Effects of cutting and burning of heather *Calluna vulgaris* on fungal fruiting in Caledonian pine forest at Abernethy Forest RSPB reserve, Inverness-shire, Scotland

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SUMMARY

In a Caledonian pine forest in the Scottish Highlands, the effects of cutting and burning on fungal fruiting differed between species, and especially between mycorrhizal and decomposer species. Mycorrhizal species seem to fruit more abundantly in cut or burned areas, whereas fewer decomposers fruit under these treatments. This suggests that burning or cutting small areas could help increase fruiting fungi diversity, but that it should probably be avoided in areas where important litter decomposer species occur. Most fruiting records were from control plots, there was just over a 50% decline in the number of fungal fruit bodies in the burnt and cut plots.

BACKGROUND

Scotland's largest surviving fragment of native ancient Scots pine *Pinus sylvestris*-dominated pinewood is located at Abernethy Forest, which has about 1,900 ha of semi-natural Caledonian pinewood and 2,300 ha of pine plantations. Experimental management of the heather *Calluna vulgaris*-dominated forest field layer began in Abernethy Forest in 2002.

The objectives of the experiment were: to determine if burning or cutting heather dominated areas within the forest would favour woodland grouse (black grouse *Tetrao tetrix* and capercaillie *Tetrao urogallus*) by increasing the amount of bilberry *Vaccinium myrtilis* and invertebrate food available for them; and to see what effect this management would have on the other species for which the Forest is important. These include fungi, of which over 740 species have been recorded at Abernethy, including almost 50 UK red list species and 40 species that in Britain are more or less restricted to Caledonian pinewoods.

ACTION

Study site: The study was undertaken in the Scottish Highlands at Abernethy Forest RSPB reserve, Inverness-shire (National Grid ref: NJ 03 09).

Experimental design and treatments: Experimental management of the heather *Calluna vulgaris*-dominated forest ground layer began at 25 sites in 2002. Each site was divided into three 20 m × 35 m plots, one to be burnt, one to be cut and the third left to act as a control. Baseline data on invertebrate numbers, and vegetation structure and composition were collected in 2002. The plots were cut and burnt in March and April 2003.

Fungus surveys: Fungi were surveyed about 18 months after the plots had been cut or burnt to see if they showed any response to the management. The 25 sites were visited during the autumn of 2004 and the macro-fungi were recorded. A total of 9.5 days was spent in the field and an average of 4 hours spent on identification on each of these evenings.

Macro-fungi have been recorded annually at Abernethy Forest for almost 20 years, and a

reserve list of around 740 species has been compiled. In line with these previous fungus surveys, the surveys for this study were centred around the peak fruiting period in September. Twenty-seven plots were surveyed between 30 August and 3 September 2004, and 48 plots were surveyed between 27 September and 2 October 2004.

The plots, marked with canes and twine, were visited in a random order. Within the central 20 m × 20 m of each plot, all fungi visible to the naked eye were identified and counted. Care was taken to examine microhabitats such as sheltered areas beneath heather and juniper *Juniperus communis*, and between dead wood. Dead or layered heather was not disturbed and dead wood was not turned over. Dung was not removed to see if any coprophilous fungi appeared on it. Care was taken to minimise the impact of the search on other organisms in the plots.

Those fungi with caps larger than 2 cm diameter were given a 'damage score' based on damage that was visible without close examination. Mammal and invertebrate grazing was included without differentiation. This method would not necessarily pick up infestations of fly larvae, and can only be used as a very general indicator of grazing levels. Only damage caused by grazing was recorded, damage caused by trampling was not noted.

The remaining area of the plot (two 7.5 m × 20 m strips at each end) was less intensively surveyed by searching whilst walking along a zigzag path.

Fungus identification: Some fungi were removed from the plots to enable identifications requiring microscopic examination. In the time available, it was not possible to make critical determinations of all the species found, and the taxonomy of some groups such as *Cortinarius* subgenus *Telamonia* is still poorly understood. It is unlikely that any of the unnamed *Cortinarius* species will receive further attention, but drawings have been made of some collections and herbarium material kept.

Statistical analysis: 2-way ANOVAs were used to compare the different treatments to test for significant treatment effects.

CONSEQUENCES

Fungus survey results: Fieldwork for this fungi study coincided with a good season for fungal fruiting, especially in comparison to 2003, which was an exceptionally dry summer. In the study plots 153 species were identified, whilst a further 21 taxa could only be identified to genus in the time available. Twenty-seven species (18% of those identified) were new to the reserve list. The high proportion of new species is in line with the findings of Tofts & Orton (1998), who demonstrated that there was a continued linear increase in the number of agarics and boleti recorded at Abernethy, even after many years of recording. Several of the new species are rare in Scotland or the UK as a whole.

Effect of treatments: A small number of taxa accounted for the majority of the total records made, with the 11 most frequently encountered taxa (*Psathyrella artemisiae, Marasmius androsaceus, Entoloma cetratum, Mycena sanguinolenta, Mycena capillaripes, Mycena* spp., *Mycena clavicularis, Mycena rorida, Mycena epipterygia, Rozites caperatus* and *Collybia dryophila*) accounting for 46% of all records. Sixty-four species had only one record, but these were not associated with any particular treatment. Similarly, the species new to the reserve were found in all treatments, without any statistically significant association. Therefore, the records of new and rarely fruiting species as a whole do not reflect the management treatments.

Overall, most records were from control plots, and there was just over a 50% decline in the number of fungal fruit bodies in the burnt and cut plots. Litter decomposers (67%) and mycorrhizal species (31%) accounted for 98% of the records. Overall, the litter decomposers were less frequent in managed plots (23% fewer records and 58% fewer fruit bodies), with an almost identical response to cutting and burning. Overall, the abundance of fruiting bodies of mycorrhizal species was significantly higher in both cut and burnt plots compared to the controls. This was most notable in burnt plots, where the numbers of fruit bodies and records were 76% and 38% higher than in the controls.

For the majority of species, the sample size (number of records) was too small to be able to investigate their individual response to management. There were 43 taxa with more than

12 records, and their occurrence in each of the three treatments was analysed:

14 out of the 43 taxa (33%) showed significant differences in abundance between treatments (Caledonian pinewood specialists are marked with an asterisk):

Seven taxa (*Entoloma cetratum, Mycena sanguinolenta, Mycena capillaripes, Mycena clavicularis, Mycena rorida, Suillus flavidus**, and *Cortinarius speciosissimus**) were significantly more abundant in control plots.

*Psathyrella artemisiae, Cortinarius gentilis**, and *Russula decolorans** were significantly more abundant in the cut plots.

*Galerina pumila, Galerina vittaeformis, Rozites caperatus** and *Collybia dryophila* were significantly more abundant in the burnt plots.

Conclusions: Most fruiting records were from control plots, and there was just over a 50% decline in the number of fungal fruit bodies in the burnt and cut plots. As would be expected, the effects of cutting and burning differ between species, and especially between mycorrhizal and decomposer species. Mycorrhizal species seem to fruit more abundantly in cut or burned areas, whereas fewer decomposers fruit under these treatments. This suggests that burning or cutting small areas could help increase the diversity of fruiting fungi, but that it should probably be avoided in areas where important litter decomposer species are known to occur.

REFERENCES

Tofts R. & Orton P.D. (1998) The species accumulation curve for Agarics and Boleti from a Caledonian pinewood. *Mycologist*, 12, 98-102.