Chapter 7

GENERAL BIOLOGY OF BARK BEETLES

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1. INTRODUCTION

Bark and ambrosia beetles are a small group of insects from the huge Coleoptera family Curculionidae (they were formerly separated in the families Scolytidae and Platypodidae). They are small endophytic beetles, living inside plant tissues during their whole life except short periods of their imaginal stage. The bark beetles generally live inside and consume phloem, a thin but nutritious tissue between outer bark and wood, while ambrosia beetles live inside wood and feed on symbiotic fungi. This group includes some of the most injurious insects for trees, especially the tree-killing bark beetles, so-called because the death of their host tree is normally necessary to the success of their reproduction (Grégoire and Evans, chapter 4). Bark and ambrosia beetles are particularly damaging for conifers. It is the most important group of the European BAWBILT, including alone half of the recorded species. Most of them are bark beetles, so this term will be used in the following to refer to all bark and ambrosia beetles.

Considering their economic importance, bark beetles have been the subject of many studies since the beginning of forest entomology (Ratzeburg 1839; Escherich 1923; Schwenke 1974), and a large part of them is concerned with their general biology. These studies mainly deal with species considered as the most injurious. Forty-seven BAWBILT bark beetle species are recorded in Europe, but one fifth of the related studies deals with *Ips typographus*, half of them deals with only six species (*I. typographus*, *Dendroctonus micans*, the species complex *Tomicus piniperda* / *T. destruens*, *Pityogenes chalcographus* and *Trypodendron lineatum*) and three quarters deals with only twelve species (the previous ones plus *Scolytus scolytus*, *Ips sexdentatus*, *S. multistriatus*, *I. amitinus*, *Tomicus minor* and *I. acuminatus*). On the other hand, very few studies deal with the biology of half of the European BAWBILT bark beetles. Consequently, knowledge about bark beetle biology varies greatly according to species. The main traits are generally known for

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all of them, but details only for a few. So it is often necessary to extrapolate from the well-known European species or from closely related species living in other part of the world, mainly in North America where similar species exist.

The majority of European bark beetle species does not belong to BAWBILT. They generally lives on dead trees or branches. Their biology, often poorly known, appears similar to BAWBILT species, but their particular features will not be taken into account in this paper. Research about bark beetles is a world process, and similar studies have often been performed in different parts of the world. However, this review is centred on European studies, so non-European results will be cited only if they differ from European ones or if there is no European equivalent.

2. LIFE CYCLE

2.1. Standard bark beetle life cycle and particularities

Life cycle description has been the main subject of a large part of the publications about bark beetles since the beginning of forest entomology. Their main features are well known and consistent, at least for the most important species (Chararas 1962), allowing a synthetic description of the life cycles.

A bark beetle life cycle is organised at each generation around a basic cycle with three phases: reproduction, development, maturation and dispersal (Fig. 1). Each of these phases could present different characteristics, leading to a rather large variability of life cycles among these species. Furthermore, the basic cycle could be repeated one or several times a year and interrupted by overwintering.

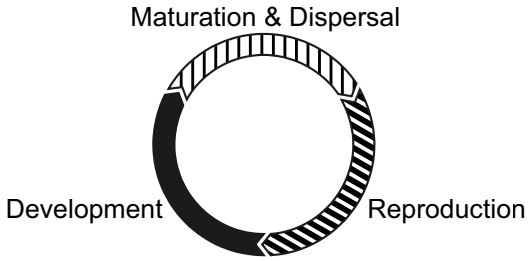

Figure 1. Basic bark beetle life cycle. Hatching density indicates the proportion of each phase which is endophytic.

2.1.1. Reproduction phase

The reproduction phase begins when mature insects arrive on their host tree. The choice of this tree is discussed elsewhere in this book (Byers, chapter 8; Lieutier, chapter 9). Most species are aggregative, a large number of adults arriving on the host tree in few hours or days. This behaviour helps meetings between males and females. It is generally controlled by pheromones and more rarely by primary attractants. In some species, such as *Dendroctonus micans*, each insect attacks the host tree alone. The tree choice mechanism is poorly known in this case.