

# ENTANGLEMENT SEVERITY RELATED TO ROPE CHARACTERISTICS FOR NORTH ATLANTIC RIGHT WHALES

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# Dynamics of Large Whale Entanglements – Case Studies

## Objectives

- Create detailed case studies for each entanglement event for which we have retrieved gear, a clear understanding of the configuration, and information on the resulting scars
- Identify the characteristics of fishing gear that cause severe and fatal entanglement risk to whales
- Integrate rope data, life history information, and whale behavior into a realistic animated model to provide a stronger scientific basis for evaluating the impact of existing, proposed, and future potential fishing methods to whales

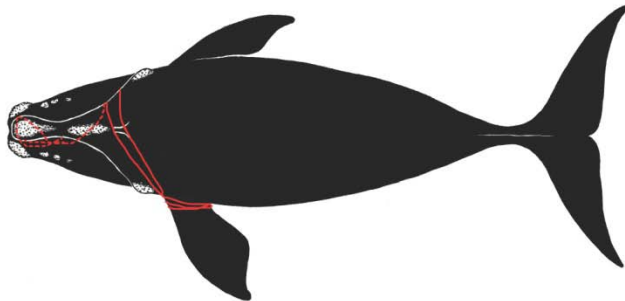
# Criteria for case studies

- ⦿ A disentanglement responder team or a necropsy team was able to document how ropes and other gear were attached to the animal;
- ⦿ Fishing gear was retrieved and warehoused by NOAA/NMFS;
- ⦿ A relatively good understanding exists of some or all the injuries produced by entangling ropes (from images, video or assessments made by disentanglers).

# CASE STUDIES

Species	Right Whale	Whale ID	Eg #2301
Date First Observed	6 Sept. 2004		
Sex	Female	Birth Year	1993
		Age at entanglement	11

Case Study ID	POCS WR-2001-21	NMFS E20-04	GEAR ID J090604 a-c
Gear Sample Collected?	Yes	Gear Type	Unknown



Reproductive prior to entanglement detection?	Yes
Reproductive after entanglement detection?	No
Wound severity	Mouth: None, Head/Rostrum: High, Flippers: High, Body: Medium, Flukes: Medium
Duration of time carrying gear	Minimum 178 days, maximum 531 days
Disentangled?	No
Status	Dead 3 Mar 2005
Number of prior entanglement interactions	3

Entanglement Configuration	Line wrapping over head from right mouthline to left flipper wraps; line essentially cleated from baleen on right to flipper on left.		
Anchoring Point(s)	Mouthline, flipper		
Gear Configuration Confidence	Moderate		
Remaining Questions	The extent of wrapping at left flipper unknown; bitter ends cannot be accounted for and unclear if any line was trailing.		
Comments	Extensive weaving of line through baleen was documented at necropsy.		
Polymer Type	PP	PP/PET	PP/PET
Gear Component			
Rope Diameter (inches)	3/8 (0.394)	1/2 (0.472)	7/16 (0.425)
Breaking Tested	486	900	700
Strength (lbs)	New	2 430	4 500
			3 500

Completed for  
18 right whales and  
22 humpback  
whales

1995-2006



06 Sept 2004 - NEA



04 Mar 2005 - WHOI



06 Sept 2004 - NEA



04 Mar 2005 - WHOI



04 Mar 2005 - WHOI



04 Mar 2005 - WHOI

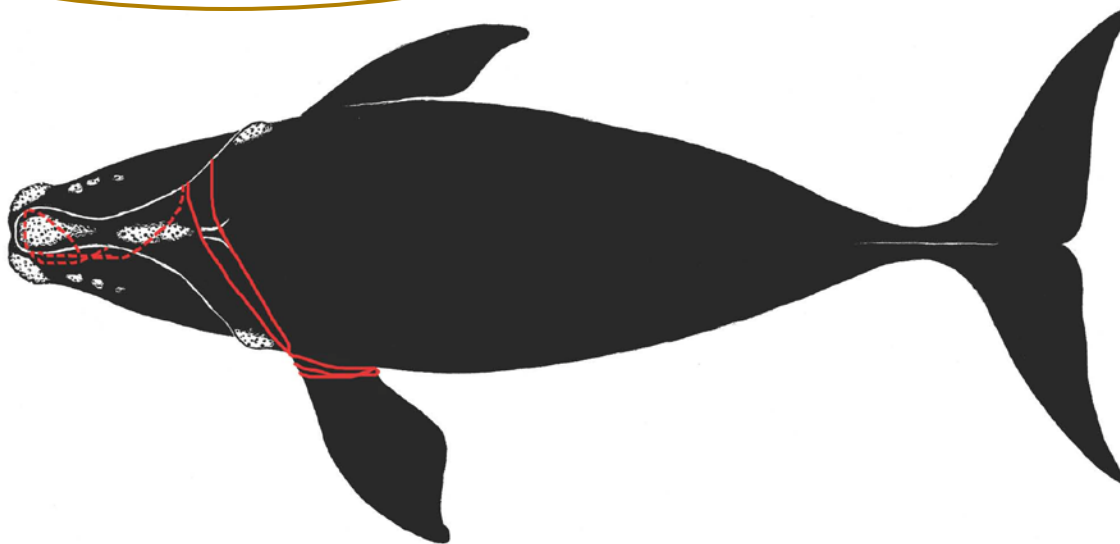


# LIFE HISTORY INFORMATION

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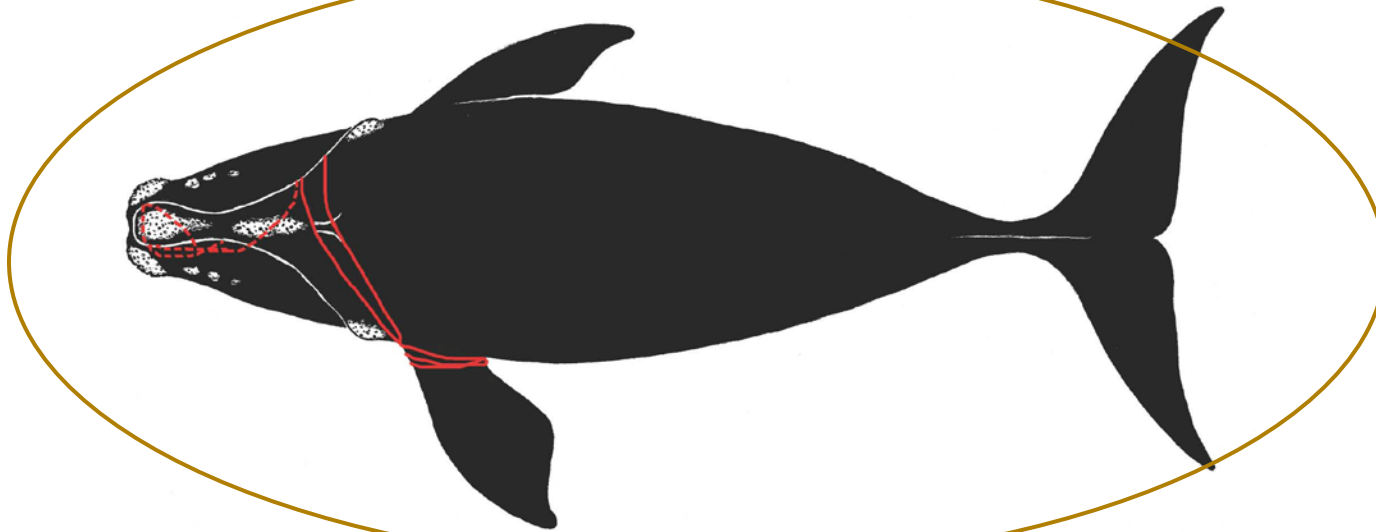
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# DETAILED GEAR CONFIGURATION DRAWING AND RELATED INFORMATION

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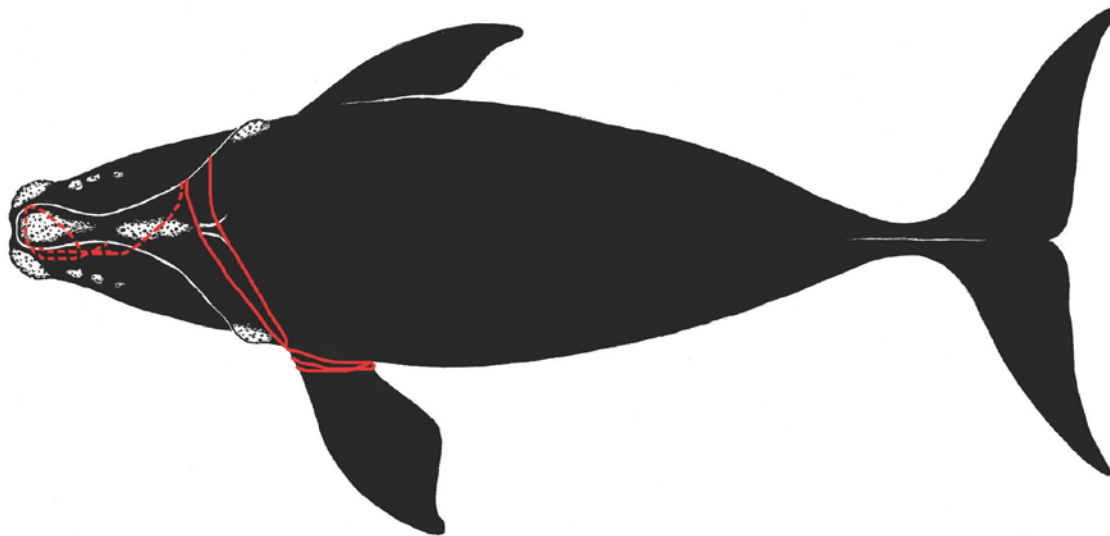


# WOUND SEVERITY, ENTANGLEMENT DURATION, DISENTANGLEMENT EFFORT, AND ANIMAL'S STATUS

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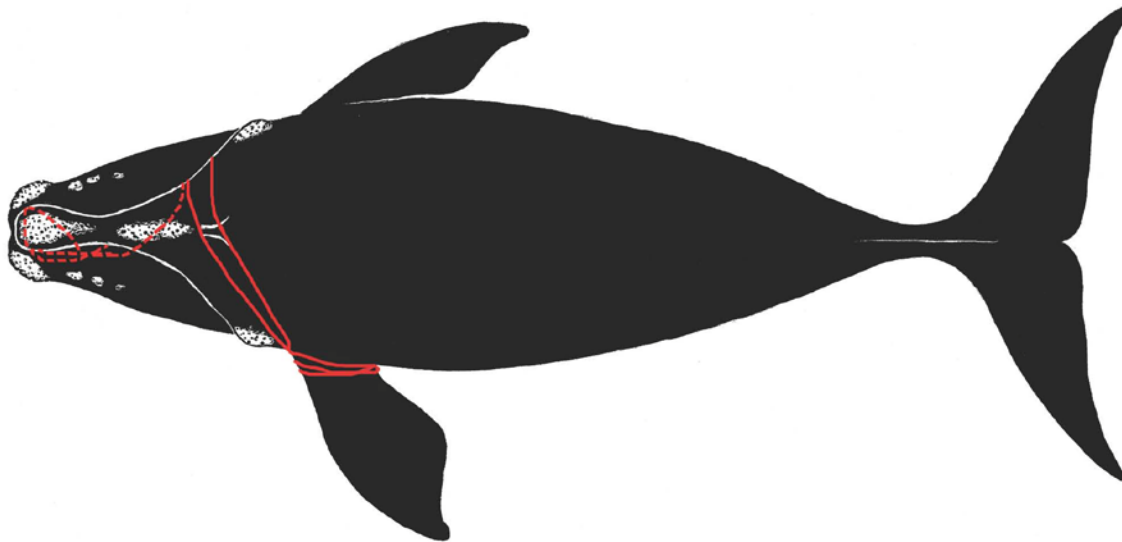
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# Rope polymer, breaking strength, and diameter of retrieved gear

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# IMAGE PAGE OF ENTANGLEMENT AND RETRIEVED GEAR



06 Sept 2004 - NEA



06 Sept 2004 - NEA



04 Mar 2005 - WHOI



04 Mar 2005 - WHOI



04 Mar 2005 - WHOI



04 Mar 2005 - WHOI



# Right whale analysis of case study data

## Methods

- **Whale analysis**
  - Assessed 18 events of retrieved gear: 4 from carcasses, 14 from animals alive at the time
  - Wound severity: low, medium, or high

# Low severity

Skin abrasions that do not appear to extend into the blubber or cartilage





# Medium severity

Broad areas of abrasion, and/or injuries that extend into blubber but do not penetrate muscle, and/or lacerations on appendages that extend beyond the skin but have a total estimated depth of less than 8cm



Flipper



# High severity

injuries extending into muscle or bone, and/or appendage lacerations >8cm in depth, and/or significant deformity



# Methods

## ■ Whale analysis

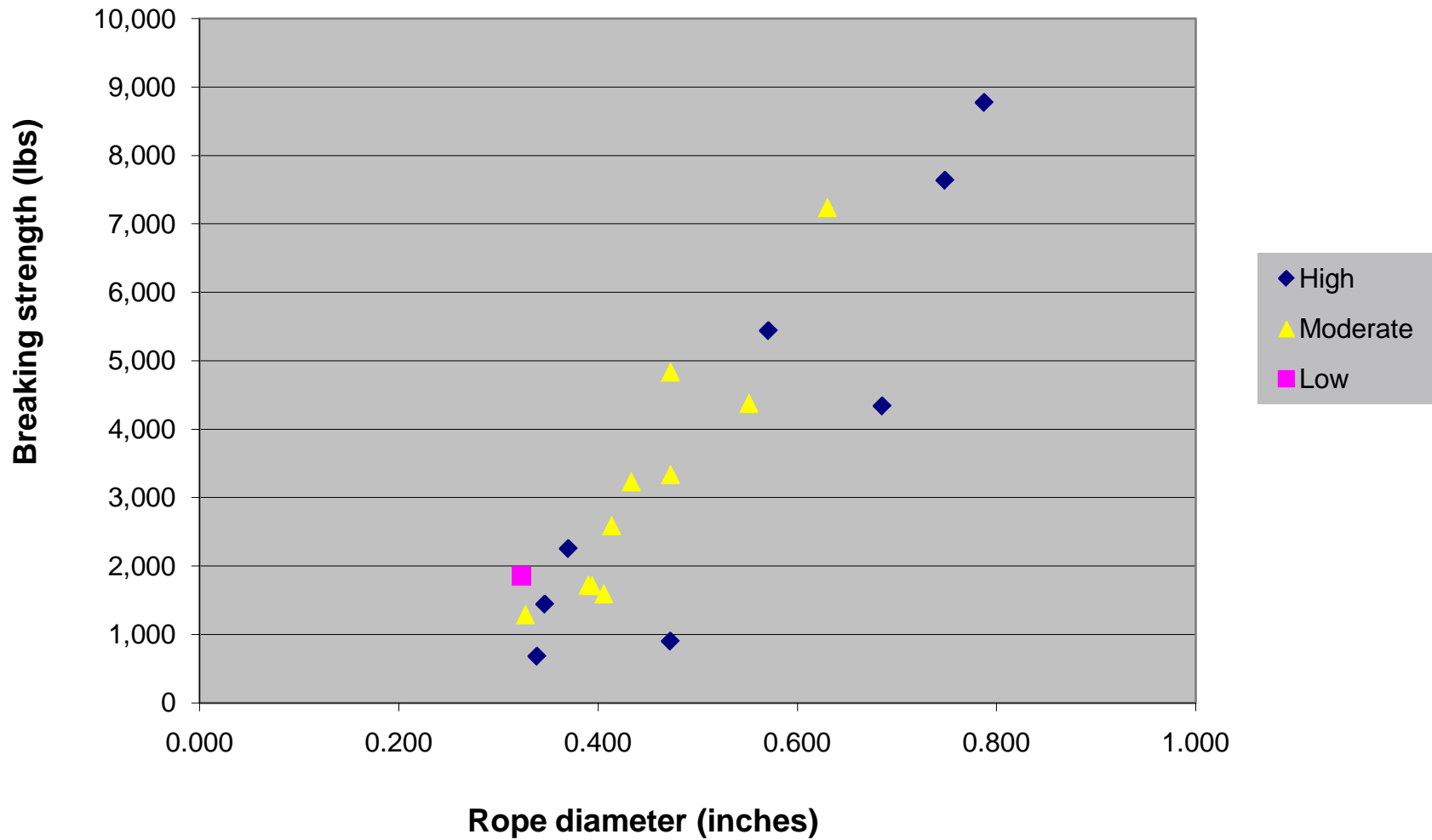
- Assessed subset of right whales only – 19 events of retrieved gear: 4 from carcasses, 15 from animals alive at the time
- Wound severity: low, medium, or high
- Age
  - Adult > 8 yo
  - Unknown
  - Juvenile 6-8 yo
  - Juvenile 3-5 yo
  - Calf/juvenile 0-2 yo



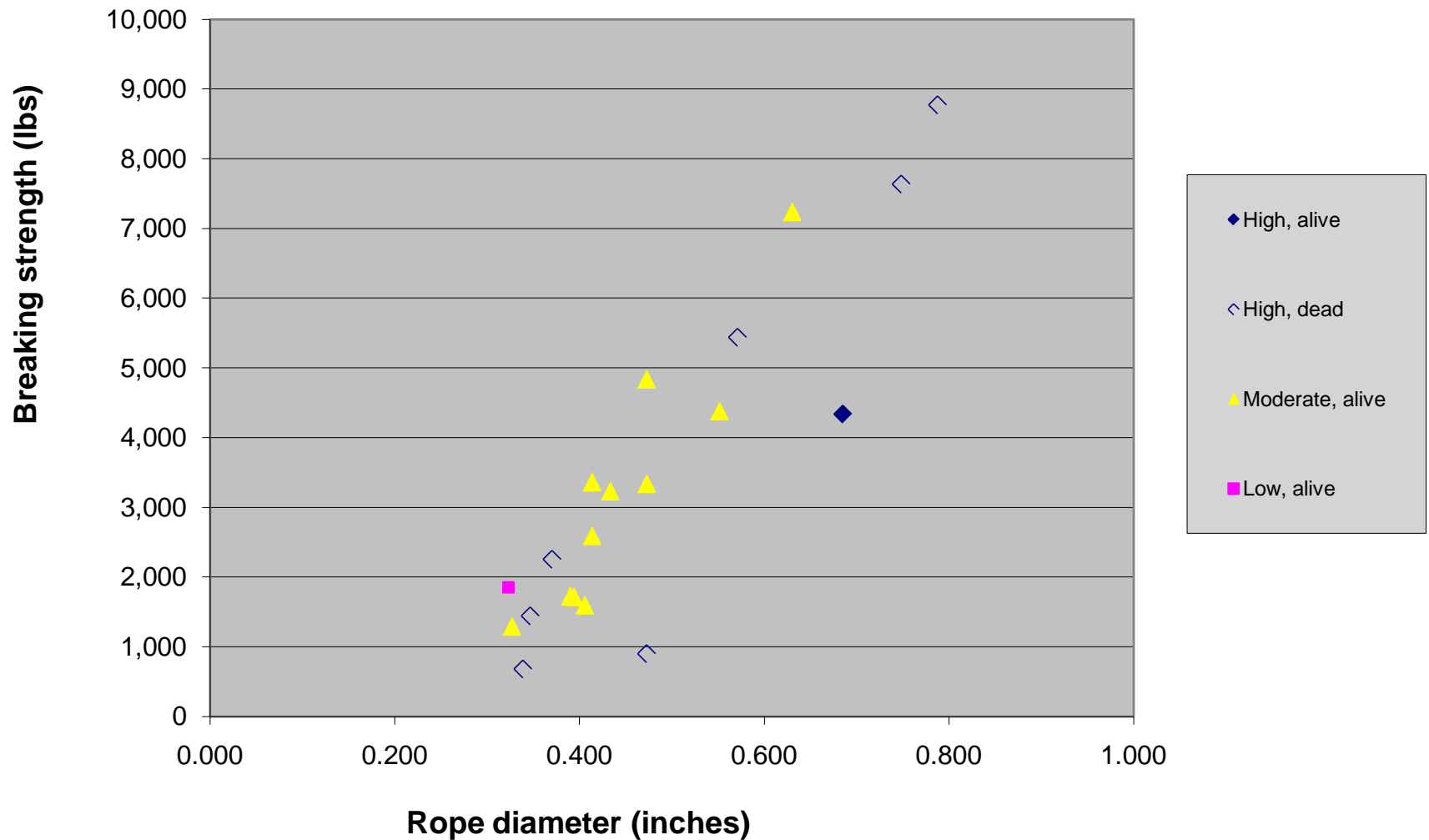
# Methods

- Whale analysis
  - Assessed subset of right whales only – 19 events of retrieved gear: 4 from carcasses, 15 from animals alive at the time
  - Wound severity: low, medium, or high
  - Age
    - Adult > 8 yo
    - Unknown
    - Juvenile 6-8 yo
    - Juvenile 3-5 yo
    - Calf/juvenile 0-2 yo
  - Fate of individual
  - Disentangled or not disentangled

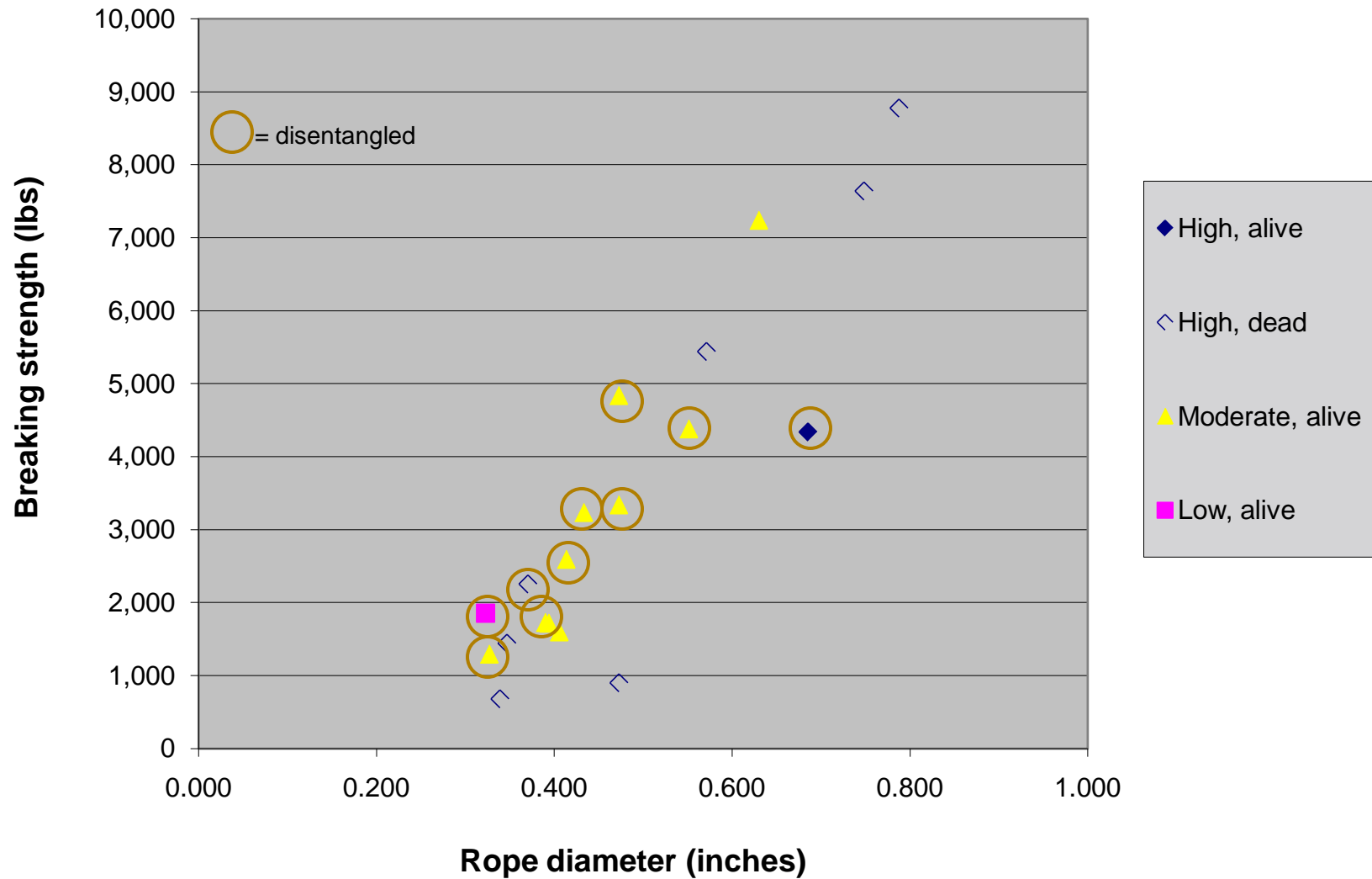
## Wound severity level



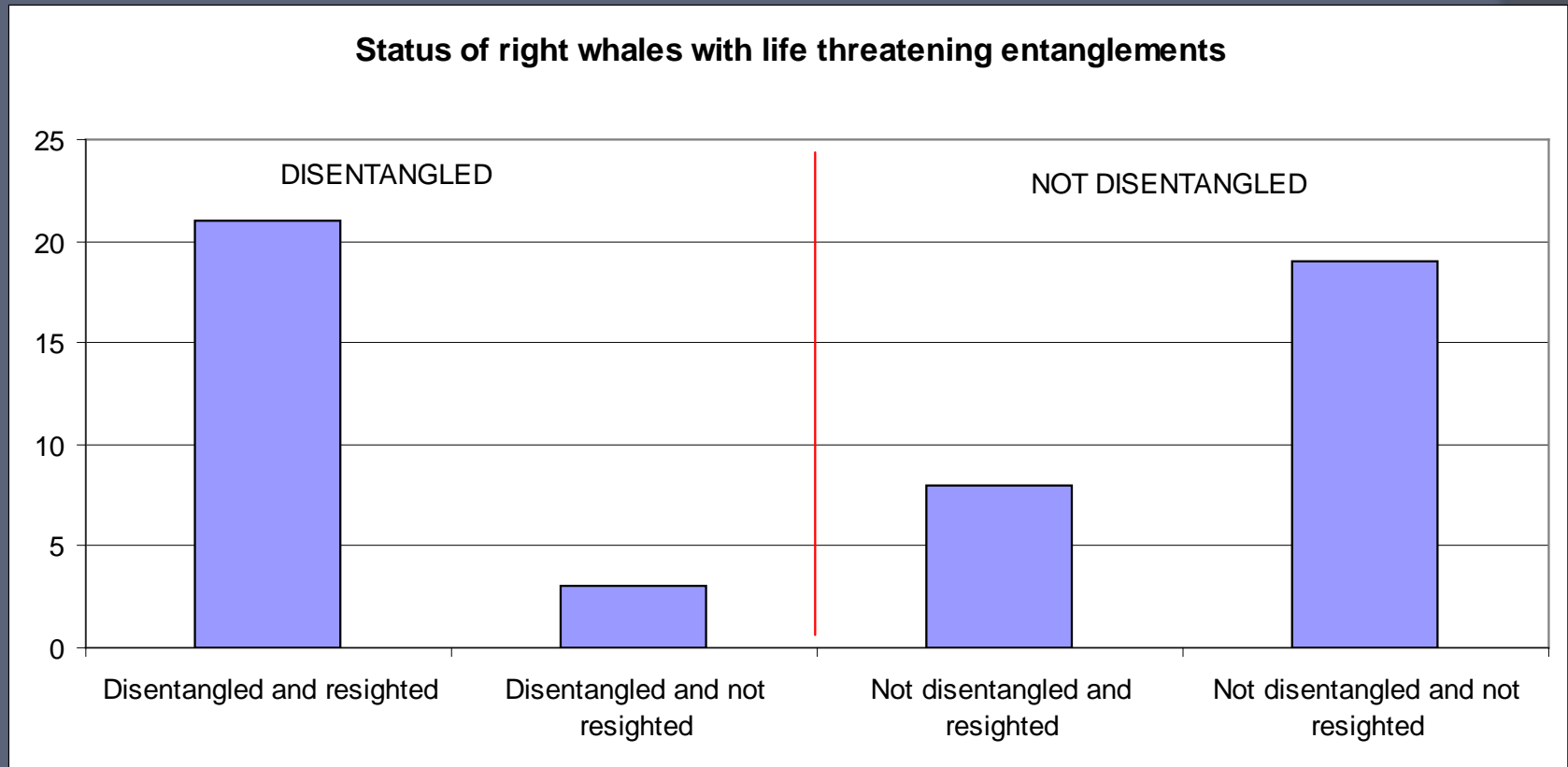
## Severity level and fate



## Severity level and fate vs. disentangled

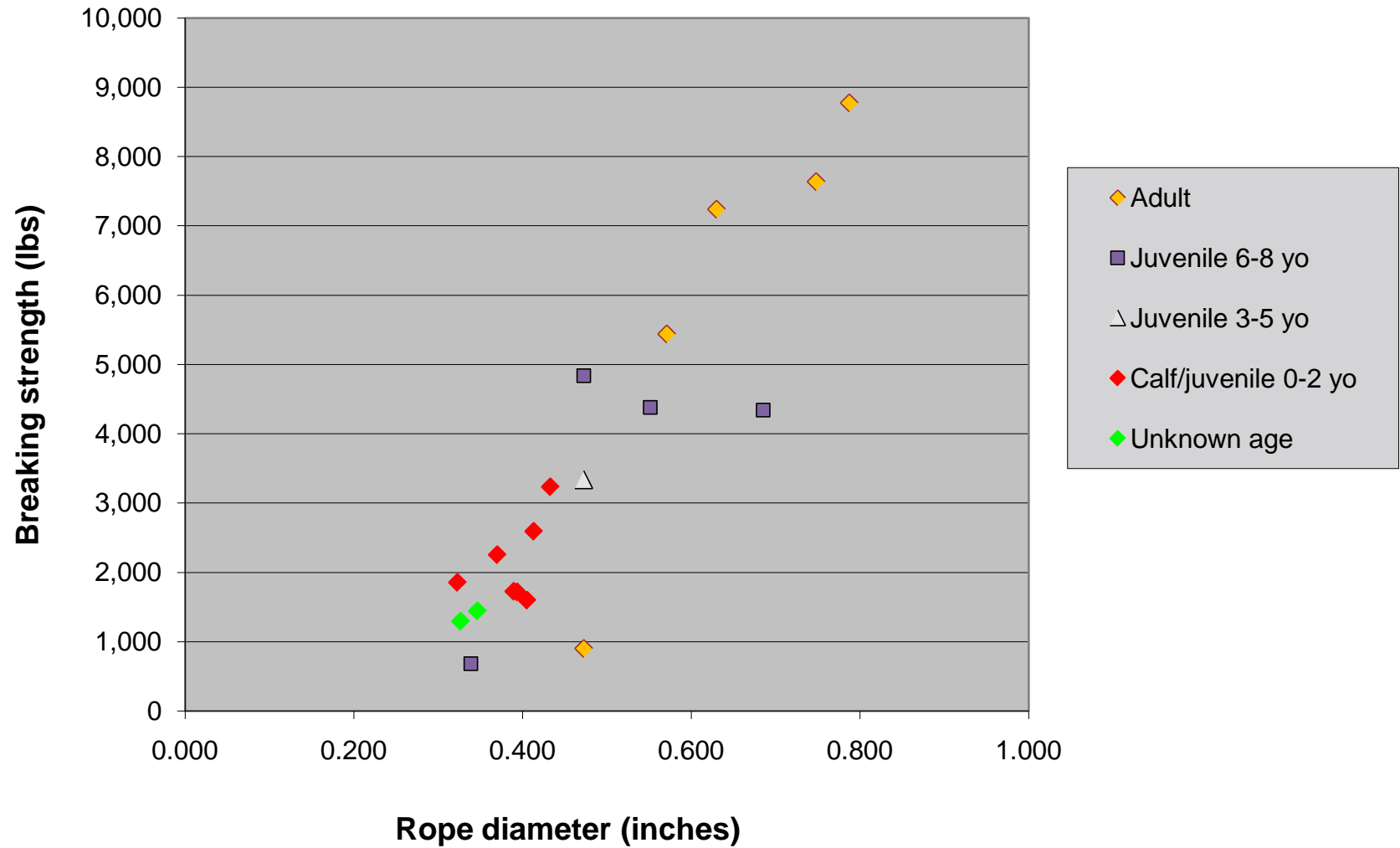


# Status of disentangled vs. not disentangled animals based on resightings – 51 life threatening events



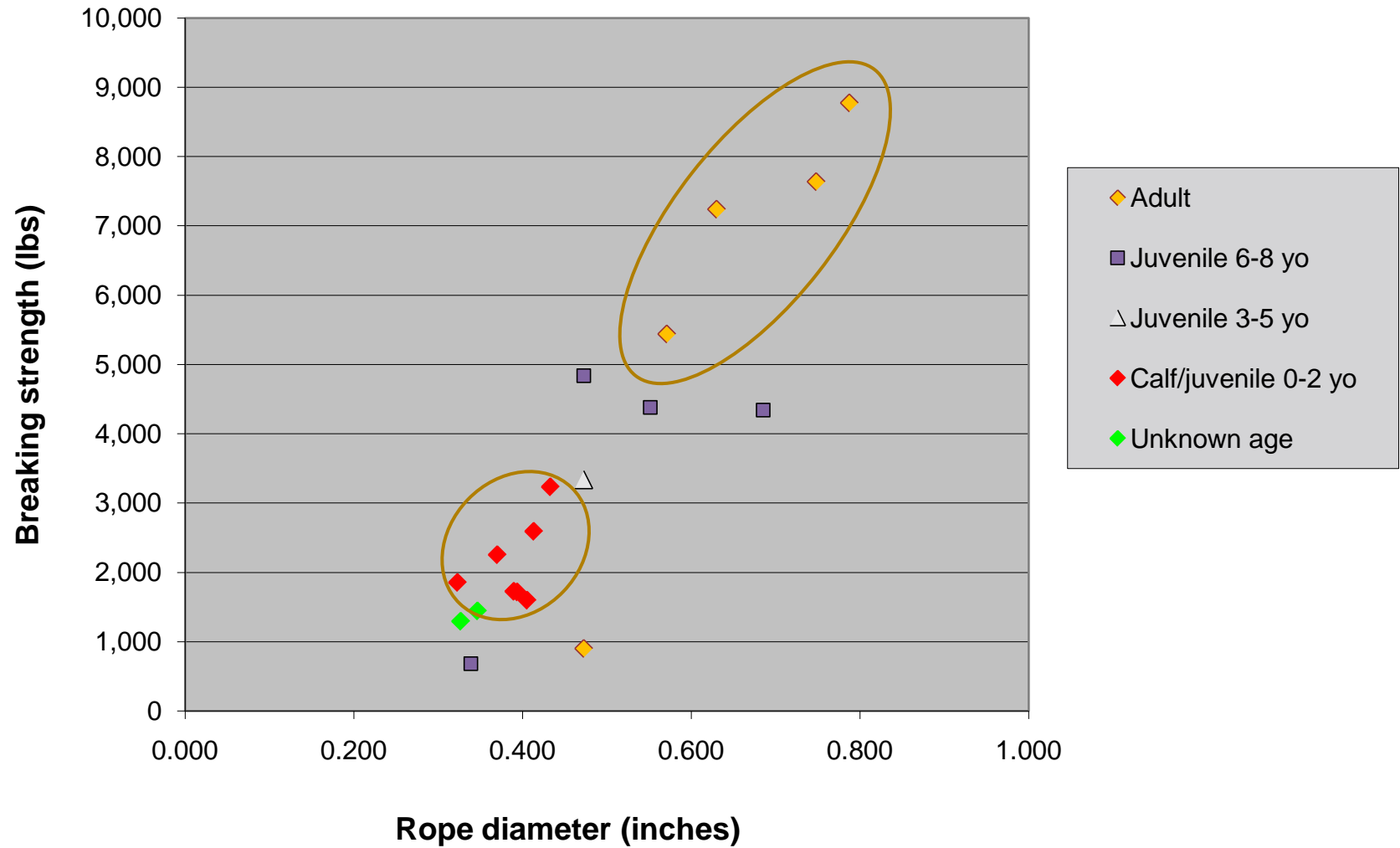
$G=3.84, df=1, p<0.001$

# Age





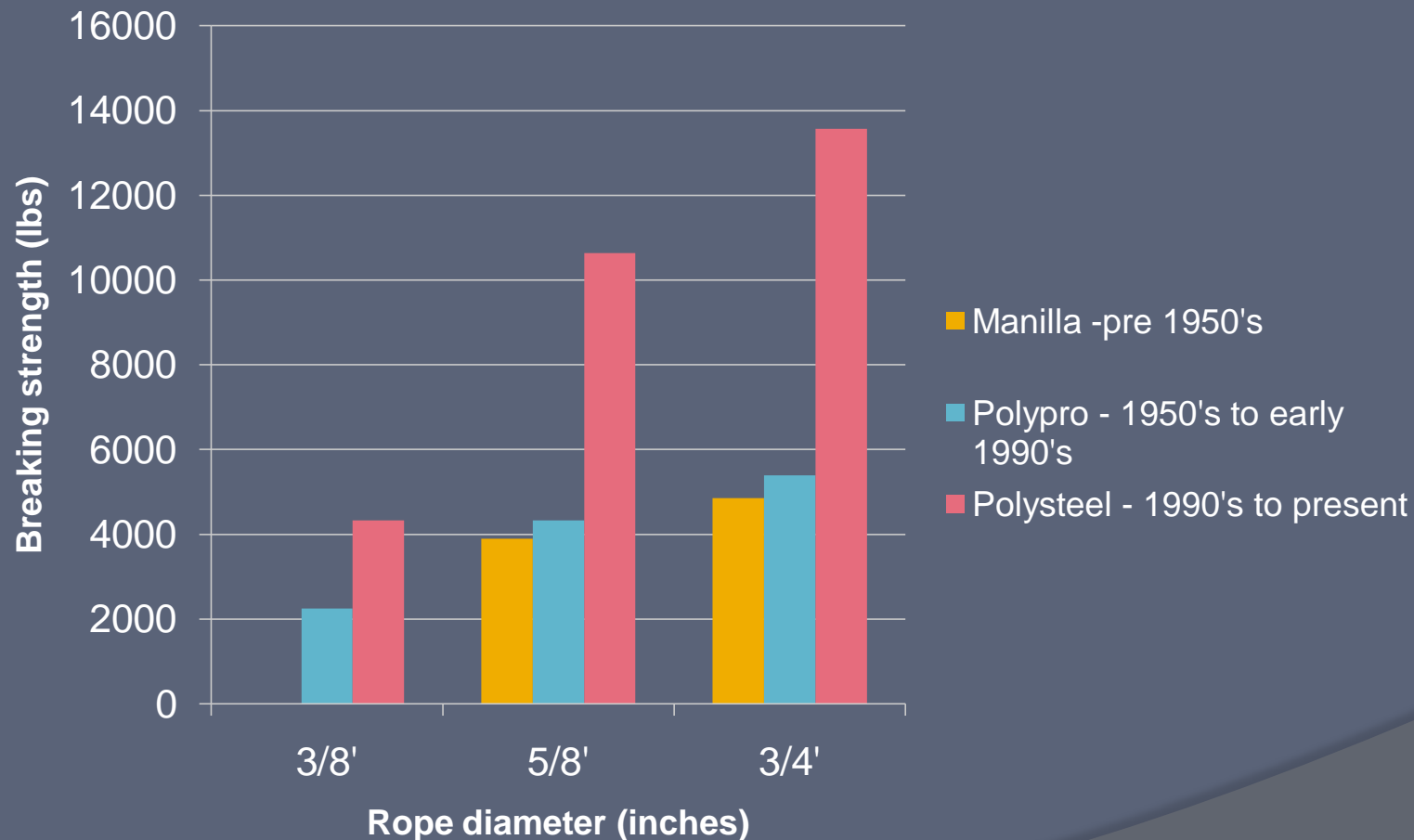
# Age



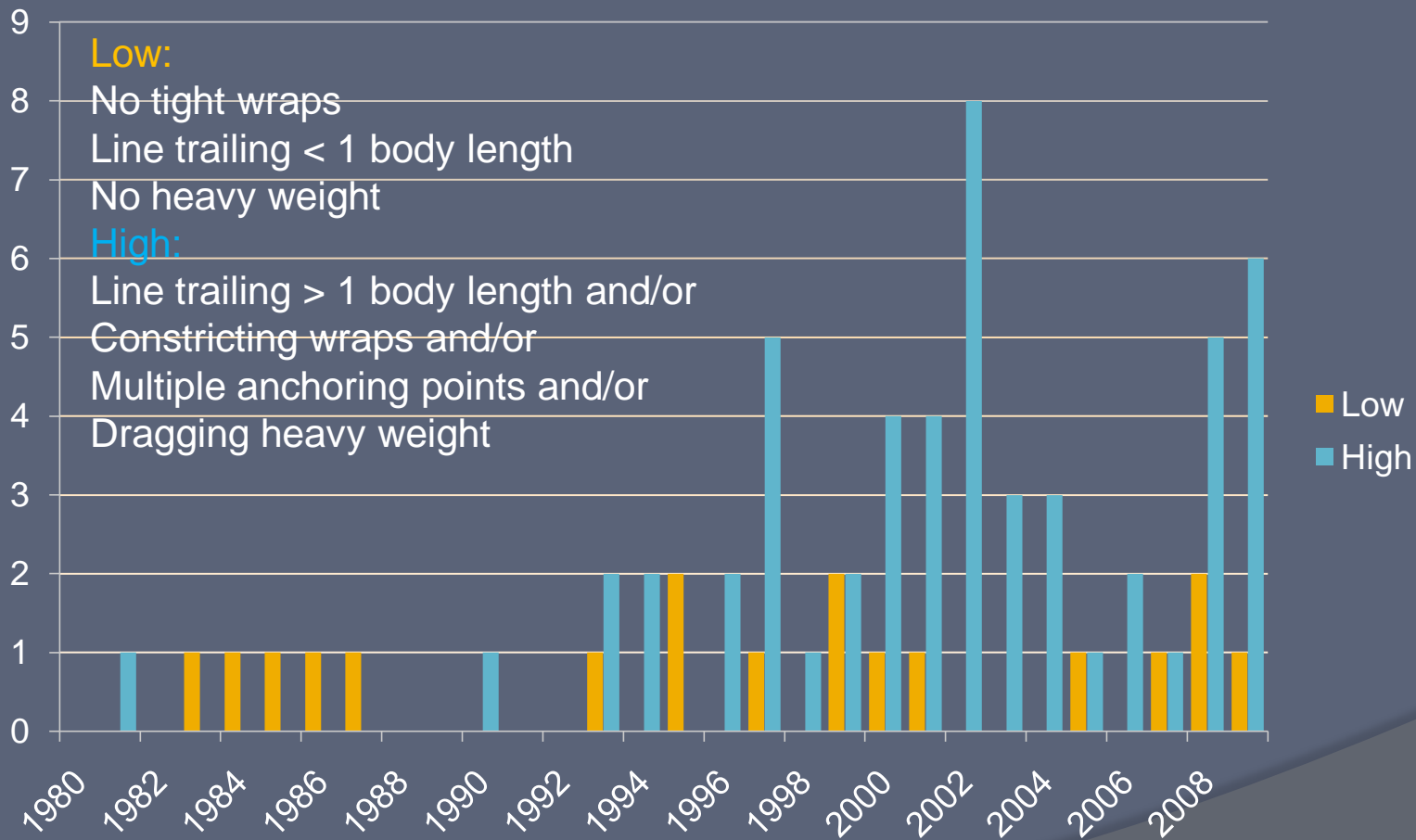
# Possible reasons why 0-2 year olds are observed caught only in lower strength gear and adults only observed caught in higher strength gear?

- ⦿ Differential use of inshore vs offshore habitats by calves and young juveniles?
- ⦿ Calves/young juveniles don't interact with offshore gear in same way?
- ⦿ Adults break free of weaker gear before a complex interaction results?
- ⦿ 0-2 yo cannot break free of stronger gear and may die during entanglement event?

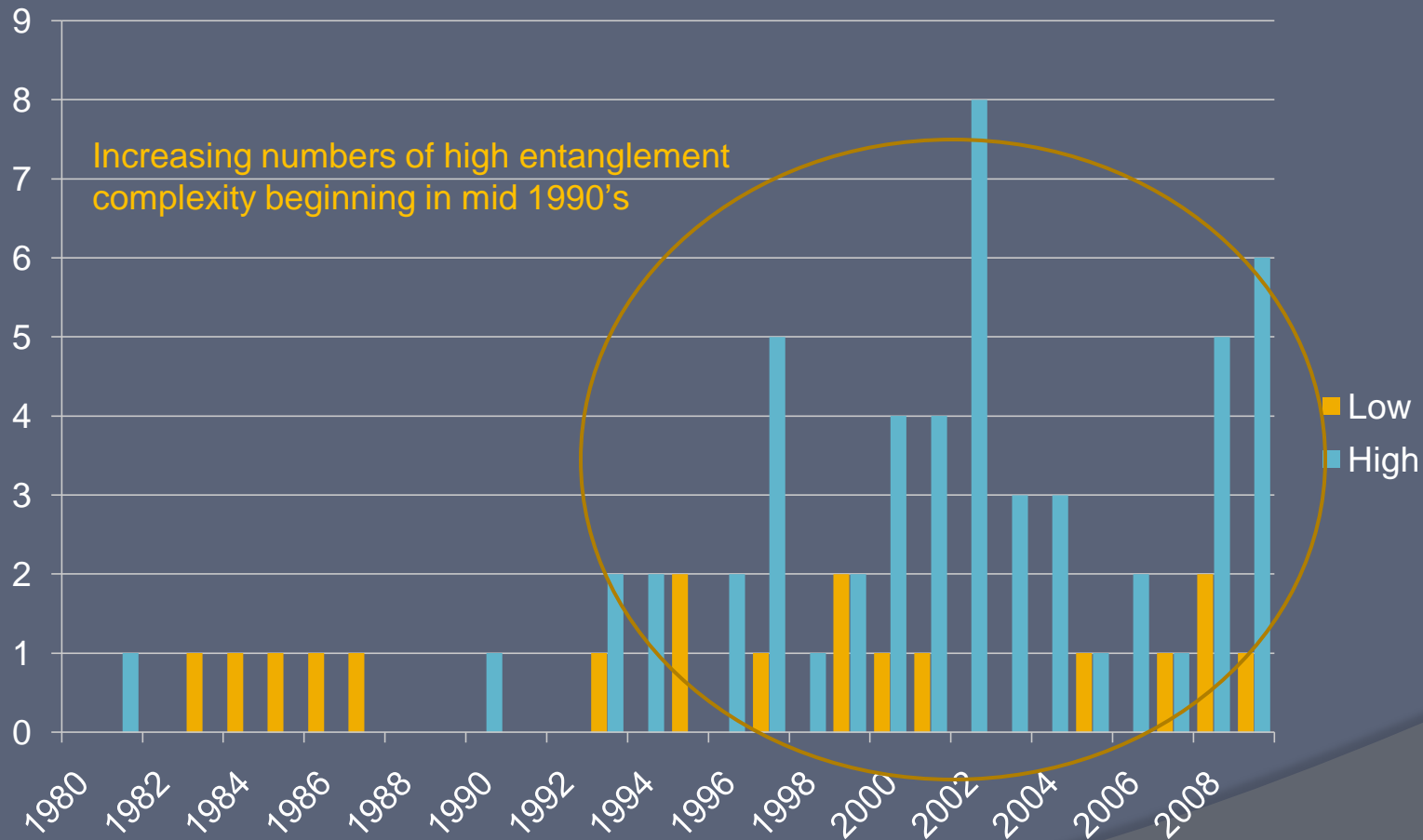
# Advertized rope breaking strengths and timeframes of general usage



# Entanglement complexity



# Entanglement complexity



# Summary of findings

- Ropes of all diameters and breaking strengths have lead to lethal entanglements
- Wound severity does not appear to be related to rope diameter or breaking strength
- Severe wounds typically lead to death and are usually the result of long duration entanglements
- Young animals are seen in lower diameter and lower breaking strength ropes than adults
- Rope strength increased in the early 1990's with the advent of copolymer rope manufacturing
- Entanglement complexity also increased in the mid 1990's



# Future work

- Conduct similar analyses as above for humpback whales and other large whales
- Feed this information into modeling underway by Duke University
- Assess severity of all 780 right whale entanglement interactions documented from 1980-2006 to determine if there is any trend in wound severity levels over time
- Interview 20+ fishermen actively fishing over many decades to evaluate how rope changes have changed how they fish

# Acknowledgements

- NOAA Award # NA09NMF4520413, “Consortium for Wildlife Bycatch Reduction”
- John Kenney, NMFS
- Variety of people who helped along the way (listed in the case study booklet)