May 2nd, 10:30 AM - 12:00 PM

Observations on abundance of bluntnose sixgill sharks, Hexanchus griseus, in an urban waterway in the Salish Sea, 2003-2012

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Sixgill Shark Research Program

SEATTLE AQUARIUM

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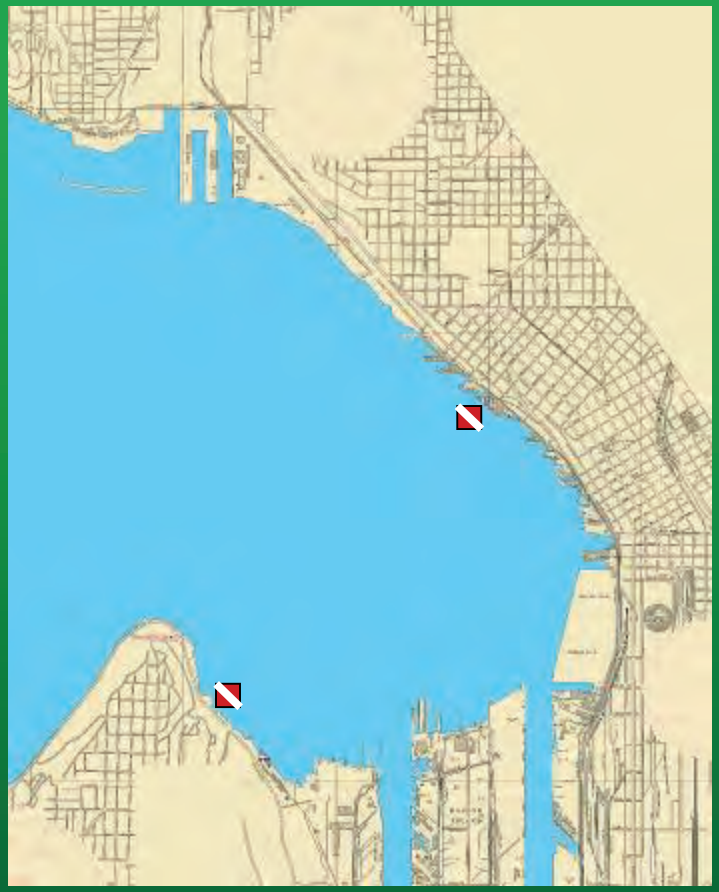
Sixgills in the Salish Sea

- This rarely studied “deep water” shark is found in the relatively shallow, inland waters of the Salish Sea.
- Its presence was known in local waters by scientists, local divers and commercial fishing communities.
- General public was mostly unaware of this large shark.
- Seattle Aquarium began studying sixgills in Puget Sound in 2003.

Where?



Elliott Bay: Diver sighting locations

Bay: Diver sighting & catch areas

Georgia basin dive sites

Project goals: To identify individual animals, movement patterns, gender ratio, local abundance, and population boundaries in Puget Sound.

1. visual tagging
2. genetic fingerprinting
3. acoustic monitoring

Research Partners

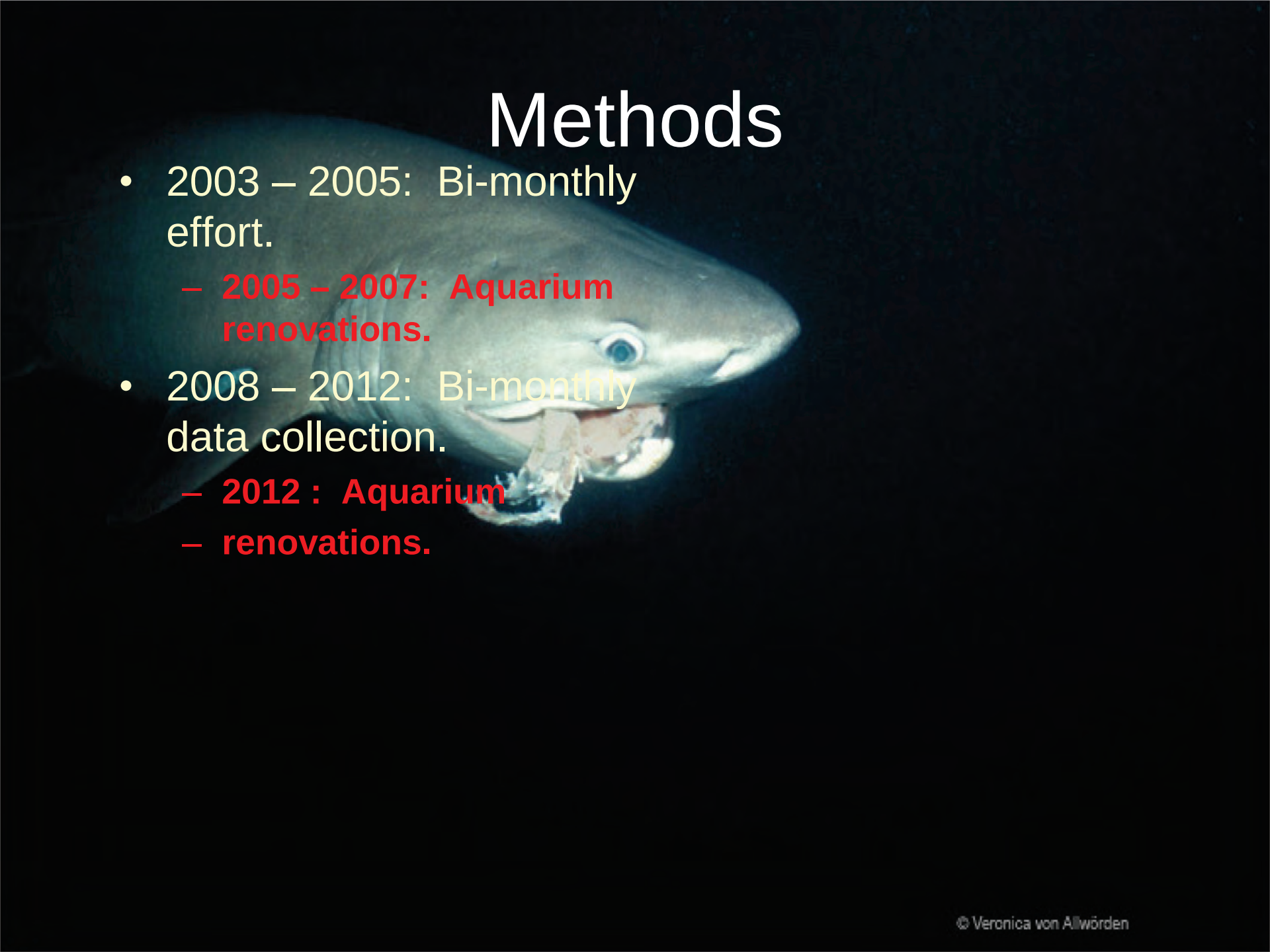
- Washington Department of Fish and Wildlife (WDFW)
- National Marine Fisheries Service (NMFS), NOAA

Methods

- Bait attracts sixgills to the research site.
- Divers insert visual marker tags and take tissue samples.
- Video is recorded for 12 hours per night.
- Individual sixgills are identified by visual marker tag or natural markings.

Methods

- 2003 – 2005: Bi-monthly effort.
  - **2005 – 2007: Aquarium renovations.**
- 2008 – 2012: Bi-monthly data collection.
  - **2012 : Aquarium**
  - **renovations.**



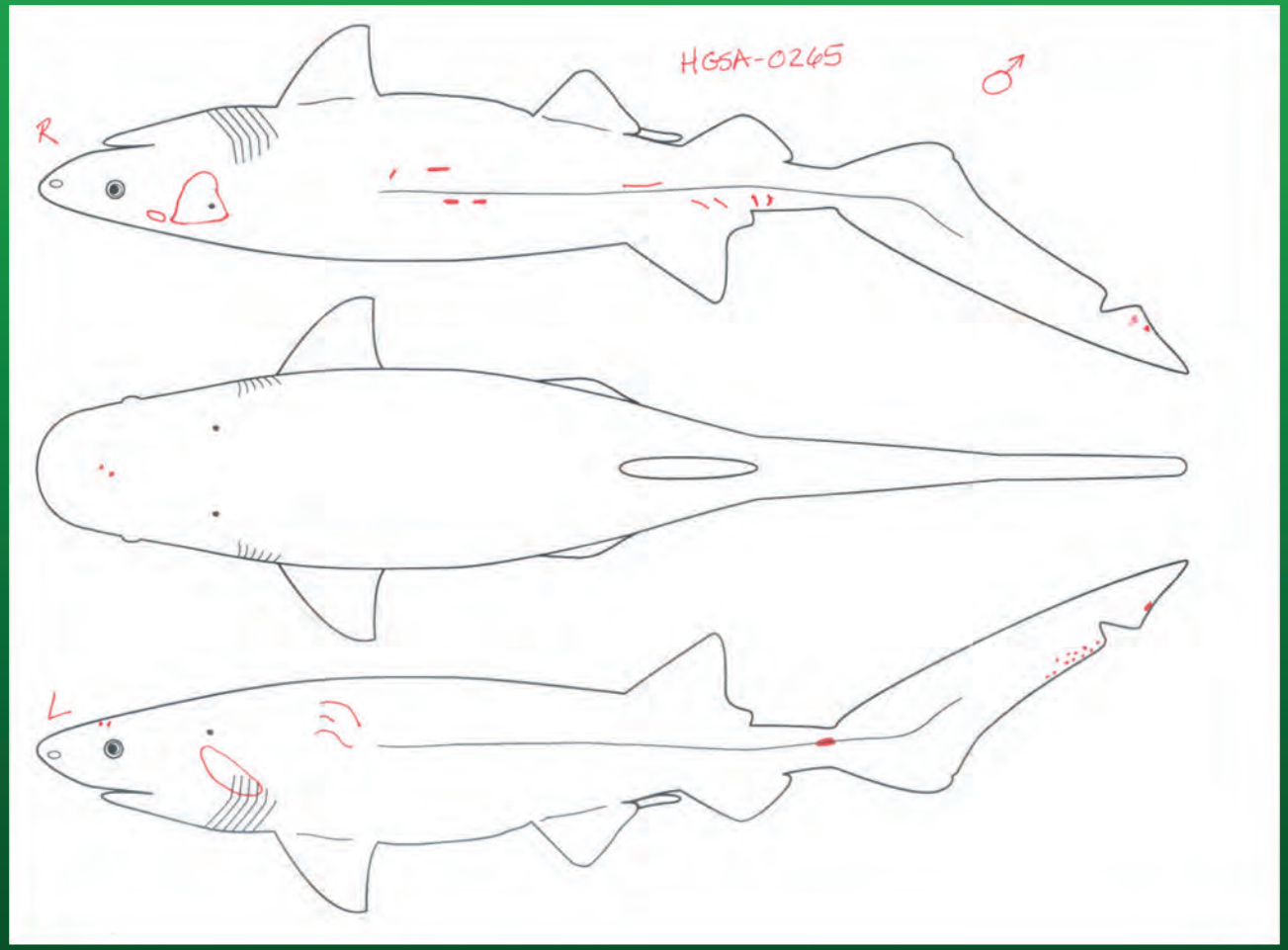
Individual identification methods

Floy VM69
Visible Marker Tag

VEMCO V32P
Acoustic Tag

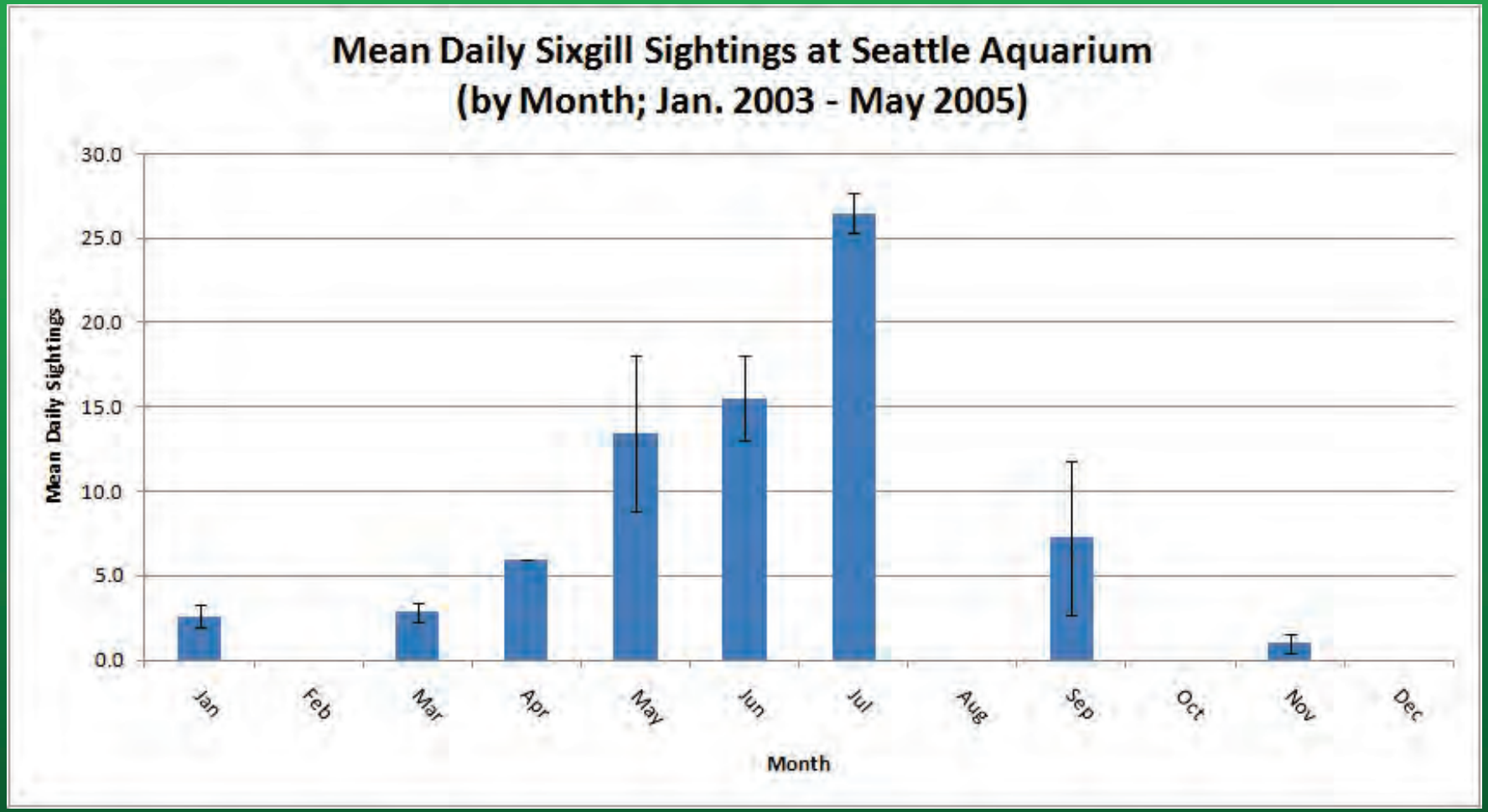
Pneudart Biopsy Dart

Identification via markings



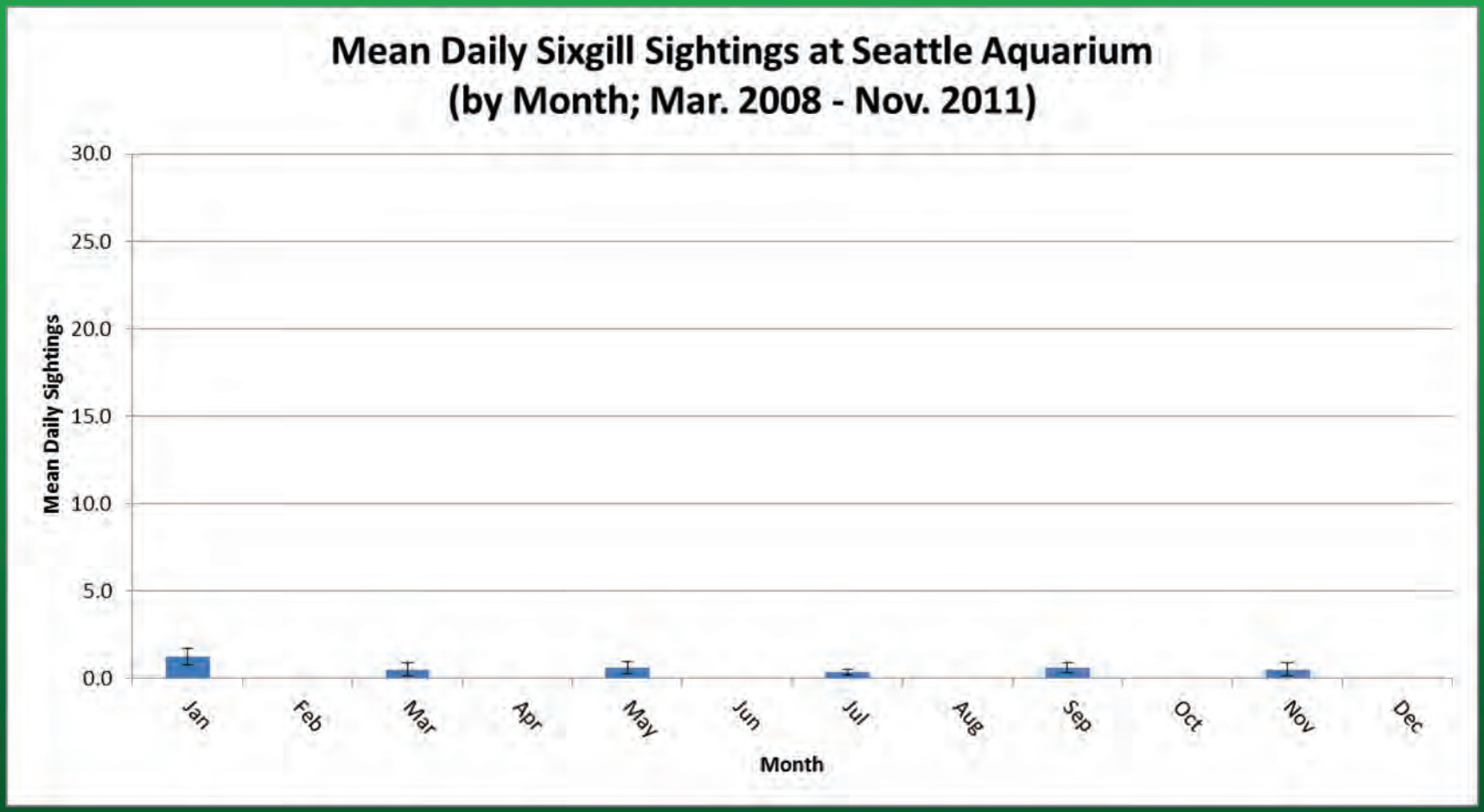
RESULTS:

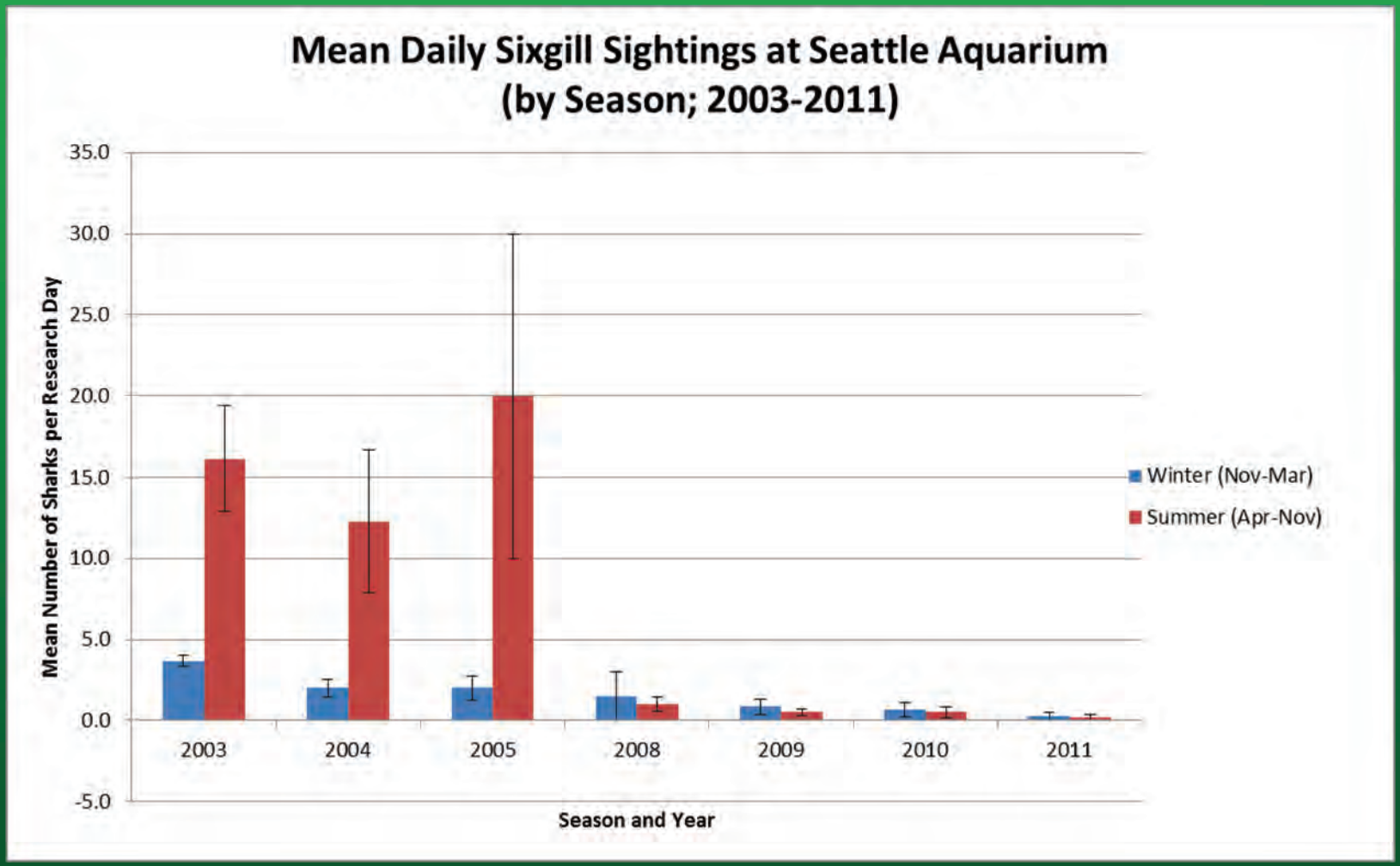
Observations 2003-2005



Then research was halted for Aquarium renovations (2006-2007) …

Observations 2008-2011




Mean Daily Sixgill Sightings at Seattle Aquarium
(by Season; 2003-2011)
Mean Number of Sharks per Research Day
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
2003
2004
2005
2008
2009
2010
2011
Season and Year
Winter (Nov-Mar)
Summer (Apr-Nov)

Sixgill observations

2003-2005

- 45 sixgills received visual tags. 17 of those sharks returned 31 times.
- 197 sightings of untagged sixgills; some may be resightings.
- Total observations = 273

- Daily counts: 0-30 identifiable sharks.
- Mark/recapture statistical software: estimated 27-98 identifiable sharks/event.

Sixgill observations

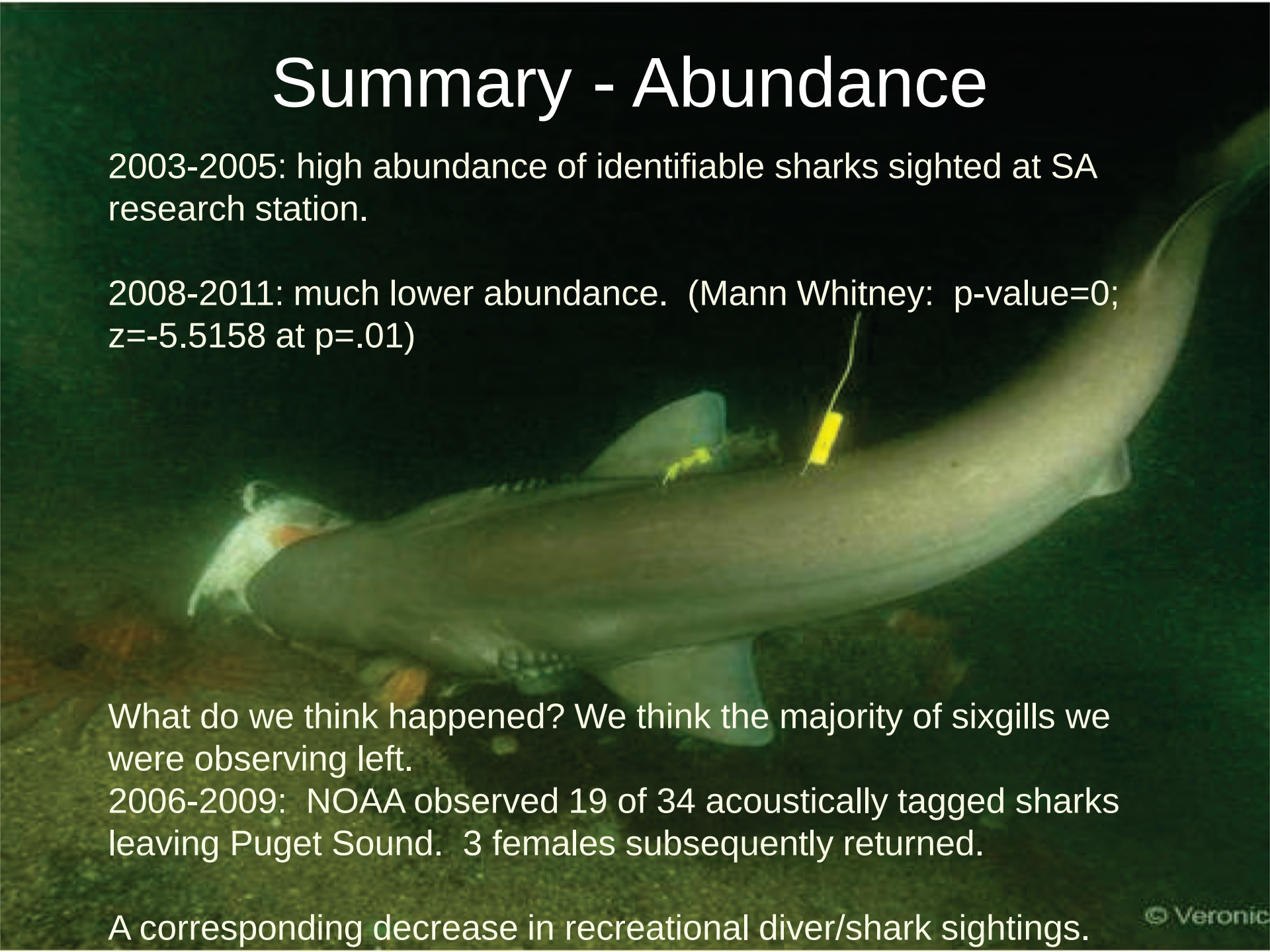
2008-2011

- None of the previously tagged sixgills returned (with a tag).
- Only one opportunity to implant a new visual marker tag (failed).
- Some days we had a single, “clean” shark.
- Daily counts ranged from 0-3 identifiable sharks.

Summary - Abundance

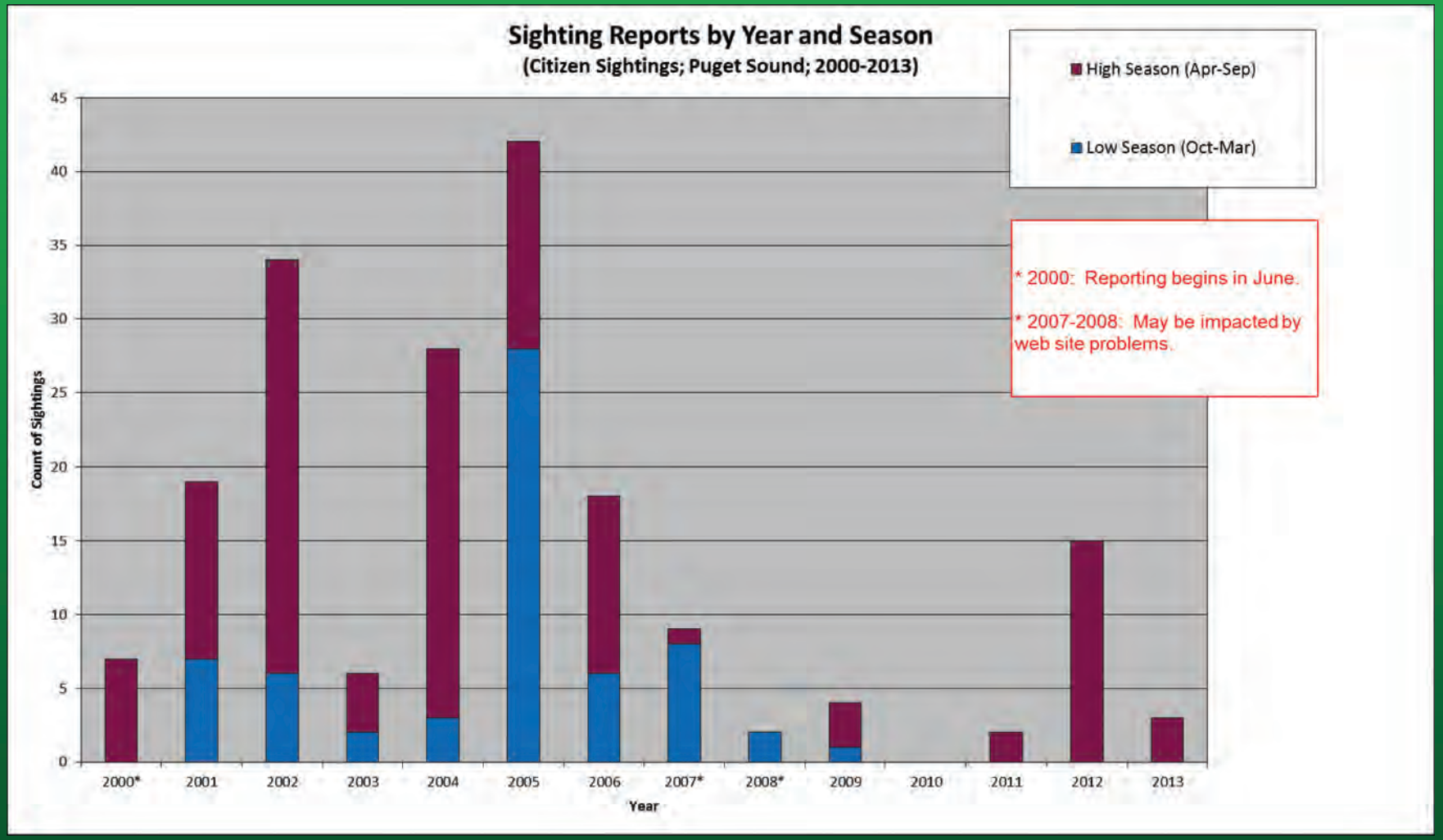
2003-2005: high abundance of identifiable sharks sighted at SA research station.

2008-2011: much lower abundance. (Mann Whitney: p-value=0; z=-5.5158 at p=.01)



What do we think happened? We think the majority of sixgills we were observing left.
2006-2009: NOAA observed 19 of 34 acoustically tagged sharks leaving Puget Sound. 3 females subsequently returned.

A corresponding decrease in recreational diver/shark sightings.


Sighting Reports by Year and Season
(Citizen Sightings; Puget Sound; 2000-2013)
High Season (Apr-Sep)
Low Season (Oct-Mar)
* 2000: Reporting begins in June.
* 2007-2008: May be impacted by web site problems.
Count of Sightings
0
5
10
15
20
25
30
35
40
45
2000*
2001
2002
2003
2004
2005
2006
2007*
2008*
2009
2010
2011
2012
2013
Year

Why?

•We know that some sixgill females give birth in Puget Sound because more than 1 female washed ashore in the process.

•Majority of sixgills documented in Puget Sound were sub-adults.

•The subadults were found in cohort groups.

•Perhaps the cohort group that used Puget Sound as a nursery left during 2006-2008 for the open ocean as suggested by the acoustically tagged sharks.

•We continue to monitor for (but have yet to see) evidence of another successful recruitment in Puget Sound.

•Similar patterns of apparent high abundance followed by a large decline were reported in Barkley Sound, BC and Flora Islet, BC during earlier time periods.

•Why do we see these patterns?

Griffing D, Larson S, Hollander J, Carpenter T, Christiansen J, et al. (2014) Observations on Abundance of Bluntnose Sixgill Sharks, *Hexanchus griseus*, in an Urban Waterway in Puget Sound, 2003-2005. PLoS ONE 9(1): e87081. doi:10.1371/journal.pone.0087081

Larson S, Christiansen J, Griffing D, Ashe J, Lowry D (2011) Relatedness, diversity and polyandry within Puget Sound sixgill sharks, *Hexanchus griseus*. Conserv Genet 12(3): 679–690. doi: 10.1007/s10592-010-0174-9