with injuries

Bottlenose dolphins

3%



- Higher frequency off Hawai'i Island

Pygmy killer whales

43%



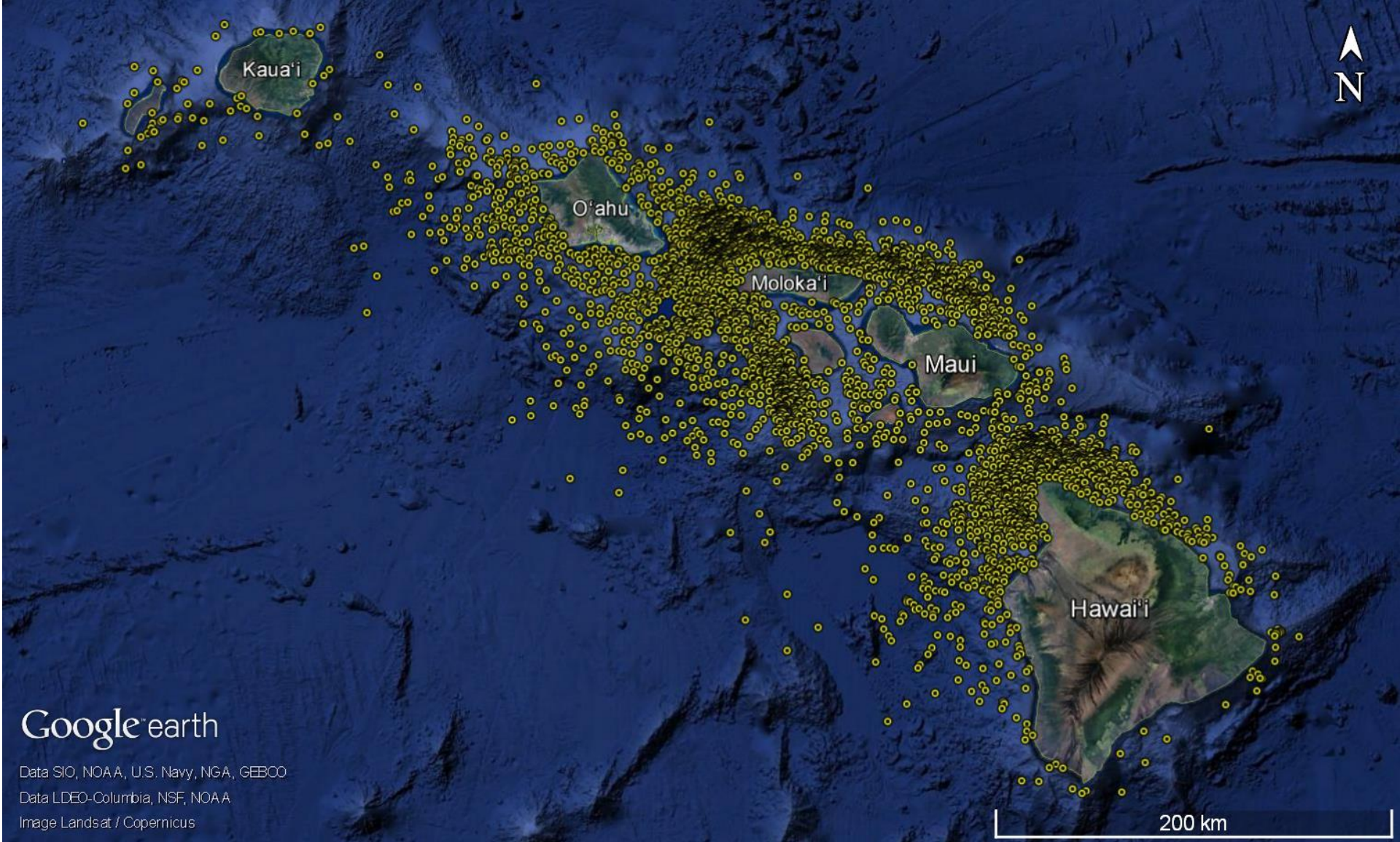
- Feeds primarily/entirely at night
- Bias towards males

Gill et al. in prep

Vanderzee et al. in prep

- represent individuals that survived fishery interactions, thus an indicator of the extent of depredation behavior rather than how many may be seriously injured or killed
- differences among species in mouthline injuries in part related to re-pigmentation of injuries (pygmy killer whales) as well as potentially gear type or outcome





Satellite tag data from main Hawaiian Islands insular false killer whales (n=38)
Locations from switching state space model (12 h time steps)

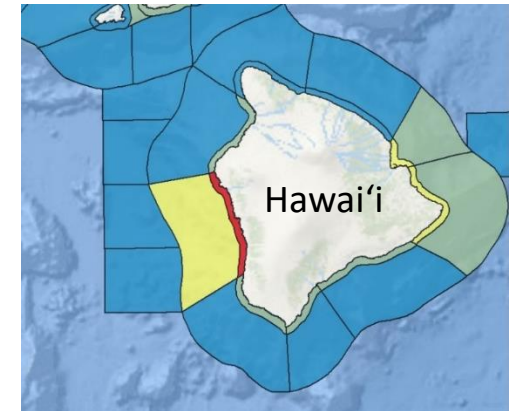
An index of overlap between false killer whales and nearshore fisheries

Primary goal: index should reflect the perspective of the fishermen

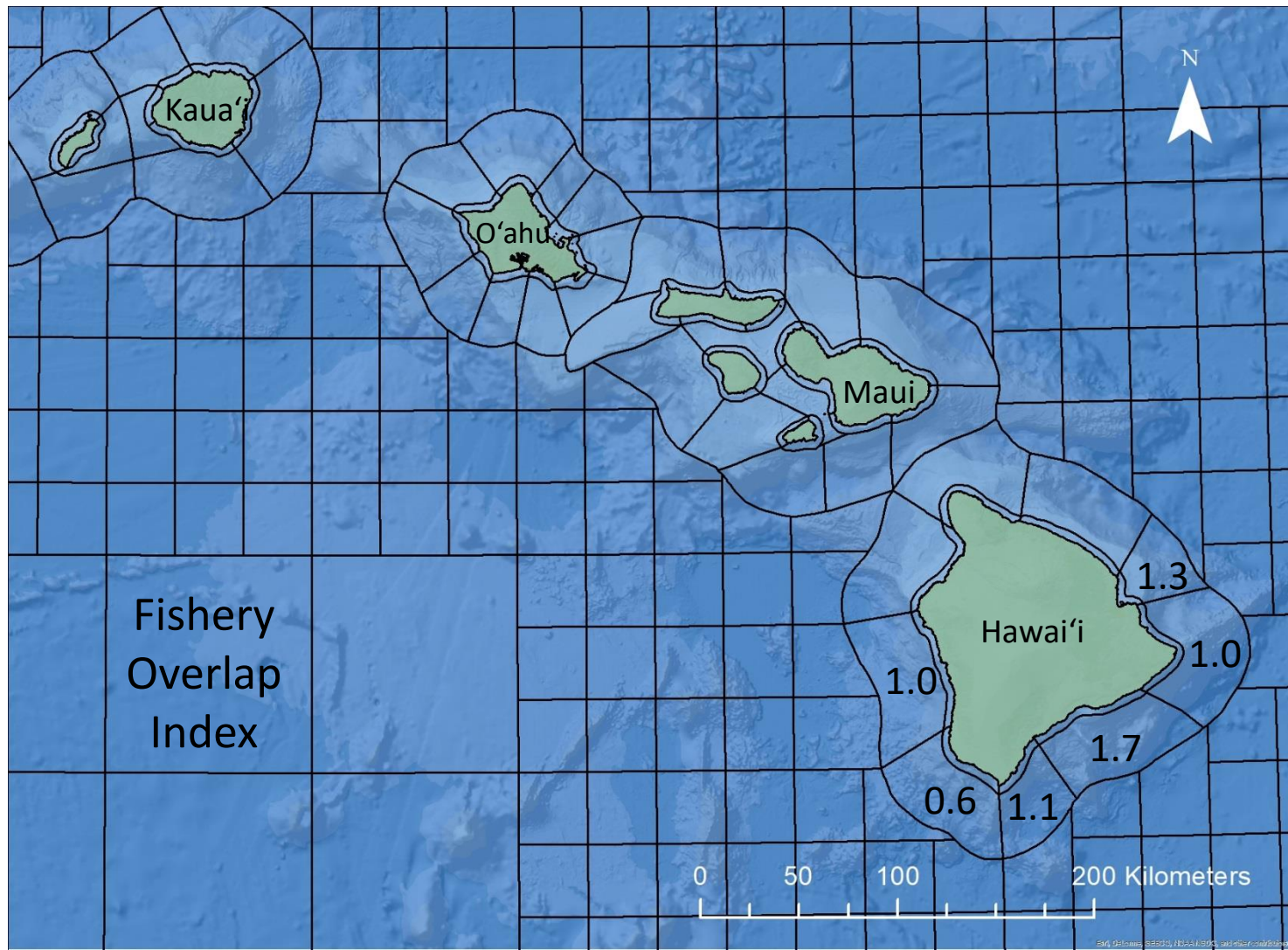
Index values scaled to Kona (west side Hawai'i Island) as it is the area with the greatest number of fishermen and greatest cumulative catch

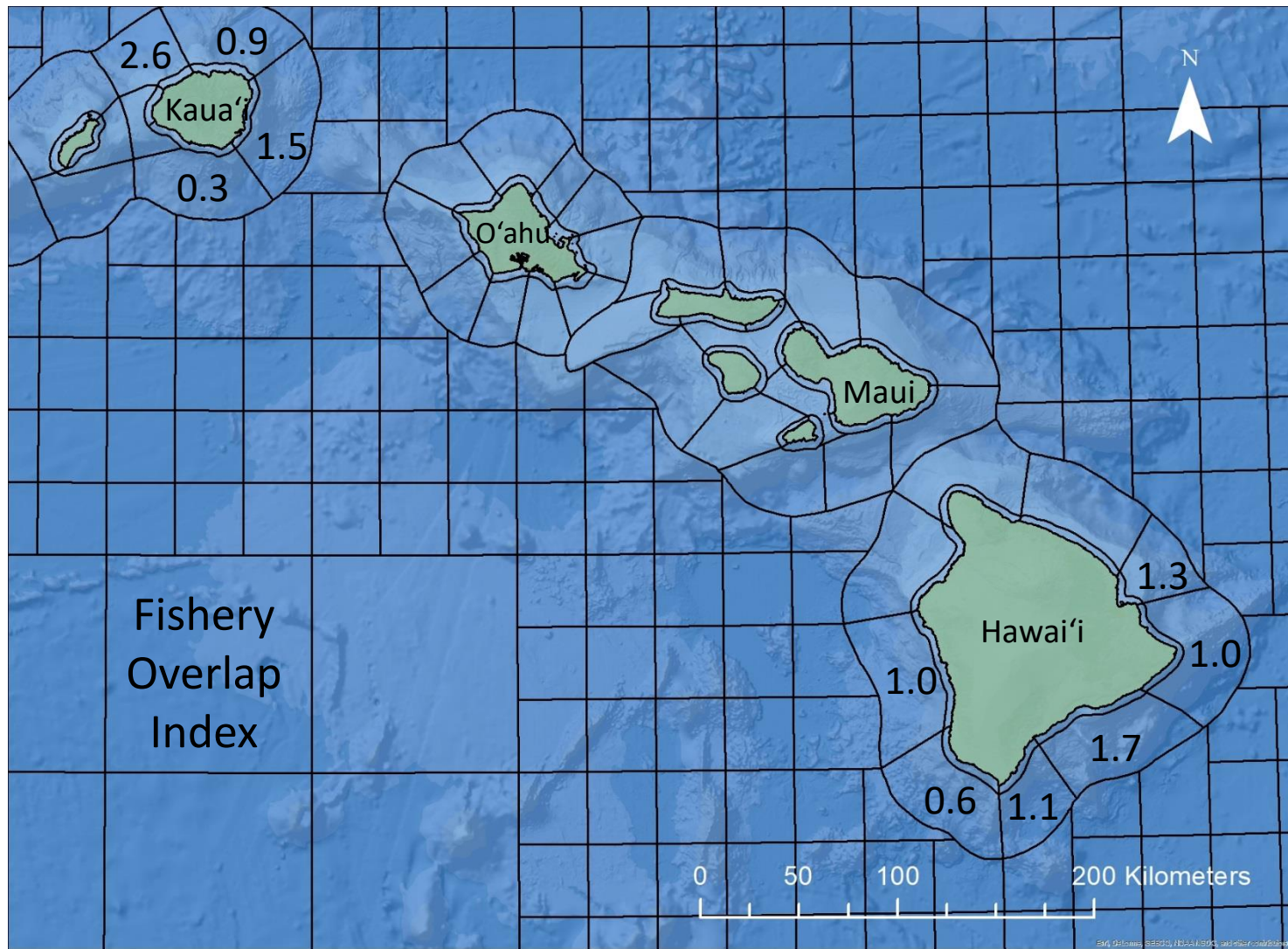
$$\text{Kona FOI} = \frac{\text{False killer whale cumulative time in zone}}{\text{Cumulative pounds of fish caught in zone}}$$

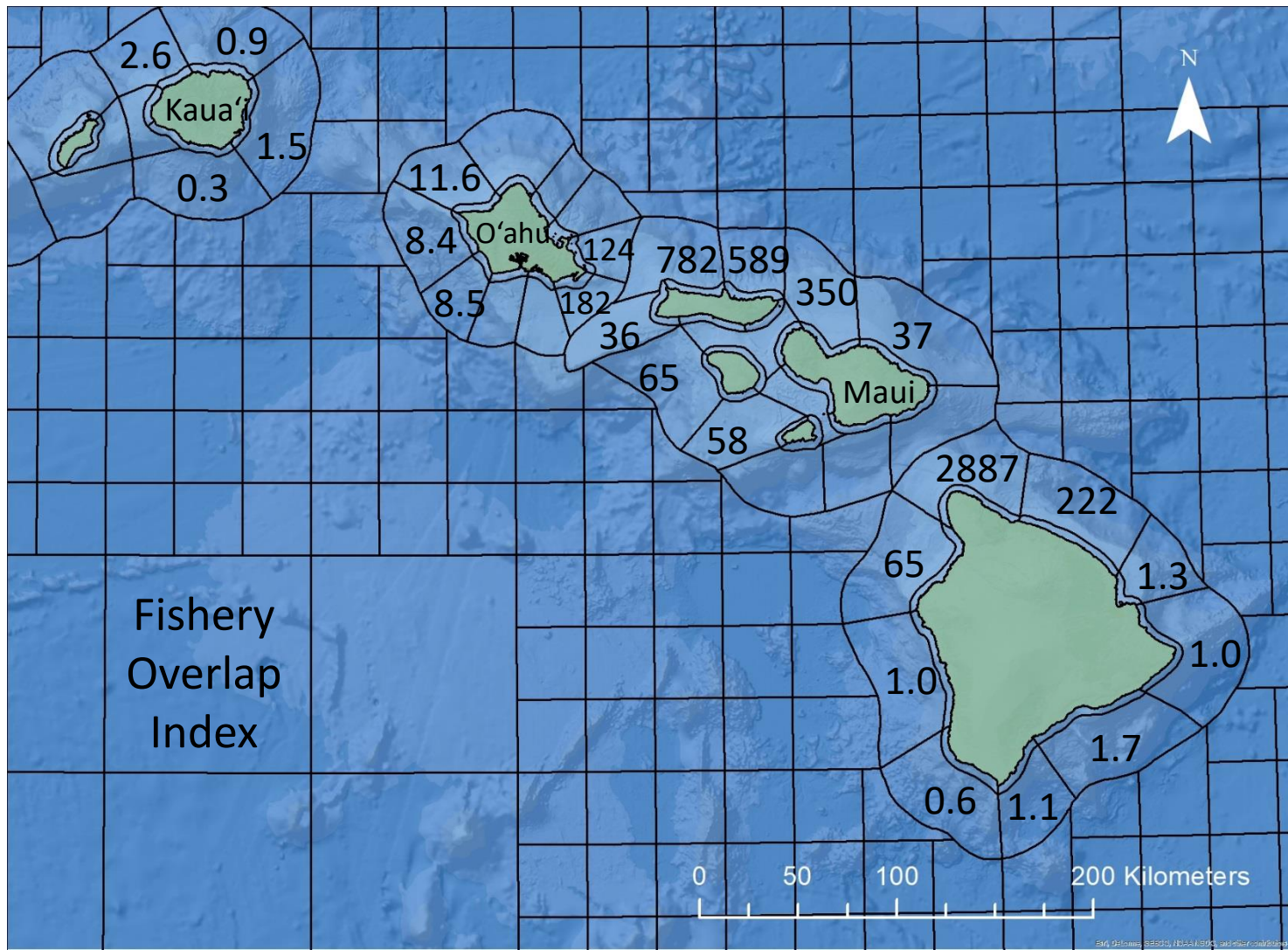
$$\text{FOI} = \frac{\text{False killer whale cumulative time in zone}}{\text{Cumulative pounds of fish caught in zone}} * \frac{1}{\text{Kona FOI}}$$



From a fishermen's perspective, this represents the likelihood of having false killer whales in your area (fishery zone) when you catch a fish (which should be related to the likelihood of depredation), relative to the likelihood if you were fishing off Kona







Sources of evidence for fisheries interactions

Observations of fishing in association with pantropical spotted dolphins



Questions being addressed:

- Spatial patterns
- Seasonality
- Estimated number of fishing vessels
- Fishing methods

Survey effort and spotted dolphin sightings from 2008-2018

Island area	No. survey days	No. effort hours	No. effort km	No. spotted dolphin sightings
Kaua‘i/Ni‘ihau	146	955	16,445	7
O‘ahu	61	418	6,943	41
Maui Nui	51	285	5,386	36
Hawai‘i	462	3,494	59,496	276

Spotted dolphin encounter duration range 1 min – 6 hr 2 min (median = 9 min)

Spotted dolphin encounters with fishing vessels present (2008-2018)

Island area	No. (%) sightings with fishing vessels present	No. of fishing vessels with groups median (range)
Kaua‘i/Ni‘ihau	0 (0)	N/A
O‘ahu	6 (14.6)	1 (1-4)
Maui Nui	1 (2.8)	1 (1)
Hawai‘i	82 (29.7)	2 (1-19)

Survey effort (2008-2018)
& spotted dolphin sightings
with no fishing vessels
present



Kawaihae
Harbor

Honokohau
Harbor
Hawai'i

Keauhou

Miloli'i

Google Earth

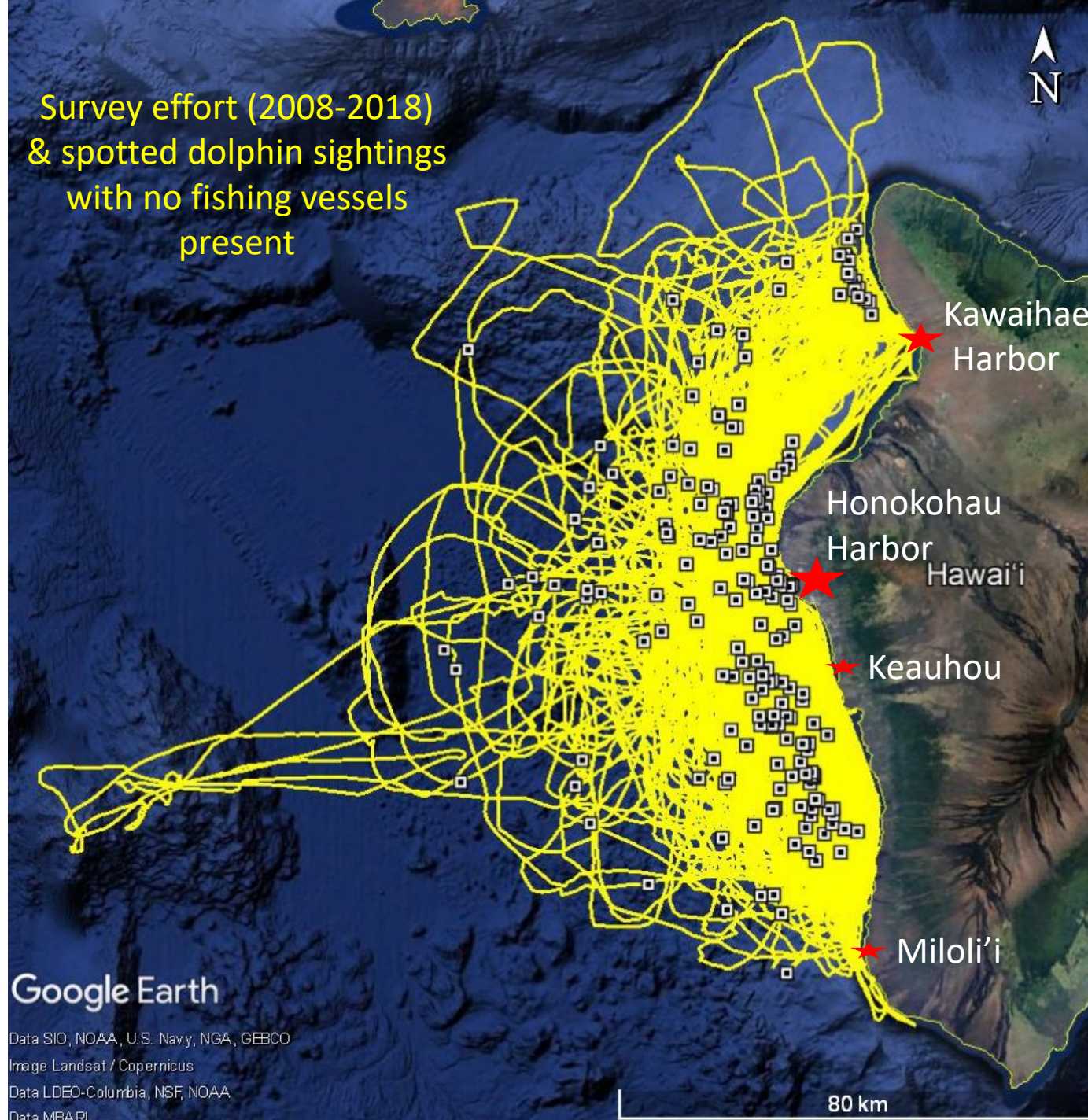
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat / Copernicus

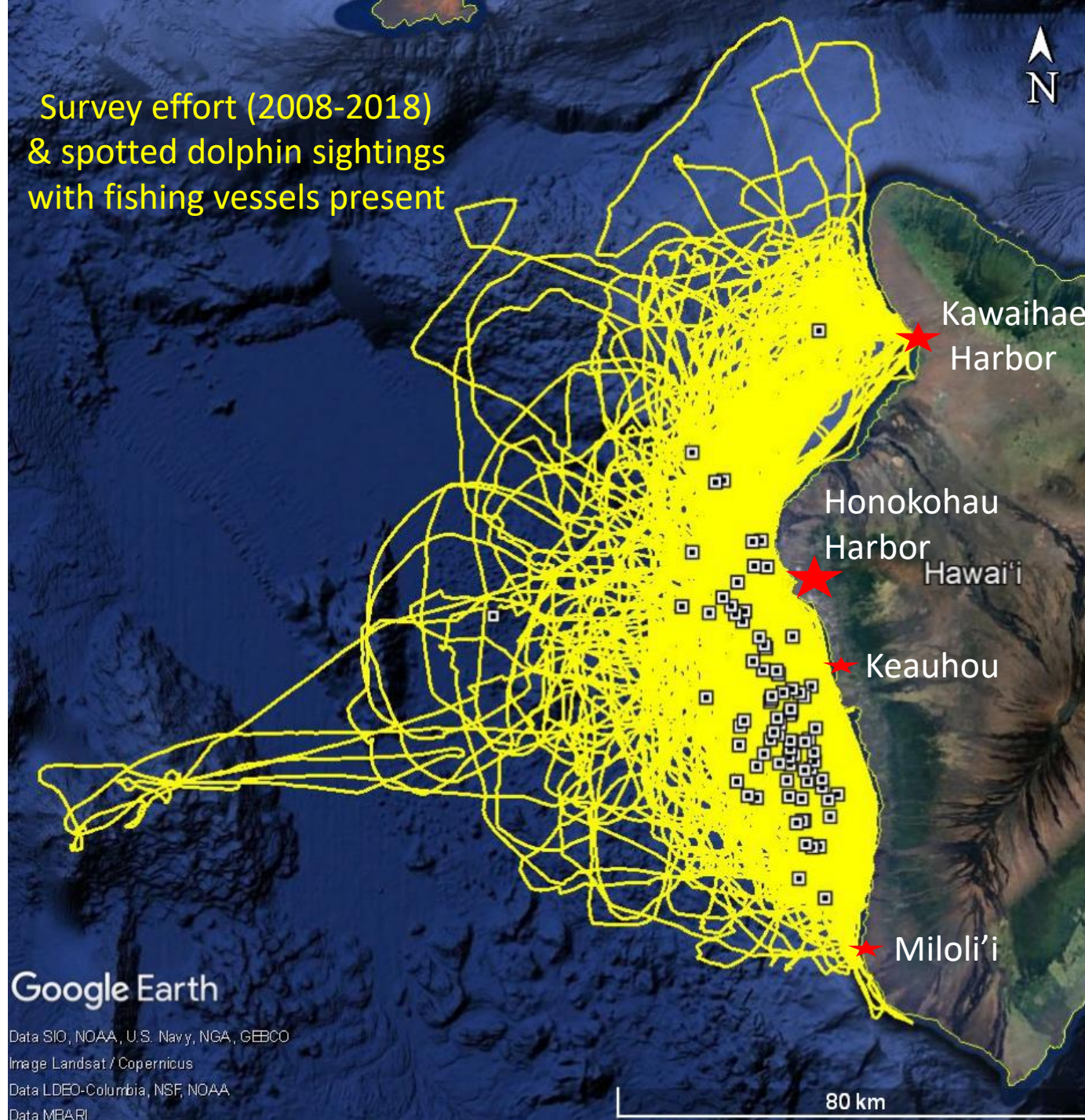
Data LDEO-Columbia, NSF, NOAA

Data MBARI

80 km



Survey effort (2008-2018)
& spotted dolphin sightings
with fishing vessels present



Seasonal variation in fishery interactions off Hawai'i Island

Quarter:

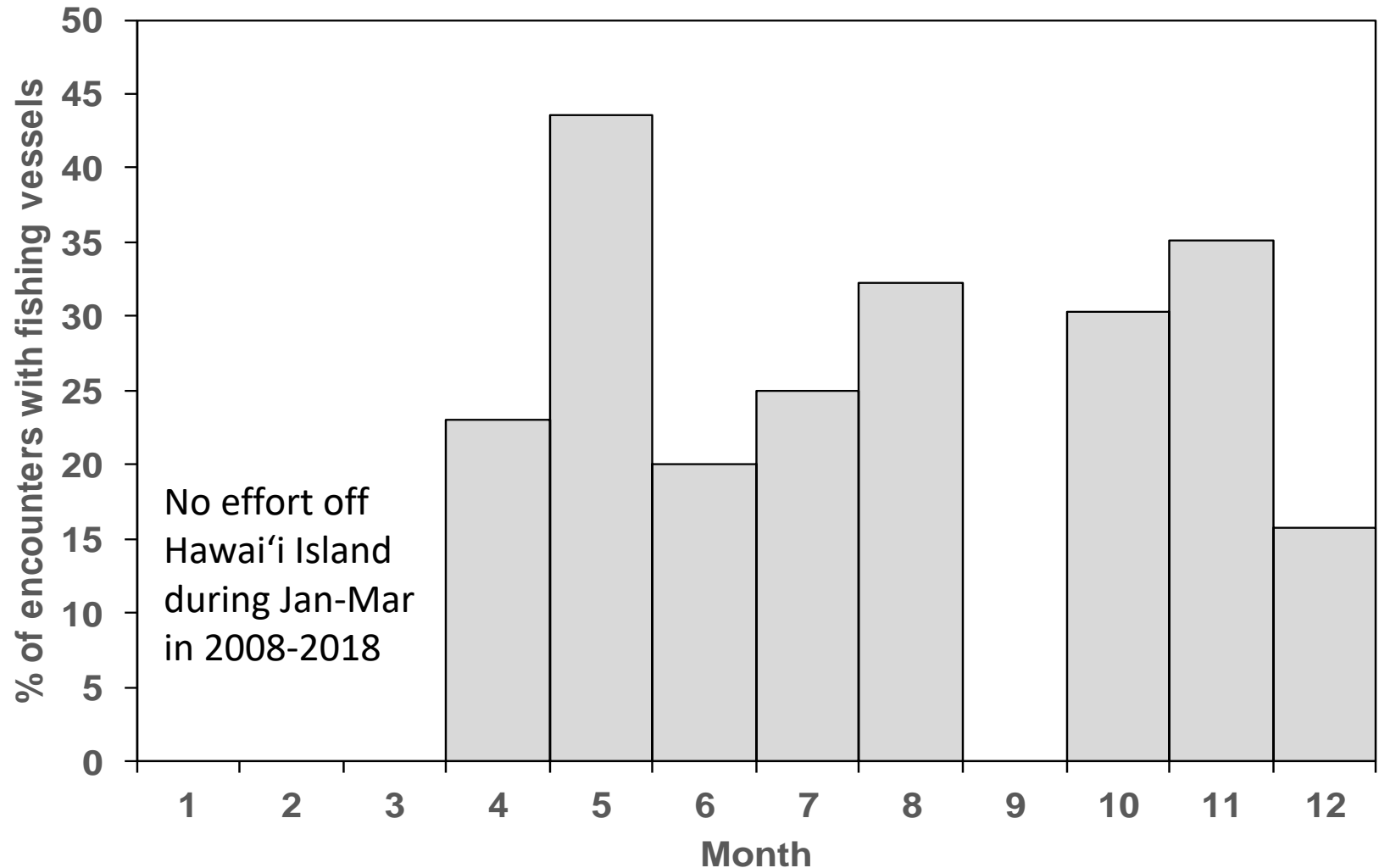
First

Second

Third

Fourth

***Mean # CMLs:** 558 (SD=73) - 764 (SD=85) - 660 (SD=100) - 479 (SD=62)



*Commercial Marine License info from PIFSC FEAT 1995-2014

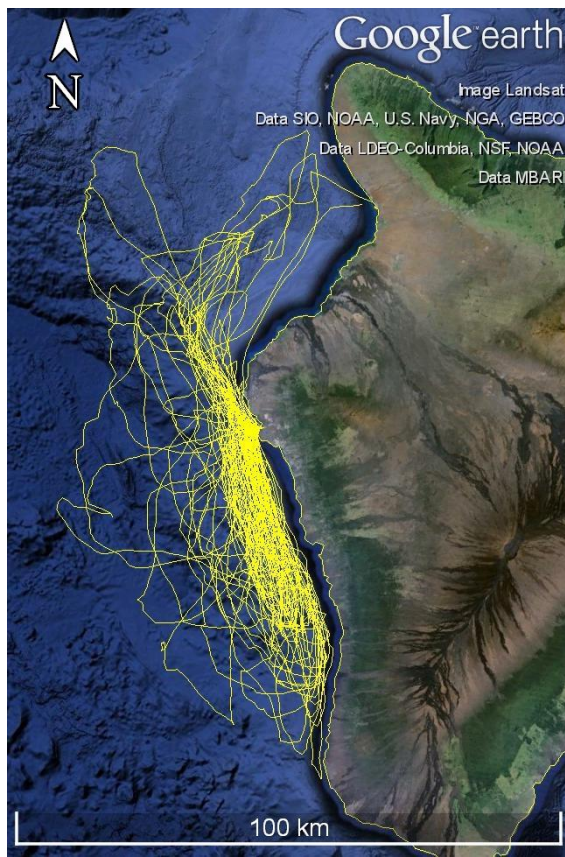
Lincoln-Petersen* estimates of # vessels fishing with spotted dolphin groups off Hawai'i Island

*Closed model, assumes no births/deaths/immigration/emigration

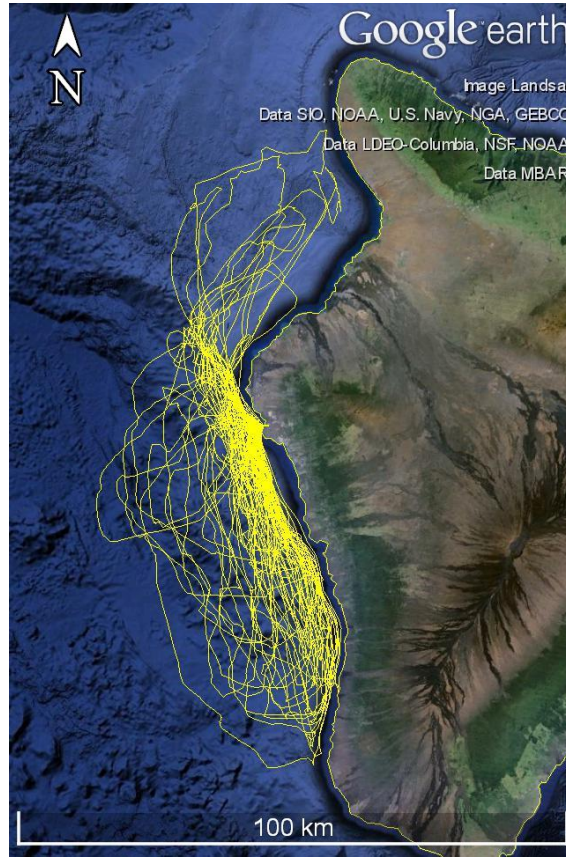
2011-2012

N=162 vessels (SD =12)

2011 effort



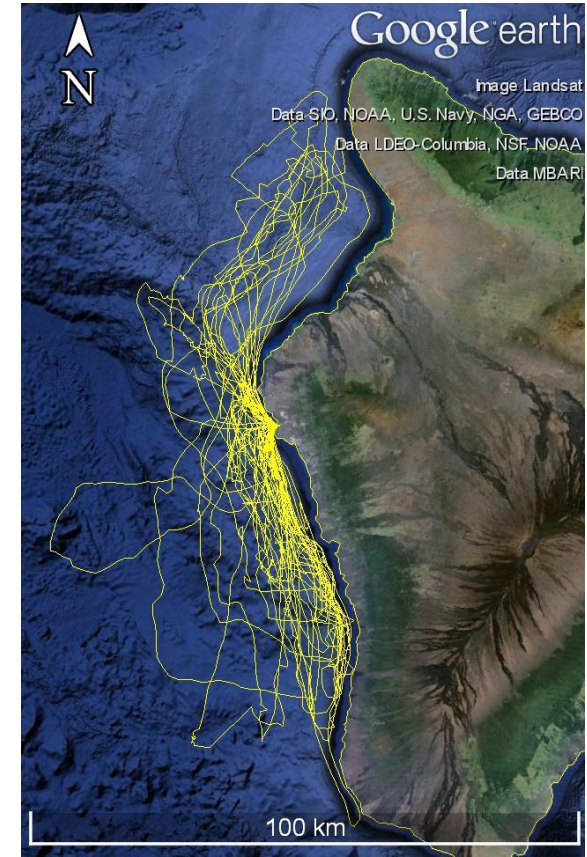
2012 effort



2012-2013

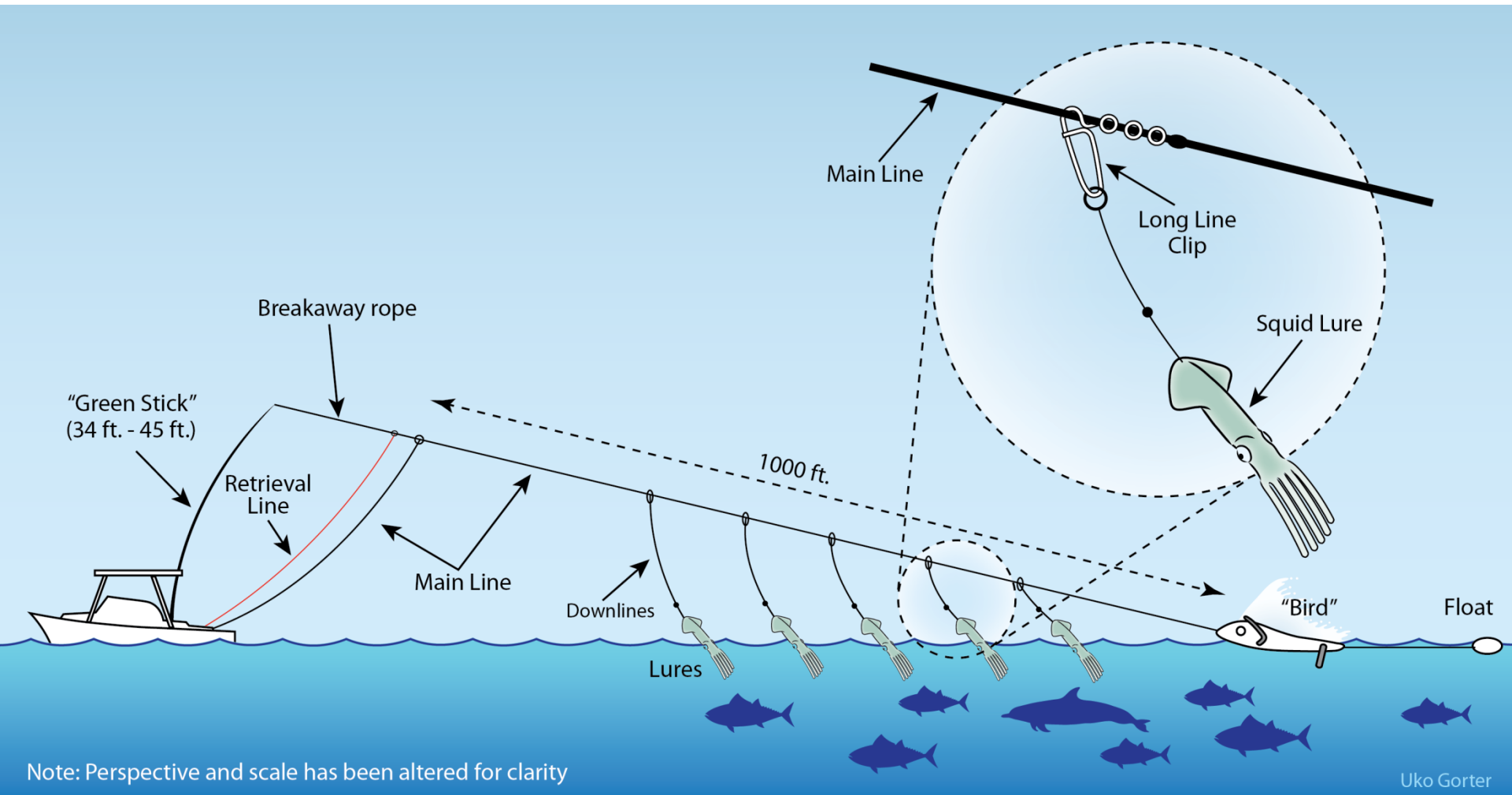
N=336 vessels (SD = 17)

2013 effort



Fishing methods with dolphins

Variety of methods (trolling through, “greenstick” fishing, re-positioning (palu ahi))



Fishing methods with dolphins

- Trolling through (including “green stick” fishing) in 22 of 24 encounters (91.7%)
- Re-positioning (palu ahi) in 13 encounters (54.2%), 12 w/trolling through
- Trolling around in three (all also w/trolling through or re-positioning)
- One encounter (4.2%) with vessel circling group but not through



What we don't know

- Bycatch rates
- Abundance estimates (except for MHI insular false killers)
- Serious injury and mortality rates

