Quantifying Paternal Investment During Pregnancy in Northern Pipefish *Syngnathus fuscus*

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1 Abstract

Sexual selection theory postulates the emergence of intra-sexual competition where one sex, most commonly the female, selects a mate in terms of heightening the reproductive success of offspring (Liker et al., 2015). Thus, sexual selection plays a major role in influencing sex roles and produces variable differences in relative parental care investment; while exemplifying portrayals of sexual dimorphism (Chu and Lee, 2012). Ripley and Foran (2006) observed the progression of complete sex reversal in *S. fuscus*, where females essentially produce eggs of poor nutrient density; and males compensate by exhibiting increased paternal care and investment. The trade-off between the number of offspring per given clutch and the quality (e.g. nutrient density and egg size) may provide insight as a measure of fitness within a species (Stearns 1989) as well as the relative investment of each sex independently. The number of offspring produced by parents is directly influenced by the relative investment per offspring as well as the available resources for uptake within the environment (Lloyd 1987), thereof selection acts on. This study aims to understand the underlying mechanisms behind maternal and paternal care investment in *S. fuscus* by first assessing whether there is a correlation between female size in relation to egg circumference. Additionally, paternal investment was investigated by comparing the dry-weight of newly-fertilized embryos with the dry-weight of newly-released juveniles. Nutrient allocation of carbohydrates, lipids, and proteins was also assessed within the newly-fertilized embryos and newly-released juveniles to further investigate paternal investment. Measurable differences between the dry-weight and nutrient allocation between embryos and juveniles would indicate whether there are differences in investment among the two sexes. These results add comparative information of the unique sex reversal behavior in Syngnathidae and further our understanding of parental investment on embryonic development.

1.1 *Aim 1*: Correlating female size with egg size.

Hypothesis: As female standard length increases, egg circumference also increases; producing a positive correlation. Fecundity increases with female size (Morita and Takashima, 1998), therefore larger females are expected to produce larger eggs as more energy can be invested per egg within a clutch in a given reproductive cycle.

1.2 *Aim 2*: Quantifying paternal investment during pregnancy.

Hypothesis: The occurrence of sex-reversal in this species exhibits anisogamy when comparing gametes of both sexes and it is predicted that male *S. fuscus* invests considerable amounts of energy (i.e. proteins, lipids, and carbohydrates) to developing embryos from nutrient poor eggs initially deposited by the female.

2 Experimental Design

Adult *S. fuscus* will be sampled at Shinnecock Bay, NY, USA (4051'22.37"N, 7230'3.063"W). Salinity as well as temperature will be recorded prior to net seining with a 6 x 2 m length across a 100 m transect sampling range. Pipefish obtained will be identified and recorded for meristic characteristics (total

length, standard length, sex) as well as their reproductive status (male,female, juvenile). Total expected sampling for optimal experimental procedures is twenty (n=20) for each sex exhibiting sexual maturity. A subset of 10 females will be obtained in order to assess the correlation of female size (standard length) with the circumference of egg size (n=10; each), if any correlation exists.

Collected specimens will be held within holding tanks (n=8), each split into quadrants, where males and females will be separated during pre- and post- breeding periods. Mate assignment will be controlled over by equating the sizes of both sexes to the smallest degree possible in order to maximize the eggs deposited into the brood pouch. Following completion of the pregnancy cycle, newly-released juveniles (n=20) from each brooding male will be collected, measured, dried, and weighed to compare differences between the dry-weight of newly-fertilized embryos from the same mating pair. Additionally, a subset of newly-fertilized embryos (n=20) and newly-released juveniles (n=20) will be assessed for nutrient density of proteins, lipids, and carbohydrates to further investigate to what degree males invest in paternal care. Any deviation of weight and nutrient density would indicate male energetic investment and provide information on the comparisons of sex reversal within this group of Syngthidae.

3 References

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