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Evolutionary Biology Studies on Latitudinal Variation in Sexual Selection Pressures in the Medaka

Abstract

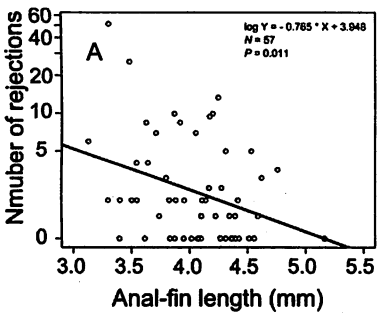
Species in tropical animals tend to have more conspicuous coloration and ornamental morphology, compared with temperate animals. Since male secondary sexual characteristics often evolve through sexual selection, the morphological and body-color differences between tropical and temperate animals may be explained by stronger sexual selection pressures at lower latitudes. The purpose of this study is to verify the latitudinal variation in sexual selection pressures, using the medaka (*Oryzias latipes* complex), as a model system which is known to exhibit latitudinal variation in the degree of sexual dimorphisms in fin lengths.

First, I tested female mate preference for male longer fins. Laboratory mating experiments indicated that anal- and/or dorsal-fin lengths of males contributed to female preference, i.e., males with longer anal and/or dorsal fins were less likely to be rejected by females (Fig. 1). This suggests that longer fins in low-latitudes males can be explained by stronger inter-sexual selection pressures.

Second, I examined mating behaviors of males and females to test if they latitudinally vary in a manner consistent with the latitudinal cline in sexual selection pressures. Laboratory mating experiments revealed that males from lower-latitude populations fight and court more frequently than males from higher-latitude populations (Fig. 2), suggesting that both intra- and inter-sexual selection pressures are stronger at lower latitudes. In addition, females from lower-latitude populations did not accept males easily, especially when mated with higher-latitude males (Fig. 3), suggesting that female choosiness has also coevolved across latitudes through Fisherian runaway process.

Finally, I compared seasonal patterns in the occurrence of mature individuals in the wild between two latitudinal populations to test if operational sex ratios (OSRs) are more male-biased at low latitudes. Field collections revealed that mature females occur in greater synchrony during a shorter period of the year in the high-latitude population than in the low-latitude population (Fig. 4). In contrast, mature males tended to be present throughout the reproductive season both in the high- and low-latitude populations (Fig. 4). As a result, OSRs were estimated to be more male-biased in the low-latitude population, as expected, strongly supporting that sexual selection pressures are stronger at low latitude.

The shortening of reproductive season with increasing latitude is well known not only among fishes but also among other aquatic and terrestrial animals, suggesting that the latitudinal cline in OSRs and resultant cline in sexual selection pressures are widespread among a variety of taxa. Thus, I propose that the conspicuous coloration and ornamental morphology of many tropical animals reflect that sexual selection pressures are stronger in tropical regions than in temperate regions.



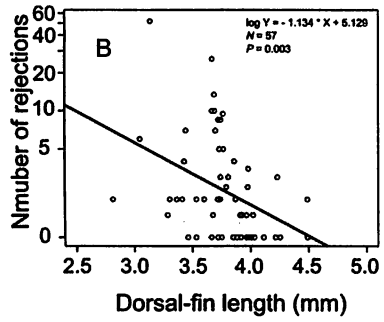


Figure 1. Results for single regression analysis of the number of rejections (log-transformed) on anal-fin length (A), and dorsal-fin length (B) among F2 hybrid males between an Okinawa female and an Aomori male.

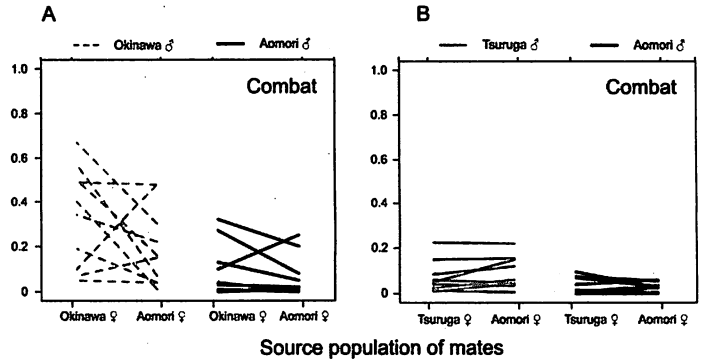


Figure 2. Frequencies of male–male interactions (combat), in the Aomori–Okinawa comparison (A) and Aomori–Tsuruga comparison (B). Each line represents one individual male mated with females from the same versus different populations.

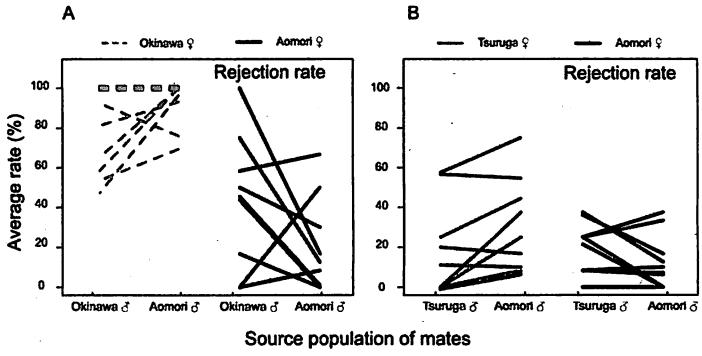


Figure 3. Rate of wrapping rejection by each female in the Aomori–Okinawa comparison (A) and Aomori–Tsuruga comparison (B). Each line represents one individual female mated with males from the same versus different populations.

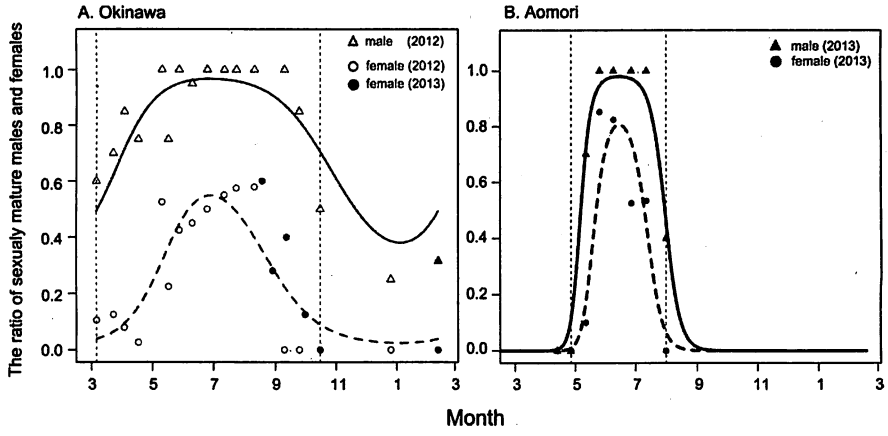


Figure 4. Seasonal change of the proportion of sexually mature males or females during 2-day observation period, respectively, that were >20 mm standard length (A, Okinawa; B, Aomori). Solid and dashed lines (estimated using generalized additive model) represent males and females, respectively.