

# Seasonal Habitat Use and Reproductive Productivity of Northern Rockfish, *Sebastes polyspinis*, in the Gulf of Alaska

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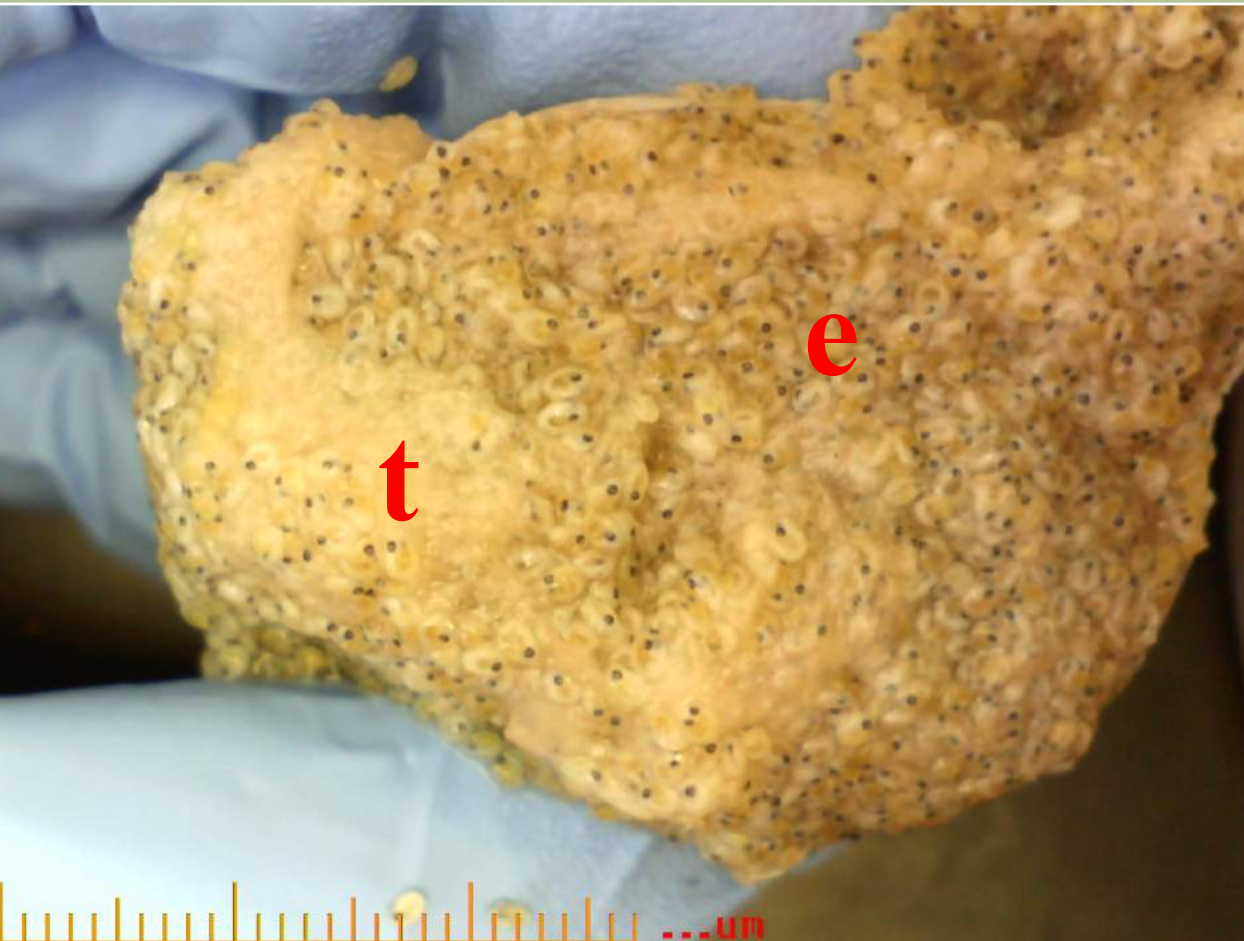


## Reproductive Success

Northern rockfish are deterministic total spawners with a high synchronous seasonal reproductive cycle. Like all members of the *Sebastes* genus they are live-bearers with internal fertilization. Reproductive success in this study is defined as complete development of oocytes without any evidence of reproductive failure or concentrations of degenerative tissue within the ovary. In order to examine reproductive success the ovary will be examined:

1. Whole and in cross section.
2. Microscopically using a dissecting microscope to look at the overall structure of the developing ova or embryos.
3. Histologically using standard procedures to section and stain ovarian tissue using hematoxylin and eosin.

Figure 1: A northern rockfish ovary collected in May 2014 exhibiting normal development (eyed embryo stage); a) whole ovary section, b) microscopic view of embryos, and c) histological cross section of the ovary.



a) This whole ovary contains eyed embryos ("e"). Tissue ("t") is also visible but there are no unfertilized ova present.



b) Within this ovary, only eyed embryos were present.



c) The histological section also contained eyed embryos, post ovulatory follicles, and connective tissue. The photo shows several eyed ("e") embryos.

## References

Bowers, M.J. 1992. Annual reproductive cycle of oocytes and embryos of yellowtail rockfish, *Sebastes flavidus* (Family Scorpaenidae). Fishery Bulletin 90: 231-242.

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## Objective

### Examine the productivity of northern rockfish in different habitats and seasons in the Gulf of Alaska

#### Habitats

Three habitat types were examined at the 49 Fathom Pinnacle in the central Gulf of Alaska:

1. Low Relief (bare)
2. High Relief without biotic structure (boulder)
3. High Relief with biotic structure (coral)

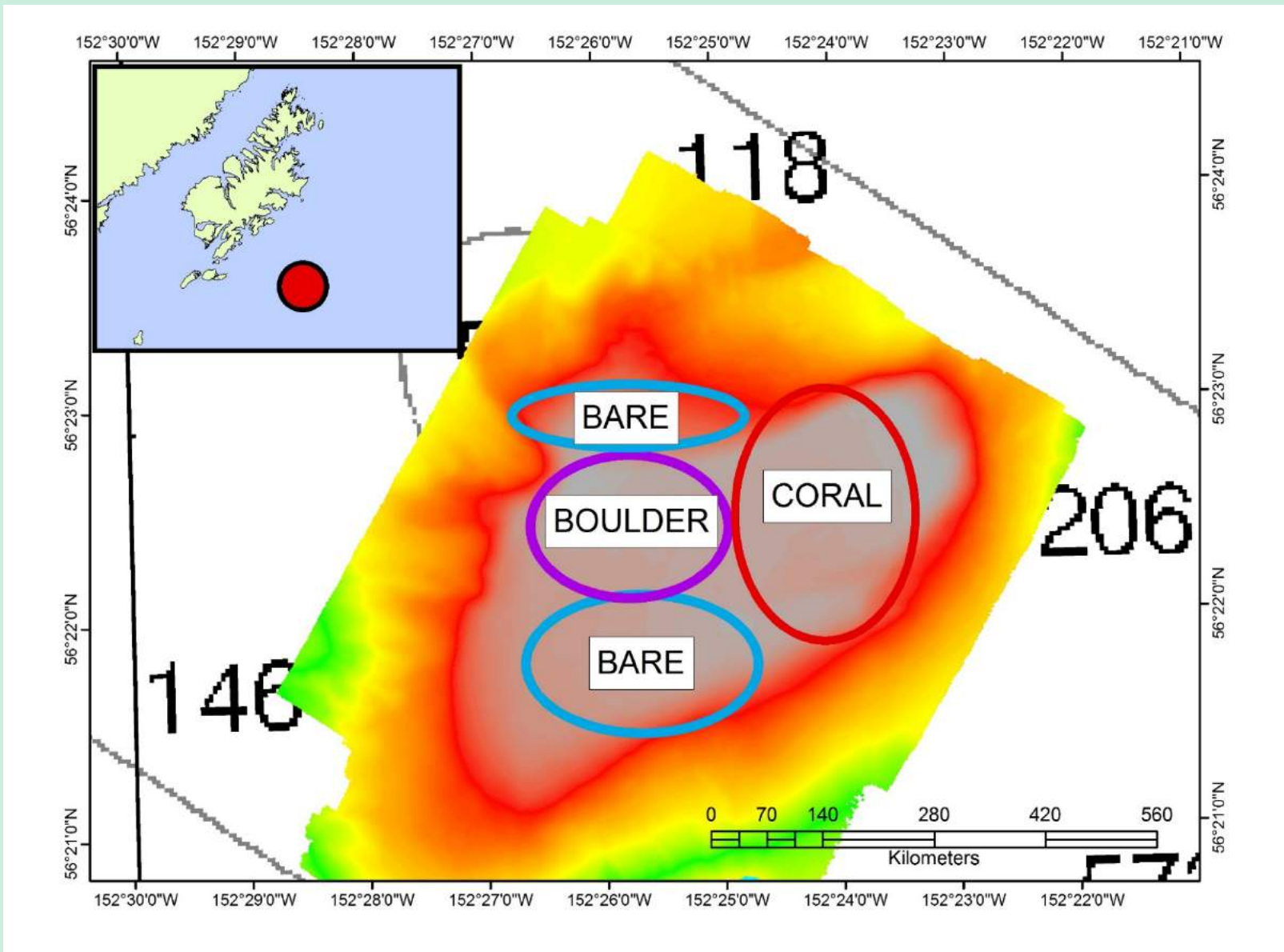


Figure 3. The 49 Fathom Pinnacle sampling site south of Kodiak Island with each habitat area delineated. Multibeam data are shown as a layer on a nautical chart.

#### Seasons

The *F/V Gold Rush* was chartered in May and December 2014. During each charter northern rockfish were collected from each habitat type at the 49 Fathom Pinnacle.



#### Reproductive parameters

The following parameters were utilized to examine reproductive productivity:

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 will be 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 will be calculated for each mature, developing fish using the equation  $GSI = \text{ovary weight} / \text{total fish weight}$ .
4. Fecundity: A subsample of fish collected within each habitat type will be utilized to examine fecundity. 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 (Witthames et al. 2009).



## Results to Date

- ❖ Partial or complete reproductive failure was found in northern rockfish in all habitats (Figure 4). The mechanism for this failure was predominately a lack of complete fertilization which occurred in approximately 30% of northern rockfish in all three habitats during the May season. Rates of reproductive failure were much smaller in December (prior to fertilization) and usually occurred in the form of partial ovary degeneration.
- ❖ 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 either eyed or in the late embryo body stage.
- ❖ The GSI for this species was significantly higher during the spring months due to the increased state of development during this time period. There were also significant differences between habitats during the May cruise with the higher GSI values in the coral habitat than the bare and boulder habitats (Figure 5).
- ❖ Relative fecundity was also significantly higher in the coral habitat during the month of May and was lowest in the boulder habitat during this month. A similar pattern exists in the samples from December but the highest relative fecundity occurs in the bare habitat instead of the coral habitat (Figure 6).
- ❖ Preliminary results suggest there may be some differences in productivity between habitats with complex high relief habitat having more productive rockfish.

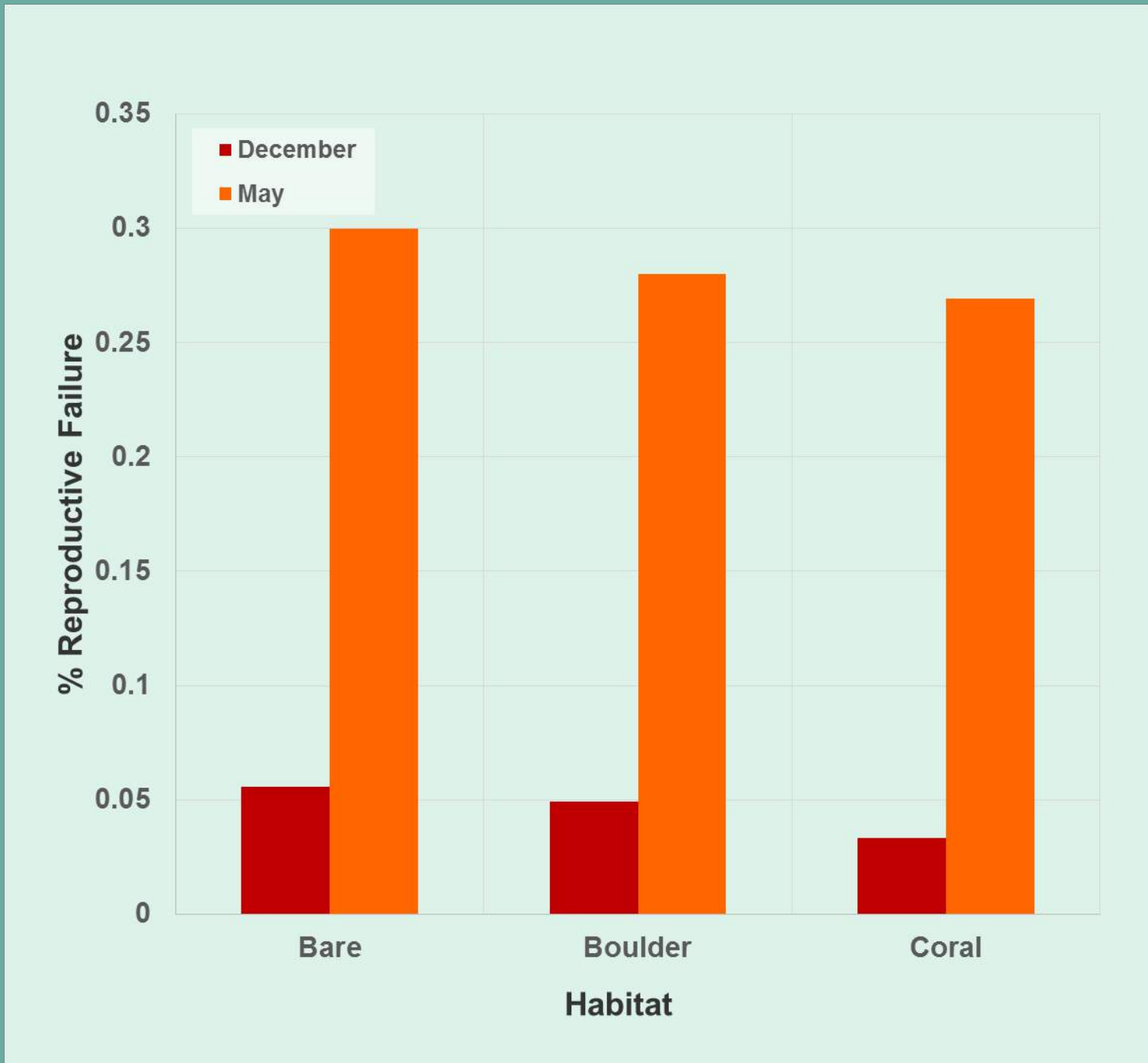


Figure 4. The percent of mature northern rockfish collected that exhibited partial or complete reproductive failure in May and December in three habitats.



Figure 5. The GSI of mature northern rockfish females collected in May and December in three habitats.

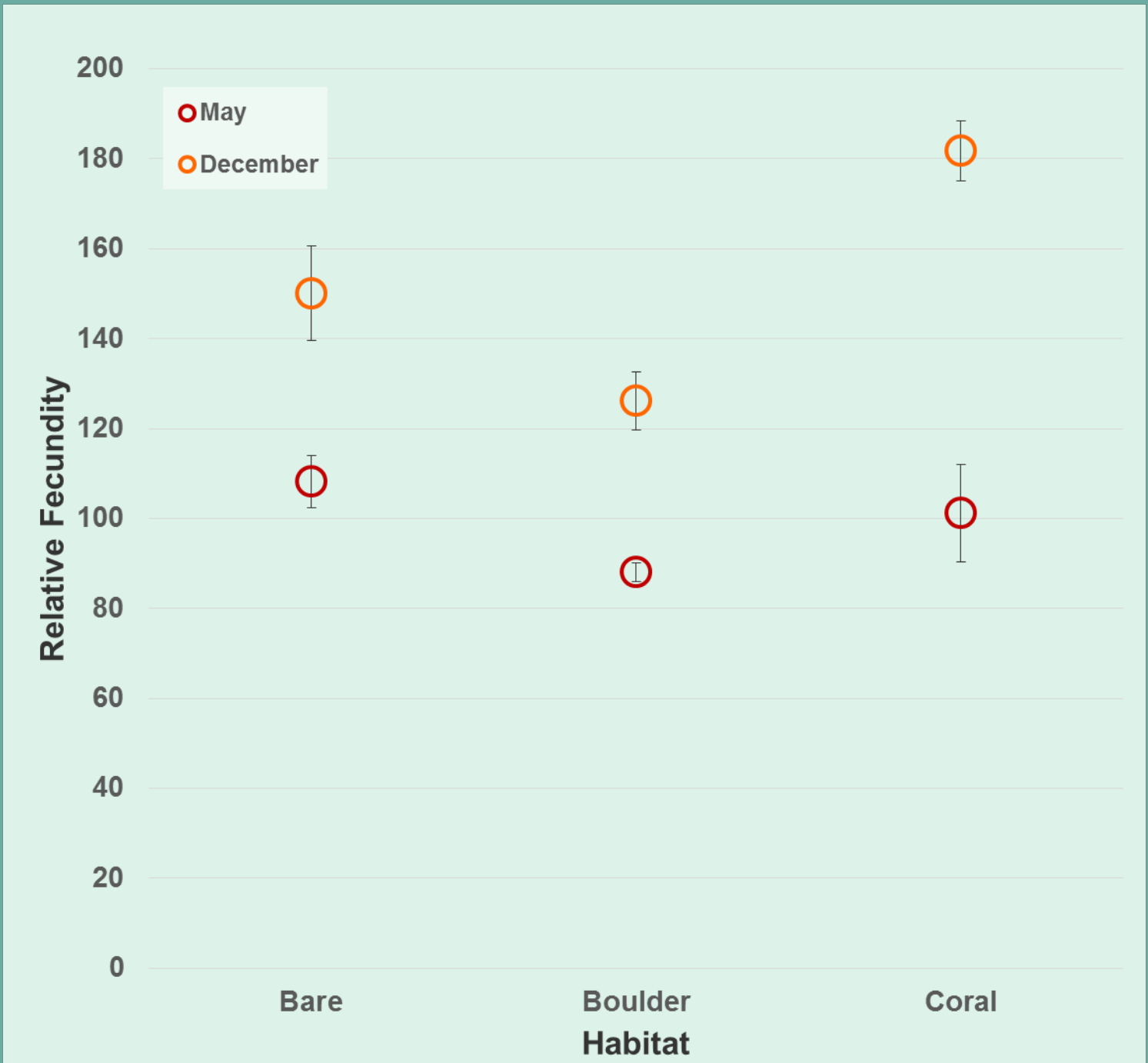


Figure 6. The relative fecundity of mature northern rockfish females collected in May and December in three habitats.

## Reproductive Failure

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

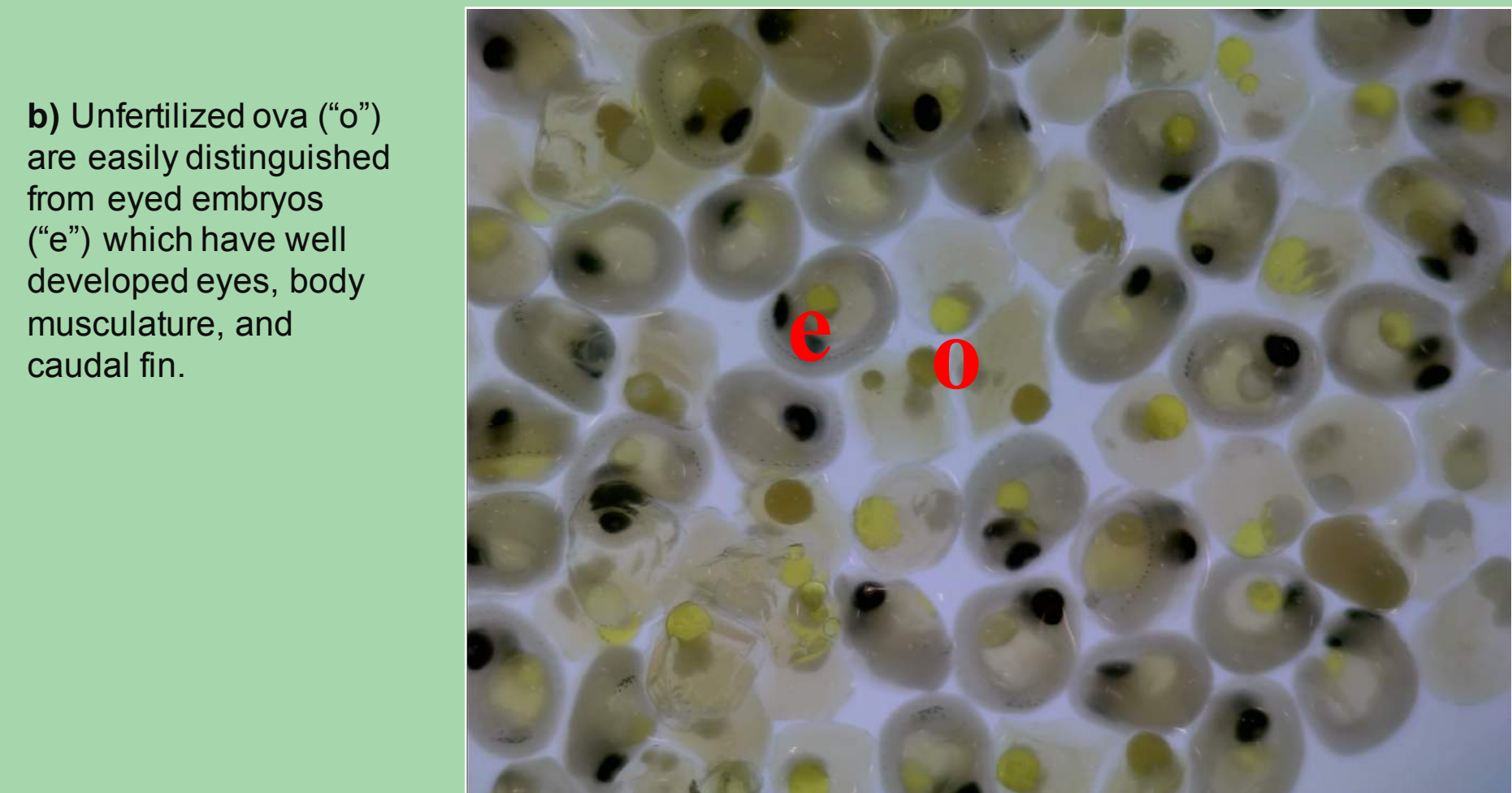
- 1) Skipped spawning occurs when a mature fish 'skips' a spawning season.
- 2) Ovary degeneration occurs when a large and visible portion of the ovary is in a degenerative or hardened condition.
- 3) Fertilization failure occurs when a portion or all of the developing oocytes do not become fertilized.

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

Figure 2: A northern rockfish ovary collected in May 2014 exhibiting partial reproductive failure; a) whole ovary section, b) microscopic view of embryos and unfertilized ova, and c) histological section that also includes eyed embryos and unfertilized ova.



a) This ovary section has an area of developing eyed embryos (left side, "e") and a larger region of unfertilized ova (right side, "o"). The successful reproductive output of this female would have been significantly smaller than a female with a fully fertilized batch of developing embryos.



b) Unfertilized ova ("o") are easily distinguished from eyed embryos ("e") which have well developed eyes, body musculature, and caudal fin.



c) Unfertilized ova ("o") remain in the blastodisc formation or one cell stage. Eyed embryos ("e") are at a much later stage of development.

## Acknowledgments

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