Age, growth and maturity estimates of spotted ratfish (*Hydrolagus colliei*) in British Columbia

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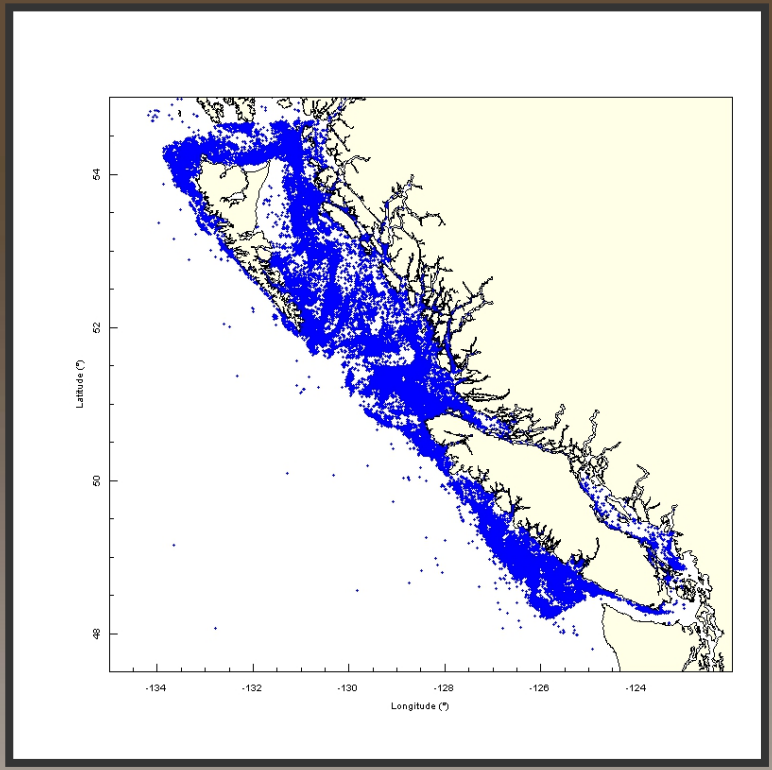
Biology

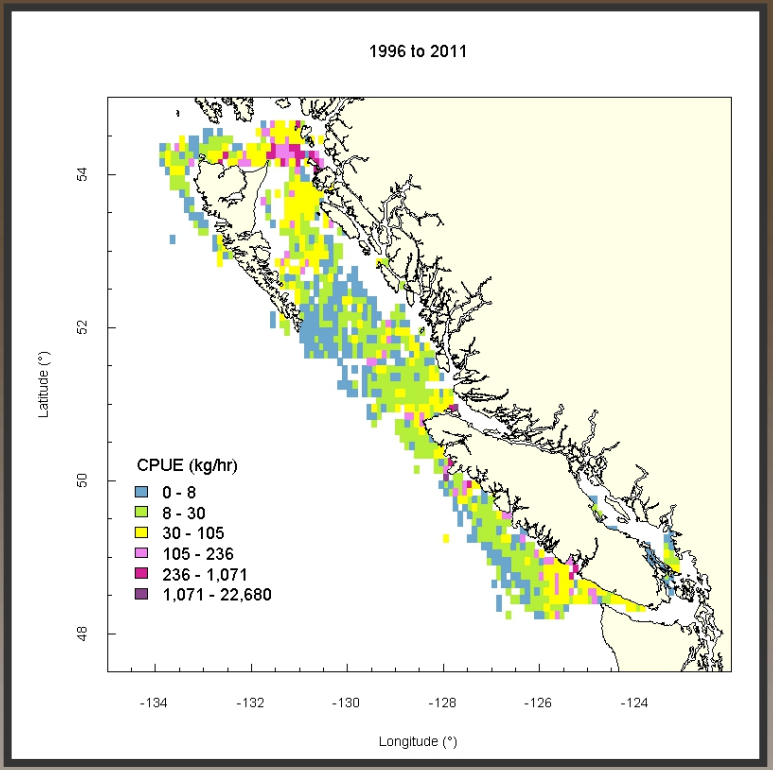
- Shortnose chimaera (Chondrichthyan - sharks, skates)
- Prominent venomous spine at first dorsal fin
- Males have a frontal tenaculum atop the head
- Oviparous: single embryo in an egg case
- Gestation: 9-12 months (Dean 1906)
- Emerge at about 13 cm and grow quickly in the first year to about 30 cm; maximum length of 100 cm
- Chondrichthyans are equilibrium strategists (King and McFarlane, 2003) with extreme low fecundity, late maturation and longevity making them susceptible to overexploitation

Abundance and distribution

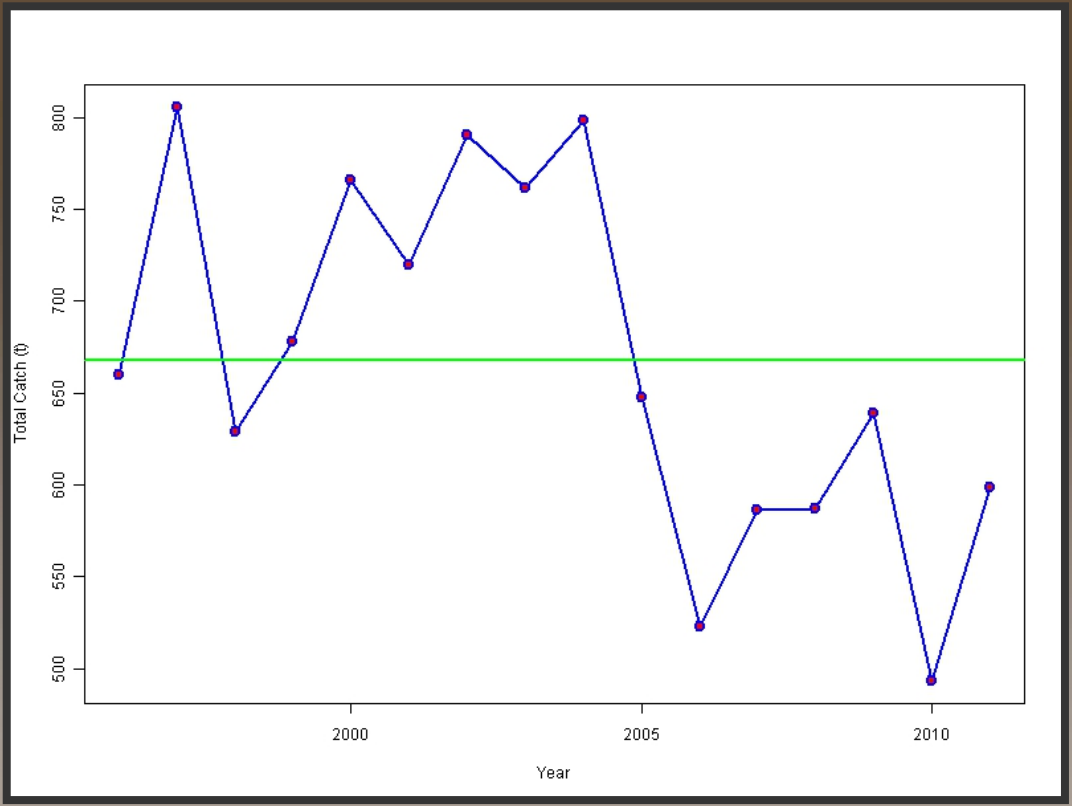
- benthic on the continental shelf and along the slope
  - including bays, sounds and inland waters
- intertidal to depths 913 m (Alverson 1964)
- observed BC commercial bottom trawl of 1,029 m

Abundance and distribution





Abundance and distribution



- peak of 800 tonnes
- bycatch by trawl averages 540 tonnes per year

- fourth highest (by weight) bycatch species in the BC trawl fishery following arrowtooth flounder, spiny dogfish and Pacific hake
- yet stock status is unassessed, and sustainability of bycatch unknown

Need for age estimates

- Stock Status
  - Sustainable Fisheries Framework
    - stock status of all encountered fish
  - Marine Stewardship Council
    - impacts of certified fisheries on bycatch species
  - International focus on chondrichthyans (FAO, IUCN)
- Ecosystem Role
  - large biomass?
  - diet consists of crabs and euphausiids
    - overlap with all flatfish (halibut, sole, arrowtooth flounder)
- vital life rates (growth, maturity schedules, mortality) dependent on age estimates
  - yet unknown

Age and growth estimation

- despite being highly abundant and widely distributed, very little is known throughout their range
- recently (Barnett et al. 2009) for CA to WA:
  - $PCL_{50\%}$ 36 cm for females and 29 cm for males
    - size at 50% maturity increased with latitude
- chondrichthyans lack bony structures (otoliths)
- age estimates for other chimaeras available from dorsal spine band counts of transverse sections (Sullivan, 1977; Freer and Griffiths, 1993; Moura et al., 2004; Calis et al., 2005)
  - recently, Barnett et al. 2009 rejected dorsal spines band counts for *H. colliei*

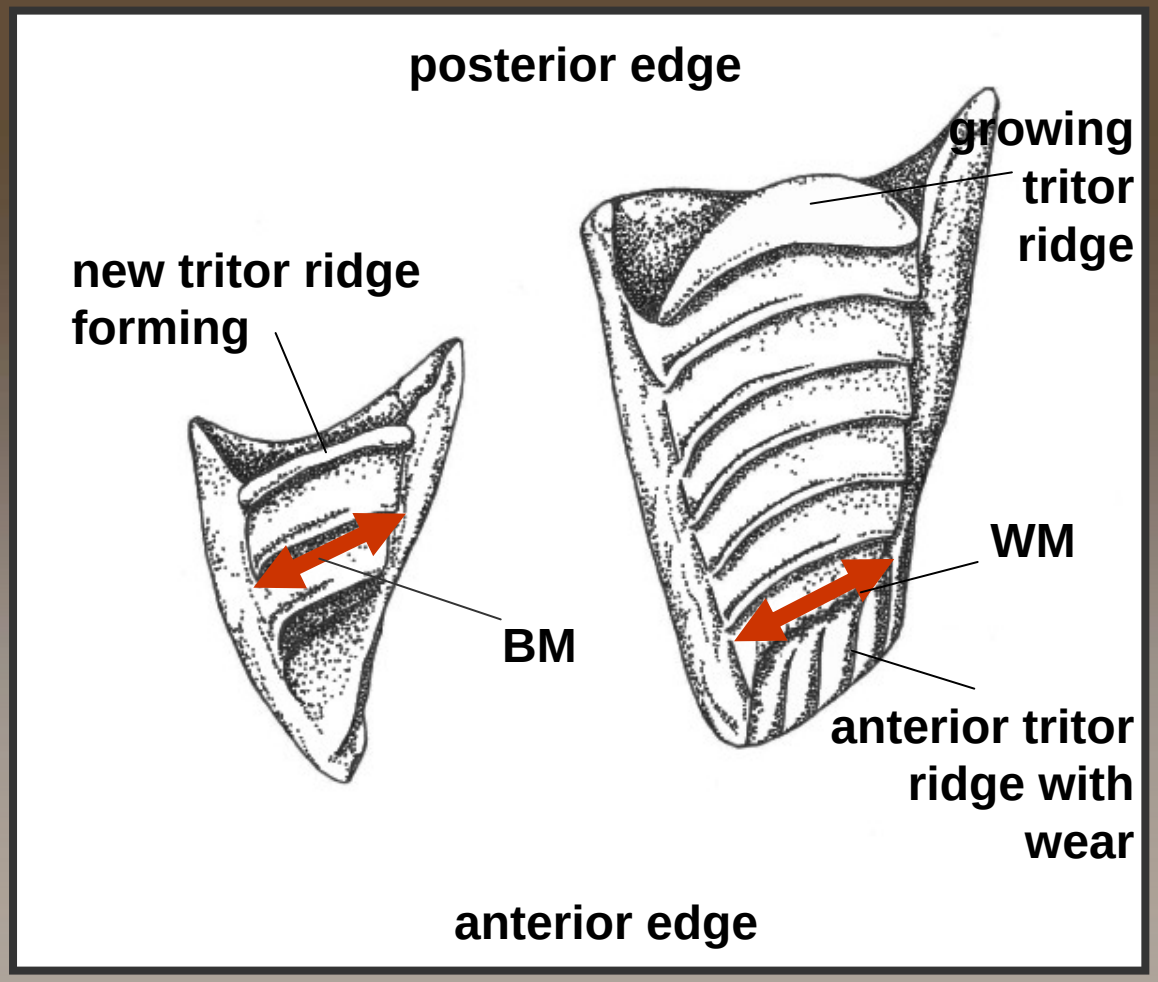
Age and growth estimation

- number of tritor ridges on the vomerine tooth plates increases with size of fish (Johnson and Horton, 1972)
  - anterior edges are worn, so complete counts can not be made for older fish
  - posterior growth is continuous throughout its life, but is it aseasonal? (Didier and Rosenberger, 2002)

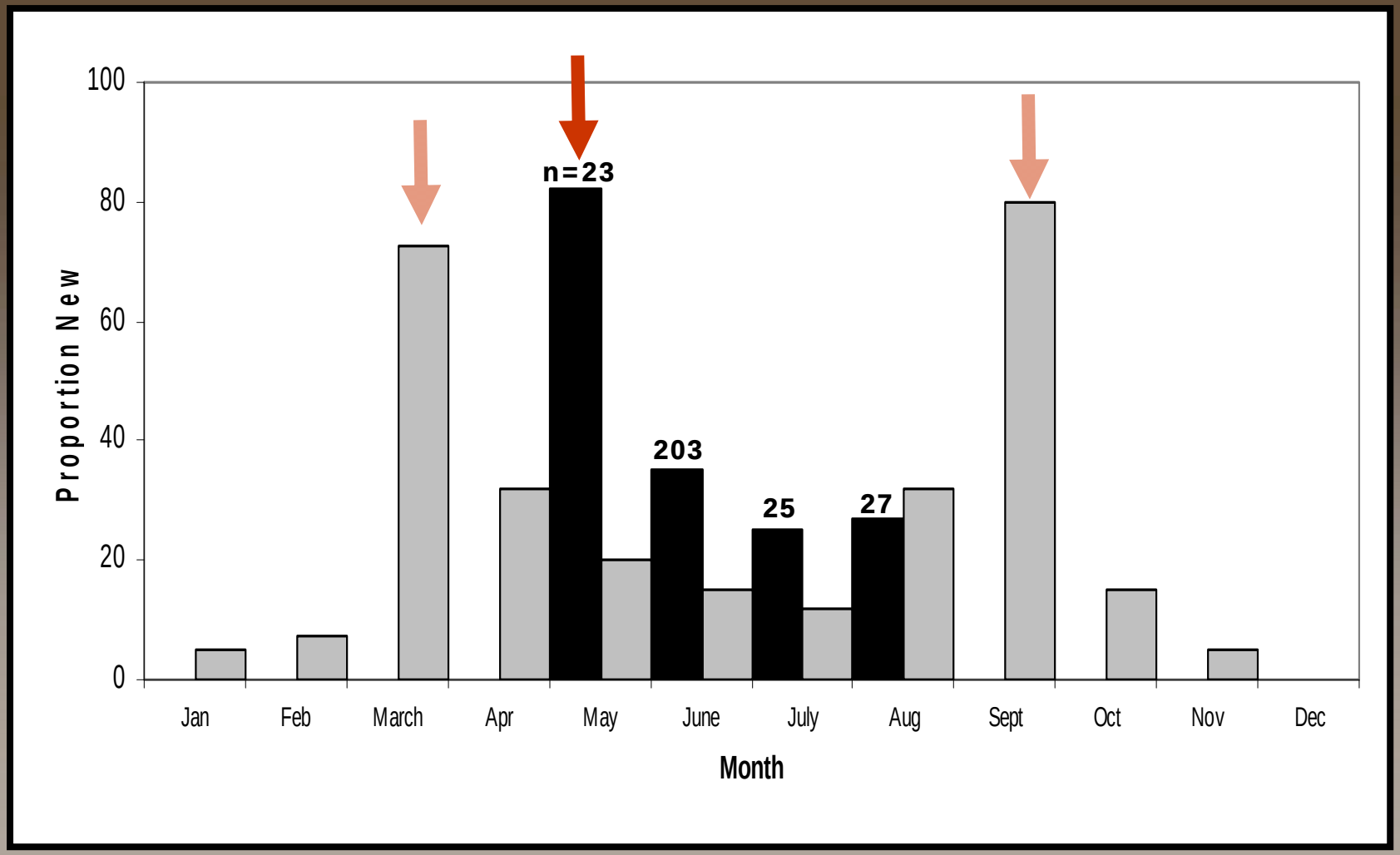
Age and growth estimation

- tritor ridges of the vomerine tooth plate have been used for age estimation of spookfish, *H. mitsukurii*, in Taiwanese waters (Cheng-Hao, 2011)
  - anterior edges are worn, so complete counts can not be made for older fish
    - *use widths to estimate worn ridges*
  - posterior growth is continuous throughout its life, but is it aseasonal?
    - *evidence that ridges are formed seasonally*

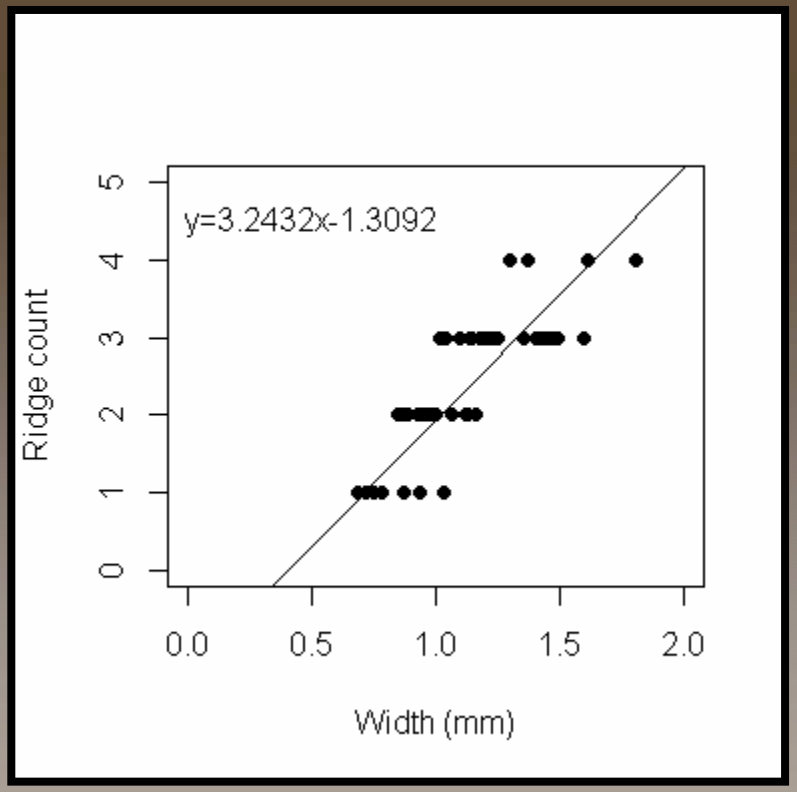
Vomerine tritor ridges



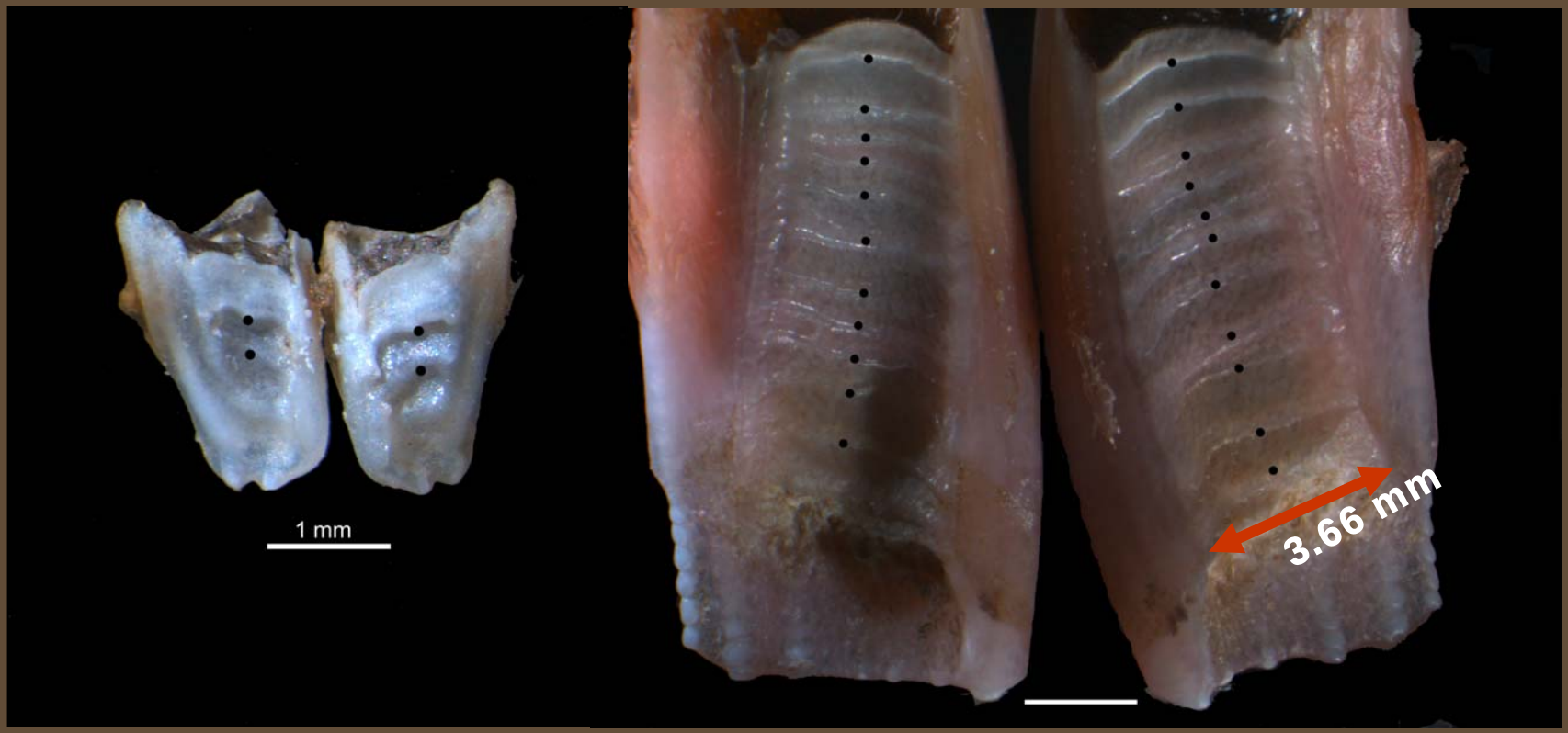
Seasonality of developing tritor ridges



Estimating worn tritor ridges



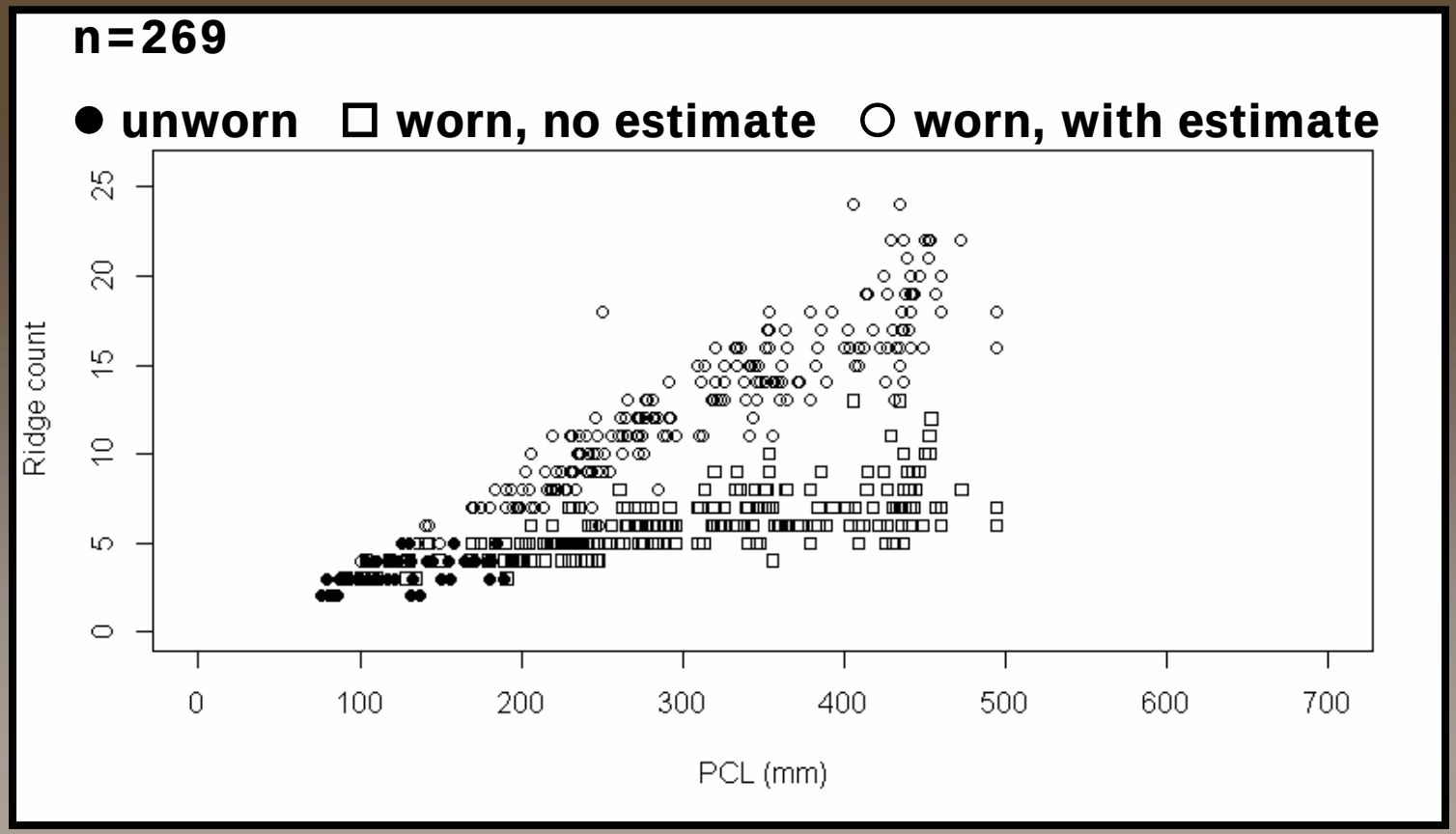
- n=52 immature fish
- PCL range 76-194 mm
- number of complete tritor ridges 1-4
- $p<<0.001$; $R^2 = 0.76$
- non-linear estimation not significant



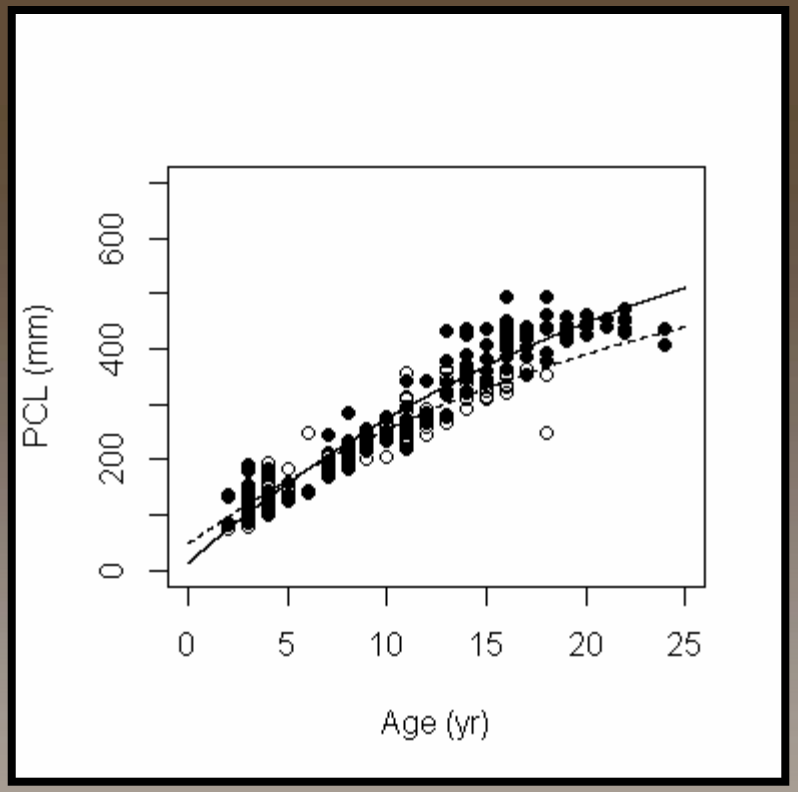
- immature male; PCL=83 mm
- 2 developed tritor ridges
- age estimate=2

- mature female; PCL=454 mm
- 11 developed tritor ridges
- estimated worn tritors = 11 (-1)
- age estimate = 21

Increasing ridge count with size

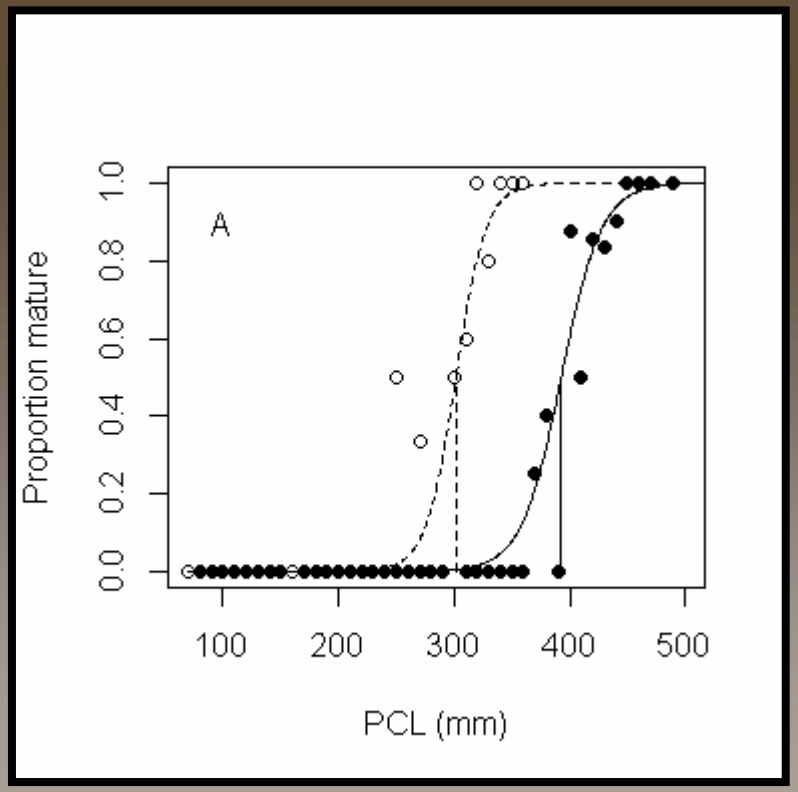


Growth curve estimation: one ridge per year



- Males (n=118)
  - L_{inf} = 652 mm
  - k = 0.04
  - t_0 = -1.85
- Females (n=151)
  - L_{inf} = 789 mm
  - k = 0.04
  - t_0 = -0.43
- F=2.39, p<<0.001
- two ridges per year doubles the growth coefficient k

Size at 50% maturity estimation



- Males
  - $PCL_{50\%}$ = 302 mm
- Females
  - $PCL_{50\%}$ = 393 mm
- larger size-at-50% than southern latitudes

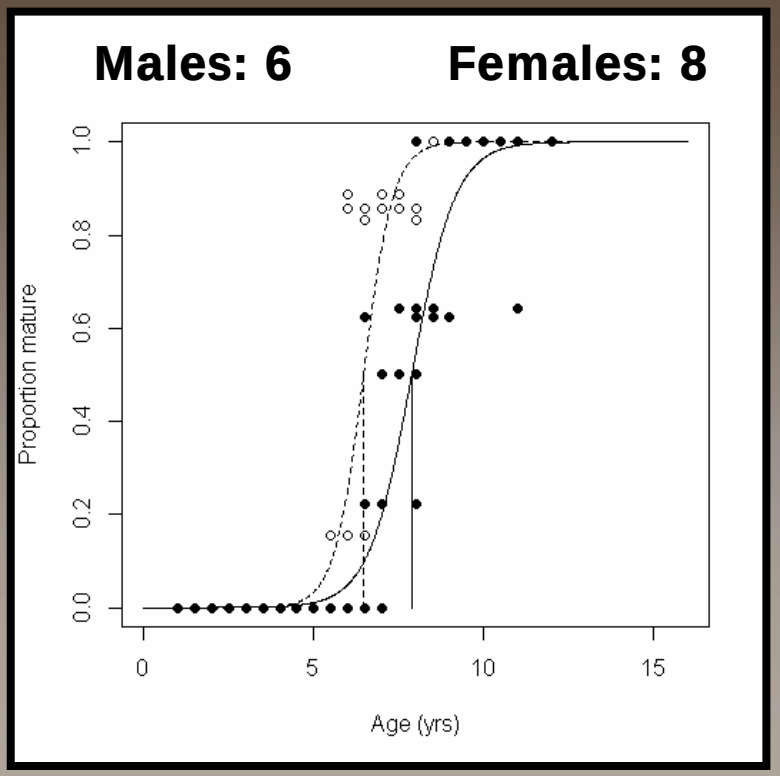
CA to WA:

- Males
  - $PCL_{50\%}$ = 285 mm
- Females
  - $PCL_{50\%}$ = 359 mm

Age at 50% maturity estimation

One ridge per year

Two ridges per year



If you made me guess.....

.....I would guess one ridge formation per year

- these ecosystems have a very distinct seasonal cessation to growth in other species
  - one annuli formation per year is well documented

- we are collecting seasonal specimens

Conclusions

- there are regional differences in size at maturity
  - BC estimates are larger than CA-WA estimates
- vomerine tooth plates are a potential age estimation structure based on tritor ridge count
  - number of worn ridges can be estimated
    - extend the count ~ width relationship
  - requires full seasonal edge analyses to identify the periodicity of growth
  - requires validation - bomb radiocarbon analyses