

Biology of the Breaksea Cod *Epinephelides armatus*, a serranid with an unusual pattern of sexual development

Photo: Bryn Farmer

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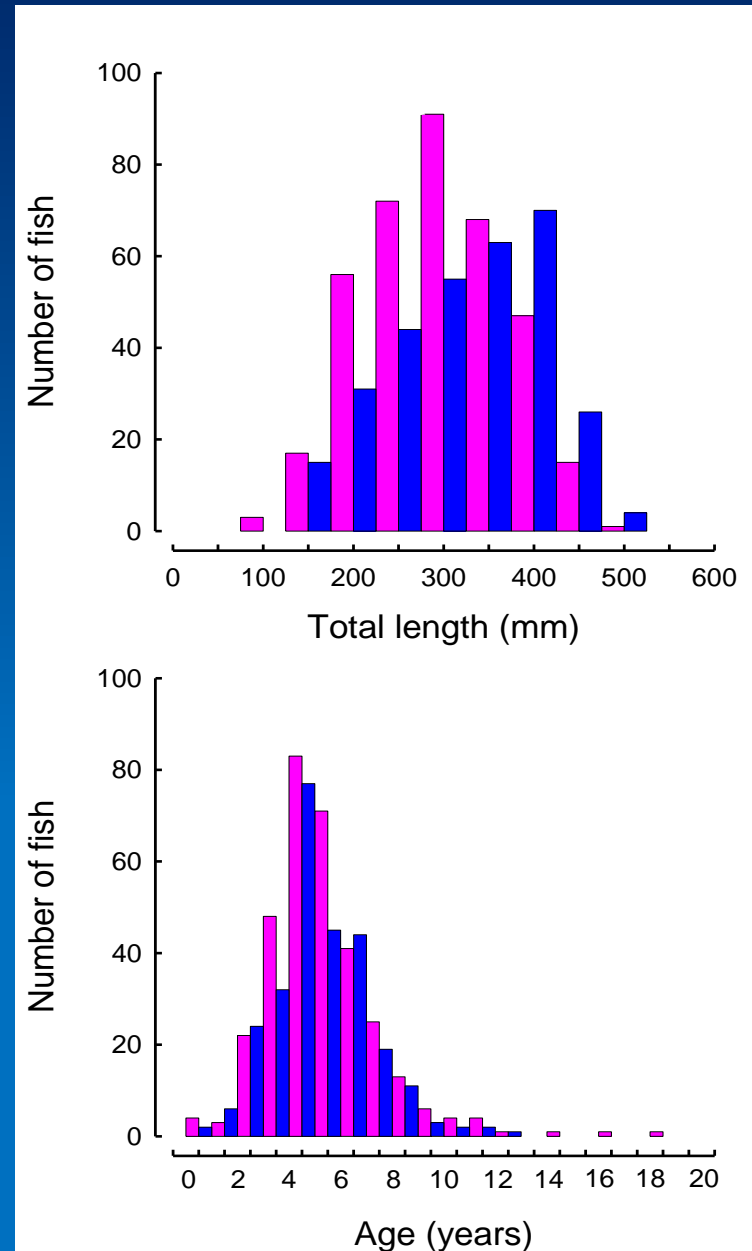


Breaksea Cod (*Epinephelides armatus*)

- ❖ Medium-sized fish (~ 3 kg), recreationally important
- ❖ Endemic to south-western Australia
- ❖ Sub-family Anthiinae, sole member of *Epinephelides*
- ❖ Suggested (in unpublished work) to be a protogynous hermaphrodite (female to male sex change)
- ❖ Many serranid species are protogynous hermaphrodites
- ❖ However, several serranid species previously designated as protogynous hermaphrodites later shown to be gonochoristic (separate sexes)

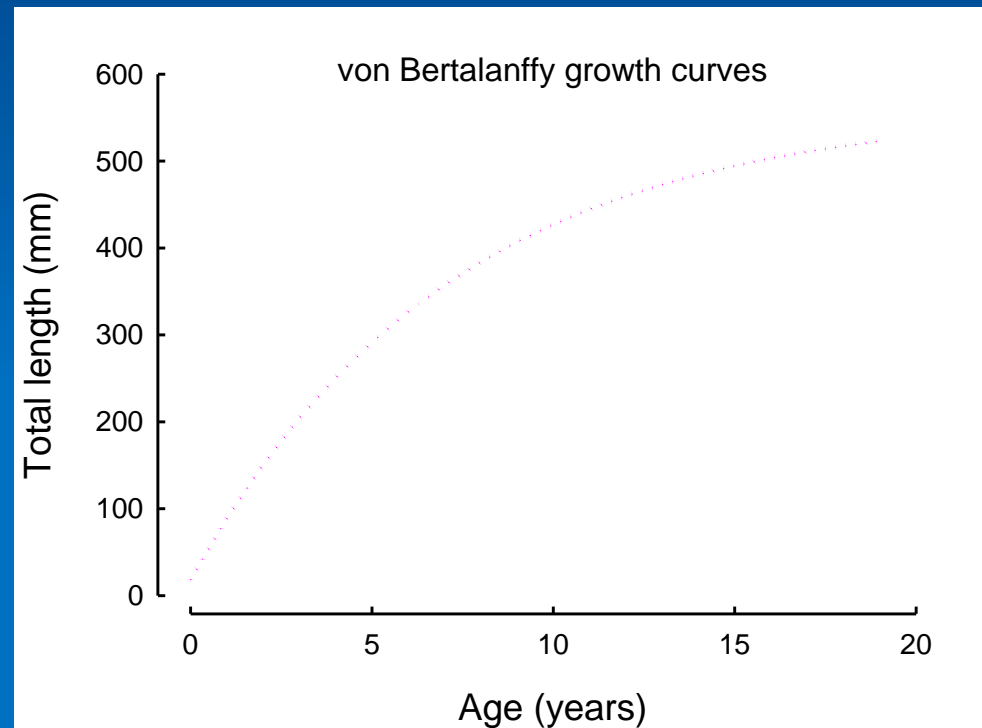
Length and age compositions

- ❖ Length-frequency distributions for the two sexes differ
- ❖ Males dominate larger length classes
- ❖ Age-frequency distributions for the two sexes similar
- ❖ Age compositions thus provide no clear evidence of hermaphroditism



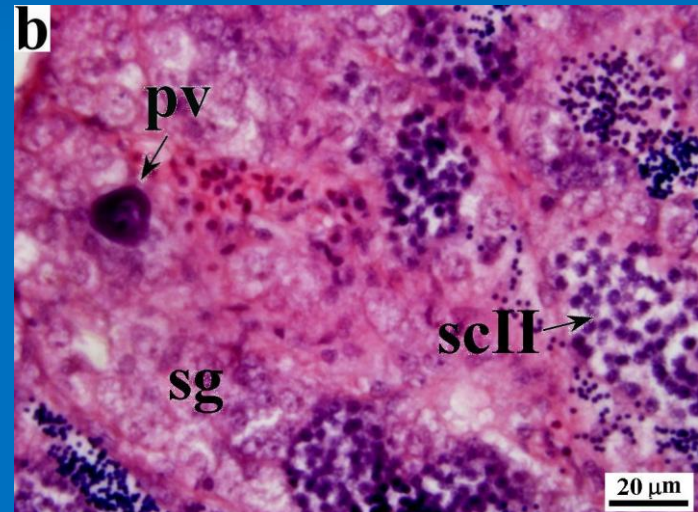
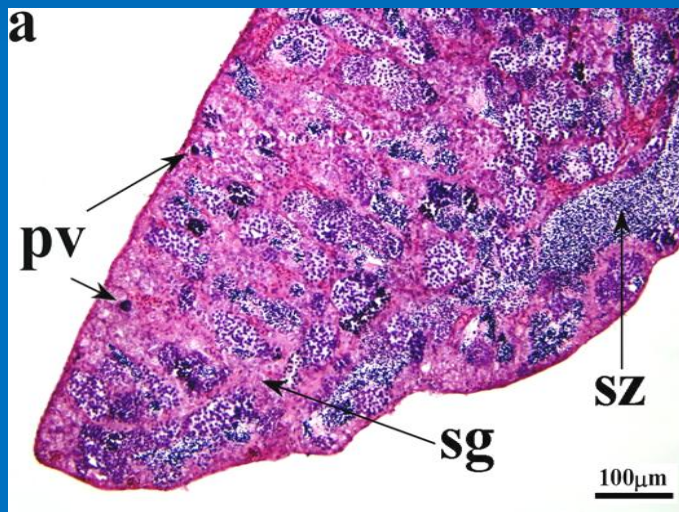
Growth of males and females

- ❖ Lengths at age of males greater than females throughout most of life
- ❖ Age 3 - 225 vs 200 mm
- ❖ Age 5 - 358 vs 327 mm
- ❖ Slightly faster growth of males helps explain differences in size compositions



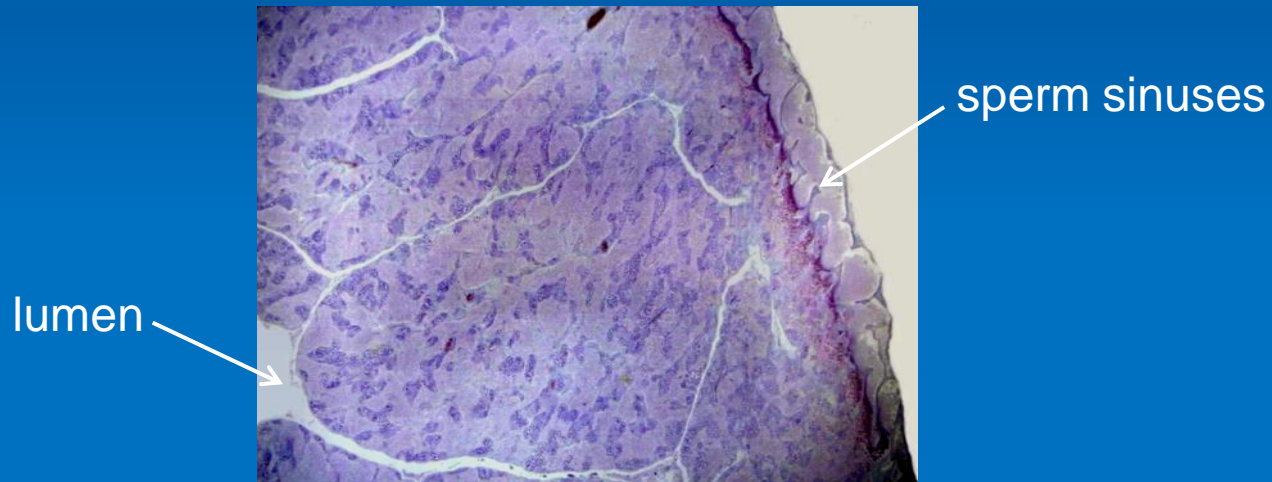
Histology provided no evidence for protogynous hermaphroditism

- ❖ 180 histological sections of gonads examined, covering a wide size range of fish, caught from throughout the year
- ❖ No ovaries contained testicular tissue
- ❖ 3 testes contained a few, scattered previtellogenic oocytes



Secondary testes

- ❖ “All male serranids have secondary testes” (Sadovy & Domeier, 2005)
- ❖ Secondary testes are testes which contain a central, “ovarian” lumen and peripheral sperm sinuses. These testes are considered to have been derived from ovaries, as in *Epinephelus coioides*.



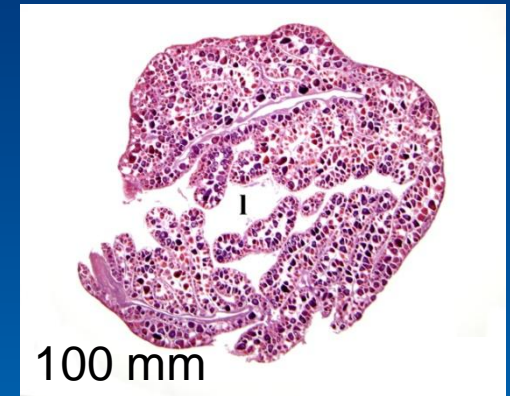
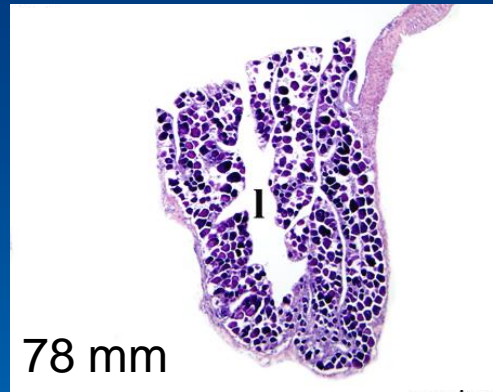
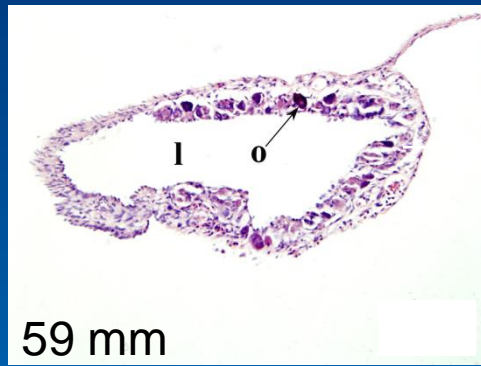
- ❖ Presence of secondary testes in serranids does not provide evidence that a species in this family is hermaphroditic

Testes in Breaksea Cod

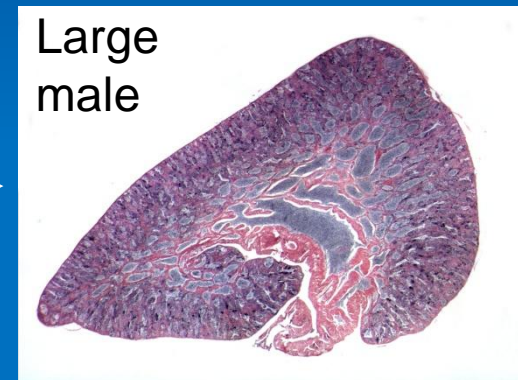
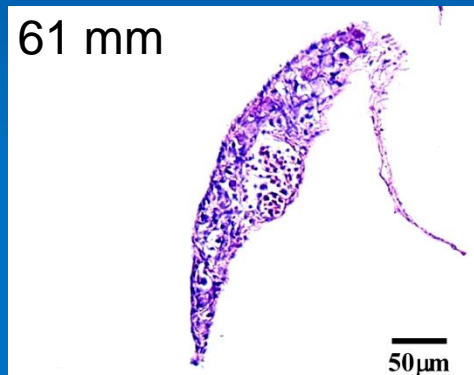
- ❖ Males of Breaksea Cod would be expected to possess secondary testes, as is the case with other serranids
- ❖ Males of gonochoristic serranids with secondary testes can develop from a bisexual juvenile stage
- ❖ Do male Breaksea Cod possess secondary testes, and does this species have an early bisexual juvenile stage?

Testicular development in Breaksea Cod is highly unusual for serranids

Ovaries



Testes

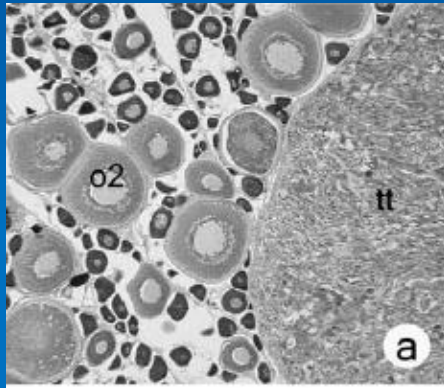


- ❖ Testes have no lumen or peripheral sperm sinuses even in early juveniles
- ❖ Central sperm duct in testes as in gonochoristic species of many other fish families. No evidence of an early bisexual juvenile stage

Patterns of gonadal development in serranids

- ❖ Pattern of gonadal development differs among the subfamilies of the Serranidae
- ❖ Progression from complete separation of ovarian and testicular tissues (Serraninae) to various degrees of separation of tissues (Anthiinae) to complete integration (Epinephelinae) (Smith 1965; Hastings, 1981, see also Sadovy & Domeier, 2005)

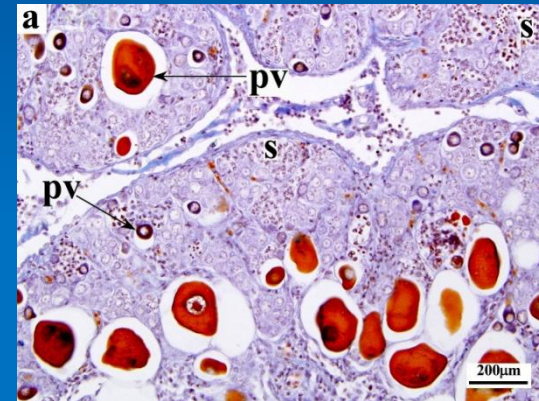
Serraninae (*Paralabrax*)



Above photo from Sadovy & Domeier (2005)



Epinephelinae (*Epinephelus*)



- ❖ Certain patterns of gonadal development within the Serranidae useful as a phylogenetic character

Scheme from Sadovy and Domeier (2005)

- ❖ Serraninae – ancestral group. **Gonochorism considered ancestral condition** (e.g. genus *Paralabrax*)
- ❖
- ❖ Anthiinae – derived group. Mainly protogynous. Gonochorism considered derived
- ❖ Epinephelinae – derived group. Mainly protogynous with a few cases of gonochorism, e.g. Nassau grouper *Epinephelus striatus*. **Gonochorism considered derived**

How does breaksea cod fit in?

- ❖ The absence of secondary testes in Breaksea Cod implies either that
- ❖ Breaksea Cod has progressed so far from hermaphroditism to gonochorism that the bisexual juvenile stage and secondary testis arrangement has been lost
- ❖ Or Breaksea Cod evolved from a different ancestor to other Anthiinines

Acknowledgements

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- ❖ Sue Morrison and Barry Hutchins of WA Museum for samples of very small *E. armatus* and useful discussion
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