

Sexual signalling and noise pollution in the sea

- Implications for courtship behaviour and reproductive success in two vocal species of gobies

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DISSERTATION ABSTRACT

Many marine animals use acoustic signals to mediate social interactions. Acoustic cues and signals are especially important in water because sound is unique as a sensory modality propagating with little attenuation over long distances, at all depths, and irrespective of the water current direction. Anthropogenic underwater noise is a global pollutant of increasing concern but its impact on reproduction in fish is largely unknown. Hence, a better understanding of this important link to fitness is crucial. Here, I compared different courtship traits, including courtship sounds, in two sympatric *Pomatoschistus* species and I found that courting males of the common goby *Pomatoschistus microps* sing louder and produce sounds of shorter duration than males of the sand goby *Pomatoschistus minutus*. Furthermore, eyes of *P. minutus* females turn black during courtship attempts, whereas this is not the case for females of *P. microps*. Dark eyes in females of *P. minutus* were more likely to be displayed by more gravid females, but males did not respond behaviourally or preferred dark-eyed females. I suggest that dark eyes are not a signal per se but may be an aspect of female mate choice, possibly related to vision. Furthermore, I examined if an experimentally altered body condition in *P. minutus* males affects acoustic and visual display and if it influences females' decision to spawn or not. Visual and acoustic courtship and reproductive success was studied under two experimental food regimes (high food and low food) and compared to a control group (fish from the field). Condition did not affect visual or acoustic courtship, nor did it affect mating success. Females only spawned with males that produced sound and courtship sounds are likely to be important in female mate choice. To further understand how anthropogenic noise can affect mating success by masking the acoustic cue, I experimentally tested the impact of broadband noise exposure on the behaviour and reproductive success of *P. microps*. Noise treatment had similar frequency range as anthropogenic boat noise and was presented either continuously or intermittently. The continuous noise treatment had the most detrimental effect by reducing spawning probability, whereas male nest-building behaviour and active pre-spawning behaviour (including courtship) were unaffected. Additionally, females took longer to spawn under continuous noise than in the control. Egg density was significantly higher in both noise treatments compared to the control. Since sexual selection can be sensitive to changes in the environment I also investigated effects of noise on male mating success in *P. minutus*. I compared no added noise ('silence') to added artificial Brownian noise to create disturbance at moderate levels. In silent condition, successful males were significantly larger than unsuccessful males, which was not the case in the noise treatment. More males received eggs in the silent treatment compared to the noise treatment, creating a relaxed opportunity for sexual selection in the silent environment. However, here was no significant effect of treatment on the number of spawned eggs. The results suggest that disturbance caused by noise can influence mating decisions and traits under sexual selection. In conclusion, in this thesis I show that noise, particularly a continuous noise exposure, negatively affects reproductive success, highlighting its potential to impact fish demography. Future studies in natural conditions are required for a better understanding of the impact of noise on fish reproduction. Thus, I suggest that aquaria studies should be performed in a low noise environments, since noise clearly can affect the outcome of an experimental result.