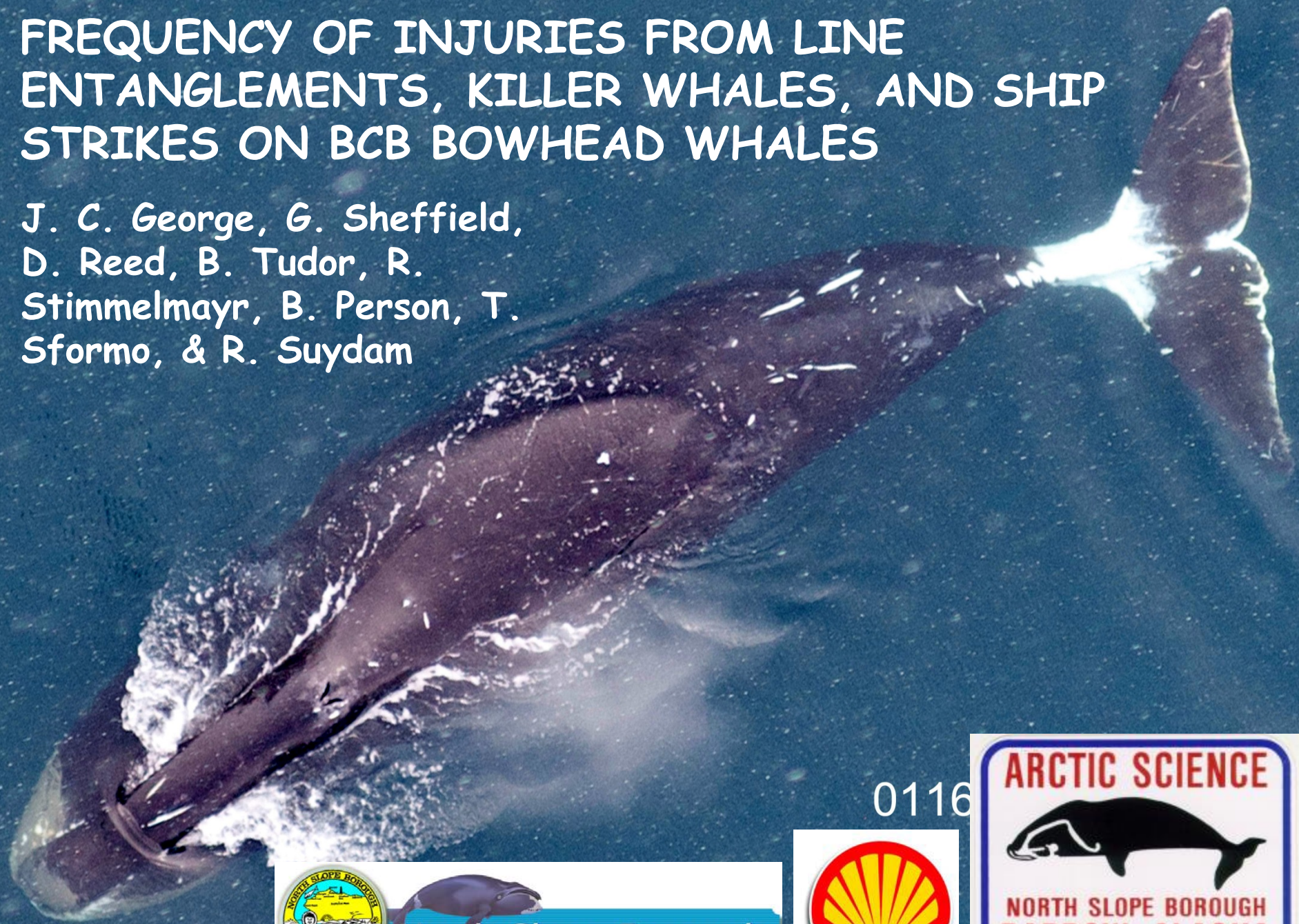


FREQUENCY OF INJURIES FROM LINE ENTANGLEMENTS, KILLER WHALES, AND SHIP STRIKES ON BCB BOWHEAD WHALES

J. C. George, G. Sheffield,
D. Reed, B. Tudor, R.
Stimmelmayer, B. Person, T.
Sformo, & R. Suydam

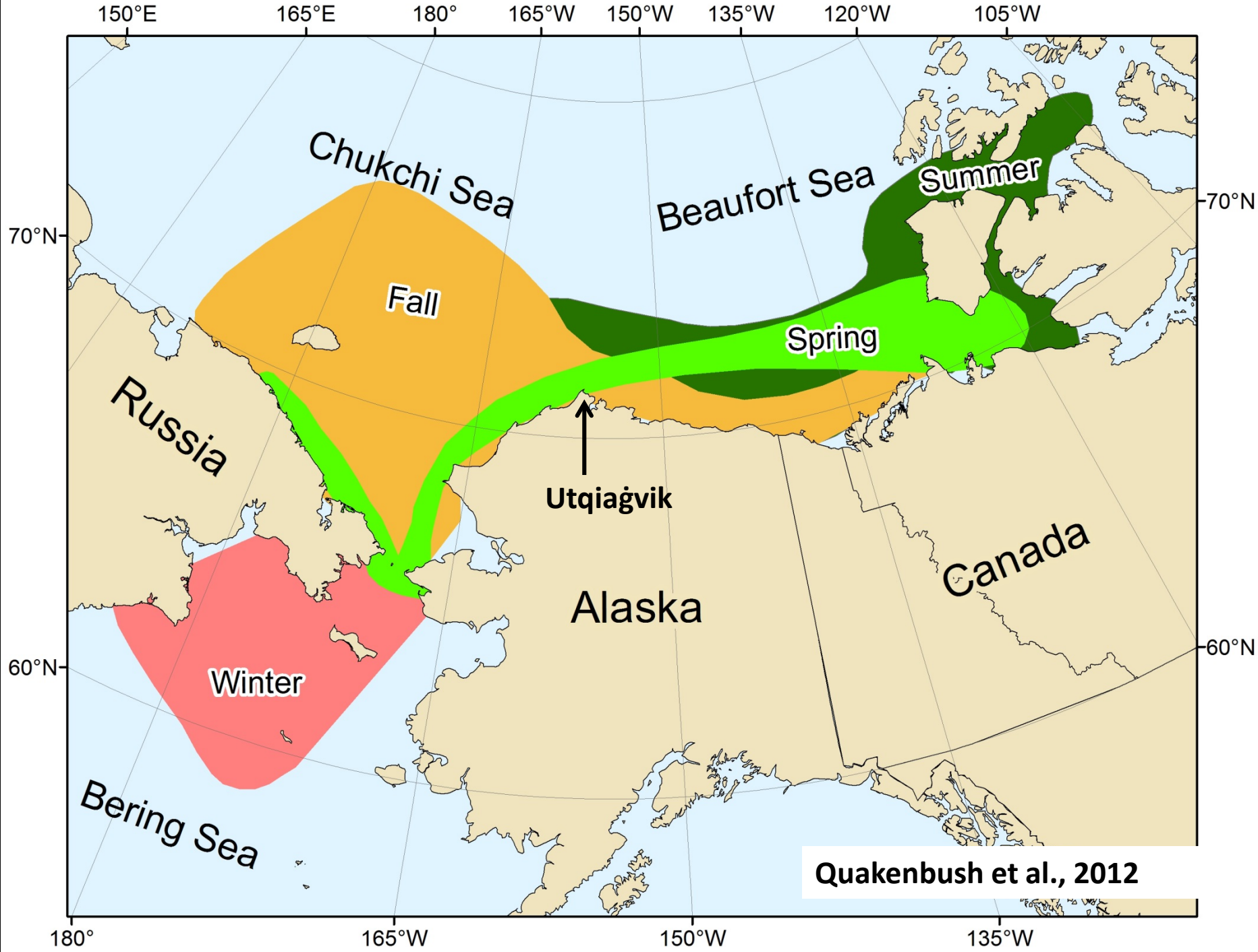


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North Slope Borough





Why study bowhead scars?

- Scarring leaves a long-term record of injuries, useful for life history, photoID abundance estimates.
- Provides means to estimate anthropogenic & killer whale injury rates & develop baseline
- World-wide fishing gear entanglement is a main source of anthro-mortality for all whales @ >300,000/year

(Read, A. J., P. Drinker, and S. Northridge. 2006. Bycatch of marine mammals in U.S. and global fisheries. *Conservation Biology*. 20:163-169.)

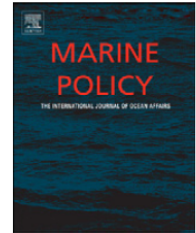


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Implications of Arctic industrial growth and strategies to mitigate future vessel and fishing gear impacts on bowhead whales

Randall Reeves^a, Cheryl Rosa^{b,1}, J.Craig George^b, Gay Sheffield^c, Michael Moore^{d,*}

^a Okapi Wildlife Associates, Hudson, Que., Canada J0P 1H0

^b Department of Wildlife Management, North Slope Borough, Barrow, AK 99723, USA

^c University of Alaska Fairbanks, Marine Advisory Program, Box 400, Nome, Alaska 99762, USA

^d Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

- Lessons learned from NA Right whales likely apply to bowheads
- Ice reduction leading to increased vessel traffic & comm. fishing further north
- Bowheads doing well but proactive management and legislation needs to start now
- Need baseline information on injury rates

OBJECTIVES (current analysis)

- 1) Calculate frequency of scars on harvested bowheads (1990-2012) from:
 - a) Line entanglements
 - b) Large vessel strikes
 - c) Killer whale attacks

- 2) Compile information on all gear types recovered from bowheads alive and dead

METHODS

- Collaborated with hunters to examine whales, identify & document whale scars and gear
- Reviewed over 1,000 records and 100s of photographs of landed whales (back to 1972)
- Tabulated ~521 records *suitable* for analysis
time period: 1990-2012
- Applied logistic regression to evaluate different covariates (length, sex, year, year-group)
- Use AIC to rank competing models

Data primarily based on examinations of landed whales in cooperation with hunters



FIELD DATA SHEET (since ~1990)

NSB DEPARTMENT OF WILDLIFE MANAGEMENT
RORHHEAD HARVEST FORM

CAPTAIN: CREW Little Eye SPECIMEN NO. 1684

SEX: M/F LENGTH: 29 ft. in 08 m Whale Type? Cal M L B

LOCATION: OFFSHORE MANILA BAY GPS (lat/long) 14°21'33" N 120°41'34" W

Date & Time Struck: 4/20/16 5:10 AM/PM Time of Prayer: AM/PM

Date & Time Landed: 4/20/16 5:10 AM/PM (when pulled to ice or shore)

Date & Time butchering begins: 4/20/16 9:57 AM/PM GPS Loc. of Butchering Site: 14°21'33" N 120°41'34" W

Date & Time butchering ends (roll call): 4/20/16 11:55 AM/PM

Examiners: W. Brown, P. Miller, D. Brown, C. G. George, T. J. Brown

SCARRING, COLORATION, ETC. (circle; ? = not sure)

Rope entangle wounds: Y N ?

Killer whale bites: Y N ?

Ship strike: Y N ?

White at base of flipper: Y N ?

White around eye: Y N ? (score)

White on genital slit: Y N ? (score)

White streak on baleen: Y N ? (score)

MALE Nipples: Y N ?

Description of markings, baleen, lesions, scars, etc. *Take photos!*
a few small scars, nothing that would be detectable from dorsal photos

Chin Patch: lateral 0 cm max. ventral 23 cm

White score:
1 = salt-pepper
2 = whitish
3 = white paint

Length of white on peduncle: 0 cm (score)

Whale lice (ectoparasite): Examined Y/N Present Y/N Approx. #

Describe location, numbers, etc.: Frozen # Ethanol #

PHOTOGRAPHY: (Y/N?) Photographer Name: W. Brown, P. Miller, D. Brown, C. G. George, T. J. Brown (whichever form was used)

GENERAL REMARKS: general obs. of whale, comments from whalers, whale behavior, weather and sea conditions, etc. 10:02 surface
under eye = 2.5"

SCARRING, COLORATION, ETC. (circle; ? = not sure)

Rope entangle wounds: Y N ?

Killer whale bites: Y N ?

Ship strike: Y N ?

White at base of flipper: Y N ?

White around eye: Y N ? (score)

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Kontrollieren Sie die...
Kriterien...
Schüler

RESULTS

LINE ENTANGLEMENT SCARS

- Body length and Gender (M>F) explained most variation in data
- ~50% of landed whales \geq 17 m showed entanglement scars
- Rare on small whales
- Most injuries to peduncle, flukes and axilla

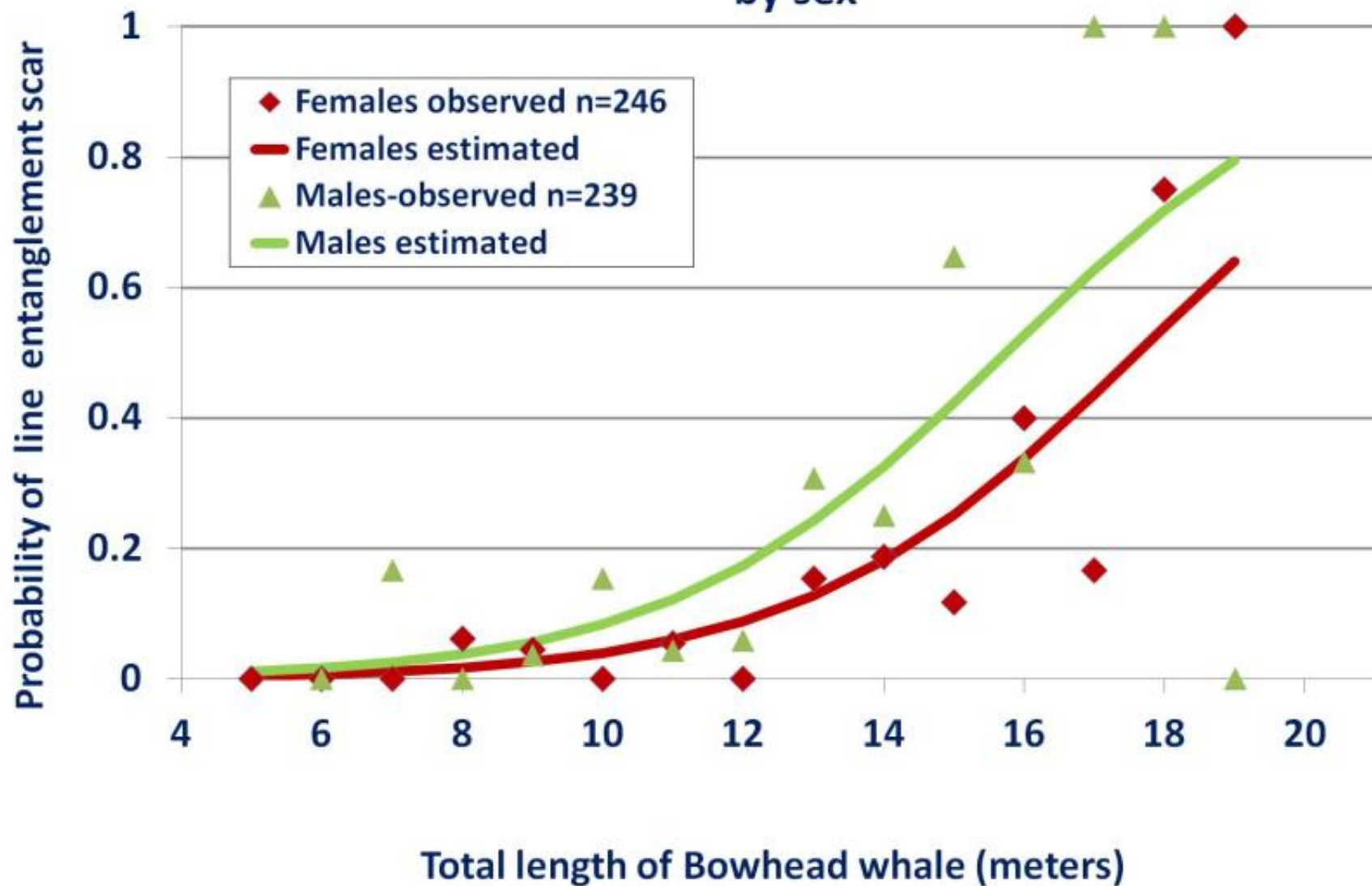
Examples of entanglement scars



Captain Ruben Aiken, 36 ft, male; 5 May 2017, (whale 17B6)



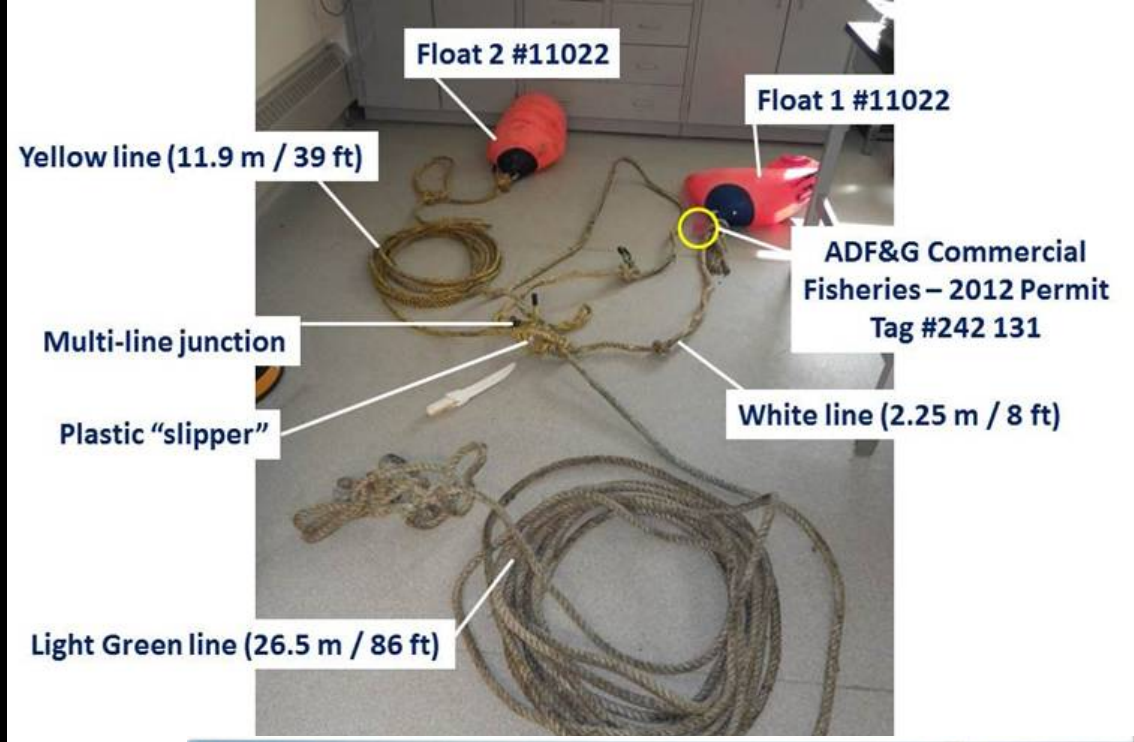
Bowhead length vs. probability of line entanglement scars by sex



WHALES WITH GEAR ATTACHED

- 15 reports of bowheads entangled (1980-2015)
 - 7 stranded dead
 - 8 observed free-swimming
- At least three strandings had confirmed commercial pot gear (one confirmed crab gear)
- 2 harvested in 2017

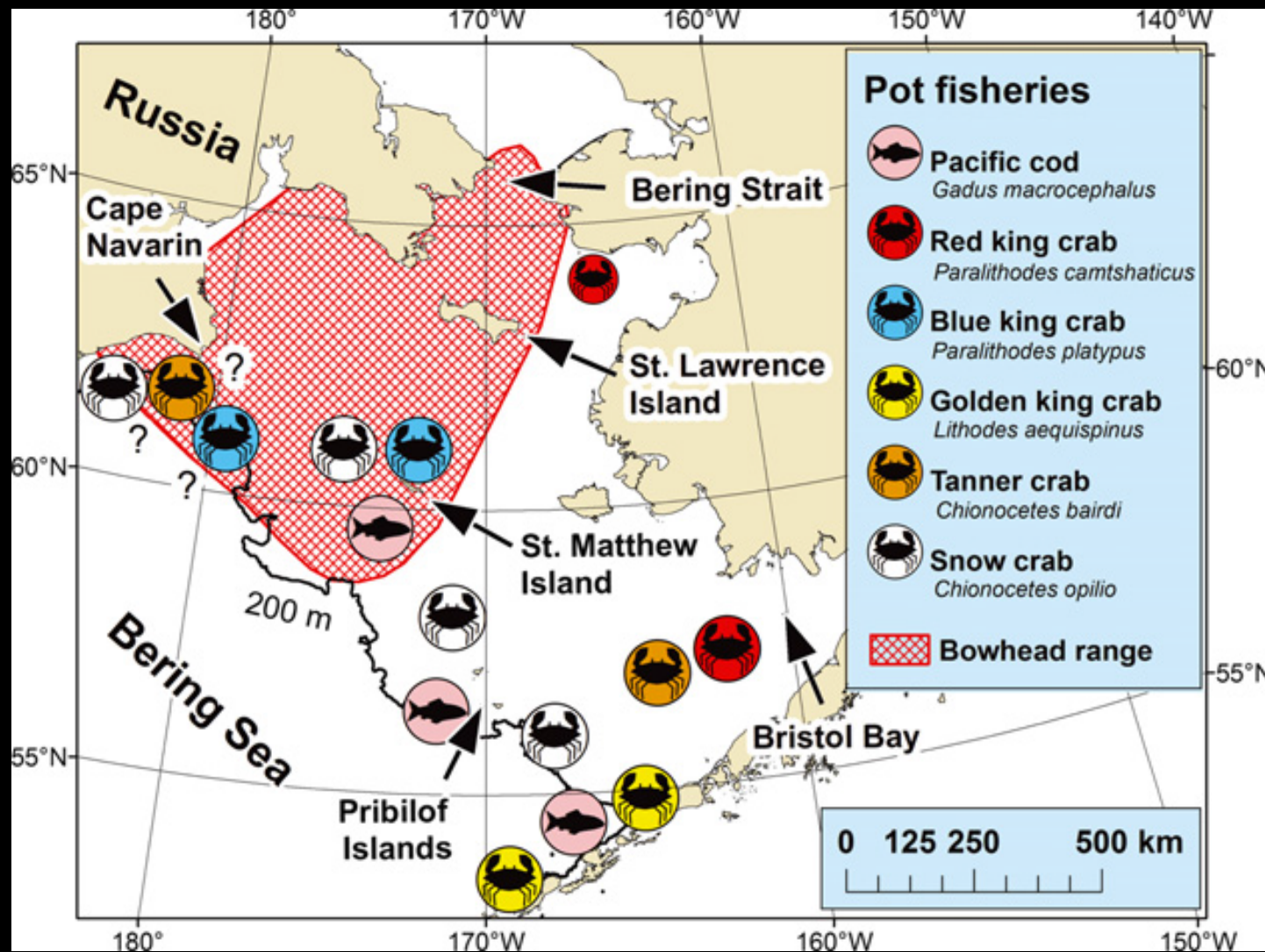
2015 Stranding at SLI



Commercial crab fishery gear recovered from bowhead near Saint Lawrence Island. July 2015. Deployed 2012 by Crabber "Saga"



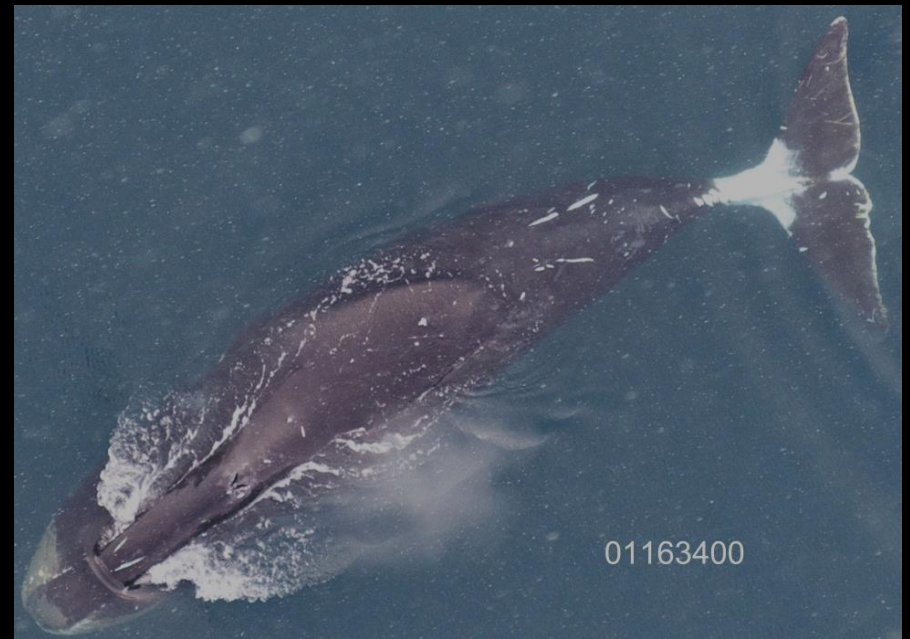
Citta et al., 2013. Potential for bowhead whale entanglement in cod and crab pot gear in the Bering Sea. MMSci.



Inter-year matches were used to estimate scar acquisition rates



1985



2011



Givens Statistical Solutions
Data Analysis and Modeling for Scientists

Entanglement Scar Acquisition Rates for Bowhead Whales

From Interyear Photo-ID Matches

J. Craig George¹, Barbara Tudor¹, and Geof Givens²



¹North Slope Borough Department of Wildlife Management, P.O. Box 69, Barrow, Alaska 99723 ²Givens Statistical Solutions, LLC, 4913 Hinsdale Drive, Fort Collins CO 80526

Background

Aerial photo surveys provide a broad range of information for analyses ranging from abundance estimates, to calving rates, to injury assessment. Bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort Sea (BCBS) stock overwintering in the Bering Sea overlap spatially with commercial crab/fishing operations. George *et al.*, (2017) found 12.2% of the landed whales carry entanglement injuries, mainly on large older animals. An analysis of aerial photos (n = 693) from the 2011 spring survey near Utqiagvik, Alaska, indicated that 12.6% (n = 87) show evidence of entanglement scarring, closely matching the estimates for harvested whales. The mortality rate is unknown, but 10 whales have been found dead or severely entangled in pot gear from 1983 to 2015. Using interyear photo-recaptures of the same individuals, this study estimated the rate at which bowhead whales acquire entanglement scars.

Methods

We assessed inter-year matches (n = 117) from a multi-year (1985, 1986, 2003, 2004, 2005, and 2011) mark-recapture study (Givens *et al.*, 2017) for adequate photo quality of the caudal peduncle. To determine an entanglement rate, we examined the interyear matches with adequate photo quality (n = 117) during the study period, i.e., between the



Aerial images of an inter-year match photographed in 1985 without entanglement scarring



Entanglement Rope injury against the appear on flukes but pectoral fin



Entanglement scar on caudal peduncle. This is an example of an entanglement scar.

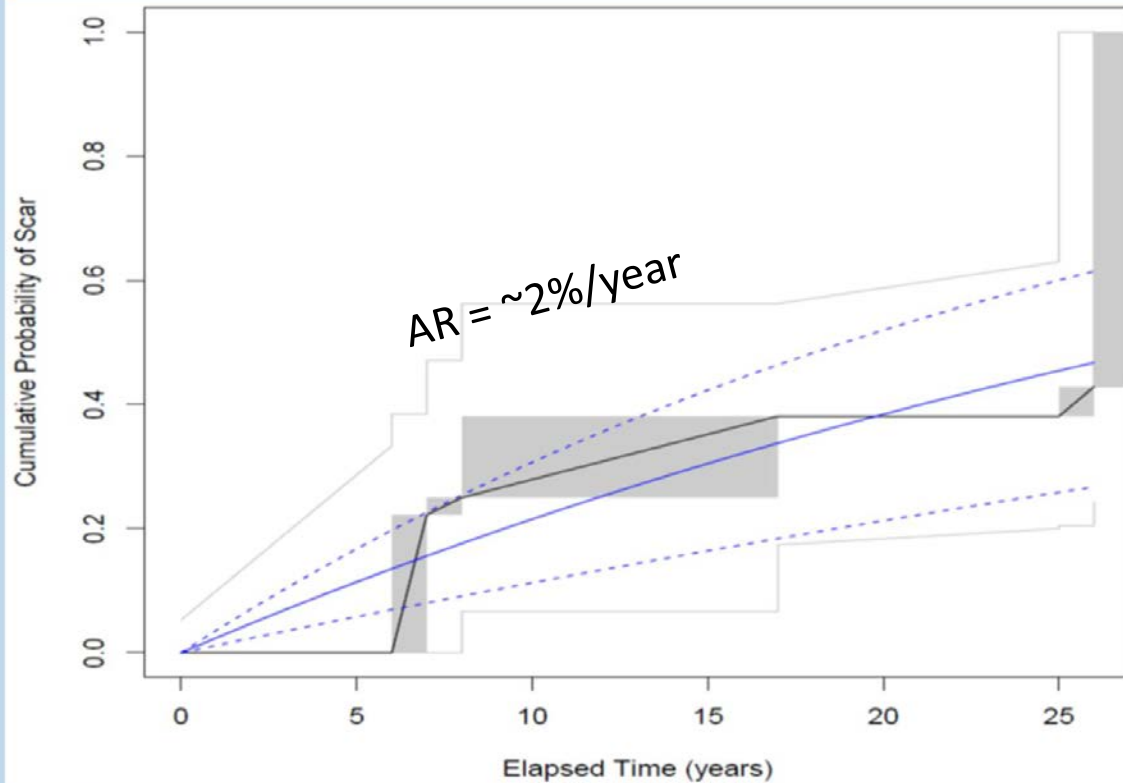


Entanglement scar on caudal peduncle.

Example of commercial fishing gear found on an entangled bowhead in the Bering Strait Region in 2015.



Example of commercial fishing gear found on an entangled bowhead in the Bering Strait Region in 2015.



of estimated probability of an entanglement the elapsed number lack and gray lines interval censored analysis: black line is curve, faint gray 95% confidence shaded boxes are ate regions due to pling 'granularity', lines are the curve (solid) and (dotted) for the analysis.

ary using two tial model. Both ibility of acquiring a ese estimates agree harvested whales s >50 years carried ively high rate ations of harvested concern for BCBS ; of entanglement vested whales.

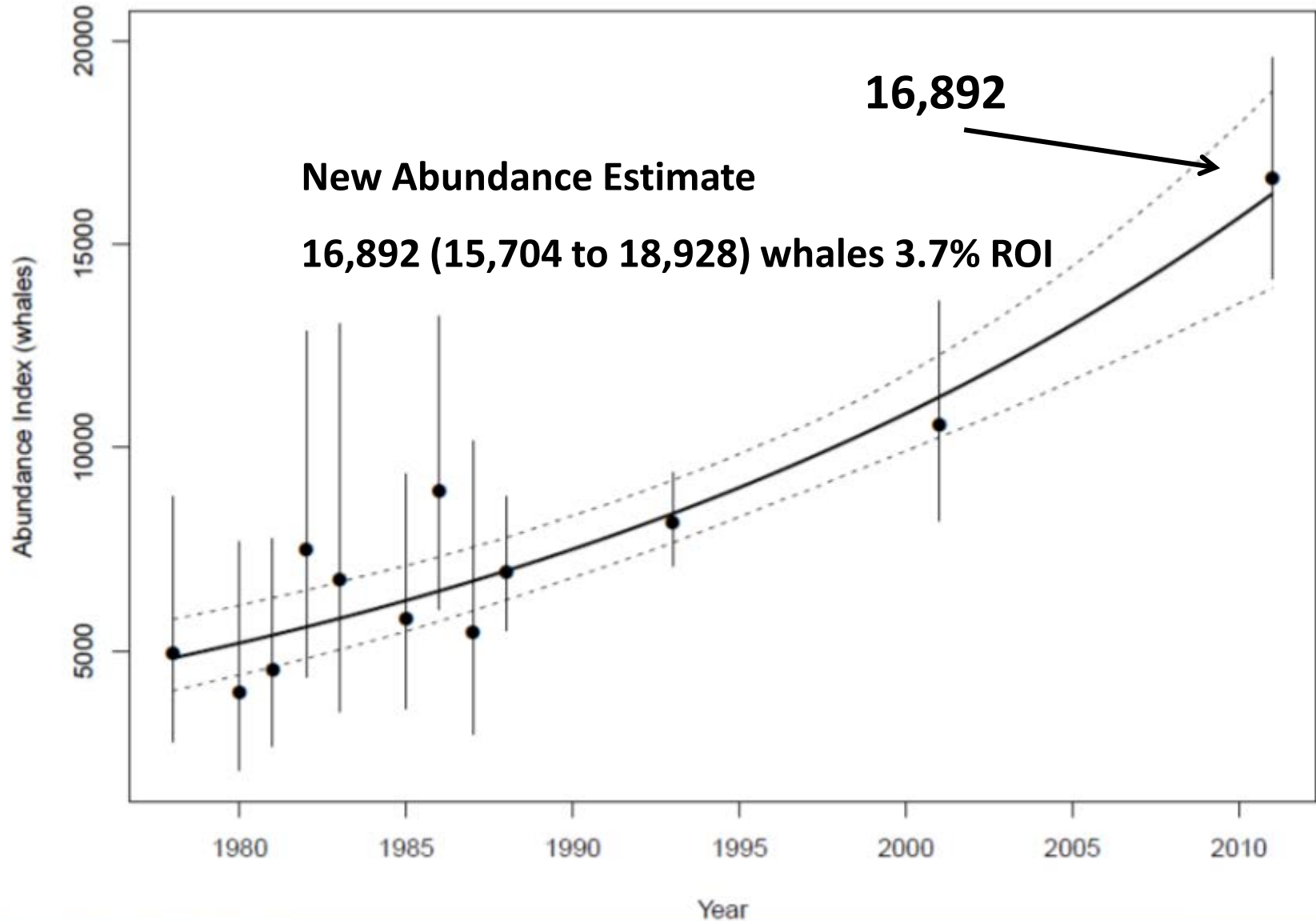
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References

- George, J.C., Sheffield, G., Reed, D.J., Tudor, B. and Suydam, R. 2017. Frequency of Injuries from Line Entanglements, Killer Whales, and Ship Strikes on Bering-Chukchi-Beaufort Seas Bowhead Whales. *Arctic* 70(1): 37–46.
- George, J.C., Tudor, B., Givens, G.H., Mocklin, J., Vate Brattström, L. 2017. Initial Investigations of Bowhead Whale Entanglement Scar Frequency and Acquisition Rates via Aerial Photography. Paper SC/67.A/HIM presented to IWC Scientific Committee May 2017 (unpublished). 14 pp.

Photo credits: NOAA, Marine Mammal Laboratory, Seattle, WA; Lgl Limited, King City, Ontario, Canada; NSB Department of Wildlife Management, Box 69, Utqiagvik, Alaska 99723; Cay Sheffield, Alaska Sea Grant, University of Alaska Fairbanks, Fouch 400, Nome, Alaska 99762
Permits: Aerial surveys: NMFS Permits 782-1719 and 14245 issued to NMML. Examinations of harvested whales: NMFS Permits 814-1899-01, 814-1899-02, 17350-00, and 17350-01 issued to North Slope Borough.

BOWHEAD POPULATION SIZE



SHIP STRIKES

- Low occurrence for BCB bowhead whales (good news)
- Established a robust baseline to measure change



EXAMPLES OF SHIP INJURIES

2004 Barrow



1978 Pt. Hope

2010 Gambell



1987 Wainwright

Summary

1. Hunters provided key information.
2. Entanglement scars more freq. on large older whales; more freq. on males
3. Entanglement not interfering with BCB recovery, but needs to be addressed.
4. Bering Sea Crab Association interested in engaging on entanglement issues w AEWG
5. Ship strikes appear to be at low levels - keep it that way
6. Long-term baseline for measuring change

FUTURE WORK & CONCERNS

- Refine estimates of scar acquisition rates: what do these data tell us?
- Estimate entanglement rates using independent aerial photo-ID data
- Engage with commercial fishing industry re awareness and potential solutions to entanglement
- Prepare and distribute educational materials on identifying / reporting scar types

Acknowledgements

- Alaska Eskimo Whaling Commission member communities; Barrow Whaling Captains Association, NMFS Marine Mammal Lab
- Many, many, many field biologists/examiners
- DWM Director Taqulik Hepa and NSB Mayor Harry K. Brower Jr. and former Mayors
- Funding: North Slope Borough, NSB-Shell Baseline Studies Program, UAF Marine Advisory Program





Quyanaqpak!