Pacing Harvest with Tract Recovery for Wild Geoduck Stocks: Management Changes in South Sound

Washington Department of FISH and WILDLIFE

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Pacific geoduck
Panopea generosa

- mature at 2-3 yrs old
- broadcast spawners
- long larval period

- large, 2.2 lb ave. weight
- deep in substrate
- fecund
- old, 179 yr. max. age

Fishery, statewide:

- harvestable biomass estimated at 194 million lbs, across ~25k acres
- large biomass extracted, 4.5 million lbs in 2019
- high economic value, US $50 million annual


Jake Johnston


Wilson Johns


Morningstar Green


Jeremy Walls, Steve Sigo, Dan Sigo, Dakota Vigil

Squaxin Island Tribe

Nisqually Indian Tribe

Puyallup Tribe of Indians

Washington State Department of Health

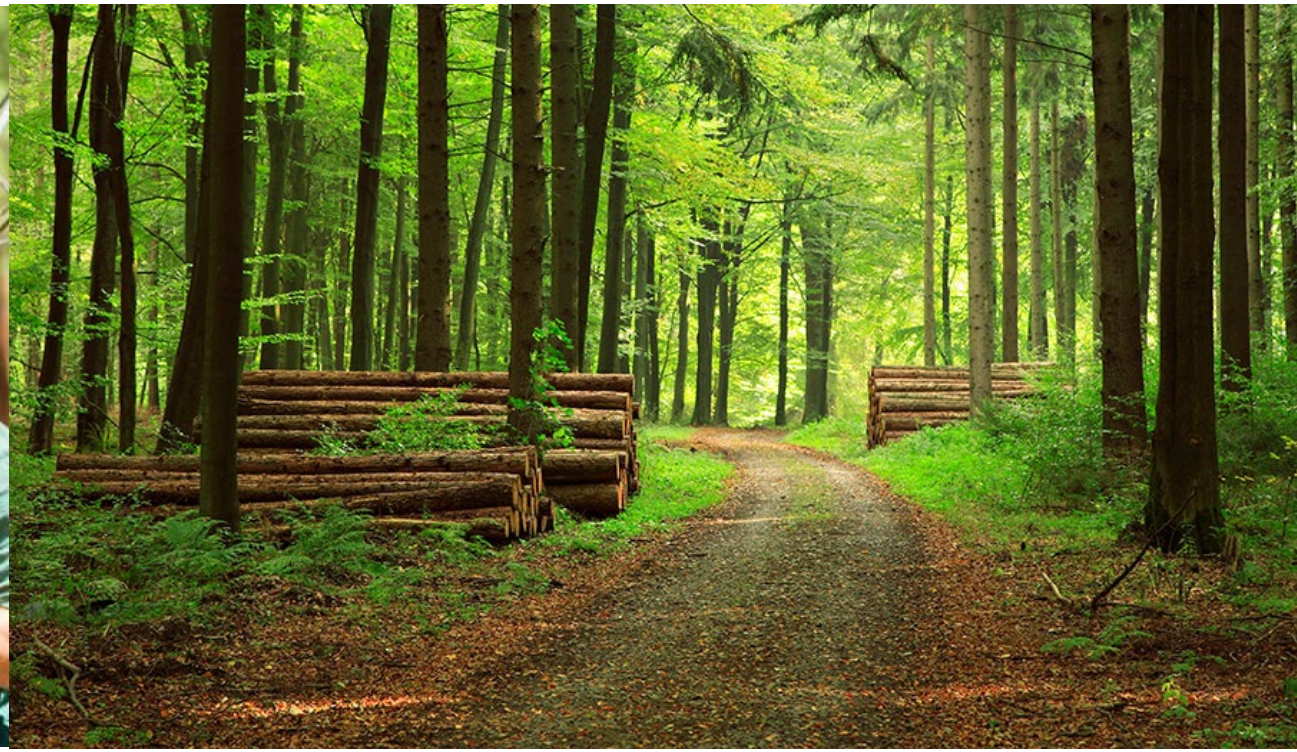
Washington Department of Fish and Wildlife

Closer to forestry than fishery management

Discrete tracts of 20 – 800 acres are harvested intensively over a number of years

After most of the geoducks have been removed, tracts are shut down and left to recover to pre-fishing density over a period of decades

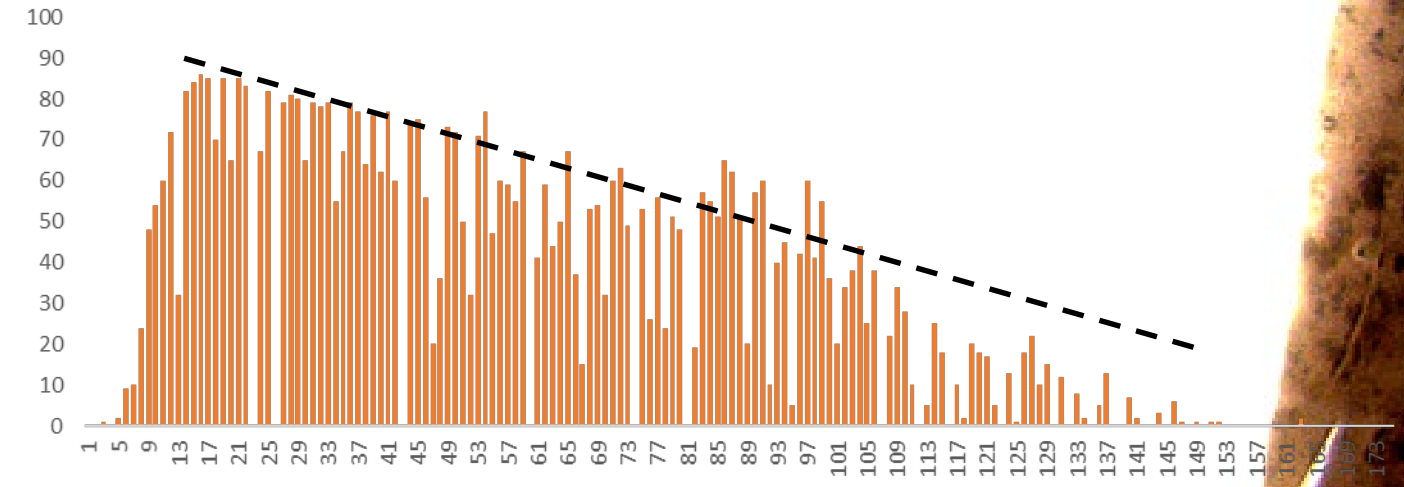
Concentrates harvest impacts and simplifies monitoring



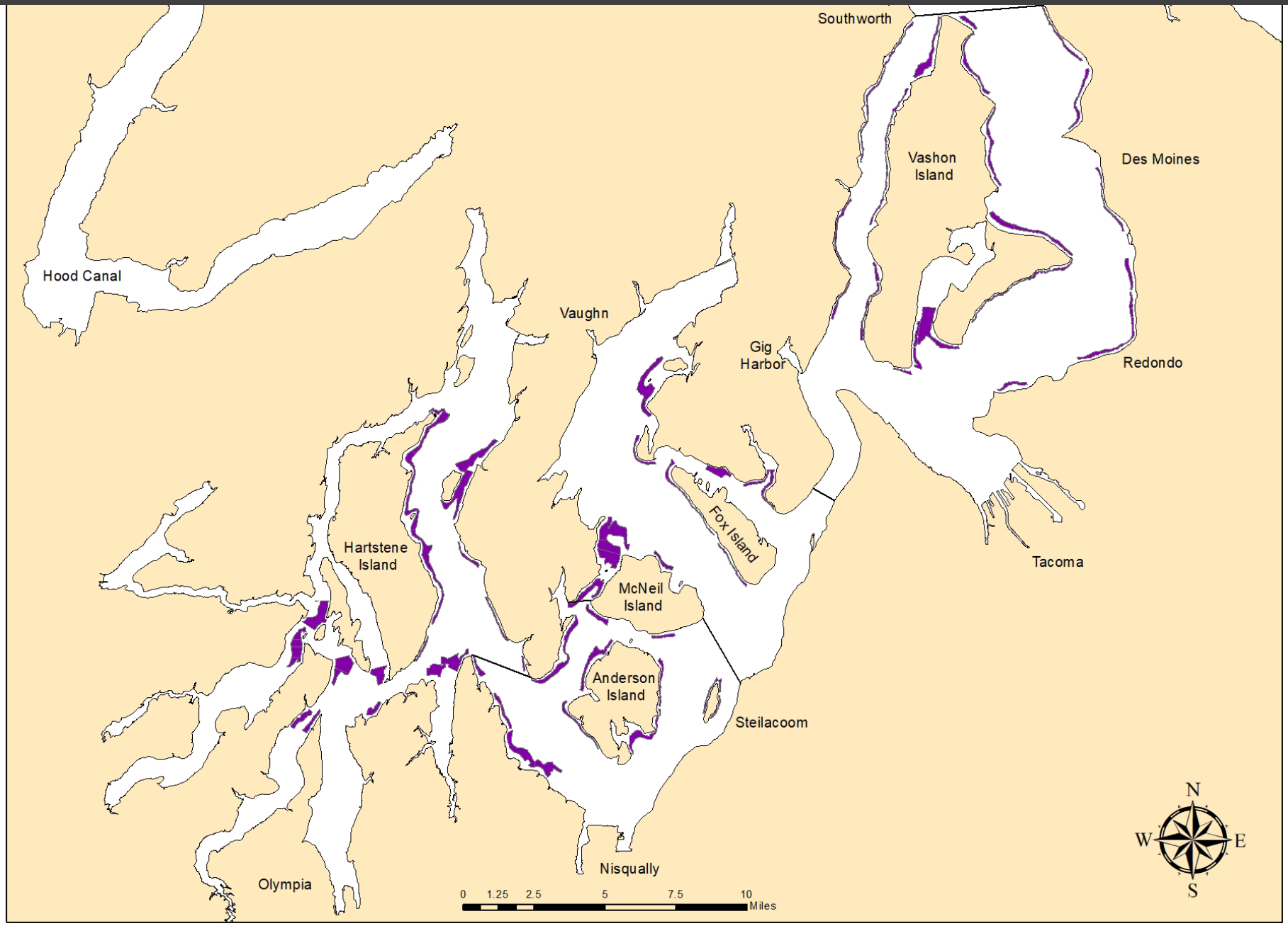
What should the harvest rate be?

Long-lived, slow-growing animals =
relatively low annual harvest rate

Harvest rate for the last 20 years (2.7%) has been advised by a yield model based on growth, age-at-maturity, fishery selectivity, and **natural mortality**.



Yield model doesn't prescribe a harvest rate, it computes a harvest rate given manager choices. **Yield model does not include tract recovery rate as a parameter.**


Southworth
Vashon Island
Des Moines
Hood Canal
Vaughn
Gig Harbor
Redondo
Fox Island
Tacoma
Hartstene Island
McNeil Island
Anderson Island
Steilacoom
Nisqually
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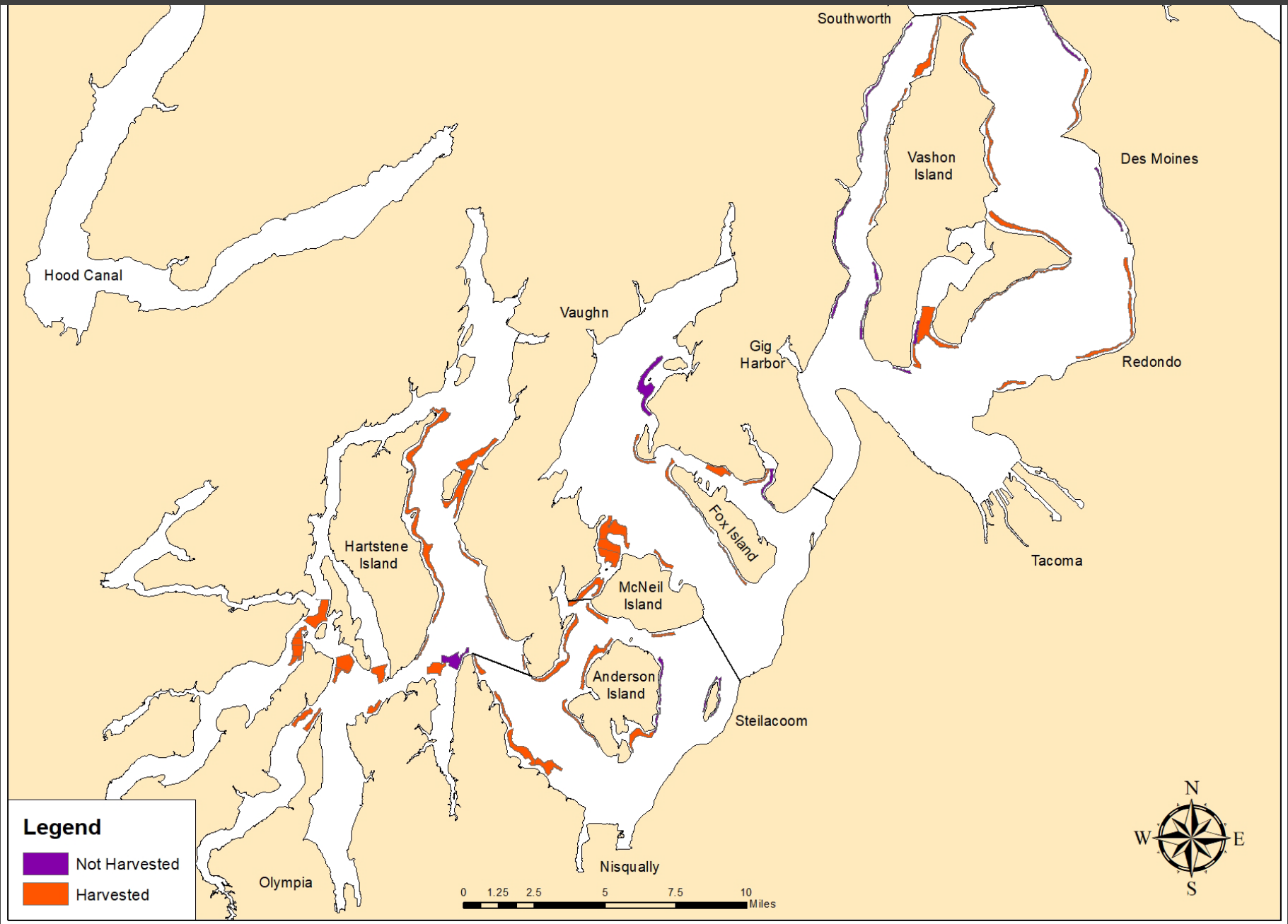
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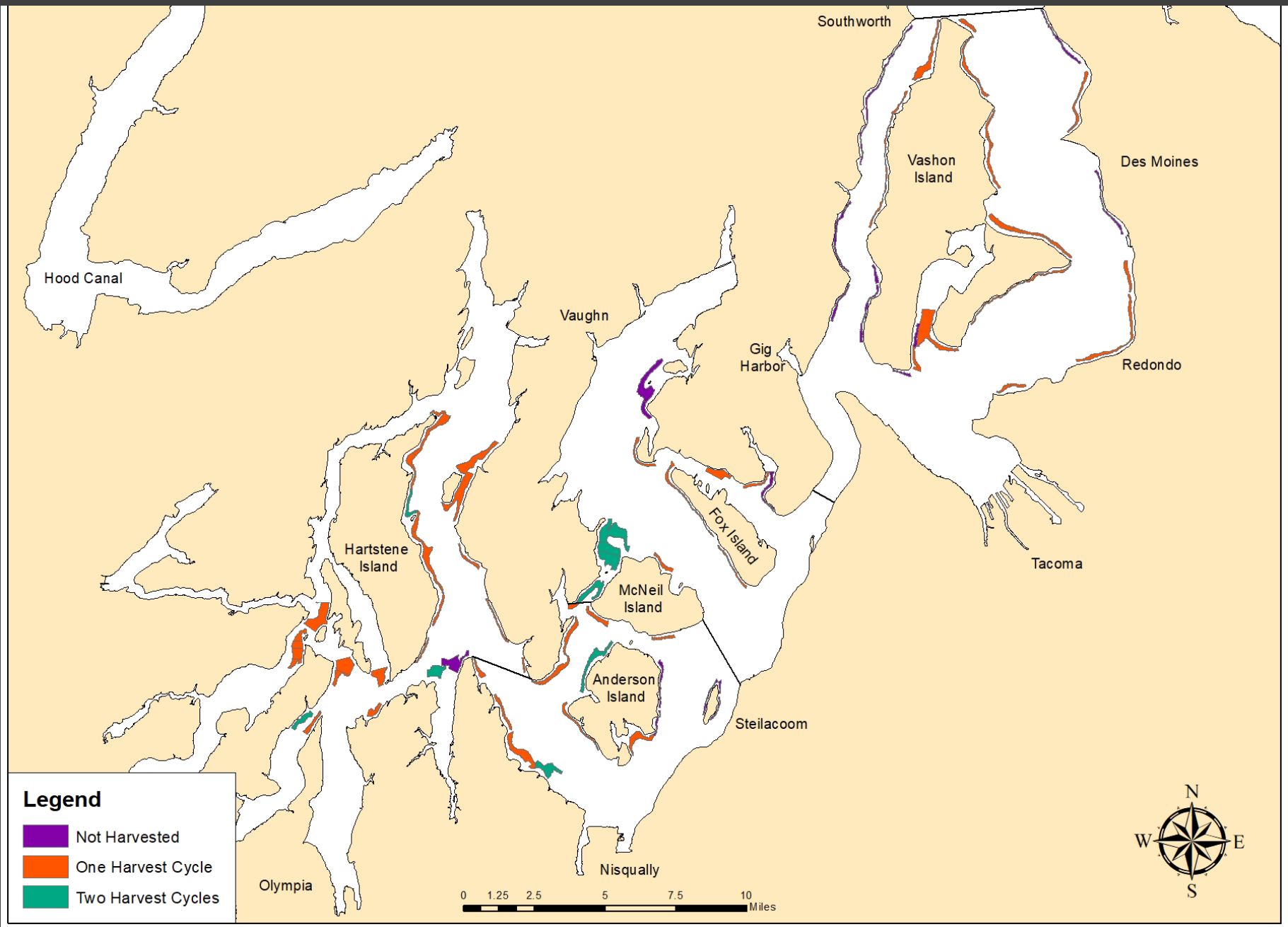
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Not Harvested
One Harvest Cycle
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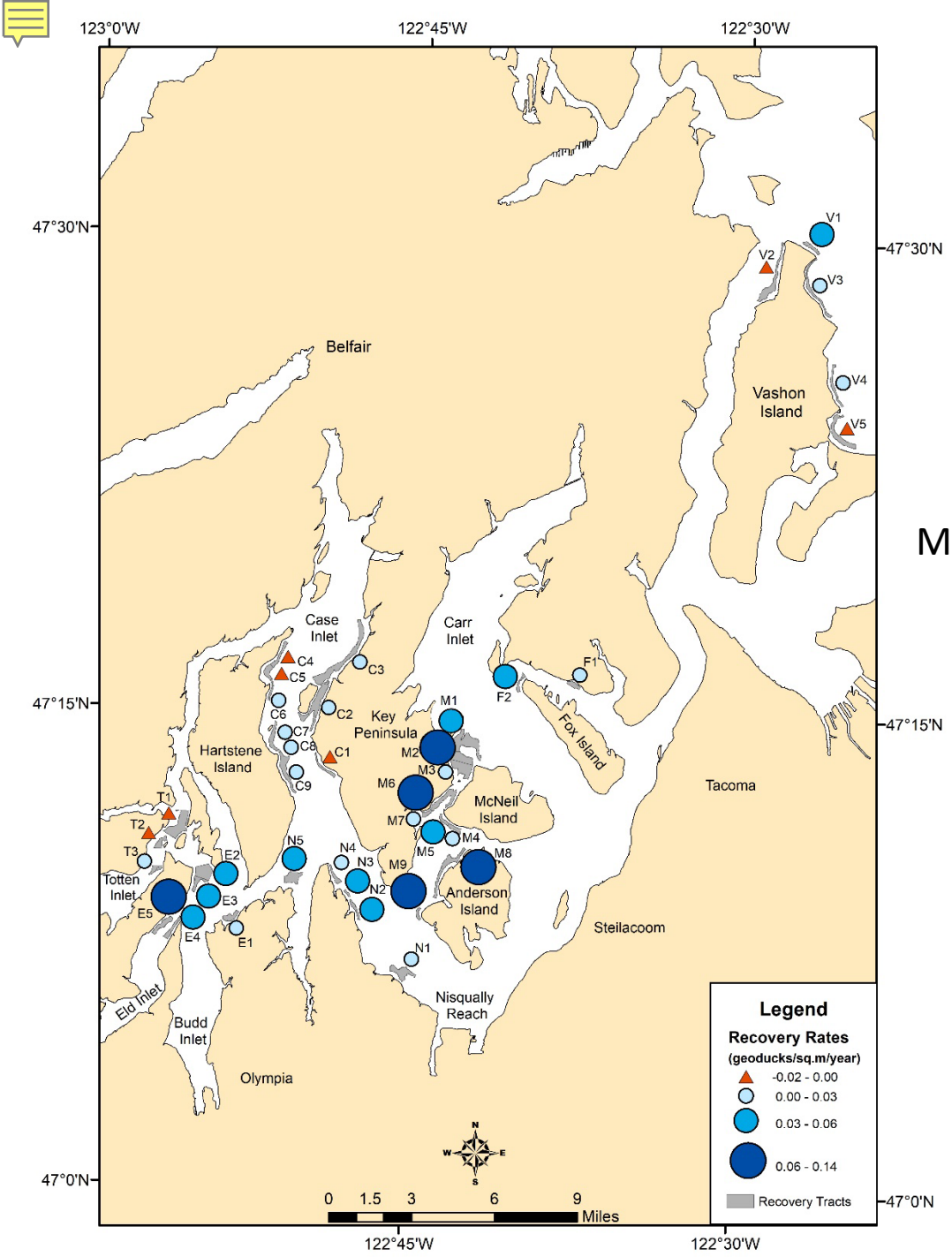
Do recovery rates agree with the harvest strategy?

Recovery rate is calculated from a series of surveys after fishing is completed

At time of model development, average time to recovery to pre-fishing density was estimated to be 39 years (range 11 – 73 years) based on 15 tracts.

The chosen harvest strategy and 2.7% annual harvest rate would be conservative relative to this recovery rate.

Does the most recent information (more tracts, more time elapsed) still agree with the harvest strategy?



South Puget Sound geoduck tracts for which a recovery rate can be calculated

Mean = 0.03 geoducks / m^2 / year

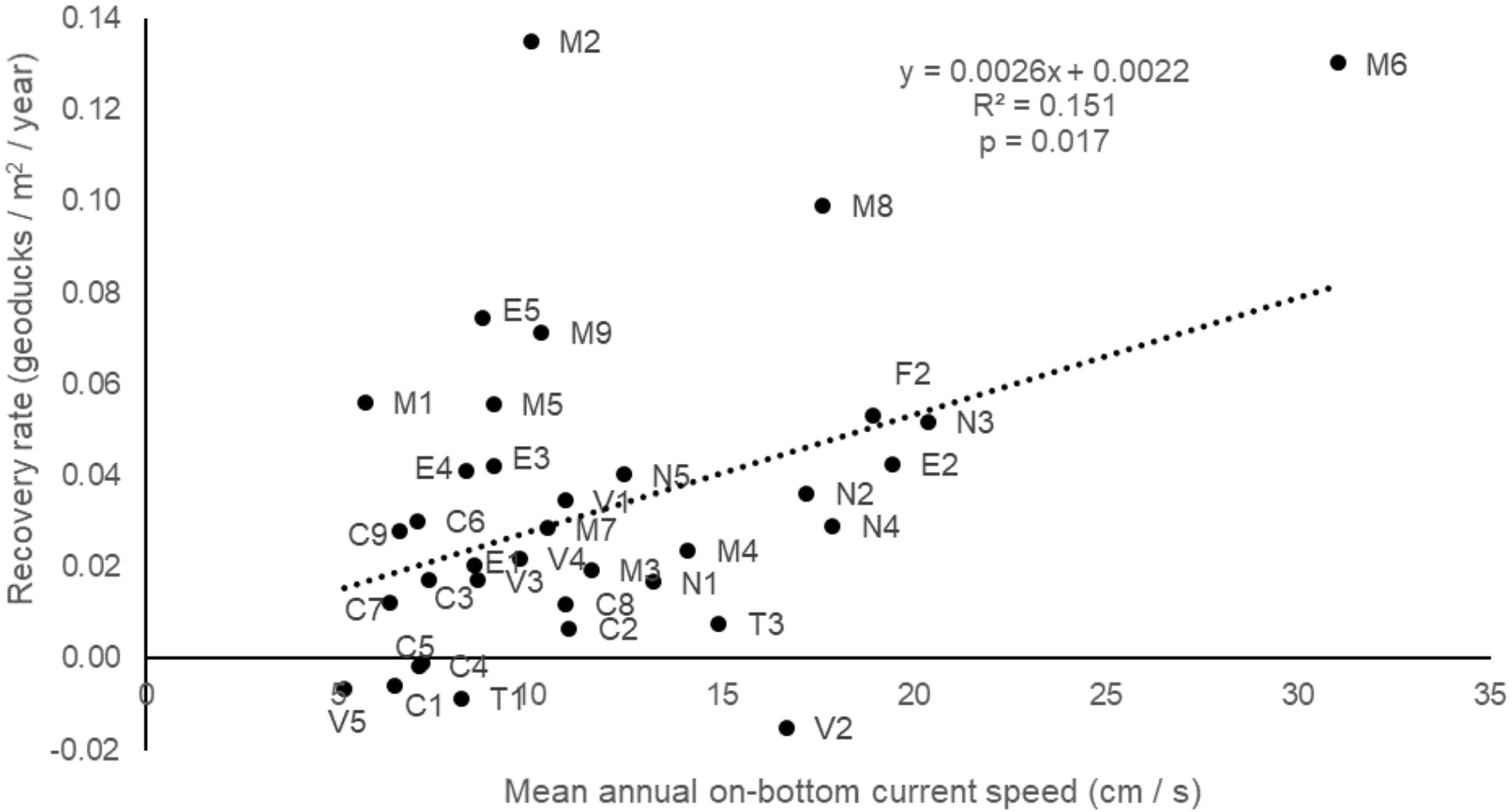
Mean Density Removed = 1.7 geoducks / m^2

Mean recovery time of 55 years

Stevick et al. 2021, Fisheries Research

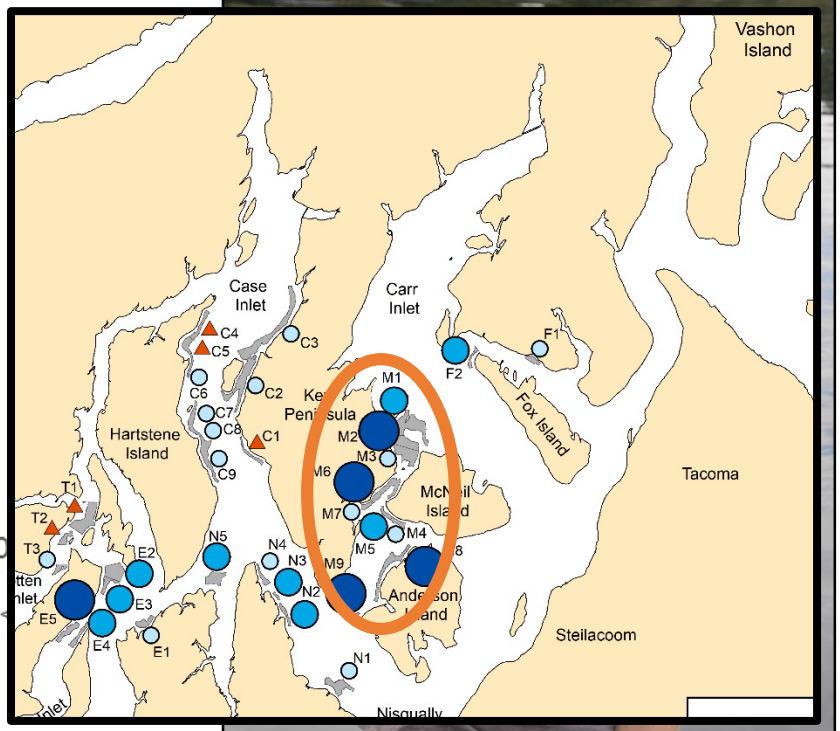
Why do some tracts recover faster than others?

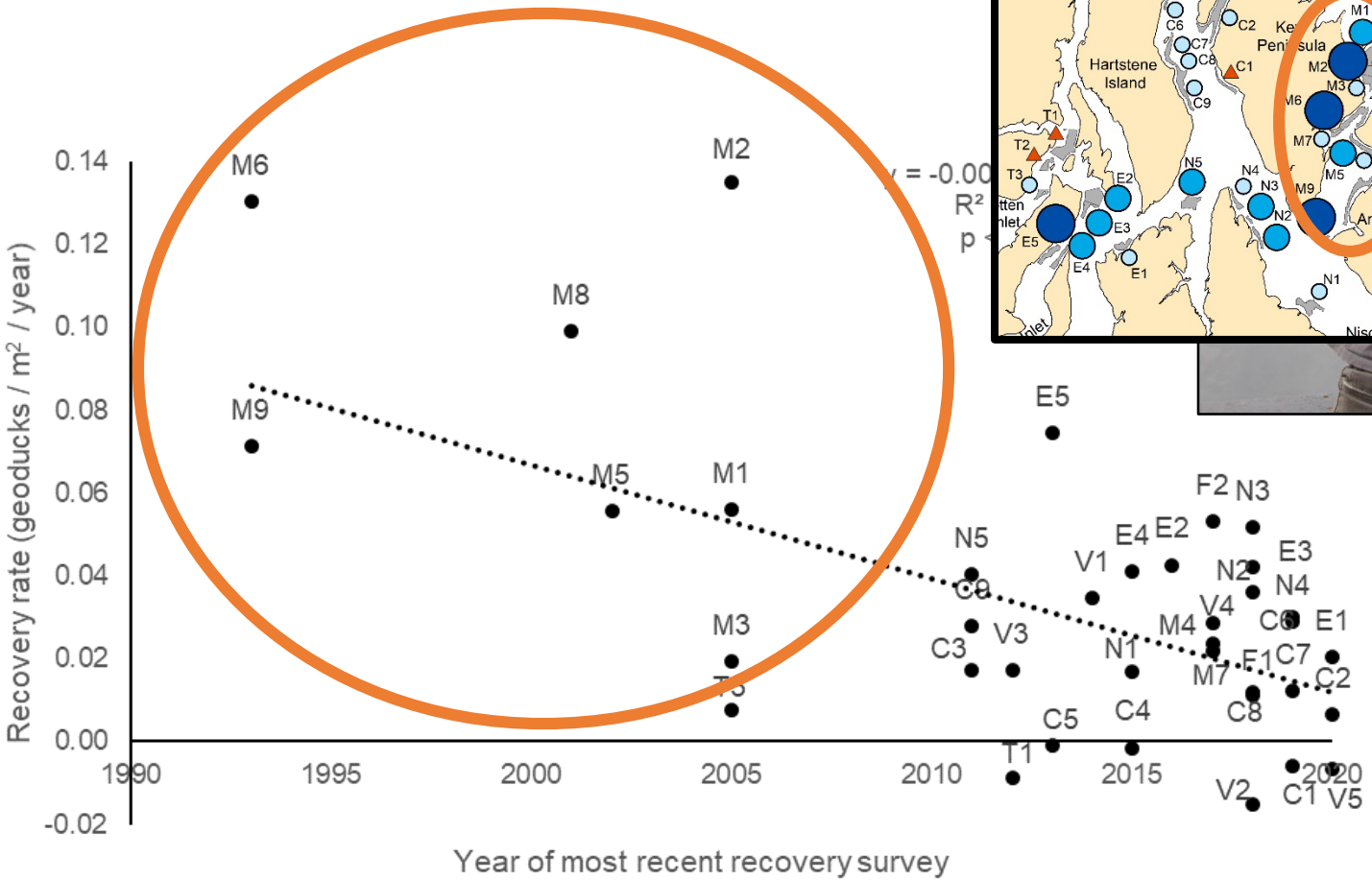
Aside from spatial patterns, we attempted regressions between recovery rate and substrate, year, pre-fishing density, post-fishing density, density removed, and % fish-down.



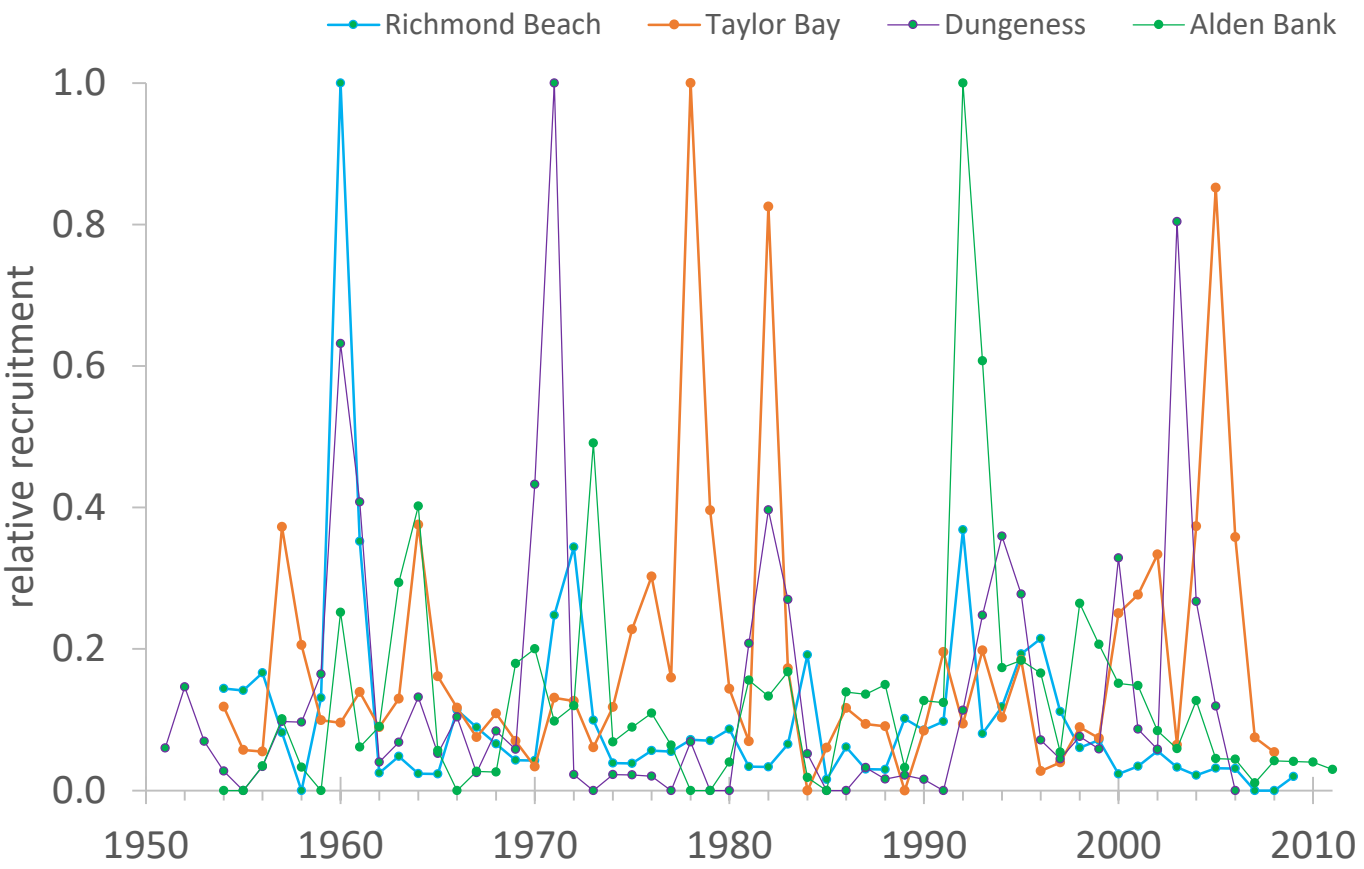
(current data: Ahmed et al. 2019, Ecology Pub. 19-03-001)

Is the recovery rate declining over time?

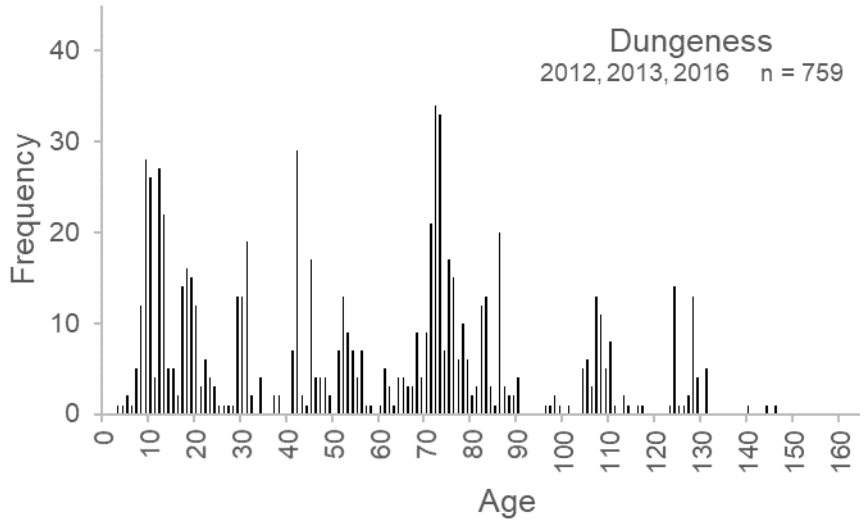


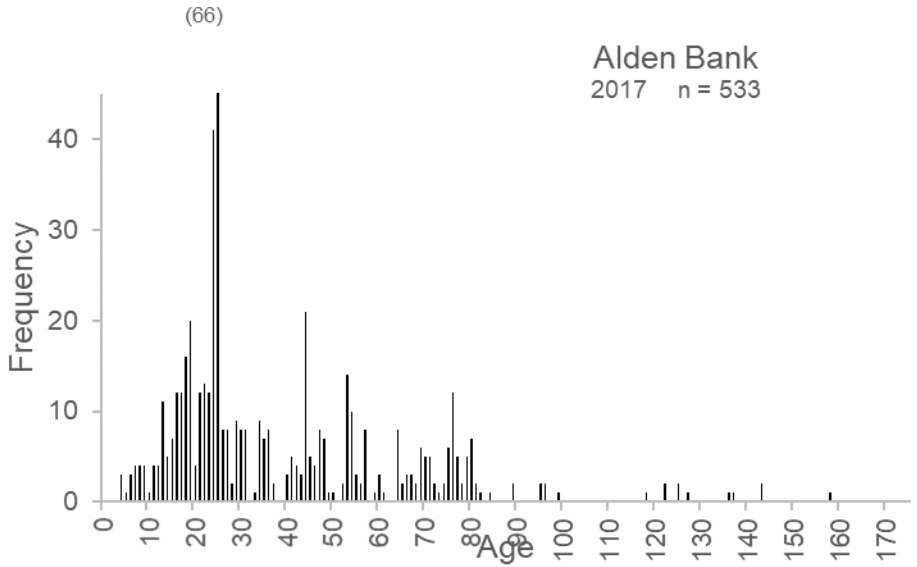


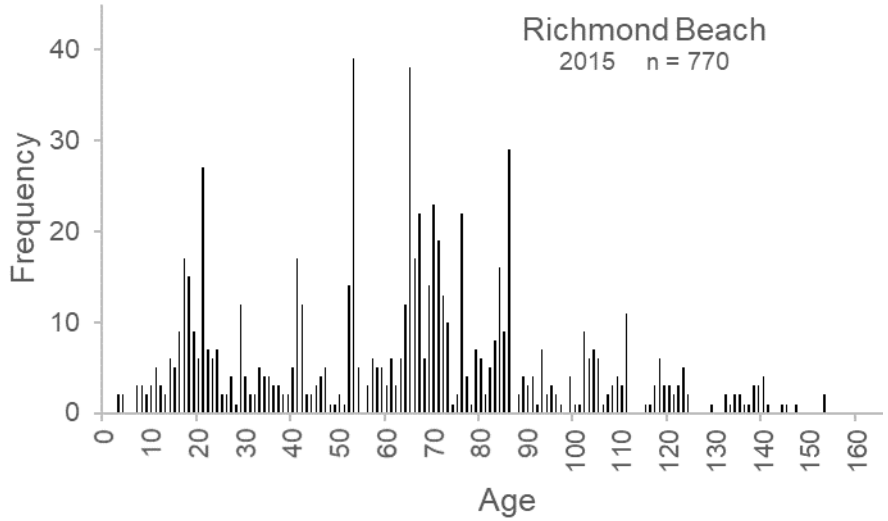
What is the shape of the recovery curve?

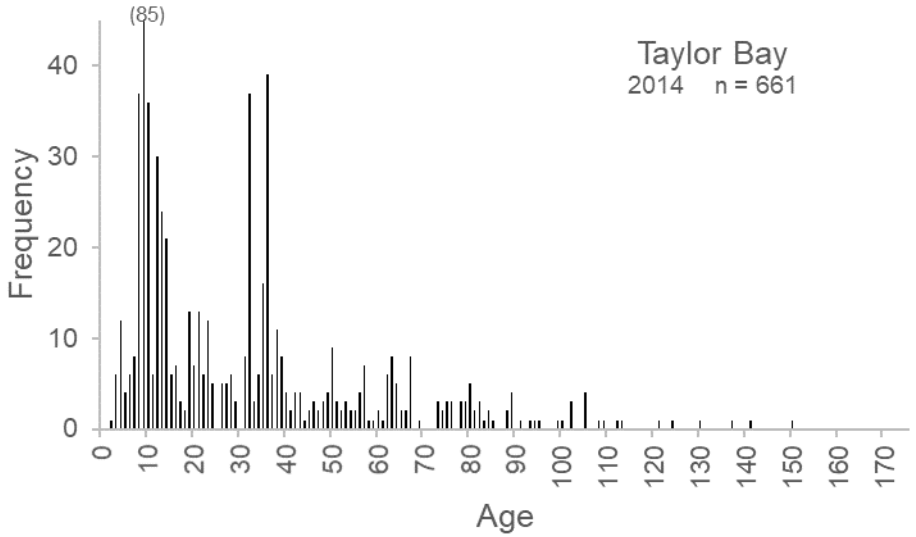


Why does recovery not agree with the model prediction?









Where should we go from here?

Empirically

~~Age-distribution~~-based estimate of natural mortality

Recovery-based management

~~Yield Model~~

"If it is based on a long span of time, an empirically determined turnover (i.e., recruitment) rate for commercially fished geoduck beds could be used to validate, improve, or replace the harvest rate strategies on the basis of structural models."

- Bradbury and Taggart 2000

Conclusions

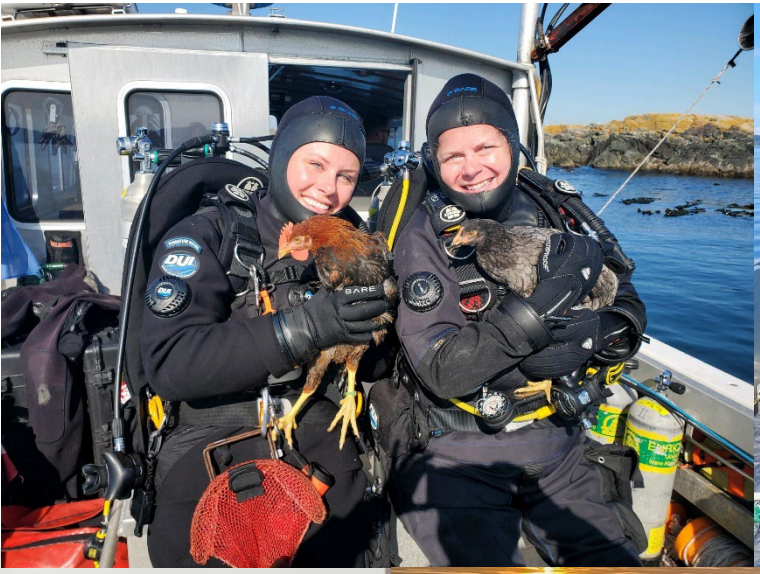
- Tract recovery is considerably slower than estimated when the current harvest strategy was developed.
- It is unclear if recruitment has slowed or there is simply more information from a longer period of time.
- It is also unclear why some areas are faster to recover than others.
- The shape of the recovery curve is also unknown.
- Some areas are transitioning to a recovery-rate-based system
  - All recovering tracts are surveyed on a rotational basis
  - Regional recovery rates are updated and inform harvest rates
  - In some regions, much work will be needed to get appropriate data

- No matter the details of the harvest strategy, total harvest will have to be reduced in areas with slow recovery.

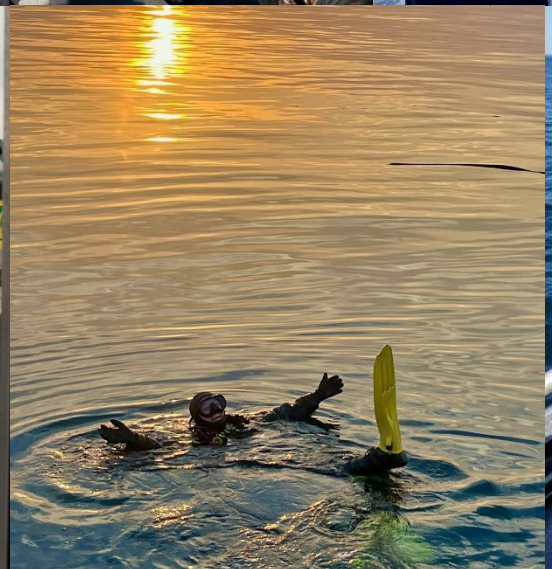
- The pace of the geoduck fishery is mind-blowing.

THANKS

To all the tribal and state divers who collected all the recovery information, John Gala at Ecology for Salish Sea Model information, and to those who helped compile information such as Eric Sparkman and Bob Conrad.







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