then carry out testing but the result of any test should not remove the client’s obligation to pay for the stock. Should testing prove positive in this case, we would argue that we cannot be held responsible for stock out of our control.

Marketing
It is intended that Natural Area actively market the improved protocols as a positive initiative to the benefit of clients, the environment and the nursery industry in general.

Industry acceptance
There is no doubt that some, maybe many in the nursery industry will not accept that these proposed changes are necessary or in their interest to implement. However, having seen the impact elsewhere on Phytophthora introduction to a production nursery, the author has no doubt that the introduction of higher standards is very much a sound risk management exercise.

It is expected that the restoration and revegetation industry will establish design, operational and supply standards for projects and these are expected to include demanding standards on suppliers of seed and plant stock.

Implementation
We are currently road-testing the concept with clients in the lead up to the 2015 supply. The Directors of Natural Area Holdings/Natural Area Nursery expect to fully implement the improved protocols by end first quarter 2015. The author would appreciate constructive criticism and comment on the proposal from those involved in nursery and revegetation activity.

References

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Phenology and its contribution to understanding how plants adapt to a changing world

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Introduction
Phenology, a term first coined by Charles Morren Snr in 1849, is the study of the timing of key life-stages such as flowering and seeding in plants, or bird migration and fledging. It also involves examining the relationships between each of these stages and the influence of environmental factors such as climate on them (Leith 1974).

These stages, in turn, drive a wide range of processes at the community and population levels, at local and regional scales, and at ecological and evolutionary time scales (Dunlop and Brown 2008). They also influence many aspects that society values, such as food production, tourism and human health (van Vliet 2010). For example, hay fever is triggered by a phenological stage – the release of pollen.

Changes in the timing of phenological stages are also one of the first signals of a species being influenced by and adapting to a change in climate. This adaptation is probably indicative of phenotypic plasticity: the potential for a given genotype to be expressed differently in different environments.

Each part of the reproductive cycle influences the preceding and succeeding stages: a bud becomes a flower which becomes a fruit which in turn produces seed. Weather influences the timing of each part of this cycle. Hence, each individual life-stage is a potential point for adaptation in a changing climate.

Historical Data
Long-term and historical data can provide a baseline against which current timing can be assessed. They also allow examination of which climate variable may have the most influence and therefore can be used to predict future changes in the timing of a particular life stage. Additionally, they easily illustrate if changes have occurred and, if long enough, at what point in time the change is most likely to have occurred.
A recent example (1983 to 2006) uses the observations of first flowering dates of 65 lowland forest, understory species in Victoria. Of the 65 species, 13 seem to be adapting: eight flowered from 0.7–3.3 days per year earlier, five species flowered 1.0–2.9 days per year later, while 52 did not change significantly.

One of the earliest Australian examples of historical phenological data is provided by The Royal Society of Tasmania. The Society recorded the leafing, flowering and fruiting dates of plants in the Royal Tasmanian Botanical Gardens between 1864 and 1885. Examination of the records has found that that 53% of the 48 species have at least one life stage driven by changes in rainfall, minimum temperature, or both.

Additional data from private observatories in Hobart, New South Wales, and South Australia were also analyzed. A graph showing the variation in first flowering dates of eight species, later flowering species, and five species whose first flowering date did not change.
Experimental Data

Experimental evidence further aids our understanding (e.g. identifying which climate variables are most influencing a given life stage) and can help tease apart whether the adaptation that is occurring is phenotypic, genetic or a combination.

These studies, however, are usually focussed on individual stages. Studies which examine more than one stage help in understanding how changes in timing of one stage might influence another. Nugent et al. (2014) grew Button Everlasting (Coronidium scorpioides) and Sweet Hound’s Tongue (Cynoglossum suaveolens) in both a control (outside) environment and a glasshouse (on average 5.6°C warmer than the control). Plants were watered every 1–3 days to standardise any soil moisture interactions with the stage. Each of four life-stages – first bud visible, first and last flowering, seed dispersal – occurred earlier (20.9—60.0 days) in the warmer environment. The duration of stages was also longer in the warmed environment except for budding to first flowering.

Interestingly, for both species timing of first flowering showed the largest differences between the control and glasshouse treatment, followed by the first bud appearance, the end of flowering and lastly presence of mature seed. Therefore, in these two species at least, differences in one stage were not clearly evident in another. However, the large shifts in each stage demonstrate both species display a high degree of phenotypic plasticity in their reproductive phenology, potentially allowing greater adaptability to elevated temperature. It was also interesting to note the plants grown in the warmer environment were taller and produced larger seeds.

Conclusion

Changes in the timing or duration of plant life-stages can alter vegetative and reproductive output, potentially changing the distribution and abundance of individual species, and hence the composition of plant communities. This can in turn alter the quantity and distribution of resources such as nectar and pollen, impacting on the faunal species that depend on these resources. Phenological studies – whether using historical records or experimental data – can improve understanding of climatic influences on plant life-stages. Historical records provide a baseline against which current behaviour can be compared, and from which prediction of changes in response to future climate can be made. Experimental studies can tease apart the influences of climate on individual species. Phenology thus provides a vital tool in understanding and predicting plant community responses to a changing climate.

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