Seal and sea lion predation on rockfish in Puget Sound

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Rockfish and Hexagrammids

- Intense sport and commercial fisheries in the late 1970s and early 1980s reduced lingcod and rockfish to extremely low abundance by the early 1990s.
- Lingcod are in above average condition in north PS currently due to changes in fishing regulations.
- Rockfish populations in many or all areas of Puget Sound including the San Juan Islands are in critical condition.
- Puget Sound/Georgia Basin Distinct Population Segments of Yelloweye and Canary Rockfish are listed as threatened, and Bocaccio Rockfish as endangered under the US Endangered Species Act.
Competition by pinnipeds for fish resources has intensified since MMPA was enacted in 1972 and bounties ceased. Washington pinniped populations have increased 7-10x.
Pinnipeds in Salish Sea

- 50-60,000
- 500-1,000 *
Pinniped foraging

- Opportunistic predators - feed on locally abundant prey and commonly switch prey types as prey abundances change annually and seasonally
- Diet typically dominated by a few species ~ adult salmon, herring and gadids
Pinniped diet studies using scat in Salish Sea

Harbor seals
- Protection Island (1980s)
- Strait of Georgia (1990s)
- San Juan Islands - ???

California sea lions
- Everett (late 1980s-early 1990s)

Steller sea lions
- No data
San Juan Islands

- Area of focus for a number of rockfish recovery efforts
- Marine reserves designed to recover rockfish, ling cod and other bottom-fish were established.
- Harbor seal population has grown exponentially in recent years, with an estimated 41,500 – 56,400 harbor seals distributed in the San Juan Islands, Strait of Juan de Fuca and Strait of Georgia
- No diet data
Harbor seals use over 150 haulout locations throughout San Juan Island archipelago.

One of the most dense concentrations of seals in the world!
4 Specific Aims

1. Describe the relative importance of each prey species or family in the diet of seals
2. Determine if there are significant differences in seal diet seasonally and regionally
3. Estimate the size (age) of rockfish (to species if possible) being consumed by seals using otoliths recovered from scat samples
4. Determine whether different methods of investigating diet produce different estimates of rockfish consumed
3 ways to examine seal diet

1. Scats

2. Fatty Acids

3. Stable Isotopes
Scat Sample collection

4 years:

- Spring – March/April
- Summer/Fall – Aug/Sept
- Winter – Dec/Jan/Feb

4 Regions
Scat collection and processing
Estimated frequency of occurrence of the 6 primary prey species or species groups in harbor seal scat samples (n=1683) for spring, summer/fall and winter seasons, 2005-2008, in the San Juan Islands.
Estimated frequency of occurrence of the 6 primary prey species or species groups in harbor seal scat samples (n=1683) by region all seasons combined, 2005-2008, in the San Juan Islands.

- Ad Salmon
- Anchovy
- Herring
- Gadids
- Other
- Sand lance
- Rockfish

Graph showing frequency of occurrence with regions indicated as EB, RS, SJC, and SSG.
Rockfish species

Few otoliths recovered

All ages:
• juvenile (age 0-2)
• subadult (age 2-4)
• adult (age 6+)

Species:
Yelloweye Rockfish
Black Rockfish
Puget Sound Rockfish +
Rockfish

- Small amount of predation may be important when harbor seal and rockfish populations are put into context.

- Rockfish may be “buffered” from predation when other prey species are abundant.

- Rockfish may be more likely to be consumed during winter when harbor seal diet becomes more diverse.
Fatty Acids

Primary prey species / multiple age classes / n=267
Fatty Acids


Padilla Bay Vendovi Is.
Bird Rocks ** Belle Chain

blubber core
PRELIMINARY: Average diet composition using fatty acid analysis of harbor seals in the Bird Rocks region in the spring (n=6) and fall (n=4) of 2007 and the winter (n=4) of early 2008.
Comparison of 2 methods for estimating diet

Different estimates!!!

Scat data produce frequency of occurrence statistics (sum can be greater than 100%)

Fatty acid data produce an estimate of true diet composition (sum = 100%)

For example, every scat could contain herring remains (100% frequency of occurrence), but that does not mean that herring are all that is being eaten.
Comparison of 2 methods for estimating diet

**Adult Salmon:**
Scat (RS): 16-49%
FA: 0 - <1%

**Herring**
Scat (RS): 16-64%
FA: 0-22%

**Rockfish**
Scat (RS): 4-10% overall
FA: 0-12%
Comparison of 2 methods for estimating diet

Large, adult rockfish may be under represented in diet if they are either torn apart at the surface or if they are not ingested and spewed.

Not the case for small schooling species – PS RF
Comparison of 2 methods for estimating diet

Scat samples are composed of what was eaten in previous 24-48 hrs

Fatty acid profiles provide what was consumed during previous weeks

Potentially important difference for seasonally abundant prey species - adult salmon appear to be nearly absent from the diets according to QFASA results, no blubber samples were collected from late May-early October when adult salmon are most abundant
Foraging Ecology

Satellite tags

TDR

• Mk9

• Mk10F (GPS)

HTR
Comparison of 2 methods for estimating diet fatty acid results with caution

- Analyses are ongoing
- Sample sizes are small
- Prey groups may be adjusted
Rockfish population models should incorporate the low and high estimated pinniped predation rates on rockfish in diet analyses.
Percentage occurrence (FO) of prey species in Steller sea lion scat samples, 2006-2008, in the San Juan Islands (n=67)

1 sample contained adult rockfish remains
California sea lions

- No diet data have been collected in the San Juan Islands
- Numbers are low
- No predation threat to rockfish at this time
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Questions?