Review and advice for the Species-specific Management Plan (SMP) for *Parsonsia dorrigoensis*

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This report is presented in three sections: review of the SMP, discussion of conservation objectives and recommendations. The review refers to the SMP prepared 16 March 2020 and amended July 2021.

1. Review of SMP

My review is in the context of the SMP satisfying the broad, in-principle, objective of maintaining the viability of the species. I note that the CIFOA regulatory documentation does not explicitly describe what is meant by viability of a species. My review comments relate to the relevant sections of the SMP as listed below.

Section headed 'Objectives'

The listed five dot-point objectives are all potentially relevant to the general objectives of protecting the species and maintaining its viability. However, the SMP lacks explicit conservation objectives based on a practical interpretation of what is meant by these general concepts. Without such explicit objectives, it is not possible to assess the extent to which a monitoring program is likely to be effective. It is also difficult to assess the context for, and relevance of, the dot-point objectives as stated. Objectives listed as second to fourth dot points relate to statements under the heading 'Conservation and management issues' and these statements could be formulated as explicit objectives if considered appropriate. Alternative development of explicit objectives is discussed further below, under 'Discussion of possible conservation objectives'.

Sections headed 'Distribution and abundance' and 'Ecology and biology'

Although data are limited and information is derived mostly from casual field observations, these sections provide a generally adequate description of the characteristics of the species in the context of the SMP. However, there are two aspects of the description which are highly uncertain. One is the occurrence of larger plants in rainforest. I'm not aware of any evidence or observations that it grows into a large canopy vine and to my knowledge there is very little detail available for the few records from rainforest. The other is the longevity, for which I'm unaware of any data.

Section headed 'Conservation and management issues'

The SMP makes several untested predictions or assumptions. Although untested, these predictions or assumptions seem feasible based on the little available data and casual observation. The second to fourth SMP dot point objectives relate to these predictions or assumptions, but this is not made explicit. Depending on the development of alternative conservation objectives, it may be appropriate to specify the predictions and assumptions in this section as quantitative objectives against which the effectiveness of the SMP may be assessed.

The SMP does not indicate the expected response of *P. dorrigoensis* to forest operations, but there is a statement in the previous section that recruitment may occur following suitable disturbance. This is plausible considering that many of the current records are from previously harvested areas.

Section headed 'Requirements'

Subsection 1. 'Distribution surveys'

As they are described in the SMP, distribution surveys alone may be too haphazard to obtain unbiased quantitative estimates of the total population size of the species within State forest. They almost certainly will not allow unbiased quantitative estimates of confidence levels. It is unlikely that opportunistic surveys of reserves will allow any extrapolation to estimate total population size in reserves, but they will provide at least an estimate of the minimum size of reserved populations. For unbiased quantitative estimates of population size and uncertainty, it is preferable that a more strongly structured sampling approach be used, which may include, or be integrated with, pre-operational surveys. However, I accept there is a trade-off between increased survey effort and the value of the data obtained. How this trade-off is managed will depend on more explicit conservation objectives, thresholds of uncertainty and whether possible bias can be taken into consideration in interpreting results.

Subsection 2. 'Flora SMP Exclsuion Zones'

SMP Exclusion Zones will reduce the extent of any immediate population reduction caused by harvesting. They will also potentially provide a set of unharvested control sites, if required for experimental purposes, outside of formal reserves. However, the medium to longer term contribution to the conservation of the species is uncertain. It is possible that *P. dorrigoensis* is short-lived relative to the harvest cycle or may require particular disturbance regimes for persistence, fruiting or recruitment. If so, there is no certainty that plants will persist or recruit in exclusion zones, in the medium to longer term, to any greater extent than persistence or recruitment in harvest zones. Preferably, the effectiveness of exclusion zones for conserving the species requires monitoring, in addition to the need to monitor harvest impacts. However, this may be beyond the scope of the resources available to implement the SMP or may not be necessary depending on the conservation objectives for the exclusion zones.

Subsection 3. 'Monitoring'

Due to uncertainty over basic ecological characteristics, *P. dorrigoensis* potentially presents some difficulties for monitoring generally and monitoring of individuals specifically. As a vine, plants are also more difficult to assess in a consistent manner, than would be the case for trees or shrubs. Although not proven, observations suggest that the species may be clonal, producing multiple stems from an underground root system. Stems may fluctuate in size and number due to senescence, seasonal conditions or other factors. Because of these characteristics, it is appropriate that the proposed monitoring includes a plot-based component in addition to tagging and assessment of individuals.

There is a risk that the number of sampled plants may not be adequate to detect an effect at the desired level of confidence. This depends on the conservation objectives and chosen thresholds. Using only presence or absence, it is possible to estimate power for a threshold effect size based on a binomial distribution. For example, a sample of 20 plants gives a power of 60% to detect an hypothesised decline of 30%, relative to the alternative hypothesis that the decline is 50% or higher. For 60 plants, the power to detect a 30% decline is 92%. Using the associated plot counts is likely to provide greater power, depending on the variance of the counts, which is currently unknown. As data are collected, consideration could be given to simplifying the assessment and increasing the number of plants and plots, if required.

The proposed monitoring does not allow for assessment of recruitment outside of existing stands of plants. Such recruitment may contribute significantly to the post-harvest maintenance of

populations, but assessing it will require substantially extra effort. Ignoring it may lead to an overestimate of population reduction in harvested areas. Whether this is critical depends on specific conservation objectives and balancing the risk of overestimated deleterious impact against the effort required.

There is no comment on management implications for results of monitoring. There perhaps should be.

Subsection 4. 'Post-fire Recovery Assessment'

I note that this has been done and reported (2020 progress report by John Willoughby, dated Feb 2021). The observation that *P. dorrigoensis* could not be located at half the previously recorded sites suggests a high population turnover, although, as the report notes, this is not necessarily a fire response. This may have implications in respect of the longer term need to monitor recruitment outside existing stands of plants.

Discussion of possible conservation objectives

Parsonsia dorrigoensis is in the 'keep watch' category. This category indicates the species has been assessed as 'secure' for the next 100 years without targeted site-based management, although the rationale for making that assessment is not clearly documented. In that context, in order to assess whether CIFOA and SMP conditions are effective, the SMP needs a clearly-stated conservation objective (or objectives) beyond the 'keep watch' assessment.

If sufficient data were available to allow a quantitative analysis of the probability of extinction in the long term, one possible conservation objective would be to set a maximum threshold for that probability. In my view, sufficient data are currently not available to allow an accurate analysis of this type for *P. dorrigoensis*. A simpler alternative is to specify a minimum reserved population size or a maximum population reduction (relative to a current baseline) due to harvesting, or both. These thresholds are essentially arbitrary, but may be guided by commonly accepted conservation thresholds such as those used for IUCN criteria. This is ultimately a management or regulatory decision, but I suggest that the thresholds of minimum total population size of 10 000 mature plants and maximum 30% decline in population size over ten years or three generations (whichever is the longer) be used as a guide to set a conservation objective. These are the thresholds for IUCN 'Vulnerable' status based on these two criteria. A conservation objective which just exceeds the population size and is just below the decline threshold implies a 'Near Threatened' species (generally consistent with the 'Keep Watch' category). An objective which uses a substantially higher threshold for population size (e.g. 20 000) and substantially lower threshold for decline (e.g. 20%) implies a 'Least Concern' species. Although the IUCN criteria and thresholds relate to total populations, it is open to discussion whether a decline threshold should be relative to the total population on all tenures, the population only on State forest or that on all public land. In making recommendations, I assume that, in considering the need to maintain viability of the species, reserved populations are included, but that populations on private land may not be included.

Recommendations

Management of *Parsonsia dorrigoensis* is hampered by lack of information on aspects of its biology such as clonality, reproduction and recruitment. Although the SMP has the potential to contribute some of this information, much is beyond the scope of the SMP and would benefit from a post-graduate research project.

Apart from lack of biological information, there are also limitations of existing quantitative data. Accordingly, I suggest the SMP should follow a stepwise process, with each step determining implementation of subsequent steps. However, it may be appropriate to take advantage of concurrent opportunities to obtain data which may be useful for later steps (e.g. simultaneous survey and monitoring), where such opportunities arise.

Step one:

Determine an explicit conservation objective or objectives, by agreement among relevant parties. This should include consideration of whether, or to what extent, it will be assumed that reserved populations will be maintained in the long term, with mortality being balanced by recruitment.

Step two:

Obtain quantitative estimates, with confidence levels, of total population size and population size in formal reserves and in broad categories of State forest management zones. This has the potential to consume substantial resources and needs to be done in the most efficient way possible. I suggest one possibility is to use existing locality data to develop potential distribution models (e.g. using MaxEnt) and then sampling the modelled distribution to validate and refine the models. Models should be developed across all tenures. Existing data are likely spatially biased to State forest, but I expect the distribution of records is less biased in environmental space. Bias in validation sampling of the modelled distribution should be minimised to the extent practicable, but depending on the conservation objectives and likely access constraints, sampling may not be practical or necessary on private land.

Because it cannot necessarily be assumed that harvest impact causes a decline at the time scale of the harvest cycle, there is an opportunity at the survey stage, potentially with relatively very little extra cost, to obtain retrospective data on harvest impacts by recording site-based harvest history from field observations. I suggest that this information is worth collecting in a systematic and standard manner, even though its utility may be reduced if the number of plots is insufficient. Assessment of harvest impact by this method is likely to require a substantially greater number of plots than are needed to validate the distribution model. For example, based only on frequency of occurrence, to detect a 30% difference with a power of 80% would require approximately 270 plots if the recording frequency is 50%.

There is risk that models may not be as accurate as desired, reducing confidence in the final population estimates. As sampling proceeds, there needs to be periodic checking of results in relation to the level of accuracy required to satisfy conservation objectives, to ensure that resources used for sampling are kept within appropriate bounds.

Step three:

Assess population size in reserves (including State forest reserves) and determine need for monitoring. This could be done based on lower confidence limits of population estimates and on estimates of decline using pessimistic or worst-likely scenarios based on the uncertain parameters of longevity, time to maturity and the proportion of plants of *P. dorrigoensis* which are likely to be severely damaged or killed in intensively harvested areas. If pessimistic estimates are within bounds acceptable to achieve explicit conservation objectives, no further monitoring may be required. Otherwise, the intensity of monitoring may be determined by the extent to which estimates deviate from acceptable bounds.

Step four:

If monitoring is required, determine the most appropriate design based on conservation objectives. For example, balancing numbers of plots or plants as sample units and extent of detail required for individual plant assessment, and whether it is necessary to determine extent of recruitment not associated directly with existing standing plants.