AGGREGATION OF SPRUCE BARK BEETLE IN MIXED AND PURE STANDS

Report by Maartje J. Klapwijk – 30 December 2022

Background

The Eurasian spruce barkbeetle (SBB) (*Ips typographus* (L.)) is a notorious pest of the Norway Spruce (*Picea abies* (L.) H. Karst). In the recent years damage caused by this species of bark beetle has increased and currently millions of cubic meters of spruce forests are being killed in Europe. Sweden has been suffering its largest drought induced outbreak of the spruce bark beetle and the damage since 2018 is estimated to 32 million m^3 of killed spruce.
To locate suitable breeding material SBB needs to navigate through the landscape. However, the signal given by host plant volatiles is often weak in attracting SBB and therefore tree encounter is thought to be rather random process. When suitable breeding material is found, male SBB will use an aggregation pheromone to attract both additional males and females. Mass attack is needed to overcome the defence of the tree and promote successful colonisation. When the males are establishing themselves in the tree, females will join them. Several females will join a male, mate, and start their maternal galleries to lay eggs. The aggregation pheromone is so attractive that also neighbouring trees are at risk of being attacked. The process of host tree location could be inhibited by the presence of volatiles of deciduous trees like birch. Attacks of spruce bark beetle are more likely to occur in pure spruce stands than in mixed stand. But it is unclear what mechanisms are underlying this observation. We investigated one potential mechanism: The influence of initial density by SBB males, i.e., level of pheromone release, on the attraction of further males and females.

Experimental design and data collection

The field experiment was carried out in 22 forest stands in central Sweden located near Almunge, Uppland. Six stands had been clear-cut in 2022, six stands were clear-cuts between 1-5 years old, six stands were pure spruce, and four stands had a mix of deciduous trees. The experiment was set-up at three locations at each location contained a combination of the different treatments described above, 2 of each type. However, the deciduous treatment was unevenly distributed, two locations only could be assigned one deciduous treatment and one location was assigned two deciduous treatments. We collected spruce bark beetles early in the flight season and selected the males from the females. We used stem sections of spruce (hereafter referred to as logs) and inoculated them with different numbers of male spruce bark beetles (1, 5 and 25 males). Each treatment received a set of four logs three corresponding to the different inoculation densities and one log without any male inoculation. All logs were left in the field for 30 days, but the starting date varied, the experiment ran from 30 May until 21 July. During which time we employed funnel traps to estimate flight activity in the areas and we measured temperature in each treatment.

Preliminary results

Preliminary analyses show that the number of additional attacks was highest in the pure spruce treatment followed by the 2022 clearcuts and the old clearcut and the deciduous stands received the lowest number of additional attacks. Another clear pattern is that the logs with 25 inoculated males received the most additional attacked in all treatments, and that most additional attacks were found in the first week of exposure. Even though the number of additional attacks are strongly related to treatment and initial inoculation density, the number of nuptial chambers created and the total length of the mother gallery is similar when compared within the inoculation groups. However, data on female colonisation success and pheromone emission from the logs still need to be analysed.

Plan for publication

We will write a scientific publication for a forestry related journal, like forest ecology and management or agricultural and forest entomology. We will collide this with other data on spruce bark beetle and mixed forest to provide a comprehensive assessment of the effect of the presence of deciduous trees on spruce bark beetle activity and colonisation behaviour. This latter effort could result in both a popular science publication (for example FaktaSkog) and a scientific publication.

Economic Overview

Type of cost	Amount
Three research assistants (May-Aug 2022)	272 665
Travel to and from field sites	66 063
Spruce sections, Lab material, material for log-stands	6 105
Entrepreneurs hired for spruce harvest	24 025
Costs for Premises – among which Climate Chamber	45 465
Indirect costs (OH)	126 581
Total Costs	**540 902**