Acoustic communication and behaviour of the golden haired pine bark beetle, *Hylurgus ligniperda* (Coleoptera: Curculionidae)

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Abstract

The golden-haired bark beetle, *Hylurgus ligniperda* (Coleoptera: Curculionidae: Scolytinae) imposes significant threats to New Zealand pine log exports. To date, control strategies against this invasive insect have relied heavily upon fumigation treatments. However, novel environmentally friendly and cost-effective strategies that decrease reliance on fumigants and can be used as part of an integrated package of disinfestation methods are urgently needed.

The adults of *H. ligniperda* produce characteristic and species-specific sounds when disturbed or aggregated. Males produce distinct audible simple and interrupted chirps using an elytral abdominal stridulatory mechanism whereby the pars stridens, usually present on the left elytrum, are scrapped by the sclerotized pegs present on the seventh segment of the abdominal tergite, whereas the females (despite having a similar stridulatory mechanism) just produce a click-like sound. Although the ability to produce sounds by *H. ligniperda* has been acknowledged for decades, nothing is yet known as to the relevance of acoustics on the behaviour of this species.

Thus, the main objective of this thesis was to study the sound-related behaviours of *H. ligniperda* under various scenarios (i.e. distress, mating, competition territoriality and colony) and to investigate the functions and characteristics (temporal and spectral) of the acoustic signals produced by this insect and their role in intraspecific communication.

Our results indicate that the role of sound in communication in the case of *H. ligniperda* is oriented more towards communication between the sexes rather than within individuals of the same sex. Depending upon the scenarios studied, the males of *H. ligniperda* can produce different frequencies of acoustic signals, ranging from 232 Hz to 21890 Hz. The minimum and maximum amplitudes of male acoustic signals (chirps) were highest in a colony context (-661270 and 764270), and lowest during competition (-12633 and 190383). The males did not produce any sounds (chirp) during mating. Similarly, the spectral analysis indicated that the females can produce acoustic signals of different frequencies in the range from 256 Hz to 23875 Hz. The minimum and maximum amplitudes of the female acoustic signals (clicks) were highest during competition (-189034 and 1041600) and lowest when they were distressed (-275112 and 191270). Toothstrike duration for male chirps (0.047 sec) and click duration for female clicks (0.012 sec) were longest when the beetles were distressed.

When distressed, the males produced a significantly higher number of simple chirps with a longer chirp duration and higher toothstrike rate. Similar patterns were observed for distressed females, that produced significantly higher number of clicks with a longer click duration. The role of interrupted chirps for distressed males was minor. However, in a mating context, the interrupted chirps seemed to play a more significant role in communication than the simple chirps.

Courtship displays were carried out by the males when the female was a virgin and never occurred when the female was already mated by a different male. The duration of the courtship displays was affected by competition between males. Mating time was also affected by the presence of competing males. When there were no males competing for a female in a mating trial, the duration of the courtship and of the mating was found to be comparatively longer than in the presence of competing males. Although *H. ligniperda* was previously reported as a monogamous species, the observations of this thesis indicate that this insect is a polygamous species with the ability to mate multiple times with multiple partners.

This study provides a good example of acoustics research in insects and a proof-of-concept for future research on acoustics as a deterrent or behaviour-modifying tool for *H. ligniperda* control.

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