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Peterken, George; Cracknell, David; Beamish, Cesca; Healey, John

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Ash dieback (ADB) has cut a swathe through our landscapes, woods, management programmes and research priorities. First identified wild in 2012 in an ancient wood in Norfolk, it rapidly reached west Wales and the western Highlands. Louise **Hill (2022**) recently reviewed its origins, biology and impacts and summarised our responses. Hopes are centred on finding resistant trees from which we can collect seeds for replanting. This will take at least a decade, and meanwhile huge numbers of mature trees within and outside woods are being felled, partly for public safety and partly to use the timber before it deteriorates.

But, is this active response always necessary and desirable? In particular, could we leave ADB to run its course in woodlands being managed for nature conservation if, first, we fell or top dangerous ash close to paths? And, would the ash population eventually restore itself if we did so? We ask partly because of the precedent of 'Dutch' Elm Disease in the 1970s, which elicited a strong pessimistic response, epitomised by publication of *An Epitaph for the Elm* **(Wilkinson 1979)**, but which actually left some woodland elm populations unscathed and others to perpetuate themselves as underwood trees (**Peterken and Mountford 1998, Rackham 2003**).

Here we relate how ADB has changed the ancient, mixed deciduous Lady Park Wood (Monmouthshire and Gloucestershire) and assess the capacity of ash *Fraxinus excelsior* to remain a component of the mixture. Since 1945, the wood has been reserved for research into how natural ('unmanaged') woodland develops. It has grown without any felling, thinning or planting, and the growth, condition and survival of several thousand individual trees growing within 10 recording transects have been recorded at semi-regular intervals (**Peterken and Mountford 2017)**, thereby providing an exceptional opportunity to analyse the response of ash to ADB at the individual tree level. Within the wood, ash competes over a range of site conditions with beech *Fagus sylvatica*, sessile oak *Quercus petraea*, small-leaved lime *Tilia cordata*, large-leaved lime *Tilia platyphyllos*, wych elm *Ulmus glabra*, birches *Betula pendula* and *B.pubescens*, gean *Prunus avium* and aspen *Populus tremula* and with other tree and shrub species in the underwood. This mixture is largely confined to the southern Welsh borderland, but, nevertheless, we hope our findings will provide some guidance for managers of nature reserve woodlands elsewhere.

Initial progress of ash dieback in Lady Park Wood

Disease was first detected as wilting shoots in tall saplings in August 2017, when ash contributed about 25% of the total basal area. Further similar infections were seen in 2018, by which time many young ash in an adjacent compartment were clearly dying back. At that stage, we had seen no ADB in mature trees within the reserve, but when a tall ash growing near one of the permanent transects split and fell in autumn 2018, parts of the crown were seen to be infected.

By 2019 83% of the ash in the canopy were infected and the crowns of 25% of the total ash population had lost 80% or more of their crown foliage to dieback. A year later, 93% of the trees in the recording transects were dying back and 41% had lost 80% or more of their crown. The degree of infection varied enormously, even between neighbouring trees. ADB infected trees on all site types, but appeared to be most severe on the moist, alkaline soils of the lower slopes. The smaller ash in the underwood were more infected with ADB than those in the canopy and sub-canopy.

This was the point at which the pattern of initial infection was analysed in detail (**Cracknell et al 2023**), taking advantage of assessments in 2019 and 2020 of almost all trees growing in the 10 permanent recording transects and relating this to the record of individual trees kept since 1945. Key points:

- Topographic position had a major effect: severity of ADB was much greater in ash on the lower ground with moister soils and potentially higher humidity.
- Severity of ADB was least in a stand that had been thinned in 1983 and 1992 (all other areas have been left unmanaged since 1945).
- Neighbours matter: ADB was less in ash trees surrounded by a greater proportion of ash trees in their neighbouring six trees, with a corresponding lower proportion of trees of other species. Ash trees may be less competitive as a neighbour than the other species, so having ash neighbours may increase the vigour of ash trees, making them more resistant to the pathogen.
- The point about neighbours is reinforced by the finding that ash trees with a small diameter and/or a slower previous diameter growth rate, most of which grew in the underwood and sub-canopy, suffered greater severity of ADB.
- A scatter of trees remains throughout the reserve which have not yet suffered from ADB, some of which grow close to other trees that have been severely affected.

Assessing the responses of ash to ADB

We assessed the resilience of ash to ADB by distinguishing resistance to infection from recovery in the face of dieback. Resistance was measured by assessing the proportion of the original crown that remained alive whereas recovery could be judged by the quantity of new growth forming within the crown, on the trunks and from the base of the trunk. Perforce, these assessments were approximate: we simply recorded the percentage of the original crown that remained alive and the amount of new growth ('sprouts') in each position in four classes - none, few, some and much – relative to the size of the tree. We also noted whether the sprouts were themselves dying back. As the disease progressed, dead twigs fell off and crown sprouts became harder to distinguish from original crown. Throughout, a few ash were hard to assess because their crowns could not be seen fully through the dense lower foliage of beech and lime. We also recorded the girth of each tree.

Six years on: ADB in September 2023

Following limited surveillance in 2021 and 2022, all ash within the transects were recorded again in September 2023. By then 380 ash remained alive (from a population of 464 trees in 2019) within the monitoring transects (**TABLE**), of which 48% lacked any original crown foliage and just 24 trees (6%) appeared to have complete original crowns. Records from 2019-2022, however, showed that 13 of the latter group had been recorded with less than 90% original crown at a previous recording, suggesting that they may have recovered after suffering limited dieback. The tiny band of 11 apparently immune trees (which would have been 13 if two others had not been felled earlier in

2023 as part of safety fellings) and 13 recovered trees was joined by a further 49 ash that appeared to have almost complete original crowns (70-95% crown cover in 2023). Some of the latter had never had less than 90% crown foliage, but most had evidently recovered from limited dieback.

Collectively, these trees combine a high degree of resistance with a substantial degree of recovery. They were found in all stands and in all site types except the moist colluvial fan at the bottom of the slope, though even here a few canopy trees with little or no dieback could still be found outside the transects. Most had large crowns and grew in the canopy, but sub-canopy, underwood and small-crowned trees were also represented. We do not know whether any saplings would have resisted ADB because fallow deer recolonised the reserve in 2017 and ate the lot.

A further 119 trees appeared to retain some original crown, of which 28 had apparently partially restored their crown after 2020 by growing more crown sprouts. These are the trees that still demonstrated a degree of resistance, albeit limited in the case of the 71 trees with less than 30% crown foliage in 2023. All but five of the 119 had responded by generating at least a few sprouts.

In the population as a whole, the generation of crown and trunk sprouts was greater in trees that had suffered more dieback of their crown foliage. This new growth is the sole means of survival of the 172 trees that retained no original crown in 2023. Of these 107 showed some or strong crown and/or trunk resprouting, but 65 demonstrated neither resistance nor recovery: they remained barely alive with just a few, usually weak, trunk and/or basal sprouts.

Mortality

Ash trees did die before ADB arrived. Of the 179 ash recorded in the old-growth stands in 1945 122 died before 2017. Most of the casualties were small and slow-growing individuals which were weakened in competition with stronger neighbours. Many responded by growing trunk and basal sprouts before finally expiring. Some were blown down or knocked over when neighbouring trees fell, small underwood trees were sometimes crushed by falling limbs, canker weakened a few large trees and saplings perished after repeated browsing by deer.

These processes all continued after the arrival of ADB, so, how much of the post 2017 mortality can be blamed on ADB? Of the ash that had been alive immediately before the arrival of ADB 223 were dead by September 2023. In addition, saplings and basal sprouts that had not yet reached 1.3m - the height at which they would have been counted as recruits - also vanished.

In the stands that had hardly been touched since coppicing stopped in 1870 (‘old growth’) none of the 20 ash that died since 2013 was obviously killed by ADB, though they may have been weakened by it. The lost canopy trees were either toppled by wind, knocked over by other falling trees, heavily cankered, already severely damaged or severely restricted by a neighbour. Three near the edge of the reserve were felled by Natural England for safety reasons. The underwood and sub-canopy trees that failed could have been excluded by shade, part of the ongoing, natural self thinning of unmanaged stands.

ADB was certainly responsible for some of the mortality in the stands that had grown after 1942 (‘young growth’). The 34 saplings and 8 basal sprouts from large trees were browsed by deer, but not before many withered with ADB. The 32 ash lost from the underwood were slow growing trees with small or tiny crowns that were already failing: here ADB visibly administered the coup de grâce. Most of the 43 ash lost from the sub-canopy survived to 2020, but many were clearly diseased by then.

Three of the 25 ash lost from the canopy were felled by falling beech and one was cankered. Many of the remaining 21 declined rapidly between 2019 and 2020: in these cases ADB must have been primarily responsible. The 11 trees felled by Natural England were cut high and have re-sprouted.

In the stands on the steep slopes below the cliff, which had been thinned in 1942, most of the 18 small trees lost from the underwood were abundantly infected before they died, but some larger trees toppled, presumably victims of loose rootholds and/or unbalanced crowns. Natural England felled another 28 in 2022-23. In the managed stand, which had been thinned in 1983 and 1992, leaving an open canopy, most of the ash that died were small, slow growing individuals in the underwood or trees that had already fallen before ADB arrived. Even though they received more light than is customary in the underwood, they were evidently too weak to resist ADB.

In all stands, many of the saplings that had not yet reached 1.3m (and therefore had not been counted as recruits) were quickly infected by ADB, but fallow deer returned to the reserve at the same time. All but the tiniest saplings have died, but we have no means of knowing whether any would have survived ADB in the absence of deer.

Summarising, the deaths of very few ash can be blamed solely on ADB, but ADB certainly contributed to the loss of saplings and small, slow-growing trees in the underwood that had long been shaded. Apart from the trees that were felled by Natural England, the great majority of the trees in the canopy were still alive in September 2023, albeit in many cases reduced to dead crowns and supported solely by trunk and crown sprouts.

Continuous monitoring

The progress of ADB was monitored by recording ash on one transect every September from 2019 onwards and this revealed that a majority of ash in this admittedly small sample had more foliage in 2022 than in 2021. This modest recovery was, however, reversed in 2023. In the portion that crossed the old-growth stands, the 67 ash recorded in 1945 had been reduced to 23 by 2017. ADB abated in 2022: 14 of the 23 trees still alive in 2021 had more foliage in 2022, 3 had less, and 6 remained unchanged. Two of the trees were unchanged simply because they were free of ADB in both 2021 and 2022. In the portion that crossed the young-growth, 24 trees remained alive in 2015, but by 2022 only 14 remained alive. Most of the rest had been knocked over by falling beech and lime and the attempted regrowth had been killed by ADB. In 2022, 8 of the 14 showed some recovery, but in 2023 all but two had died back further. Significantly, the two exceptions were an apparently immune underwood tree and another recorded as 90% crown cover in 2023.

Commentary

Our observations suggest that only a very small proportion of the original ash population could be immune to ADB. If we count all trees that have never had less than 90% crown cover when assessed, the proportion is just 3.3% of the trees alive before the arrival of ADB or 5.1% of the trees alive in 2023. Casting the net wider to include strongly resistant trees, 17% of the trees that were *in the canopy* before ADB arrived (and thus not subject to the shade in the lower strata) have never had less than 70% of their original crown cover. A further 48% of trees *in the canopy* with 30-60% of original crown cover in 2023 and/or many sprouts in the crown or on the trunk, have demonstrated limited resilience.

When ADB arrived, Lady Park Wood contained several groups of ash saplings and many millions of seedlings, most of which were actually tiny saplings, several years old, but very slow growing. Within this population, we would expect many hundreds to be inherently resistant to ADB, even if we apply the 1.5% proportion indicated by the trees unaffected by ADB and accept that young trees are inherently more vulnerable than older ones. Unfortunately, resistant saplings and seedlings had no chance of growing because the perimeter fence failed and deer gained unfettered access just when ADB was first detected.

Management has reduced the advance of ADB. Some 60% and 82% of ash in the canopy of the stand that was thinned were infected in 2019 and 2020 respectively, compared with 86% and 95% in the unmanaged stands. By 2023, 44% of the canopy trees in the managed stand had never been recorded with less than 20% of their original crown cover, compared with just 15% in the young-growth stands, their direct equivalent in the unmanaged stands. The extra canopy space afforded to ash in the thinned stand has evidently strengthened their resistance to ADB.

Ash in LPW competes for canopy space with beech, small-leaved lime, large-leaved lime and other species. In the underwood it also competes with hazel and several other kinds of small tree. As ADB advances, so the trees of these and other species have gained a competitive advantage. In particular, crowns of beech and limes will, on the present trajectory, increasingly occupy the space that ash might occupy.

Ash is not without hope. A meta-analysis of studies of ADB across Europe found that, even after 20 years of exposure, no site has lost more than 85% of all its ash, though few ash are completely healthy (**Coker et al 2019**). Natural woodland shows less mortality than plantations. Even naturally regenerated saplings seem less affected than mature trees in plantations. This analysis found that the mortality rate in natural woodland (i.e., not plantations) is most likely to fall within the range 50-75% after 30 years, but 100% mortality could not be ruled out.

Despite this, six years into the ADB infection, the long-term prospects for ash in Lady Park Wood remain uncertain. If it were just a matter of resisting the disease and contending with increased competition from beech and limes, then we would be reasonably confident that ash will survive at a much reduced proportion of the stands. However, despite the manifestly sick state of most surviving trees, the main long-term threat is not ADB but deer, which since 2017 have destroyed almost all the regeneration established since the perimeter fence was erected in 2007.

Lady Park Wood has an uncommon combination of tree species and circumstances, but our experience may provide some general guidance for managers of woodland nature reserves elsewhere. Responses to ADB and the prospects for ash must be reviewed in the particular circumstances of each reserve. Ideally, they should also be considered in relation to the history of both the stand and the ash population. This may reveal that, however catastrophic ADB looks now, it may not be the greatest long-term threat to the survival of ash as a significant component of a mixed deciduous woodland.

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References

Coker, T.L.R., Rozsypálek, J., Edwards. A., Harwood, T.P., Butfoy, L., Buggs, R.J.A. 2019. Esimating mortality rates of European ash (Fraxinus excelsior) under ash dieback (Hymenoscyphus fraxineus) epidemic. Plants People Planet, 1, 48-58.

Cracknell, D.J., Peterken, G.F., Pommerening, A., Lawrence, P.J. and Healey, J.R. 2023. Neighbours matter and the weak succumb: Ash dieback infection is more severe in ash trees with fewer conspecific neighbours and lower prior growth rate. Journal of Ecology, 111, 2118-2133.

Hill, L. 2022. The other pandemic: ten years of Ash Dieback. British Wildlife, 34, 113-122.

Peterken, G.F. and Mountford, E.P. 1998. Long-term change in an unmanaged population of wych elm subjected to Dutch elm disease. Journal of Ecology, 86, 205-218.

Peterken, G. and Mountford, E. 2017. *Woodland development. A long-term study of Lady Park Wood*. CABI, Wallingford.

Rackham, O. 2003. *Ancient woodland*. New Edition, Castlepoint Press, Dalbeattie.

Wilkinson, G. 1979. *Epitaph for the elm*. Hutchinson, London.

Authors

George Peterken was a woodland ecologist with the Nature Conservancy and successor bodies. **David Cracknell** was a journalist who then researched ash dieback for his recent M.Sc. In Forestry from Bangor University. He manages his small woodland in Kent. **Cesca Beamish** is BSBI joint vice-county recorder for Worcestershire. **John Healey** is Professor of Forest Sciences at Bangor University.

TABLE. Summary of the impact of ADB on ash in Lady Park Wood as assessed in September 2023.

All stands	**RESISTANCE % of original crown foliage remaining**					
RECOVERY Presence of sprouts within the crown or on the trunk	**None***	**Less than 30%**	**30-60%**	**70-95%**	**100%**	**Total**
Many crown or trunk sprouts	40+11	33	5	6	2	86+11
Some crown or trunk sprouts	67	24	14	6	3	114
Few crown or trunk sprouts	62	17	18	29	8	134
No crown or trunk sprouts	3	2	9	8	13	35
Total^	172+11	76	46	49	26	369+11

* 11 trees in the young growth were pollarded in 2023; when recorded in 2020, 5 retained 70-95% of their original crown foliage. ^ includes a few trees felled shortly before assessment.