

Marine ecosystem conservation research in the North Pacific: rockfish and sharks



In situ research conducted by the



Shifting baselines



Why study rockfish?

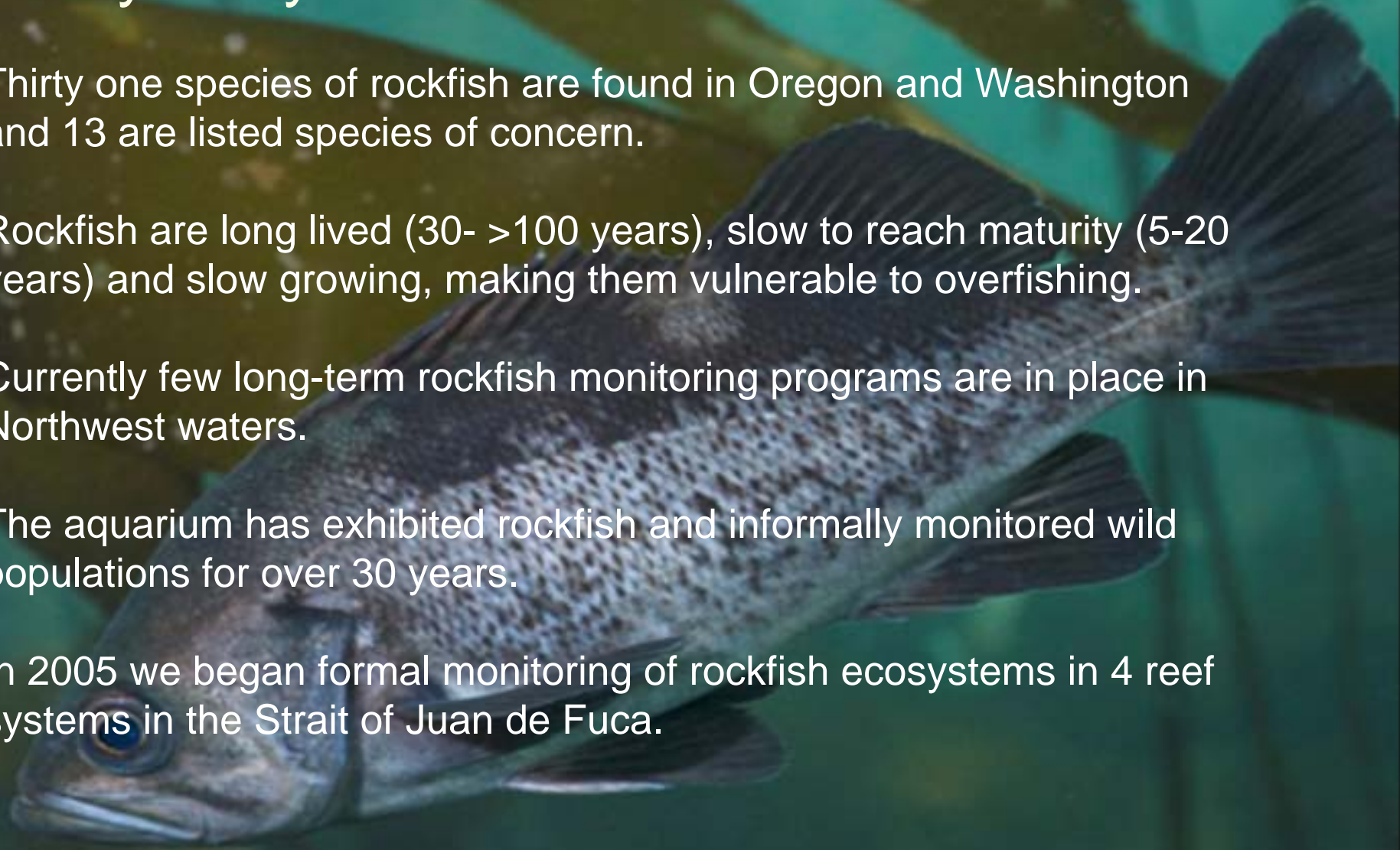
Thirty one species of rockfish are found in Oregon and Washington and 13 are listed species of concern.

Rockfish are long lived (30- >100 years), slow to reach maturity (5-20 years) and slow growing, making them vulnerable to overfishing.

Currently few long-term rockfish monitoring programs are in place in Northwest waters.

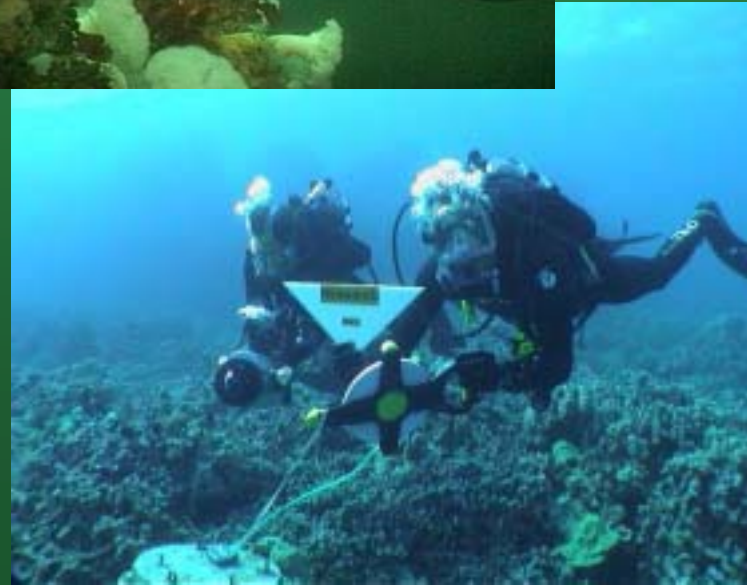
The aquarium has exhibited rockfish and informally monitored wild populations for over 30 years.

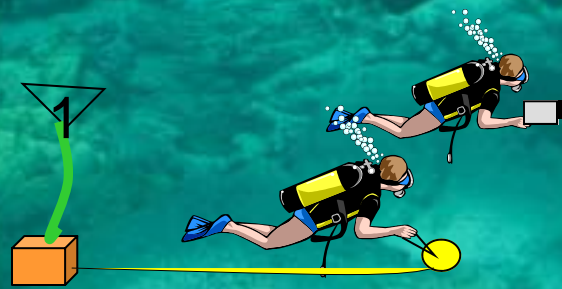
In 2005 we began formal monitoring of rockfish ecosystems in 4 reef systems in the Strait of Juan de Fuca.



The goal is a repeatable annual count in fixed locations to measure significant changes in species diversity, abundance and size classes over time.

Using underwater video transects, a proven and precise method to measure abundance of sessile fish species such as rockfish and lingcod .





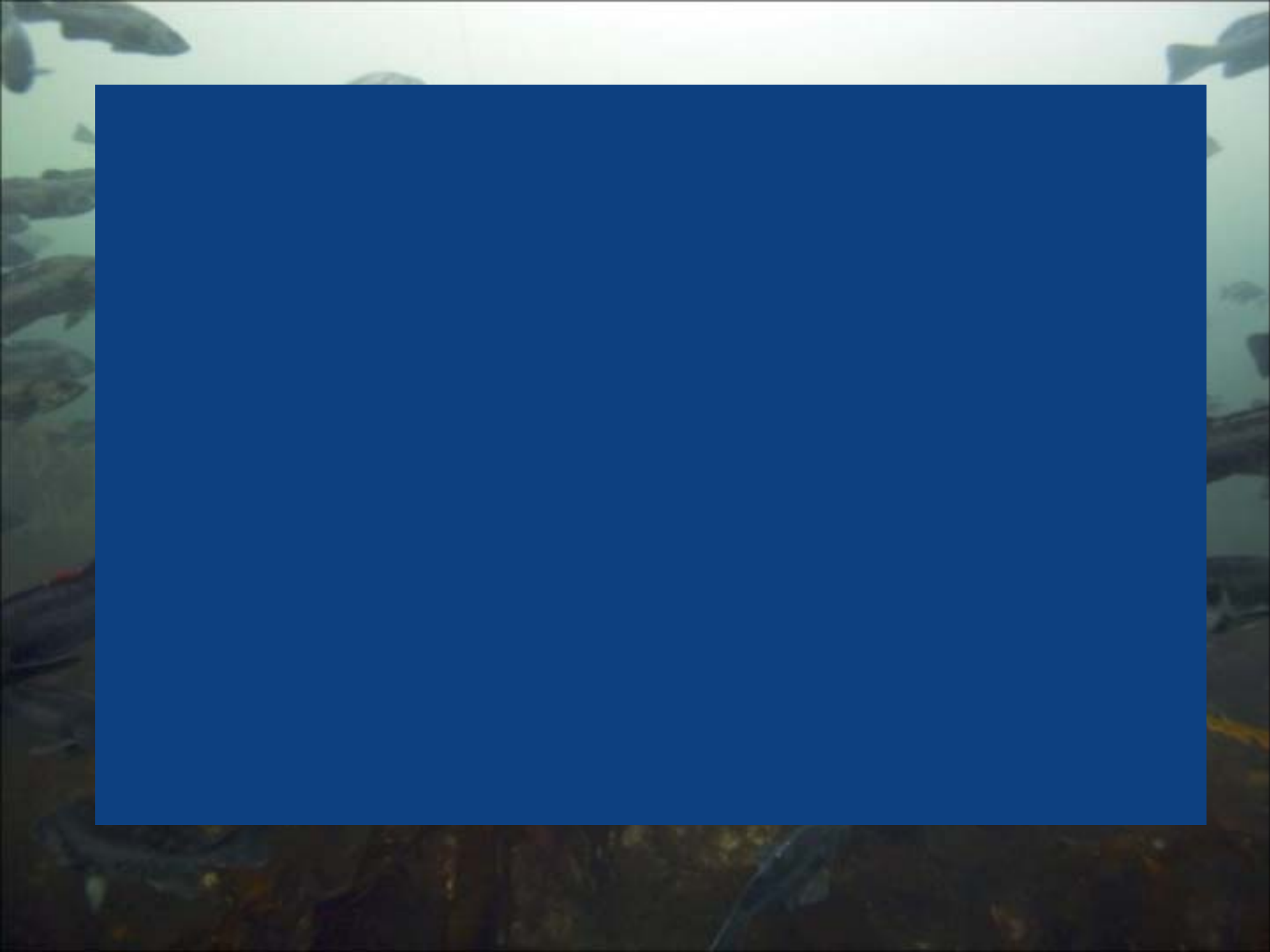
4. South Reverse 50 meters

1. North Forward 50 meters

3. South Forward 50 meters

2. North Reverse 50 meters





Results





The majority of adult fish species were the schooling rockfish: blacks and blues.

The highest numbers of these fish were found in 2006, 2007 and 2009 in all sites.

Other common species include: kelp greenling, china rockfish, and lingcod.

There was a significant recruitment event of juvenile rockfish in 2006 at all sites.



Stability in numbers of rockfish in these areas was evident with no significant change between years in adults observed. The non significance found over this study period highlights the differences between current observations and twenty year old recollected experiences by the same observers. This is an inferred example of how the shifting baselines phenomenon affects results.

We have expanded these surveys to reef fish ecosystems in South Puget Sound, Oregon and Hawaii.





Sixgill Shark Research Program



SEATTLE AQUARIUM

Bluntnose Sixgill Shark

Hexanchus griseus

- Up to 16 feet & 1500 pounds.
- Six gill slits (unlike more recently evolved sharks that have 5).
- Deep water species.
- Found in all oceans of the world.
- An at risk species because of the potential for overharvest.
- As a top predator they promote species diversity and overall ecosystem health.



Sixgill Sharks in Seattle

- Their presence has been known in the relatively shallow waters (surprising for a deep water species) of Puget Sound by scientists, local divers and commercial fishers.
- General public is mostly unaware this large shark (4th largest predatory shark in the world) inhabits Puget Sound.



Seattle Aquarium Sixgill Shark Project Goals

- To identify individual animals, movement patterns, gender ratio, local abundance, and population boundaries.
 1. visual tagging
 2. genetic fingerprinting
 3. acoustic monitoring

Research Partners

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

Zoo and Aquarium (PDZA)

- Seattle Aquarium

Where?



Eligible areas for
diving locations

Individual identification methods

**Floy VM69
Visible Marker Tag**



**VEMCO V32P
Acoustic Tag**



Pneudart Biopsy Dart



Tagging Summary

Total Number Sharks Visually Tagged

45

Total Number of Sharks Acoustically Tagged

7

Total Number of Returned Sharks

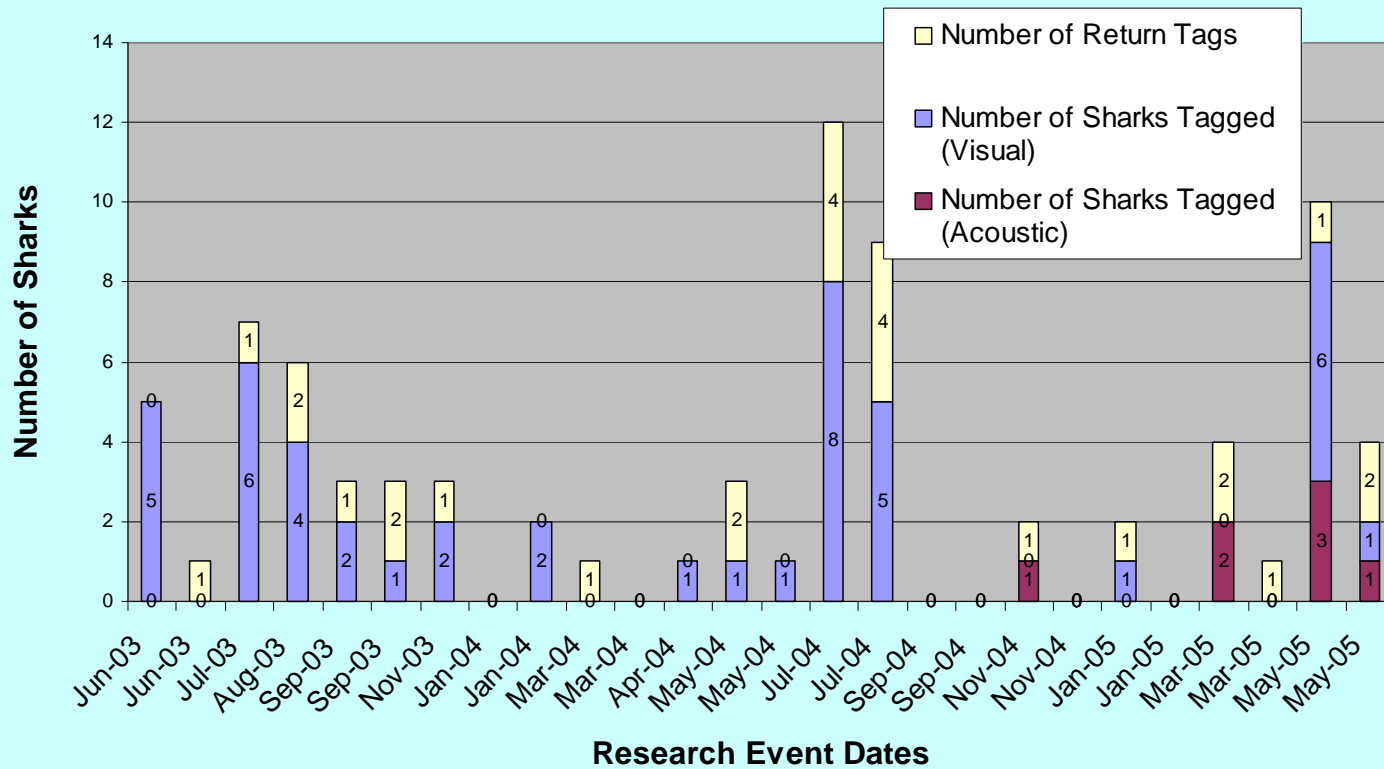
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Tag return rate at research site

35.56%

Visual Tagging Results

2003 - 2005 Tagging Summary



Population Genetics

- 15 microsatellite loci were highly polymorphic within sixgills.
- Tested in other shark species: Sevengills, Dogfish, Angel Shark and Leopard Shark. All loci were found to work well.
- Point Defiance Zoo and Aquarium, Aquarium of the Bay and Monterey Bay Aquarium provided tissue samples from other species.
- Diveristy: Ave. no. Alleles: 45 and Ave. Heterozygosity: 89%.
- High level of diversity suggesting no historical bottleneck due to harvest or other natural causes.

Relatedness:

We found a high degree of relatedness among sixgill sharks sampled during the same research event or longline set. Sharks caught at the same time and place are cohort groups.

Percent relatedness and size results per research event and set

SET ID	N	FS	HS	U	size	se
Mean	9.09	0.53	0.13	0.34	2.25	0.13
SE	2.10	0.06	0.03	0.05	0.07	0.02

Female with pups: Paternity analysis



- 2007 Female sixgill with 71 pups.
- Genetic analysis showed polyandry with 8 males.
- Found to be the pattern in 80% of sharks analyzed using similar methods.

So What do we know?

- Puget Sound and Georgia Basin appear to be a nursery areas for sixgill sharks.
- Adult females return from the open ocean to birth pups.
- Pups in one litter are sired by more than one male, increasing genetic diversity.
- Juveniles remain in local waters as cohort groups that exhibit strong home ranges with seasonal directed movements .
- Majority of sixgill sharks present in Puget Sound are immature. As the grow bigger and approach adult size they have been documented (acoustic receivers) leaving Puget Sound for the open ocean.
- Future will focus on monitoring long term trends, recruitment cycles and sixgills beyond Puget Sound to determine the uniqueness of this region to sixgill sharks.



Questions?