STARTING A CONSERVATION COLLECTION OF *SORBUS PSEUDOMEINICHII* – THE CATACOL WHITEBEAM

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ABSTRACT

There are three endemic *Sorbus* species on the Isle of Arran in Scotland: *Sorbus arranensis*, *S. pseudofennica* and *S. pseudomeinichii*. The latter is the most recently discovered and is represented in the wild by a single individual. Seed propagation and vegetative propagation by chip budding were initiated for all three species at the Royal Botanic Garden Edinburgh (RBGE). This has been successful and there are now conservation collections of these species growing at RBGE.

INTRODUCTION

On the Isle of Arran off the south-west coast of Scotland there have been multiple hybridisation events involving the commonly occurring *Sorbus aucuparia* (rowan), the chromosomes of which are diploid, and the apomictic *S. rupicola* (rock whitebeam), a tetraploid. When a species is apomictic it does not need to be fertilised as it already has a full complement of chromosomes. The first hybridisations between *S. aucuparia* × *rupicola* gave rise to the triploid *S. arranensis*, Arran whitebeam, which reproduces by apomixis. A backcross between *S. aucuparia* and *S. arranensis* produced the tetraploid *S. pseudofennica*, Arran service-tree (Hull & Smart, 1984; Robertson *et al*., 2004a & b).

In the herbarium at RBGE there is a *Sorbus* specimen which was collected by D.N. McVean in 1949 and is labelled *Sorbus arranensis.* Lusby *et al*. (1996) refer to it as being a possible hybrid between *S. pseudofennica* and *S. aucuparia.* This proved to be the case when Ashley Robertson carried out work for his PhD on the genetics of the Arran species of *Sorbus* (Robertson, 2000). The new species was named *Sorbus pseudomeinichii*, the Catacol whitebeam, after the name of the glen where it grows. The new species most closely resembles *S. aucuparia* with completely divided leaflets but it has a large terminal lobe, larger than any of the lateral leaflets (Robertson & Sydes, 2006) (see Fig. 1).

When it was discovered that there were three individuals of *S. pseudomeinichii* with two genotypes, researchers knew that hybridisation had happened at least twice in the north-west of Arran. This triploid species is apomictic but has a greater proportion of its inheritance from *S. aucuparia* than the triploid *S. arranensis* that is derived more from *S. rupicola*. The population has now declined to one single tree which has fallen

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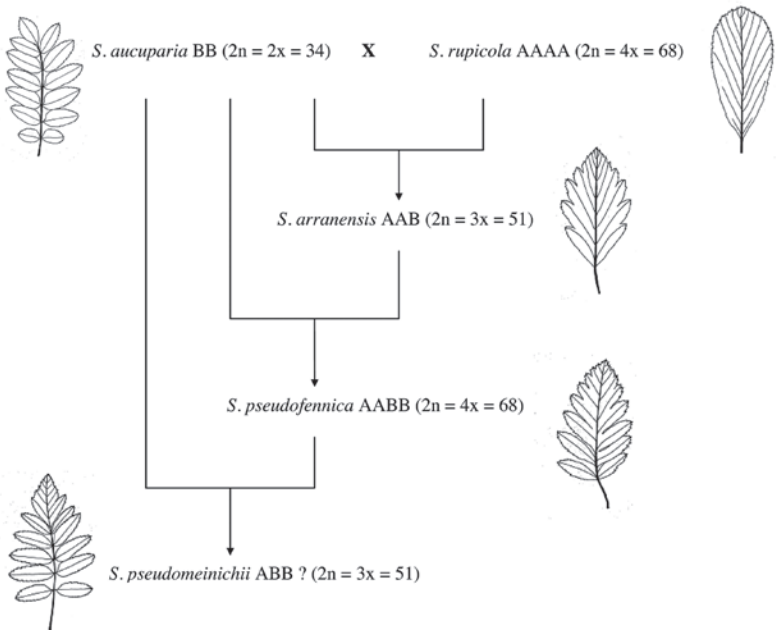

Fig. 1 Relationships between *Sorbus* taxa of Arran. The letters A and B indicate haploid genomes from *S. aucuparia* and *S. rupicola* respectively. Ploidy levels are given in brackets. Diagram drawn by Ashley Roberston.

over and produced multiple stems. All three endemic species are confined to fourteen localised sites around Glenn Diomhan, Gleann Easan Biorach and Glen Catacol in the north of Arran and, while there is a fence around one large population, there has been little opportunity for regeneration beyond the fence because of high levels of grazing. As there is only a single specimen of *S. rupicola* at Glen Dubh, near Brodick on the east side of Arran, there is now less opportunity for a continuing pollen exchange and speciation, *S. aucuparia* being the only other species frequently present (see Fig. 2). For a strong population to develop there needs to be an active, dynamic pollen exchange with frequent hybridisation events in this location (Robertson *et al*., 2010) but until this can be established it was decided that conservation collections should be formed for all three species. It was particularly important that this be done for *S. pseudomeinichii*, and the single site where it occurs has also now been fenced to protect it from further grazing damage and allow ample space for seed germination in a protected environment.

PROPAGATION

Sexual and asexual propagation methods were used to propagate the endemic Arran *Sorbus* taxa. Initially seeds were collected and later vegetative material was collected for chip budding.

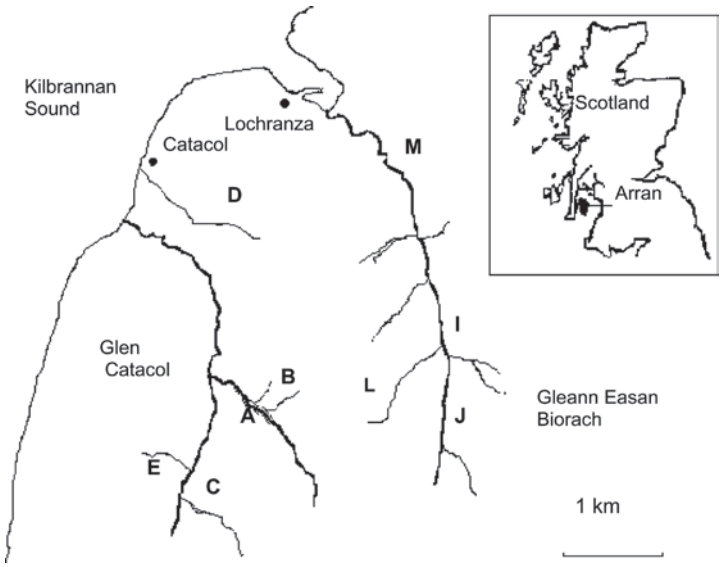

Fig. 2 Location of *Sorbus* species on Arran. The letters refer to the collections made for the PhD thesis of A. Robertson (Robertson, 2000). Map drawn by Ashley Robertson.

Seed

The first visit to Glen Catacol was made in 2006 with horticultural staff from RBGE, Graeme Walker, Area Officer for Scottish Natural Heritage (SNH) and Ashley Robertson, who had studied these populations for his PhD (Robertson, 2000). The aim of the visit was to use Ashley's knowledge to identify the different clones, to attach additional tags containing the species' name and the clone information based on Ashley's thesis work and to collect berries for propagation. Many of the trees had been tagged in the past but tags can fall off or become lost in lower growth. Three clones had been found for *S. arranensis* and six for *S. pseudofennica*. It was known that there were two plants of one clone of *S. pseudomeinichii* in the course of Ashley's study; however, in 2006 there was only one healthy tree remaining.

With appropriate permissions from SNH, fruits were collected from all three taxa in order to obtain a genetically representative conservation collection. *S. pseudomeinichii* seemed to be fruiting well at the time; however, when inspected, most seeds were damaged by insects or pathogen infection.

Soon after collection, the seeds of *S. pseudomeinichii* were extracted from the ripe fruit and rinsed under tap water to produce clean seed for sowing. Ten seeds were sown in individual Rootrainers™ with one seed per cell. Rootrainers™ are a hinged modular-cell planting system which is particularly useful for tree seeds because they encourage downward growth of the new roots and reduce root disturbance when plants are potted on or planted out. Seeds were sown into John Innes seed compost and top-dressed with

flint grit. No pre-treatment to stimulate germination was applied. The Rootrainers™ were placed in the outdoor seed frame. Of the ten seeds of *S. pseudomeinichii*, only one germinated, in June 2007, and gave rise to a vigorous multi-branched tree sapling which had reached the height of 50cm by August 2011 (see Fig. 3).

When the seedling had two to four true leaves it was potted on into an Air-Pot™ using a growing medium containing equal quantities of small-, medium- and large-grade composted bark with added slow-release fertiliser with an N:P:K ratio of 15:9:11 +2.5Mg0 and placed in a shade tunnel. Air-Pots™ encourage the development of a healthy radial root system with many fine roots (Single & Single, 2010). The shade tunnel enables plants to harden off and to grow in an environment that most closely resembles the conditions in the wild.

A number of factors are likely to limit the success of growing the *Sorbus* of Arran from seed: the low percentage of viable seed in the wild, which is often due to insect predation; the annual variability in seed production (in some years, for instance, the trees fail to bear fruit); the slow and erratic germination pattern which may stretch over a period of five years and possibly more; and the climate, which appears to influence dormancy. For example, seeds of *S. pseudofennica* were sown in September 2006: one seed germinated in 2008, one in 2009, nine in 2010 and two in 2011. The best germination rate so far was recorded after the winter of 2009–2010 when the temperatures reached were lower over a longer period than those of 2006, 2007, 2008 and 2011.

It has also been observed that seedlings are slow growing as they put more energy into building up a strong root system during the first four years.

Chip budding

Given the constraints in using seed for propagation another attempt was made at propagation by collecting vegetative material for chip-bud grafting, known as chip budding, again after obtaining the appropriate permissions from SNH. The key advantage of the technique of chip budding is that there is no need to collect a lot of vegetative material, which would undermine the viability of the plant in the field. This is because a single, well-selected twig will have several buds each with the potential to give rise to one tree. Therefore, a large number of plants can eventually grow with this method.

Fig. 3 Multi-stemmed sapling of *Sorbus pseudomeinichii* grown from seed sown in 2007. Photo: Natacha Frachon.

It is important to have adequate separation between the buds so that they can be removed cleanly. It can be difficult collecting this material if the trees are very stunted as was the case with *S. arranensis* and *S. pseudofennica*. Fortunately, the single tree of *S. pseudomeinichii* is growing vigorously on the edge of a stream and good material was collected without affecting its health (see Fig. 4).

In early August 2007 vegetative material was collected on Arran. The labelling of the trees that had been conducted the previous summer enabled a well-targeted collection from the different clones within each species. The long-arm loppers were an essential collecting tool as most of the trees are growing on the steep, rocky sides of ravines (see Fig. 5). Once gathered, the leaves were cut from each bud-stick and all the twigs from the same plant were labelled, wrapped together in wet newspaper and placed in coolbags. The material was taken back to Edinburgh from Arran on the same day as collection. The following morning, under the supervision of Peter Brownless, Nursery Supervisor, a team of staff in the RBGE Nursery grafted the buds onto *Sorbus aucuparia* rootstocks.

With this method a chip of bark is removed from the rootstock and replaced by another chip from the bud-stick which contains a bud. Both chips are cut to expose their cambium layer and are cut out to the same size and shape in order to obtain a good fit. The chip bud is then wrapped with grafting tape to seal the cut edges as well as to hold it in place. The ties are released a month later after the buds have united (see Fig. 6).

Fig. 4 The single plant of *Sorbus pseudomeinichii* in Glen Catacol. Photo: Heather McHaffie.

Fig. 5 Collecting vegetative material with the long-arm loppers. Photo: Heather McHaffie.

This proved to be a successful method of propagation as after one year, 80 per cent of the buds had made a graft union and had started to grow. After growth was well established the top of the rootstock was cut off above the scion growth.

Layering

The final stage of chip budding is to separate the growing scion from the mother plant to preserve the genetic integrity of the grafted material and to give rise to a new independent tree. The scion is encouraged to produce roots before being cut off from the rootstock below the newly formed root mass.

Two layering techniques were used in early spring: air layering and simple

Fig. 6 A successful chip-bud graft. The scion and rootstock have formed a union and the bud is growing. Photo: Natacha Frachon.

layering. Air layering was performed above ground by making two cuts to expose the bark at the base of the scion, which was still attached to the parent plant. The cuts were dusted with hormone to speed up the rooting process and surrounded with a plastic pot containing a standard growing medium.

For simple layering, the rootstock with the growing scion was laid flat in an open bed in the RBGE Nursery and all branches of the scion were layered to produce adventitious roots. A thin sliver of bark was shaved off on the underside of the stem which was then bent, buried and pinned down to remain upright above ground level (see Fig. 7).

It is too early to say how successful the layering has been because in both methods the stems may take several growing seasons to root.

THE FUTURE OF THE COLLECTION

The trees raised through sexual and vegetative propagation will build up a genetically representative *ex situ* collection of the endemic whitebeams of Arran. There are a number of uses for the collection: for conservation, to act as an insurance against the loss of any plants in the wild populations should anything cause them to disappear; for horticulture, to gain an insight into their requirements for propagation and cultivation; and

Fig. 7 RBGE nursery staff demonstrate simple layering to HND Horticulture students. Photo: Natacha Frachon.

for education, to train students in the principles and practice of plant conservation. We also intend to distribute duplicate collections of plants to other gardens, using RBGE's regional networks. In this way the status of the species that have been propagated will be more secure than if they were all kept in one location.

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