



Orchard Network



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Orchard Network Crab Apple Project Investigating our native crab apple. or “Will the real *Malus sylvestris* please stand up?”

NEWSLETTER: THE CRAB Summer 2022



Orchard Network is a partnership of organisations working together for the conservation of orchards across the British Isles.
To see Orchard Network (www.orchardnetwork.org.uk)

The Crab Apple Project objective is to record tree, leaf, flower and fruit morphology, other fruit characteristics, and DNA fingerprints, of a range of wild crab, hybrid and feral apple trees in natural locations in the British Isles:

- 1 to see if this helps to identify native *Malus sylvestris* trees and separate them from *M domestica*, and from wild/feral hybrids with *M domestica* (and other *Malus* species).
- 2 to provide, if possible, a field identification method to separate the native *Malus sylvestris* from hybrids (and we recognize that many before us have already tried!)
- 3 evaluate the fruit of both the species and its hybrids for apple and cider apple breeding – not least to pass on its relatively disease-free character to cider apples.

Progress of the project

The funding for this national project is a grant provided by City of London, which owns open access land around London, including Epping Forest, Burnham Beeches, Ashted and Hampsted Heaths and other commons, that have many crab apple trees. The funding primarily provides funding for DNA fingerprinting of up to 350 tree samples over 3 years, and some expenses.

During the design and planning of the project in 2021, some 15 crab apple trees from Dorset and Suffolk (where the two members of Orchard Network that planned the project live) were DNA fingerprinted in preparation, and this data and their morphological data will be joined by this year's surveyed trees in our data spreadsheets.

In early May this year the project team and a group of surveyors met at City of London's Burnham Beeches to try out the Spring Survey Form on their crab apple trees, and discuss issues relating to crab apple identity. (During the meeting while inspecting a large, ancient crab apple tree with a significant rot hole, some frass, possibly of the Noble Chafer, *Gnorimus nobilis*, a Red Data Book beetle, was discovered. Appropriately, it was Steve Oram of People's Trust for Endangered Species, whose arm was down the hole!)

Right: Crab apple flowers photographed in late April 2022, all in a 500m hedge showing the range of forms. Note the petal size and colour, and lengths of stalk/pedicle. The interpretation of species is pure conjecture at this stage, but it is likely they are all *sylvestris* x *domestica* hybrids.



103 trees were surveyed in late April and May and their morphology recorded from 16 localities across England, by over 30 surveyors. From the surveys sent in, 45 trees with a wide diversity of flower and/or foliage morphology were selected for DNA analysis, and surveyors gathered leaves and sent them to EMR (East Malling Research) in June for freezing, and DNA analysis later this year; we should receive the analyses by end of this year.

The DNA fingerprinting service is provided by FruitID, who offer an affordable analysis by combining our requirement with other organizations' project analyses, carried out by EMR in large batches. Fruitid then provide the data to us in a standardized format, and can provide some interpretation. A later Newsletter will expand on the DNA fingerprinting aspect of this project.

Surveys this autumn 2022

We will request surveyors, this autumn, to survey the same trees they surveyed this spring. The autumn survey concentrates on the fruit, and will be carried out from early September to late October, giving more time to survey trees than was possible in spring. I will be circulating the Autumn Survey Form to all surveyors next week, and as with the spring survey, photographs will continue to be important, indeed, the use of photographs this spring was of great benefit. From the combined surveys of each tree we will select additional trees for DNA analysis next year.

Right: A range of crab apple fruit photographed in autumn 2021, that includes fruit from the flowers illustrated above. Only the largest, with the shortest pedicel looks like a *domestica* fruit, but is small at 3.5-4cm



We also propose some taste testing! We fully understand that for some surveyors sampling crab apple flavours may not be an attractive proposition, but we would like to know which trees bear fruit high in sugar, tannin and acid, essential attributes for breeding. More on this later...and where actual tasting is involved it will be *optional!*



In addition, we will request that surveyors, including new surveyors in new localities, survey *additional* trees if they know of them, which will be completed by surveying their flowers next spring, 2023. And we hope new surveyors, in new locations, will join the project.

Later this autumn we will also distribute the morphological data, as a spreadsheet, for all the trees surveyed this year.

The project in 2023 and 2024

An important part of this project is that we can return to the same trees to look at different aspects and also to carry out new investigations, even different DNA analyses, as needed. We will also consider any potential value, of the fruit crop. By spring 2023 we should have full survey information on over 100 trees and DNA analyses on over 60, and will then plan the remainder of the project.

SOME BACKGROUND INFORMATION

“WHAT’S IN A NAME ?”

Malus sieversii is the highly diverse, wild, central Asian, Kirghizstan and Kazakhstan species, considered to be the principal progenitor of *M domestica*, modern and ancient apples. In its native habitat it is conserved and has long been tended by local people for its crop.

Malus domestica is the even more highly diverse group of domesticated hybrids of *M sieversii*, that we call domestic apples, hybrids with other *Malus* species, including *M sylvestris*, and grown throughout the temperate world.

Malus sylvestris, a wild apple species of Europe, W Russia, Iran and Turkey, including the UK, which we consider our native Crab Apple.

Most floras from the mid-20th C (Clapham et al, to Stace) separate *sylvestris* from *domestica* as having hairless leaves twigs and buds, small c 2.5cm fruit, and being a usually thorny tree. (Although our recent survey found most of the crab apple trees surveyed had partially hairy leaves, and none have been recorded that were truly thorny).

Recent genetic research, since about 2012, considers it probable that *Malus sylvestris* is a major contributor to current range of *M domestica* cultivars, indicated by high levels of introgression (hybridization by repeated crossing and backcrossing) inferred from DNA analyses. Other *Malus* species are also considered to have been involved.

There are 30-55 *Malus* species (depending on the botanist!) across all the northern hemisphere continents. “*This genus has never been given a thorough taxonomic revision with global scope, and desperately needs one*” (Sutton 2022), see [Malus - Trees and Shrubs Online](#). All *Malus* species grow from seed easily...and “*The experience of breeding orchard apples and ornamental crabs suggests that there are few if any barriers to breeding between apple species*”(Fiala 1994) and “*even species raised from cultivated seed are likely to be hybridized*” (Sutton 2022), especially if closely related species within the same subgenus.

The Scottish Wild Apple project

The most recent investigation into *Malus sylvestris* and hybrids in the UK has been the fascinating and invaluable Scottish work published in two papers in 2018:

Ruhsam M., Jessop, W., Cornille, A., Renny, J. and Worrell, R. 2018. Crop-to-wild introgression in the European crab apple *Malus sylvestris* in Scotland and Northern England. *Forestry*, [Crop-to-wild introgression in the European wild apple *Malus sylvestris* in Northern Britain | Forestry: An International Journal of Forest Research | Oxford Academic \(oup.com\)](#)

Worrell R, Ruhsam M, Renny J, Jessop W and Findlay G. The Ecology and Genetics of Scotland’s Native Wild Apple: *Malus sylvestris*. *Forest Enterprise Scotland*. [ecology-and-genetics-of-scotlandas-native-wild-apple-malus-sylvestris_finalv3.pdf \(scottishforestrytrust.org.uk\)](#)

British Wildlife also carried a summary article.

In this project most the trees surveyed were located from national and local botanical records of *Malus sylvestris* (probably mainly by county recorders), and large old trees were clearly preferred. The trees were then recorded primarily for the hairiness of the leaves, the principal indicator used by established floras, such as Stace C A, *New Flora of the British Isles* 4th Ed 2019, for separating *sylvestris* from *domestica*; fully downy leaf undersides implied *domestica*, leaf underside with little or no down (but possibly some stiff hairs) indicates *sylvestris*, in between are likely hybrids. The trees were DNA fingerprinted and the data analysed (using two established software packages) which inferred that there was a high level of introgression from *M sylvestris* in trees where there was a low level or absence of downiness in leaf undersides.



Use a x10 hand lens to view downiness and hairs on leaves and shoots, although in direct sunlight these are usually visible with the naked eye.

Slightly confusing is that a leaf hairiness scoring system, on its own, with no other method, is used to provisionally assign a tree to a species or a hybrid. This is shown in the Worrell/Scottish Forestry Trust paper; the genetic analysis in the Ruhsam/Forestry IJFR paper.

The Ruhsam paper’s conclusion carries a very relevant precautionary note... “*However, there is also reason to be cautious about viewing genetic data as the silver bullet for all apple identification problems. Some of the cultivars assayed by Cornille et al. (2012) had very high contributions from M. sylvestris—in the case of the Russian cultivar ‘borovitsky’, which is better known as ‘Duchess of Oldenburg’ in Britain (Smith, 1971), to the point that it would have been classified as pure M. sylvestris genetically, but more likely as a hybrid or domesticated apple morphologically due to the larger fruit size*”



Right, Duchess of Oldenburg is a large apple, probably of Russian origin from about 1817, once grown commercially in England but now out of fashion, and is a good cooker!

Left: and just to confuse, here is French Crab, a hard ancient cooking apple, in UK's NFC called *Malus domestica* and in the USDA collection (in USA) called *Malus sylvestris*!



Interestingly, the Worrell/Scottish Forestry Trust article, proposes we should call *M sylvestris* "Wild Apple", instead of "Crab Apple" which has been used for too many small, ornamental, species or hybrid apples and is confusing. Indeed today "crab apple" is widely used to refer to any small fruited tree that isn't edible, and usually one grown for its flowers even to any or all of the many *Malus* species, other than the domesticated apple. I sense many of our surveyors feel affronted at this rejection of an ancient name. We may not know exactly the origins of any particular crab apple (and we may never!) but either as a native or, as a long-present hybrid, it is a part of the UK's archaeophyte flora (and I am going to continue to use it for our small-fruited wild or feral apple trees, Paul).

Duchess of Oldenburg and French Crab aren't the only obviously mis-identified apples. The UK National Fruit Collection (NFC) in Kent has two trees called *Malus sylvestris* that clearly aren't in any way the crab apple we think of as our native crab apple, but they do have one morphological character in common...they both have leaves hairless underneath – as defined by floras...so they must be *Malus sylvestris*! Here they are!



Left: a tree in the NFC named *Malus sylvestris* spp *sylvestris*. Unlike any *sylvestris*, more like a *Malus* subgenus that has no "basin", a depressed groove round the sepals, and narrow leaves.

Right: also in the NFC, named *Malus sylvestris* "Simon" with large red flushed sweet fruit typical of *M domestica* (the largest fruit of any tree called *sylvestris* we have ever seen).



But both these trees have hairless underside to their leaves.....so they must be *Malus sylvestris*!

SO, WHAT ARE THE POSSIBLE LIKELY ORIGINS OF THE TREES WE CALL "CRAB APPLES" ?

Aside from the many ornamental *Malus* species from around the globe, our native or feral trees "in the wild" are very diverse; as one surveyor reported "no two are the same!"



LEFT: a collection of "apples" taken from trees in a hedge in the Cambridgeshire fens, a region of many orchards and hedges, some natural, many planted as windbreaks.

Clearly recognizable are quite obvious large apples, *Malus domestica*, possibly seedlings of cultivated apples, and the 1.5-2cm long-stemmed yellow crab apples, are, just possibly, *Malus sylvestris*.....and everything in between are hybrids?

RIGHT: Also in a hedge, is *Malus x zumii* "John Downie" an ornamental garden hybrid, considered to be a hybrid between a European and a Japanese *Malus* species, bred in England about 1875....

Makes the best jelly though!



A "pure" *Malus sylvestris* could be...

- From a long line of UK native *M sylvestris* trees.
- Seedling from a genuine *M sylvestris* gathered from trees and grown in a nursery and sold for hedging, woodland or forestry planting
 - Some may be from seed grown as UK certified (or uncertified) *M sylvestris* trees
 - Most will be from seed grown from German or other European sources of certified (or uncertified) *M sylvestris* trees.

A feral seedling *Malus domestica* could be...

- A seedling apple from a human or animal discarded *domestica* apple core, that was pollinated by a *Malus domestica*
 - from a feral seedling of one of the above pollinated by one of the above, and onwards through generations.
 - A seedling from seed sold in the Germany (or elsewhere) as *M domestica*,
 - From an apple tree in, say, Germany, used to make juice, the seed a byproduct of the apple juicing industry, sown in a UK nursery and sold as *M domestica*
 - From an apple tree in, say, Germany, used to make juice, the seed a byproduct of the apple juicing industry, sown in a UK nursery.... and sold as *M sylvestris*! For hedge planting! This was, perhaps still is, common.

A hybrid of *Malus sylvestris* and *M domestica* could be

- from a human or animal discarded *domestica* apple core, that was pollinated by a native *M sylvestris*
- seedling from a native *M sylvestris* from pollination by a crop or feral *M domestica*.
- Seedling from a feral tree hybrid *Malus sylvestris* x *M domestica*, or its feral progeny
- Seedling from a feral tree hybrid *Malus sylvestris* x *M domestica* collected as seed of *M sylvestris* for sale and growing as *Malus sylvestris*

Hybrids of *Malus sylvestris* and any of about 30 *Malus* species are grown as ornamental crab apples for their flowers.

Hybrids of *Malus domestica* and any *Malus* species may be grown as pollinators in orchard, once a very common practice.

AND any subsequent generation from any of the above.....

WE ALSO NEED TO BEWARE OF GARDEN MYTHS.....for example REVERSION!

- Woodland Trust (online) says of crab apples: "many trees you come across in the wild have grown from domestic apples that have self-seeded, and either reverted to a wild form or crossed with true crabs. The closer they are to the parents, the larger and sweeter their fruit will be."
- Stace says ...of *M domestica*: "often naturalized in hedges scrub and waste ground... commoner than *M sylvestris*. Self-sown plants usually have small yellowish sour fruits."
- "Reversion to a wild form" as a genetic process is a myth. Almost all *Malus* species, and their clonal cultivars, are self-sterile, requiring pollination by another compatible clone. Crosses between two individuals result in the expected mix and redistribution of the two parent's genetic characters. Reversion may appear to occur in the progeny of a *domestica* and a hybrid with *sylvestris* by comparison with the *domestica*, especially in fruit size. And seeds from the very few apple cultivars that are self-fertile produce progeny that are a new mix of the characters of the parents of the original cultivar.

PAUL READ
AUGUST 2022



"No two are the same...."

Illustrated by these two trees just 2m apart in a meadow in Suffolk (in May).

The tree on the RIGHT...has almost sessile large white flowers, with overlapping petals. The fruit is yellow, very short-stalked and flattened, like a miniature apple.

The tree on the LEFT...has long-stalked flowers with well separated pale pink petals. The fruit is red striped on amber, long-stalked and elongate.

