Enhancing ecosystem services (nature's services) in viticulture:

1 'Greening Waipara' – a New Zealand case study

2 Guidelines for a Kent Downs Areas of Natural Beauty (AONB) restoration programme, UK.

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Strips of tansy leaf *(Phacelia tanacetifolia) (Boraginaceae)* and buckwheat *(Fagropyrum esculentum) (Polygonaceae)* in NZ vine inter-rows. Photos: Jean-Luc Deifour

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1 Introduction

This report has been commissioned by Climate Win Consulting Ltd (trading as Vinescapes) and has been prepared by Distinguished Prof Steve Wratten, Sarah Cairns and Lorien Tarjomi via the Bio-Protection Research Centre, New Zealand.

The purpose of this report is to firstly provide a detailed case study of the 'Greening Waipara' project which began in 2010 in New Zealand and continues today, led by the Lincoln University and local vineyard business community.

This is followed by the results of research/analysis undertaken by the above to provide a basis as part of the proposed Kent Downs Areas of Natural Beauty (AONB) restoration programme being undertaken by Vinescapes.

2 Greening Waipara – The New Zealand Experience

2.1 The origins of Greening Waipara

The New Zealand science funding agencies offer a range of opportunities for research funding. These are similar to NERC and BBSRC etc in the UK. Ten years ago Distinguished Professor Steve Wratten in New Zealand was funded for a 6-year programme called Biodiversity, Ecosystem Services (ES) and Sustainable Agriculture by the NZ foundation for Research, Science and Technology (FRST) – now Ministry of Business, Innovation and Employment (MBIE). This had a value of NZD $2.3 million. The work was dominated by vinecology, the aim of which was to work with the growers to return elements of functional ecology to vineyards, which are virtually monocultures. The idea was to identify and enhance above-and below-ground ecosystem services (ES). These include soil biology and plant nutrition, protection from wind, water retention, conservation, predation of pests and plant disease and weed management. Also featuring strongly were enhancing landscape features. The key challenges were to move from simply enhanced biodiversity to outcomes i.e. making a difference. This process and all its challenges is explained in a dynamic way by Chang et al (2020).

The vineyard area which was selected for this work was one hour north of Lincoln University, in the Canterbury province of New Zealand. This wide valley was originally selected for vines because the soils are appropriate and it is protected from westerly winds by the Torlesse mountain range. To the east, the Pacific Ocean provided a benign climate.

2.2 What stimulated this work?

Four key viticulturists in the valley were selected because of their high profile and the fact that their properties are adjacent to State High way 1 (SH1) which is a route of national significance in New Zealand's road network. This road carried, at the time, an average of 1 million vehicles each year, which facilitated marketing of the programme. Also, one of the four properties was run by the chairman of the Waipara Wine Growers Association, so he was likely to influence and be an advocate for his winegrowing colleagues in the same region. As he said in a story broadcast by NZ's TV Channel One

"We like the programme because it gives us a point of difference among New Zealand wine regions".

This broadcast can be seen in a Powerpoint presentation which has been made available to Vinescapes as part of this case study report.

After 3 years this programme had spread to 51 vineyards in the region, to local schools and even the local Post Office! Because of the substantial funding, we were able to employ students to take part in the planting regimes, largely using endemic New Zealand perennial plant species. One of the best NZ botanists, Dr Colin Meurk from Manaaki Whenua Landcare Research (www.landcareresearch.co.nz) played a key part in selecting the plants for their suitability as well as explaining where and how to plant them. The government funding as well as PhD funding from other sources enabled us to insert PhD students/researchers into the Greening Waipara programme to provide solid evidence-based science as a foundation for the implementation plan.

Media interest became very high with frequent radio and TV broadcasts as well as local and national newspapers.

2.3 Which plants?

The New Zealand Dept Conservation has great knowledge on the species and attributes of endemic New Zealand plants, as well as the best habitats for them and when and how to plant. Two of the PhD students, (now Dr Morgan Shields) and (Dr Jean Tomkins), worked out the wide range of ecosystem functions that these plants provided and these attributes were rapidly passed onto he growers, partly to help them understand and promote their restoration work (Shields et al 2016).

Other related work concerned butterfly habitat use in the vineyards (Gillespie et al 2012). We also used some non-native plants (see below) because they had proven value in enhancing biocontrol of pests, improving soil, enhancing pollination and ecotourism. Phacelia in particular was very attractive to honeybees and tourists, while buckwheat flowers enhanced the efficacy of biocontrol insects.

Importantly, “farmer to farmer” meetings were held throughout the valley to enhance communications. There is ample evidence world-wide that farmers are the best educators of farmers, operating in social networks rather than scientists trying to achieve and apply outcomes alone (Warner 2007, Chang et al 2020).

2.4 Where did we plant?

A limited number of low-growing plants were planted under the vines while others were planted in the inter-rows. The third group (larger plants, including trees) were planted outside the vines and in the nearby Amberley township.

2.5 What was the educational component?

A key feature was the establishment of “Biodiversity Trails” within and outside the vines. Along these trails were interpretative signs which explained the ecosystem services of the added plants. Each sign comprised the English, scientific and Māori names for the plants, along with the ecosystem services which they provide and the traditional uses that Māori made of them historically. These include a member of the Piperaceae *Macropiper*, the leaves of which generate a hot, peppery taste when chewed and Māori used this plant to ameliorate the effects of toothache and bruising. In the UK, many of the native lowland plants historically have similar functions. These biodiversity trails were, and still are world first in vineyards and of course led to visitors spending more time at the site and spending more money such as in the winery and restaurant.

Another strong outcome was such that many of the growers were so committed to the project that they re-designed the back labels of their wine bottles (see appendix) to give their marketing in the supermarkets a clear point of difference.

When the government funding agency in NZ reviewed this programme along with others in the same funding round, this activity was ranked top of 15 varied projects, based on its highest ranked scores in outputs and outcomes. The former are usually scientific papers while the latter comprise ‘making a difference’. Much fuller details of this programme are available in the Appendix and via the resources shared via dropbox.

2.6 Lessons learnt

The Greening Waipara programme was funded for 5 years. During that time our research team travelled along SH1, sometimes three times a week. This was of course costly. We also bought many of the plants from nurseries, paid the students an hourly rate and designed and installed the biodiversity trails. The local vineyard community invested many hours of labour, including major planting schemes along the side of State Highway 1. The wine growers also funded new back labels on their wine bottles and contributed to our regular newsletters. However, most of the costs were borne by the New Zealand government funding itself and by aligned PhD programmes. Most of the latter were also government-funded but from sources outside FRST.

It is tempting to ask what the extent of grower commitment would have been without these funding sources. Importantly, however, although some individual growers may have embarked on such changes anyway, there would still have had to have been a co-ordinating entity, otherwise the programme delivery would have drifted and probably subsided within the early phase.

Now, in 2020, many of the initial plantings and trails are still functional and it is very satisfying to see how these initiatives have matured. However, the required maintenance of the trails has not been effective in some cases.

In fairness, of the millions of dollars spent by the government on “applied” research, substantial, persisting outcomes are rare. This would apply to UK science also. An exception would be the establishment by Wratten’s team of “Beetle Banks” on European farmland as refuges for beneficial insects. These banks now act as refuges not only for predatory biocontrol beetles which was their original intention, but have become important havens for the grey partridge, voles, harvest mice and even hunting barn owls. This vertebrate conservation component has probably been the main reason that these banks are still being created around Europe. This is, however, as indicated above, a rare exception.

3 Prospects for south-east England Vineyard Restoration

3.1 UK Native Plants Species & Vines

Vineyards comprise working landscapes that are too large to influence in a major way. The general public prefer a scenic vista that is aesthetically and visually pleasing. So, we recommend below protocols which go some way to achieving that. The following table provides a list of flowering plants which are considered to meaningfully 'put back' and improve at least some of the functional biodiversity and aesthetics that the establishment of vines largely removed. Most are readily available in the UK as seeds. Planting plants is time-consuming and expensive. An example of sources is given for each seed source below.

Table 1 Native plants for potential use in or around UK vineyards in the southern AONB on chalk soils

Common name	Species	Longevity	Size* (cm)	Flowering period	UK availability	Plant/ seed
Birdsfoot Trefoil	*Lotus corniculatus*	Perennial	H: 15-25 S: 30-40	May-Sept	Naturescape (https://www.naturescape.co.uk/)	Seed
Burnet Rose	*Rosa pimpinellifolia*	Perennial	H: 60-120 S: 60-120	May-June	Chiltern Seeds (https://www.chilternseeds.co.uk/)	Seed
Carline Thistle	*Carline vulgaris*	Perennial	H: 8-30 S: 20-30	July onwards	Naturescape (https://www.naturescape.co.uk/)	Seed
Common Toadflax	*Linaria vulgaris*	Perennial	H: 30-60 S: 30-60	July onwards	Naturescape (https://www.naturescape.co.uk/)	Seed
Cowslip	*Primula veris*	Perennial	H: 7-20 S: 20-30	April-June	Wildflowershop (https://wildflowershop.co.uk)	Seed
Dropwort	*Filipendula vulgaris*	Perennial	H: 15-45 S: 30-45	May-Aug	Naturescape (https://www.naturescape.co.uk/)	Seed
Fairy flax	*Linum catharticum*	Biennial	H: 5-25	June-Sept	Wildseed (https://wildseed.co.uk/)	Seed
Greater Knapweed	*Centaurea scabiosa*	Perennial	H: 30-90 S: 60-100	July-Sept	Landlife Wildflowers (https://www.wildflower.co.uk/)	Seed
Hairy Violet	*Viola hirta*	Perennial	H: 5-10 S: 5-10	Mar-May	Naturescape (https://www.naturescape.co.uk/)	Seed
Harebell	*Campanula rotundifolia*	Perennial	H: 15-45 S: 60	July onwards	Naturescape (https://www.naturescape.co.uk/)	Seed
Horseshoe Vetch	*Hippocrepis comosa*	Perennial	H: 10-40	May-June	Naturescape (https://www.naturescape.co.uk/)	Seed

Common name	Species	Longevity	Size* (cm)	Flowering period	UK availability	Plant/ seed
Meadow Cranesbill	*Geranium pratense*	Perennial	H: 30-60 S: 30-90	June onwards	Naturescape (https://www.naturescape.co.uk/)	Seed
Salad Burnet	*Poterium sanguisorba*	Perennial	H: 20-60 S: 30-60	May-Aug	Naturescape (https://www.naturescape.co.uk/)	Seed
Saw-wort	*Serratula tinctoria*	Perennial	H: 30-60 S: 30-60	July-Sept	Naturescape (https://www.naturescape.co.uk/)	Seed
Teasel	*Dipsacus fullonum*	Biennial	H: 175-200 S: 100	July-Aug	Wildflowers UK (https://wildflowershop.co.uk)	Seed
Viper's Bugloss	*Echium vulgare*	Biennial/ Perennial	H: 90-100 S: 30-45	June-Aug	Plantlife (https://www.plantlife.org.uk/uk)	Seed
Wild thyme	*Thymus polytrichus*	Perennial	H: 10 S: 30	June-Aug	Naturescape (https://www.naturescape.co.uk/)	Seed
Ramsons	*Allium arsinum*	Perennial	H: 15-30 S: 15-30	April-June	Naturescape (https://www.naturescape.co.uk/)	Seed

* "Size" is indicated by H (height) and S (spread), with cm used as the unit of measure.

3.2 Non-Native UK Plants Species & Vines

Acaena below has been used successfully in the NZ "Greening Waipara" programme and performed well. The *Muehlenbeckia* hybrid below is a common, low-and-fast growing New Zealand landscape plant. Availability in the UK is unknown.

Table 2 Non-native plants for potential use in or around UK vineyards in the South-Eastern regions

Common name	Species	Longevity	Size* (cm)	Flowering period	Availability	Plant/ seed
Purple Bidibid (NZ)	*Acaena inermis purpurea* Rosaceae	Perennial	H: 5-10 S: 30-60	June-Aug	Quercus Garden Plants Ltd (http://quercusgardenplants.co.uk/)	Plant
Creeping Wire Vine Creeping Pohuehue	*Muehlenbeckia axillaris x complexa* Polygonaceae (rhubard and dock family)	Perennial	H: 20-100 S: 100- 300	NZ Oct-Dec	Green manure (https://www.greenmanure.co.uk/) Chiltern Seeds (https://www.chilternseeds.co.uk/) Bee Happy Plants (https://beehappyplants.co.uk/) Cotswold Seeds (https://www.cotswoldseeds.com/)	Plants / Seeds
Phacelia Tansy-leaf**	*Phacelia tanacetifolia*	Annual, but profligate – see producer	H: 60 S: 30	Spring - Summer	Readily available in large bags from many seed suppliers	Seed
Buckwheat	*Fagropyrum esculentum*	Annual	H: 80 S: 20	Summer	Readily available in large bags	

* "Size" is indicated by H (height) and S (spread), with cm used as the unit of measure.

** Tesco supermarkets adopted images of this flower as part of their 'Nature's Choice' product line

3.3 Agronomy of the potential plants

Sow or plant as appropriate from late Spring onwards. Buckwheat and phacelia seeds: sow in the inter-rows at c. 40kg/ha. Cultivate the inter-row lightly with a tractor-mounted rotovator. Water lightly. Repeat at two-month intervals. Drill into only one inter-row in ten. The beneficial pest natural enemy insects move 5-10m either side of the flowers, so the whole vineyard does not have to become dominated by white buckwheat flowers or blue phacelia – see front page images. When each plant species produces its first seed, cut off the top third of the plants with a tractor-mounted implement or by hand. This will induce the axillary buds to sprout, doubling flowering time. Honeybees and bumble bees with benefit greatly from phacelia nectar, so the vineyard will deliver fitter bees to adjacent crops, thereby delivering ecosystem services (pollination and honey production) to adjacent horticulturalists. Buckwheat nectar can enhance the longevity of beneficial parasitic wasps, enhancing their longevity from 3 to 42 days. This leads to a higher parasitism rate of key pests, including the key parasitoid of the key vine pest, the light-brown apple moth. Other natural enemies of this caterpillar and other pests are likely also to benefit from buckwheat nectar. Those of the spot-winged drosophila are in this group. Other UK vine pests include mealy-bugs and mites.

3.4 How to establish and maintain functioning and persisting native plant communities

What, where, how and when to plant?

It would be a good start to conduct a SWOT analysis of the proposed work. For example,

STRENGTHS: this will probably be a first for EU vines, will attract a high level of media and conservation attention and could help marketing.

WEAKNESSES: It may be difficult to establish large stands of chalk land plants as managing their establishment may be a challenge, as would be minimising weed ingress.

OPPORTUNITIES: There I potential to lead and expand this programme into more AONB and beyond, but that will depend on addressing the potential weaknesses above – and obtaining further funding.

THREATS: Funding may dry up and/or winegrowers may find the protocols too difficult or perceive no real advantages.

Model examples of how to carry out the required restoration in vines e.g. www.southdowns.gov.uk – the Winchester Focal Area Group and the www.northwessexdowns.org.uk. However, working in and around vines presents its own challenges. Previous, persistent herbicide uses may obstruct under-vine plantings, although existing irrigation is an advantage. Shrub plants may be useful outside the vines but local advice will be needed. If low-growing herbaceous vegetation within the vineyards alone, it will not enhance the landscape attractiveness, which strategically needs to be part of the project. Starting with a well-designed focus on small areas will be ideal, seeking advice from the seed suppliers such as the examples listed above, as well as the stakeholders or other local resources of relevance as per the website references above.

Information boards associated with short biodiversity trails will be ideal.

The whole project presents challenges, but south England chalk downlands can have more than 40 plant species/m^2. Similar in many ways to tropical rainforest. Traditionally, those areas were a key part of sheep grazing regimes. The extent and frequency of this are crucial – see a classic paper on this by Gibson et al (1987).

Vineyards are a special case, however, and regular, low machine mowing maybe too severe for typical chalk plants. Some New Zealand viticulturists used managed Old English Southdown Baby Doll sheep for this purpose. They can be easily managed and are too short to reach grapes.

The Lincoln University, New Zealand research group can continue to provide best practice advice with this project as it progresses, and on the principles around future programmes of this nature, albeit within the potential disadvantage of being based on desktop advice (which has its limitations).

References

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APPENDICES

The following list of key resources have been provided here as part of the Greening Waipara Case Study. These are downloadable files via:

https://www.dropbox.com/sh/vg8oemouklrp6wz/AAC_FZ-jyXUuuK87dekMIIlfa?dl=0

Appendix A: Biodiversity Trails

Appendix B: Waipara Region Maps

Appendix C: Programme Newsletters

Appendix D: Plants

Appendix E: Example Presentation - Programme Summary & Conference Poster

Appendix F: Media & Short Article Examples

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