Appendix 1 – Technical background for decision-support measures and tools

Strategic conservation planning requires measures and tools that can help with the making of choices about which actions in which places might deliver the most improvement for the greatest number of species. There is a series of questions in this planning process, each with different information requirements:

- Which biodiversity assets could occur at different places?

  Examples: species habitats and populations, ecosystem types.

- Which threats could occur at these places, and how sensitive are species to them?

  Examples: invasive species, disturbance regimes, resource uses.

- Which actions are feasible and effective enough to address the threats, and how much do they cost?

  Examples: controlling invasive species, modifying disturbance regimes; management or opportunity costs, establishment and maintenance costs.

- How much improvement could be achieved by actions at different places?

  Examples: changes in the condition of habitat for each species and/or changes in the vigour of populations.

- What is the broader context that could influence success at different places?

  Examples: the amount and connectivity of habitat around a place; the ecological regimes (fire, water etc.); the level of vulnerability to climate change; the rarity or depletion of a habitat type; the prior actions that have already been undertaken; the communities of interest, and the partnership opportunities and capabilities these bring.

- How will management options be compared and selected?

  Examples: identifying combinations of the above information to equitably represent different species needs and to maximise net outcomes.

- How will targets be set and progress measured?

  Examples: based on the above information, identifying specific, measurable, achievable, relevant and time-bound targets; using information on which actions are being implemented combined with estimates of improvement, to describe the types and amounts of outcomes our overall efforts can be expected to deliver.

In support of this Plan, the Department used the NaturePrint project to build and bring together whole-of-landscape, fine-grain spatial information relevant to biodiversity.

Inputs

A wide range of data including species and management observations, research insights, field mapping and remote sensing are brought together through shared digital systems. Maps are created by combining and extrapolating this data to provide consistent and comprehensive views across the broad areas relevant to biodiversity conservation. Habitat Distribution Models of many species (including the majority of terrestrial vertebrate animals and threatened plants) are now available and are being continually improved. Models of threats have similarly been prepared, linked to species by their traits, and linked to indicative costs from project managers.

Information on the amount of improvement in response to action (i.e. benefit) is much less developed and has required development of a measure, **Change in Suitable Habitat**, and a method for creating the first version of this data. This measure reflects net improvement for each species, which does not necessarily mean that the situation has moved from an overall downward to an overall upward trajectory (see following page).

The aim of Change in Suitable Habitat is to provide a practical measure for estimating net improvement in the outlook for species from our management actions. Persistence of native species is the fundamental idea of conservation biology.

It depends on the characteristics of:

- individuals (e.g. finding and competing for habitat, food, mates)
- populations (e.g. recruitment and death rates, mobility, genetic diversity)
- ecosystems (e.g. disturbance regimes, interactions between species).

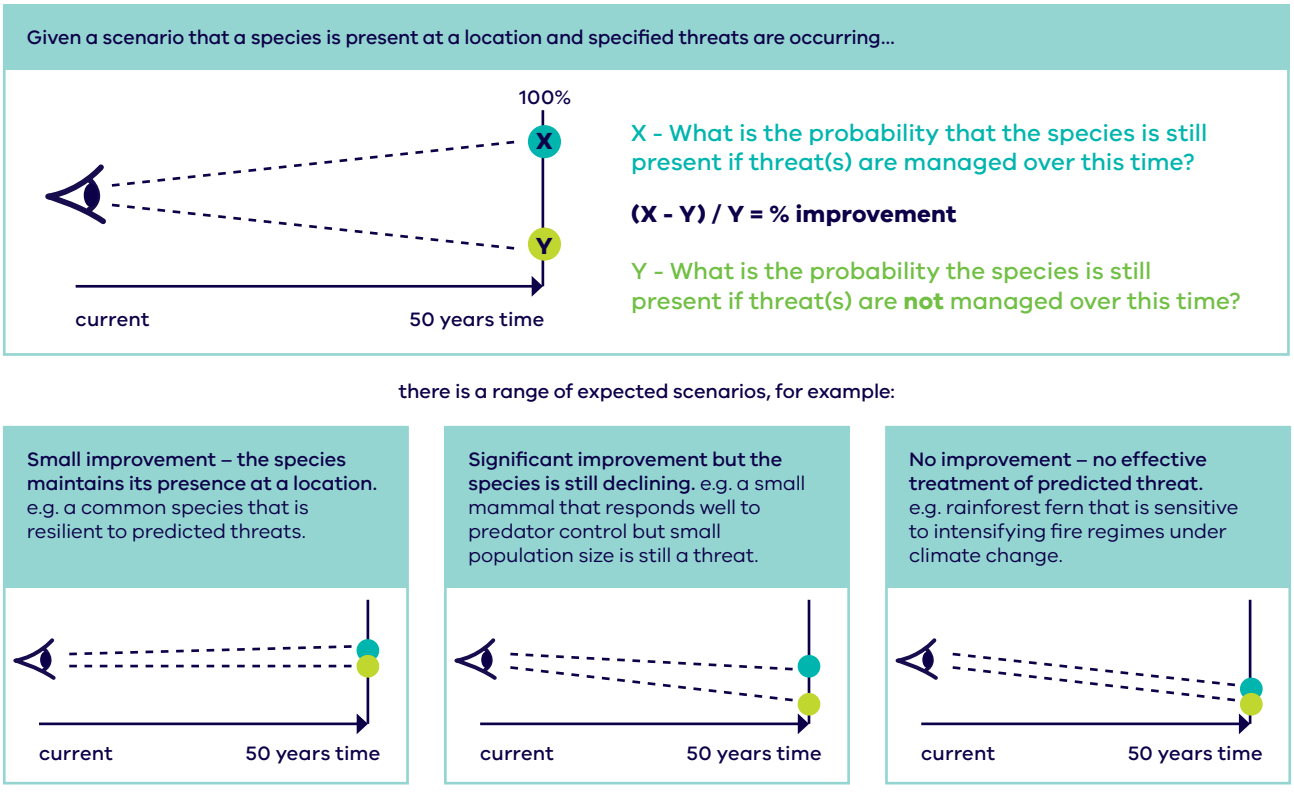
Although each of these characteristics can be described to some extent for some species, typically there is limited data, particularly for understanding the viability of populations. A practical measure of net improvement thus relies on habitat and threat information, often requiring extrapolation from available data. Like persistence or viability, improvement is a current estimate of the likelihood of future outcomes, rather than a snapshot of the current situation. Since the purpose here is to consider what could most effectively be done to make things better, the measure is designed to capture the expected difference between action and no action.

Change in Suitable Habitat at the location level is initially being estimated by an **expert elicitation** approach. Experts were presented with threat and action scenarios for particular populations of species.

The experts answered questions regarding the likelihood of that species still existing at the location if an action (or set of actions) was, or wasn't undertaken. Change is often slow, so the length of time used for estimating change (50 years) was chosen to be long enough to allow for a significant difference, but not so long as to make predictions too uncertain. Experts were asked for their confidence level around each estimate. Different scenarios were presented for different species, but also for the same species in different locations.

The data collected can be calibrated between experts, and in time with known actual situations. Due to the large number of species, threats and varied habitat contexts, experts addressed scenarios for a representative subset of species and contexts. Estimates were based on continuous, sustained management being delivered over the 50-year time period. As depicted in Figure A.1, the probability that species will still be present if sustained investment and management is supplied is **X**. However, if threats are **not** managed, the probability that the species will not be present in the long term is **Y**. The difference between X and Y indicates the likely level of improvement. In the best case scenarios, there is a significant positive change that is sufficient to deliver a reversal of a downward trend. However, there are also several scenarios that achieve less than this.

Figure A.1 Estimates of the likelihood of species persistence.



Based on this elicited data, trait-based modelling was used to infer across all species, extrapolating information regarding the response of species to different scenarios to other species with similar traits.

Current data on Change in Suitable Habitat focuses on treatment of common widespread threats or actions (e.g. invasive species, revegetation) with the expectation that further actions, particularly those requiring direct manipulations to improve adaptation to climate change (e.g. translocations, genetic strengthening) will be progressively assessed using this measure.

Since the measure is applied in an equivalent manner to different species as well as scenarios, this provides an essential contribution to thinking about how to maximise benefits across all species.

Information on broader context is generally in the earlier stages of development. Models showing habitat rarity, depletion, connectivity and vulnerability exist, and are being actively improved. Models of fire and water behaviour also exist, and analyses are being expanded to look at regimes and future scenarios. Information on communities of interest and partnership opportunities is generally based on a variety of qualitative data that is currently less suited to comprehensive analyses.

Measuring and maximising net improvement

The purpose of the Strategic Management Prospects (SMP) approach is to provide guidance on how to best invest in maximising biodiversity outcomes – i.e. what actions to take, and where.

The first step of the analysis takes the Change in Suitable Habitat data layers and identifies, for each mapped cell (225m x 225m pixel), the action or predetermined combination of actions that provides the most cost-efficient benefits for biodiversity. Actions that benefit species most in need or species that are unlikely to benefit from actions elsewhere, are weighted more heavily. This is done to give greater weight to local benefits that represent a large fraction of the maximum potential benefit for a species.

For practicality, weighted local benefit and cost data layers are 'smoothed' by averaging benefit scores over neighbourhoods where the size of the neighbourhood is determined by the minimum area required to undertake an action. This ensures local benefits account for large-scale actions (e.g. fox baiting) and prevents fragmented and unrealistic allocations of actions.

The second step is an optimisation in Zonation software that ranks locations based on the potential contribution of the most cost-efficient (best) local actions to overall species persistence in Victoria.

Only two management scenarios are considered at each location; the 'best action' (or set of actions), or no action. In doing so, this reduces the complexity of the ranking process. Zonation produces a hierarchical ranking by iteratively 'removing' mapped cells in an order that minimises the marginal loss of return on investment for each iteration. The order of removal provides a ranking of actions in the landscape, with those actions removed last offering the highest conservation return on investment. The result is an indication of the predicted areas that provide the highest, and lowest, return on investment for management action.

Dealing with broader context

The prioritisation of management actions in SMP is predominantly based on the estimated return on investment of different actions in different locations, where return on an investment is defined as Total Benefit / Cost. The Total Benefit for a given action (or set of actions) in a particular location is a weighted sum of the estimated benefits of that action to all species. It is also desirable to give additional emphasis to some locations based on broader context. For example, greater weight can be given to actions that improve or maintain important habitat areas for spatially restricted species, including naturally rare species and species that have suffered from past habitat loss. Additional weight can be given to actions that benefit species considered most at risk of extinction in the next 50 years (typically species whose distributions have been much reduced since European settlement, or species expected to lose substantial amounts of habitat in the future in the absence of management actions). Other factors can be considered in this way – for example, connectivity of habitat across the landscape, relative vulnerability of particular environments to climate change, and the level of prior action and progress that has already been achieved.

Continuous improvement to Strategic Management Prospects

The first version of SMP includes information on most terrestrial vertebrates and higher plants (including all rare or threatened species with suitable data), some key landscape-scale interventions for increasing Suitable Habitat, and their indicative costs. Although currently limited in scope, for the first time across Victoria this provides an estimate of the net Change in Suitable Habitat that could be expected by 2037, under a plausible cost-effective investment scenario.

Many of the inputs to SMP will be refined and expanded through time, so SMP will be reviewed and improved as new information is incorporated.