# Ecological management supports endangered insects

Photo: Teemu Rintala, Metsähallitus

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# Attention to Beetles LIFE target species in forestry and ecological management of their habitats

Beetles LIFE is a project that aims to safeguard the living areas of eight forest insects and the forest habitats they need. These species are endangered or near threatened and of Community importance. Finland has an important role in protecting them.

Biodiversity is highly important for forest health and effective ecosystem function. High biodiversity reduces the risk of species that harm trees spreading uncontrollably and causing large-scale damage to forests. Insects play an active role in the forest ecosystem. Insects pollinate plants, make nutrients available for them by breaking down dead organic matter, and are important links in food webs. If a small insect has survived in the wild for millions of years, it has its own role in nature and plays it better than anybody else.

The target species of the project are Aradus angularis, Phryganophilus ruficollis, Boros schneideri, Pytho kolwensis, Xyletinus tremulicola, Cucujus cinnaberinus, Stephanopachys linearis and Stephanopaco substriatus. Aradus angularis is a true bug that belongs to the order Hemiptera, whereas the other species are beetles (Coleoptera).

| Species | Scientific name | Status in Finland | EU Habitats Directive Annex | Under strict protection |
|---|---|---|---|---|
| **Aradus angularis** | *Aradus angularis* | VU | II | |
| **Phryganophilus ruficollis** | *Phryganophilus ruficollis* | VU | II, IV | X |
| **Pytho kolwensis** | *Pytho kolwensis* | VU | II, IV | X |
| **Boros schneideri** | *Boros schneideri* | VU | II | |
| **Xyletinus tremulicola** | *Xyletinus tremulicola* | VU | II | |
| **Cucujus cinnaberinus** | *Cucujus cinnaberinus* | CR | II, IV | X |
| **Stephanopachys linearis** | *Stephanopachys linearis* | NT | II | |
| **Stephanopachys substriatus** | *Stephanopachys substriatus* | NT | II | |

Table 1. Beetles LIFE target species and their status. (VU = vulnerable, CR = critically endangered, NT = near threatened)

Aradus angularis as well as Stephanopachys linearis and Stephanopachys substriatus are species of burned forests. Xyletinus tremulicola and Cucujus cinnaberinus need aspens for their habitat. Phryganophilus ruficollis, Pytho kolwensis and Boros schneideri live in forests where more decaying wood is created constantly from year to year.

# Forest fires create habitats

Photo: Ilkka Immonen

Forest fires are part of the natural carbon cycle: as long as forests have existed, there have also been forest fires. Our boreal forests have caught fire naturally from a flash of lightning, or fires have been caused by human activity. Every year, there are around 130,000 lightning strikes in Finland, which result in about one hundred forest fires. However, only one out of ten forest fires are caused by lightning. The most important cause is humans being careless with fire, and especially with campfires.

Historical forest fires can be tracked by looking at the annual growth rings of trees. Studies have found that approx. one per cent of pine-dominated forests burned annually between the 17th and the mid-19th century. Later the surface areas affected by fires declined sharply, and currently they are only a fraction of what they used to be. The average size of fires has also decreased. In the late 19th century, the average area of burned forest on state-owned land was 80 hectares, whereas in the early 2000s, it had already dropped to less than one hectare.

Today there are very few forest fires, and the areas affected by them are not large. The most recent major forest fire in Finland occurred in Tuntsa wilderness area. It burned 20,000 hectares of forest in the municipality of Salla in June 1960 and also around 100,000 hectares across the border in the Soviet Union.

Fire has turned forests into new habitats, forest fire sites, to which a number of species have adapted. A typical forest fire burns the field floor as well as twigs and branches lying on the ground, and some trees are damaged and die. Larger trees lying on the ground may burn or be scorched. The hot flames also cause charring or blackening of the bark of living trees in the base of their trunks. The phloem layer under the bark may heat up and be damaged, even if it looks like the bark is only black on the surface and the tree otherwise appears to be alive. In a more violent fire, the tops of trees may ignite, and the crown fire may spread far and wide. The end results differ depending on the intensity and duration of the fire.

The habitats created by fire vary even within the same forest. For example, the fire may not reach depressions or shaded, more humid places.

Many forest species benefit from fires, and some actually depend on scorched forests. They need burned wood for their habitat and cannot live elsewhere, or struggle to survive without forest fires, whereas others benefit from the more open forests created by the fire that let in more sunlight and heat. Dead or damaged trees left behind by a fire provide habitats for many species dependent on decaying wood, even if all of them do not require burned wood.

Due to the smaller areas of forest fire sites, Finland has already lost six species, all of which are insects. The lack of forest fires is the primary reason for the endangered status of 21 forest species, and it has made the situation of 60 other endangered species worse. Most of these species are insects, but they also include three fungi and two lichen species. The reduced availability of forest fire sites has also contributed to the endangered status of some of our forest biotopes: it is mentioned as a contributing factor in connection with 19 endangered biotopes.

Aradus angularis as well as Stephanopachys linearis and Stephanopachys substriatus live in conifers damaged by fire. Both Stephanopachys linearis and Stephanopachys substriatus live inside scorched spruce or pine bark where the fire has heated the phloem layer. Their larvae live in tunnels that they bore inside the bark. Aradus angularis lives underneath the bark of a scorched spruce or pine. Using its snout, it sucks liquids from the rhizomes of fungi living in burned trees.

# Aspen, the oasis of forest

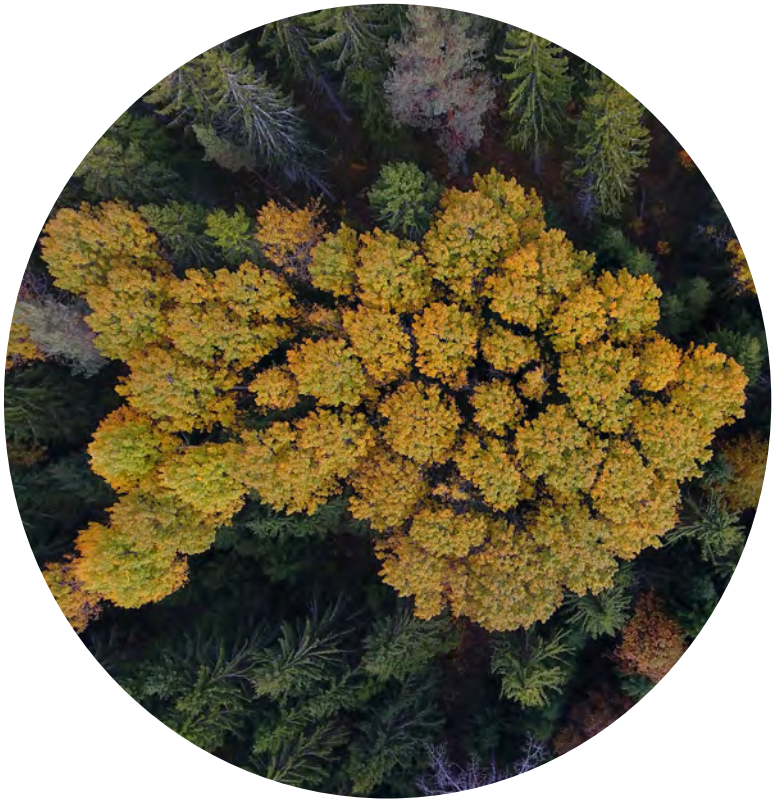


Photo: Jari Salonen

Aspens grow in many types of forests and cultural environments. This tree is vital for many forest species. Aspen bark is less acidic than that of many other trees. This makes it ideal for gastropods and a large number of mosses and lichens growing on its trunk. Larger aspens are typically hollow, or the wood inside the trunk is softer, offering opportunities for hole-nesting species.

There is a large number of species that live exclusively on aspens. Some of them feed on aspen leaves, while others live in damage parts of aspen trunks or on dead aspens. To make sure that species dependent on aspens can survive on a site in the future, aspens of different ages must grow there, and the site must offer aspens at varying degrees of decay. This is called the aspen continuum.

Old aspens provide holes and smaller areas of damage. When an aspen dies, it begins to decay immediately and gradually breaks down. Many species dependent on decaying wood only live in deadwood at a certain stage of decay. Aspens reproduce from seeds as well as root and stump sprouts. Reproduction from seeds requires the right humidity conditions. If it is too dry or excessively wet, the seeds may not germinate. In a natural landscape, forest fires have created important sites for the aspen, which is a pioneer species of the early stages of forest succession.

The aspen sprouts effectively when its trunk is damaged, or the tree is felled. Many herbivores feast on aspen saplings. Grazing elk, in particular, cause serious damage to

saplings, hampering aspen regeneration. In protected areas, aspens typically grow in old-growth forests as large individual trees or in small groups. In these closed-canopy forests, aspen regeneration is slow. Aspen saplings appearing in small clearings may fail to thrive due to excessive shading or damage caused by herbivores. Forest fires promote aspen regeneration by creating open environments for the early stages of succession. Clearings created by felling are also suitable sites for aspens. Aspens that have been damaged or felled when harvesting timber sprout effectively. Aspen regeneration on forestry land is deliberately prevented by various measures, especially on sites where the aim is to grow pines as the dominant tree species. Cervids grazing on saplings of deciduous trees also hamper the regeneration of aspens.

Aspen provides habitats for 39 endangered species. One of them is Cucujus cinnaberinus, a flat beetle with a red shell, which lives under the thick bark of sturdy dead aspens. These trees may be snags or trees lying on the ground. Xyletinus tremulicola, a spherical small beetle brown in colour, also depends on aspens. Xyletinus tremulicola lives inside the thick and knobbly bark of the aspen.

# Decaying wood is home to many species

Decaying wood provides habitats for thousands of species. Birds may incubate their eggs in it, and it provides a sheltered home for newly hatched chicks. Other hole-nesting species, including bats and flying squirrels, also thrive in decaying trees. Decaying wood is where insects lay their eggs, where their larvae grow, or where they spend their winters. It provides nutrition for many wood-decay fungi and insects and a site for mosses and lichens. Decaying wood also plays an important role in the carbon cycle of forests as a long-term carbon storage.

The wood of a tree that has died recently is hard and its bark remains attached to the phloem layer. Bark beetles are the first ones to arrive, laying their eggs inside and underneath the bark. Their larvae feed on the phloem and bark, and their tunnelling gradually loosens the bark from the trunk. Bark beetle tunnels serve as passages for many other insects living in decaying wood. In the meantime, fungi have started decomposing the wood.

Researchers of decaying wood often use a five-step scale in which the rate of decay is measured based on the softness of the wood. This rate can be determined by pressing a knife into the wood surface. If the blade does not sink in at all and the wood is still hard, it is at the first

Photo: Jari Salonen

stage of decay. When the knife slips in down to the handle, the wood has reached the fifth stage. At this stage, the tree may have been dead a hundred years, or a pine tree as many as 200 years. The fifth stage of wood decay is followed by one more stage, at which the tree is completely covered with mosses and the wood has decayed, or the only thing left is the tough heartwood. However, the shape of the tree can still be made out on the forest floor. In its last stages of decay, the tree enriches the soil and offers an ideal place for saplings to grow.

The reason that caused the death of the tree has a significant impact on the progress of decay. Due to damage to the root system or the trunk, the tree may die standing up and attract different species than a tree that falls in a storm with a root stock. When a tree fall pulls up a root stock as it falls, its connection to the root system may survive for a while, and the tree may die slowly. Pytho kolwensis is an example of a beetle that favours fallen spruces suspended slightly above the ground by their root stock.

When a tree dies, decay progresses slowly for the first five to ten years. The process then speeds up, however slowing down again when only the hardest parts of the wood are left to decompose. For example, the dense lignin-rich heartwood of a pine decomposes very slowly.

Trees in Finnish forests take a long time to decompose. During this time, the decaying wood serves as a significant long-term carbon storage and a vital part of the forest ecosystem. Pristine forests contain 60 to 90 m3/ha of decaying wood in southern Finland, with smaller volumes in the north. In commercial forests, the volume of decaying wood is 90% to 98% lower.

Insects living in decaying wood often require a certain state of decay to use the wood as their habitat. They may also only live on certain tree species and benefit from specific humidity and temperature conditions. Pytho kolwensis lives on spruces lying on the ground that have died a few years earlier. Boros schneideri is a species of pine snags. Phryganophilus ruficollis habitats comprise fallen trees, either spruces or deciduous trees, mostly birches. Its larvae only live in trees decomposed by certain wood-decay fungi. The occurrence of Phryganophilus ruficollis is associated with Canopora subfuscoflavida fungi, in particular. In order for these species to live in the forest, decaying trees of the specific type they require must be constantly available.

The reduced volume of decaying wood is a highly significant factor in the decline of forest species. One quarter of endangered forest species (181 species) have become endangered primarily because of the decline in decaying wood availability. A dead tree is full of life and an important part of a viable forest.

Photo: Maija Mikkola

Photo: Jari Salonen

# Recommendations

The following actions will help improve the odds for the target species. They also benefit a large number of other species with similar habitat requirements.

## Attention to pyrophilous species

- Preserving spruces and pines with a diameter of at least 15 cm at chest height that have been damaged by a forest fire on the burned site. Under the Forest Damages Prevention Act, at most 10 cubic metres per hectare of damaged spruces and 20 hectares of pines with a butt diameter of over 10 cm may be left in the forest.
- Prescribed burning of regeneration sites and retention tree groups for ecological management purposes. The site to be burned should have sturdy or relatively sturdy spruces or pines.

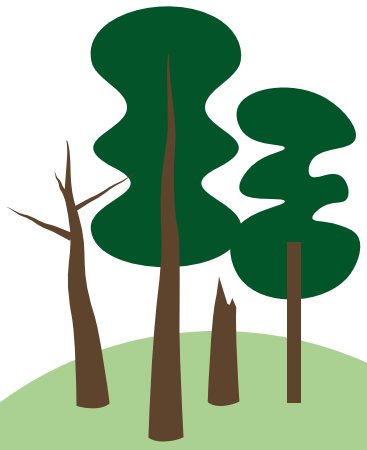
## Safeguarding species dependent on aspens

- Preserving aspen snags or fallen aspen trunks of all sizes. In forest management, care should be taken not to damage decaying wood on the ground.
- Preserving aspens of different ages in all types of fellings on suitable sites: in game thickets, retention tree groups and different protection zones. Aspens can also be grown in a mixed forest, especially with spruces and other deciduous trees. By favouring aspens, the aspen continuum is maintained: aspens of different ages and with different degrees of decay are continuously available.
- Creating artificial aspen snags in connection with clear felling and continuous cover forestry.

# Protecting organisms in decaying wood

- Preserving trees on sites where harvesting is difficult or the expected yield is low, including forests on rocky terrain, or on parts of such sites. The trees may be left to develop towards a more natural state, or into an uneven-aged forest where decaying wood is created at a more even rate.

- Preserving the surroundings of streams and rivulets. Many sites in the vicinity of streams or rivulets suitable for Pytho kolwensis are included in the habitats of special importance referred to in section 10 of the Forest Act. In this case, it is important to preserve on the site trees that, when they die, will produce habitats for saproxylic species. Sites with a deteriorated ecological status may also be left to develop towards a more natural state and, in the future, form habitats suitable for the species.

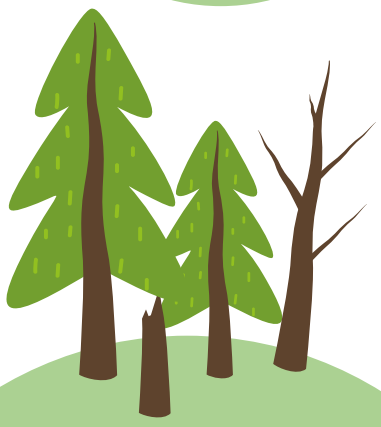


## Pine

- Saving pine snags (with a diameter of at least 15 cm at chest height) in all types of felling. The pines to be preserved can be recently dead (red or yellow-brown needles) or dead for more than a year. However, they should retain their bark in order to benefit Boros schneideri.
- Under the Forest Damages Prevention Act, at most 20 cubic metres per hectare of damaged pines with a butt diameter of over 10 cm may be left in the forest.
- Saving fairly sturdy pines in retention tree groups to produce decaying wood at a later stage. In earlier stages of forest management, the sites of retention tree groups can be planned in different protection zones, ecotones and humid depressions, or on rocky sites or near crags. Special trees, in particular, should be saved.

## Deciduous trees

- Favouring a deciduous tree mix in silviculture



## Spruce

- Retaining dead spruces and deciduous trees, both snags and logs, in connection with fellings and the harvesting of damaged trees. Trees that have died more than a year ago can be selected for this, eliminating the risk of insect damage. Less care is needed when preserving decaying deciduous trees. At most 10 cubic metres per hectare of spruces that have died and been damaged less than a year ago may be left on the ground or standing.
- Preserving retention tree groups with multiple tree species. The trees in retention tree groups will later produce suitable habitats for species living in decaying wood.
- In connection with harvesting, care should be taken not to damage trees lying on the ground that have bracket fungi and that have decomposed to the point of becoming soft.
- Restoration of drained wooded spruce mires by blocking and damming ditches.

Metsähallitus, Vantaa, 2023.