

NORTHERN ILLINOIS UNIVERSITY

**VARIATION IN BODY SIZE AND RELATIVE HEAD DIMENSIONS IN WATER
SNAKES: SEXUAL DIMORPHISM, GEOGRAPHICAL VARIATION,
PHENOTYPIC PLASTICITY, AND PERFORMANCE**

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BY

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ABSTRACT

In this thesis, I describe patterns of sexual and microgeographical variation in body size and relative head dimensions among island populations of water snakes (*Nerodia sipedon*). Female water snakes had bigger bodies and relatively larger heads than male snakes. There were significant differences among islands in relative head dimensions but not in body size. There was a significant positive correlation between physical condition and relative jaw length in both males and females. Furthermore, path analysis revealed that the total effects of all head dimensions on physical condition were positive, suggesting that head size has an observable effect on fitness.

To test whether some of the variation in body size and relative head size may be a phenotypically plastic response to feeding experience in snakes, I assigned neonate *N. sipedon* from four litters (N = 48) to two feeding treatment groups: large fish versus small fish. Repeated-measures multivariate analysis of variance revealed significant effects of treatment, sex, and litter on body size. Repeated measures MANCOVA (with body length as the covariate) also revealed a significant litter effect on change in head dimensions. The multivariate effect of feeding treatment on head dimensions approached statistical significance ($P = 0.102$), while the univariate effect of feeding treatment was significant for jaw length ($P = 0.010$). Snakes offered large fish increased in body size and relative jaw length more than snakes offered small fish. Also, females increased in body size significantly faster than males.

To investigate whether the observed variation in head size has an effect on swallowing performance, I investigated whether individual snakes differ in their ability to swallow prey, and whether this variation in swallowing ability is correlated with variation

of trophic structures. An ANCOVA (with prey size as the covariate) revealed that larger prey items took longer to ingest than smaller prey. There was a significant effect of snake identity on swallowing performance (measured as number of mandibular protractions). Spearman rank correlation of expected number of mandibular protractions with relative jaw length was negative ($r_s = -0.39$) and approached significance ($P = 0.08$), suggesting that relative jaw length may influence swallowing performance.