

Seasonal Habitat Use and Reproductive Productivity of Dusky Rockfish, *Sebastes variabilis*, in the Gulf of Alaska

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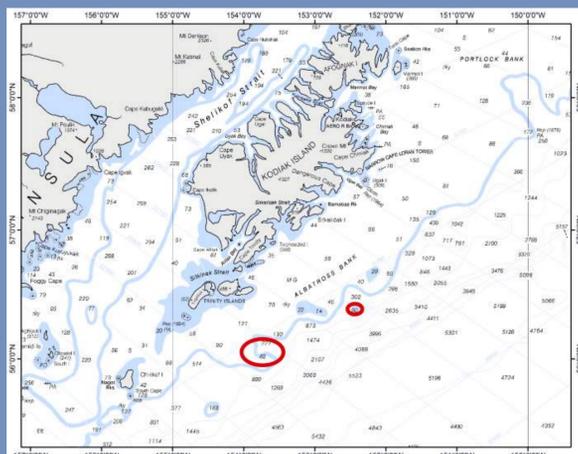
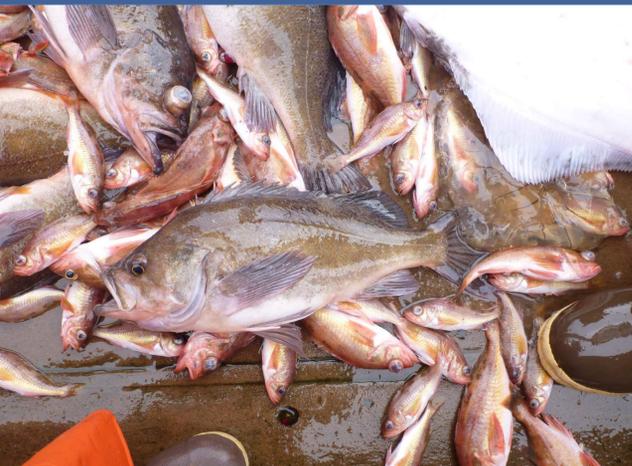


Figure 1. Sampling sites southwest of Kodiak Island are denoted, 49 FP = the 49 Fathom Pinnacle Site, SHB = Snakehead Bank Site.

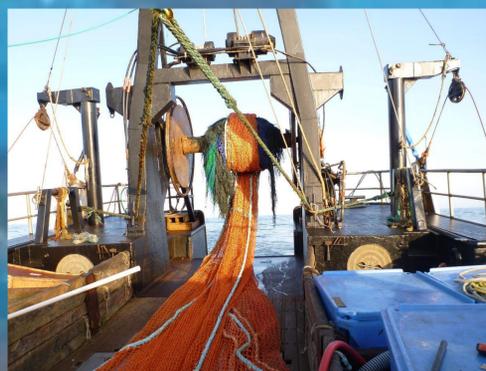
Abstract

The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act mandates the identification of Essential Fish Habitat (EFH) for each life stage of federally managed fish species. Our understanding of EFH for many rockfish species in the Gulf of Alaska (GOA) is rudimentary, especially their seasonal habitat requirements and the relative importance of specific habitat types. It is generally accepted that rockfish in the GOA have patchy distributions and frequently occur over rocky, hard, or high relief substrate. Many commercially important rockfish species are also associated with coral and sponge habitats in Alaska waters. The added complexity provided by coral and sponge habitats may offer juvenile and adult rockfish increased protection from predators and/or enhanced food resources similar to other structurally complex habitats. Our project tests whether the seasonality of rockfish distribution, abundance, and productivity differs among three habitat types: low relief, high relief rocky/boulder, and high relief coral/sponge. We examined the reproductive potential of adult dusky rockfish, *S. variabilis* found within these habitats at two sampling sites in the Gulf of Alaska. We characterized reproductive potential by calculating gonadosomatic indices and assessing development state, reproductive success, and fecundity. This research will enable us to better understand the relative importance of particular habitats to rockfish productivity throughout the year and provide data critical for understanding EFH for these species.



Methods

1. Reproductive success or failure: partial or complete reproductive failure was documented by noting skip spawning, abortive maturity, ovary degeneration, or incomplete fertilization.
2. Reproductive development: The developmental stage of the ova or embryo was determined using the terminology of Bowers (1992) but modified specifically for rockfish in the Gulf of Alaska (Conrath and Knoth 2013).
3. Gonadosomatic index (GSI): A GSI was calculated for each mature, developing fish using the equation $GSI = \frac{\text{ovary weight}}{\text{total fish weight}}$.
4. Fecundity: A subsample of fish collected within each habitat type was utilized to examine fecundity for dusky rockfish captured in December. A gravimetric method will be utilized to determine developing fecundity. The relative fecundity will be determined as the developing fecundity divided by the weight of the female (Withames et al. 2009).



Each site was sampled in May and December 2014.



Reproductive Success or Failure

The following types of reproductive anomalies or failure have been noted in this species:

- 1) Skipped spawning occurs when a mature fish 'skips' a spawning season.
- 2) Ovary degeneration occurs when a large and visible portion of the ovary is in a degenerative or hardened condition.
- 3) Fertilization failure occurs when a portion or all of the developing oocytes do not become fertilized.

The most predominate type of reproductive failure noted in samples collected from this species is fertilization failure. This type of failure was found in dusky rockfish captured in each habitat but was only easily recognizable in samples collected during the May cruises.

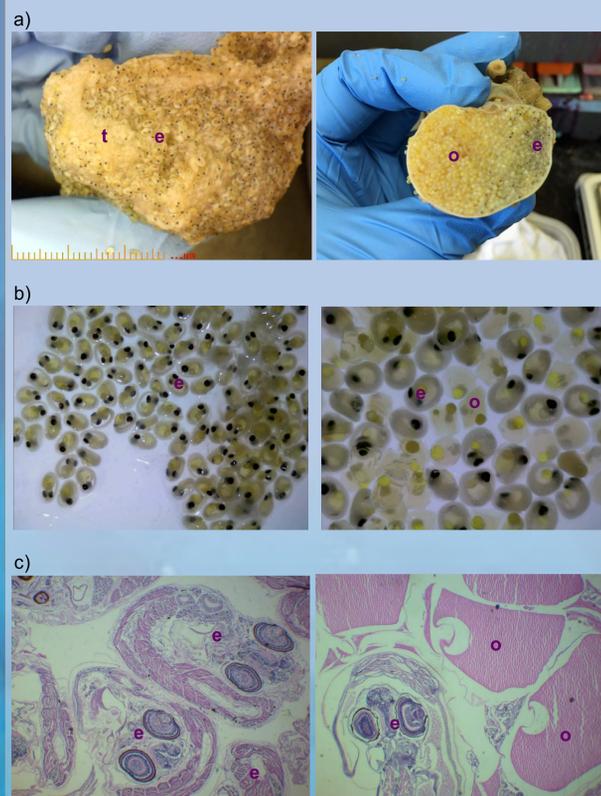


Figure 2. Normal development is pictured in the left column and incomplete fertilization is pictured in the right hand column. Partial fertilization can be seen in the a) whole ovary, b) the microscopic view of developing ova or embryos, and in c) histological cross sections of the ovary. Eyed embryos are denoted with an "e" and unfertilized ova are denoted with an "o" in each picture, ovarian tissue is denoted with a "t".



High relief boulder habitat at the Snakehead Bank site



High relief coral habitat at the a) 49 Fathom Pinnacle site and the b) Snakehead Bank site

Results to Date

1. Partial or complete reproductive failure was found in dusky rockfish in all habitats. The mechanisms for this failure were incomplete fertilization (~65%) or resting or resorbing skip spawning (~35%). Rates of reproductive failure were highest in boulder habitats (Fig. 3).

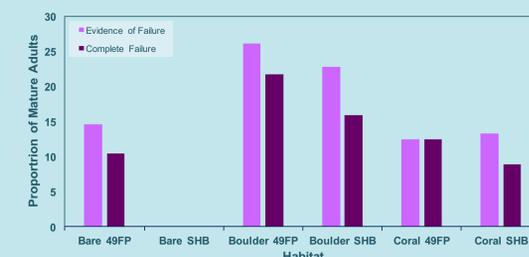


Figure 3. The proportion of mature dusky rockfish females exhibiting either partial reproductive failure or complete reproductive failure in each habitat at each site. Evidence of failure indicates both partial and complete reproductive failure.

1. Reproductive development for this species was confirmed to be highly synchronous. During the month of December all developing oocytes were in the late migratory nucleus or early ovulation stage. In May all developing embryos were in the eyed embryo stage.
2. The GSI for this species was significantly different between bare and coral habitats with the highest values from fish captured in coral habitats.



Figure 4. GSI values for mature dusky rockfish in each habitat at each sampling site, 49FP = the 49 Fathom Pinnacle site and SHB = the Snakehead Bank site. Error bars are standard error of the mean.

3. Relative fecundity while highest in coral habitat was not significantly different between the different habitats.

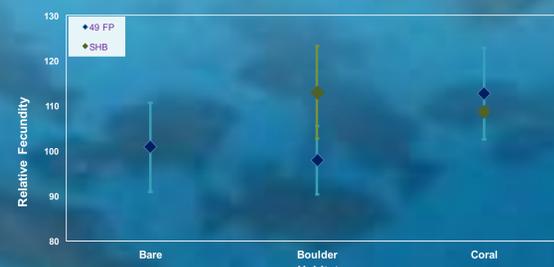


Figure 5. Relative fecundity values for mature dusky rockfish in each habitat at each sampling site, 49FP = the 49 Fathom Pinnacle site and SHB = the Snakehead Bank site. Error bars are standard error of the mean.

4. Preliminary results suggest there may be some differences in productivity between habitats with complex high relief habitat having more productive rockfish.

Acknowledgments

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