Reproductive biology of three Hawaiian goatfishes

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Outline

- Introduction to goatfish
- Methods
- Results
- Conclusions
- Applications

Parupeneus cyclostomus, moano kea
Introduction to Goatfish

- Found in all tropical and semi-tropical seas
- Inhabit sandy bottom, coral reefs, sea grass beds
- 66 species worldwide (family Mullidae)
- Hawaii has 10 species, and 2 are endemic
- Chin barbels defining characteristic

*Parupeneus multifasciatus*, moano
Introduction to Goatfish

- Can grow up to 50 cm in length
- Change color at night, camouflage
- Live in shallow (less than 3 m) to deep (150 m)
- Feed mostly on invertebrates in the sand (crabs, shrimp, worms, mollusks, and sometimes other fish)

*Upeneus arge*  
*Mulloidichthys vanicolensis*
Introduction to Goatfish

- School in both small and large groups, vulnerable to gill netting
  - Goatfish are fished and eaten around the world
  - Ex: Mediterranean, Red Sea, Japan, Australia, New Zealand, West Atlantic

Photo by Dave Rezendes
Why are goatfish important?

- **Economically: commercial fishery**
  - 3 of Hawaii’s 10 species make up the bulk of the fisheries catch
  - In 2005: 80% of the total 39,703 pounds of goatfish landed

Data compiled from DAR annual landings reports, current to 2005
Why are goatfish important?

- Ecosystem engineers (Uiblein, 2007)
- Fisheries indicators (Uiblein, 2007)
- Recreationally and Culturally
Study species: the 3 most caught fish

*Mulloidichthys flavolineatus, weke’a*

*Mulloidichthys vanicolensis, weke’ula*

*Parupeneus porphyreus, kumu*
Project Goals

Life history characteristics crucial for fisheries species:

- Ovarian development among the 3 species
- Spawning seasonality (GSI)
- Batch fecundity
- $L_{50}$ for *M. flavolineatus* and *M. vanicolensis*
- Age at which each species becomes reproductively mature
Methods

- Fish from Kaneohe Bay or South Shore, Oahu or fish market collections
- Weighed and measured (TL, FL, SL)
- Dissected and preserved: ovaries, testes and otoliths
- Embedded in paraffin or plastic resin and sectioned
- Stained with hematoxylin and eosin, PAS or toluidine blue
- Fecundity taken from sub-sample of one ovary lobe
- L50 calculated for females
Results

- Ovarian development
  - All 3 species have ASYNCHRONOUS development
  - Supported by Lucano-Ramirez et al., 2006
Results

- Spawning seasonality: *M. vanicolensis*, *weke’ula*
  - Begins in February, continues through June, ends?
  - Low in winter months
Results

- Spawning seasonality: *M. flavolineatus*, weke’a
  - Begins in March, continues through June, ends?
  - Low in winter months

![Graph showing GSI versus Month for M. flavolineatus females](chart_image.png)
Results

- **Spawning seasonality: *P. porphyreus, kumu***
  - Begins in February, continues through June, ends?
  - Low in winter months
  - Inconclusive due to low sample size
Results

About 150,000 eggs for 25 cm SL female

Over 300,000 eggs for a 28.5 cm SL female!!!
Results

- Very few large mature females
- Low GSI compared to other two species

<table>
<thead>
<tr>
<th>FL (cm)</th>
<th>Batch fecundity</th>
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<tr>
<td>27.6</td>
<td>23,186</td>
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<tr>
<td>33</td>
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<td>35.6</td>
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<td>35.6</td>
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<td>38.7</td>
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</table>

Reproduced from Moffit (1979)

Only about 15,000 eggs for a 21.5 cm SL female!!!
Results

L50 % Mature Females of M. vanicolensis

Size at 50% maturity!

No DAR size limit!

DAR size limit = 7 inches

L50 % Mature Females of M. flavolineatus

Size at 50% maturity!

7 inches
Conclusions

- Females share similar ovarian development (asynchronous)
- Spawning season overlaps for all three species (Feb/Mar- June)
- $L_{50}$ for *M. vanicolensis* and *M. flavolineatus* are smaller than or at existing minimum size limit
- Fecundity showed a positive, non-significant relationship with SL
- *M. flavolineatus* has the highest fecundity, *P. porphyreus* the lowest
Application: Using the data for conservation

- Establish biologically relevant restrictions
  - L$_{50}$ about 17-18 cm (6.69 – 7.08 inches)
  - Minimize take of ‘oama?
  - Fish outside spawning seasons?
  - Leave the really big and really small ones

Pope, 1993
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