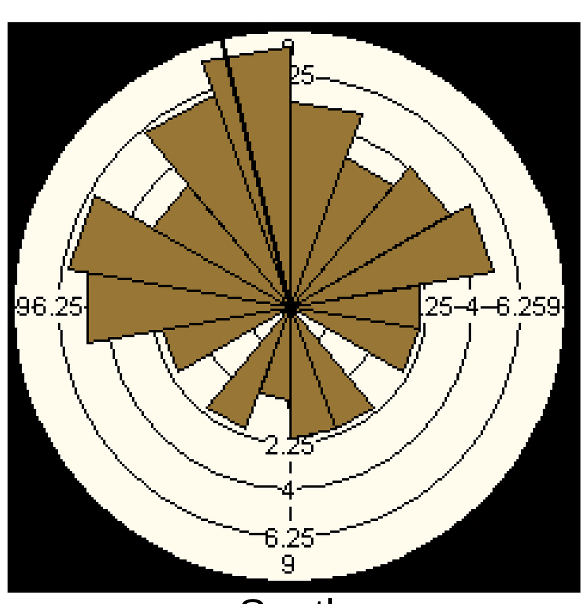
Modeling Species Dynamics to Predict Population Dynamics
Examples from recent publications

Dormancy in *Caladenia*: A Bayesian approach to evaluating latency

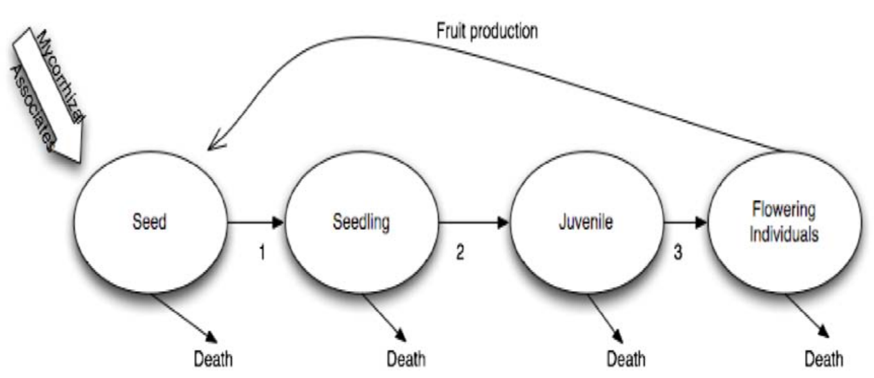
Dormancy is common in many terrestrial orchids in southern Australia and other temperate environments. The difficulty for conservation and management when considering dormancy is ascertaining whether non-emergent plants are dormant or dead. Here we use a multi-state capture–recapture method, undertaken over several seasons, to determine the likelihood of a plant becoming dormant or dying following its annual emergent period and evaluate the frequency of the length of dormancy. We assess the transition probabilities from time series of varying lengths for the following nine terrestrial orchids in the genus *Caladenia: C. amoena, C. argocalla, C. clavigera, C. elegans, C. graniticola, C. macroclavia, C. oenochila, C. rosella and C. valida from Victoria, South Australia and Western Australia. We used a Bayesian approach* for estimating survivorship, dormancy and the likelihood of death from capture–recapture data. Considering all species together, the probability of surviving from one year to the next was ~86%, whereas the likelihood of observing an individual above ground in two consecutive years was ~74%. All species showed dormancy of predominantly 1 year, whereas dormancy of three or more years was extremely rare (<2%). The results have practical implications for conservation, in that (1) population sizes of *Caladenia species are more easily estimated by being able to distinguish the likelihood of an* unseen individual being dormant or dead, (2) population dynamics of individuals can be evaluated by using a 1–3-year

Circular distribution of an epiphytic herb on trees in a subtropical rain forest.



Circular frequency distribution of orchids on trees

The distribution of the endangered epiphytic orchid *Lepanthes eltoroensis on the* bole of trees was investigated in the Yunque National Forest, Puerto Rico. Using circular statistics, we evaluated if there was preference for cardinal position on the bole of trees along two trails (Tradewinds and El Toro). In addition we tested if larger trees had larger population, and if the distribution of the orchids varied between the two walking trails. Orchids were preferentially distributed on the northwestern side of the bole of trees. Moreover, we found no evidence that the size of trees affected the number of individual orchids. This survey suggests that there is a preference for specific cardinal position on trees for the orchid and thus relocation or establishment of new populations should consider this information to maximize survivorship of this rare orchid.



Prediction vs. reality: Can a PVA model predict population persistence 13 years later?

Lepanthes rubripetala

The challenge of conservation biology is to make models that predict population dynamics and have a high probability of accurately tracking population change (increase, decrease, constancy). In this study we modeled 6 small populations of an epiphytic orchid using a Lefkovitch type analysis to predict population growth pattern based on monthly surveys for approximately 1.5 years. In addition, sensitivity and elasticity analyses were used to identify life stages with high sensitivity or elasticity that have the largest influence on population growth rate. We re-censused the populations 13 years after the first study and compared the structure of the populations to predictions based on the earlier census data. One objective was to determine if populations had achieved a stable size distribution over the 13 years period. Population growth rate models suggested that all populations should have persisted. Effective population growth rates were similar to those expected except for one where the population went extinct. The prediction slightly (but not significantly) overestimated the actual population growth rates of some populations. Elasticity analysis revealed that the adult stage is critical in the life cycle. The observed stage distributions of the populations were not stable at the beginning of the survey and neither were they after 13 years. We suggest that this might be caused by external perturbations that result in unequal mortality between life stages and stochastic recruitment events. The ability of the matrices to predict population size approximately eight generations in the future is encouraging and warrants the continued use of these approaches for PVA.

0.358	0	0	0.153
0.418	0.851	0	0
0	0	0.689	0.205
0	0.096	0.289	0.774

2008-2009 Publications only

RL Tremblay, JD Ackerman and Maria-Eglée Pérez. (**Submitted 15-04-2009**). Hitting a shifting target: consequences of temporal variation in reproductive characteristics and selection landscapes. *Proceedings of the Royal Society, London. Biological Sciences.* (Invited Paper).

Iva Schödelbauerová, RL Tremblay & Pavel Kindlmann (**In Press 2009**). Prediction vs. reality: Can a PVA model predict population persistence 13 years later? Biodiversity and Conservation

Dixon Kingsley & RL Tremblay **2009** Biology and natural history of *Caladenia.* Australian Journal of Botany **57: 247-258.**

Pavel Kindlmann, Elvia J Meléndez-Ackerman & RL Tremblay (**Submitted 06-04-2009**). Disobedient orchids: colonization and extinction rates in orchid metapopulations contradict theoretical predictions based on patch connectivity Ecography

Tremblay RL, Maria-Eglée Pérez, Matt Larcombe, Andrew Brown, Joe Quarmby, Doug Bickerton Garry French, Andrew Bould. **2009** Population dynamic of Caladenia: Bayesian estimates of transition and extinction probabilities. Australian Journal of Botany **57: 351-360.**

Tremblay RL, Maria-Eglée Pérez, Matt Larcombe, Andrew Brown, Joe Quarmby, Doug Bickerton Garry French, Andrew Bould. **2009** Dormancy in *Caladenia*: A Bayesian approach to evaluating latency. Australian Journal of Botany **57: 340-350.**

Tremblay, RL **2008** Ecological correlates and short-term effects of relocation of a rare epiphytic herb after Hurricane George. Endangered Species Research **5: 83-90.**

Tremblay, RL & Joel Tupac Otero **2009** Orchid Conservation Biology: Predicting Species Dynamics and Community Interactions. Eds. Alec M Pridgeon and Juan Pablo Suarez. Universidad Técnica Particular de Loja, Loja, Ecuador. Proceedings of the Second Scientific Conference on Andean Orchids. **Pp. 197-207.**

Tremblay, RL & José Velazquez Castro. **2009.** Circular distribution of an epiphytic herb on trees in a subtropical rain forest. Tropical Ecology **25(2): 211-217.**

Tremblay, RL & J. D. Ackerman. **2009.** Re-evaluation of evolutionary processes in orchids. Didn't Darwin explain it all? Proceedings of the 19th World Orchid Congress.

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