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SAVING OUR SPECIES

Setting trigger points for evidence-based threatened species management

Guidelines for conservation managers to integrate decision triggers into Saving our Species conservation projects

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Glossary

SoS: Saving our Species

MER: monitoring, evaluating and reporting

SoS project coordinator – the department lead responsible for coordinating each species conservation project with partners where appropriate, and reporting on project expenditure, outputs and outcomes annually.

Target: the desired site-level outcome that management aims to achieve for the target species.

Trigger point: a point in the system (such as a population size) that, if crossed, triggers a predefined intervention (also referred to as a 'trigger').

Intervention: management action taken when a trigger point is breached.

Indicator: a measurable representation of progress towards achieving objectives, for example the target species or a threat.

Monitoring metric: the specific unit of measurement used to monitor change in the condition of the indicator, for example population abundance.

Surrogate indicator: an attribute measured to make inferences about the condition of the target species.

Ramet: an individual in a group of clones, e.g. a plant that has grown vegetatively from another plant as a clone of that plant, but is a separate individual.

Genet: a group of genetically identical individuals that have grown in a specific location, all originating from a single ancestor through asexual reproduction; a group of ramets.

Introduction

Successful conservation outcomes rely on effective, timely and well-informed management. For Saving Our Species (SoS) conservation projects, SoS project coordinators and other on-ground managers need to be armed with decision-support tools that use the best available information to guide decisions on when changes to interventions are required.

To support effective management decisions, the SoS program implements a target-driven approach to management within an established monitoring, evaluating and reporting (MER) framework (OEH 2018) and supporting guidelines (Mayfield et al. 2020). The framework guides the development of project MER plans, which are used to track the state and trend of threatened species and ecological communities, as well as the trend of threats. This approach, and subsequent monitoring data, also tells us whether implemented actions have been effective, and helps us determine whether changes to existing actions are required to ensure success.

For all site-managed species, monitoring indicators for each site are evaluated annually using a traffic-light system to assess whether species, and the management of their threats, are on track to meet short- and long-term targets (OEH 2018). Species are determined to be 'on track' if monitoring indicates the population measure has met its annual target. If monitoring results are not available for a species, but indirect indicators such as threat monitoring or management actions have met their targets, then an outcome is 'inferred on track'. If a species response is not detectable and intermediate indicators are not met, then an 'inferred not on track' would be applied. Species are 'not on track' if monitoring indicates the population measure does not meet the annual target. However, challenges still exist in applying this approach when a species is observed to move into an undesirable state, and managers face the complex decision of when and how to intervene before the species becomes 'off track' or it is too late.

So, how can we ensure the data collected is used to guide where and when management interventions are most required? Management thresholds, known as trigger points, can be used for this purpose. Trigger points represent a proactive approach to management that helps to ensure indicators stay on track towards achieving targets. This is achieved by specifying points in the system (such as a population size) that if crossed, trigger a predefined intervention (Figure 1). This ensures that interventions are timely and of an appropriate magnitude. It serves as a guide to managers and decision-makers that they need to pay closer attention to a species and their threats as the trend approaches a trigger point. These guidelines expand on the SoS MER framework to provide step-by-step guidance for setting trigger points for SoS MER planning.

Ideally, triggers should be defined during initial stages of management planning. For species that already have established management plans, triggers can be set at another time as appropriate, such as during annual reporting of outcomes. However, it is central to the success of trigger points that they are set proactively. Triggers are not intended to be a reactionary approach to management that is implemented as a response to a decline.

These guidelines are designed to be used by individuals or small groups of experts who work together to manage a species. When working as a group, individuals are encouraged to first set trigger points and interventions individually (Steps 2 and 3), and then discuss the suitability of trigger points and interventions set by each individual. This creates an opportunity for different perspectives and discussions, leading to robust, justifiable trigger points and interventions.

While trigger points are most often used to indicate a species is declining, and that additional interventions are required to prevent further decline, they can also be used to demonstrate that a species is recovering. If the condition of a species recovers past a trigger point, this can serve as a guide to managers that some interventions may no longer be required. These guidelines focus primarily on describing the process for setting trigger points to prevent further decline. However, most of the steps and advice are transferable to setting triggers for recovery, and details on setting triggers for recovery are provided in Step 3b.

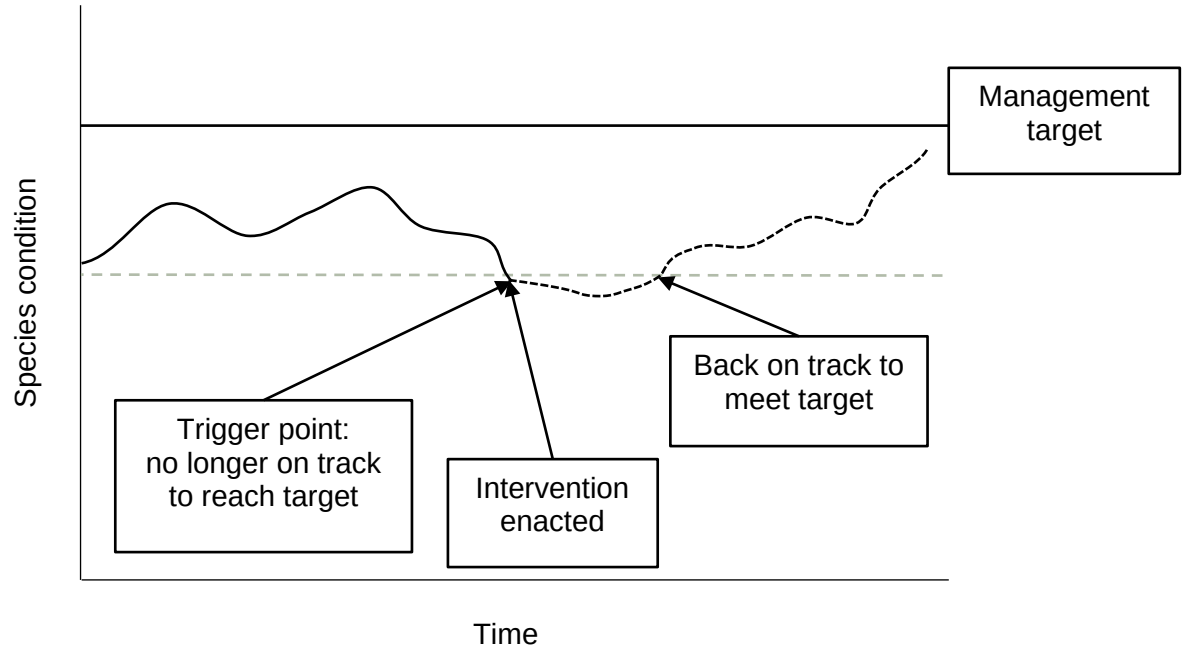

Figure 1 Trigger points help ensure species stay on track to reach management targets

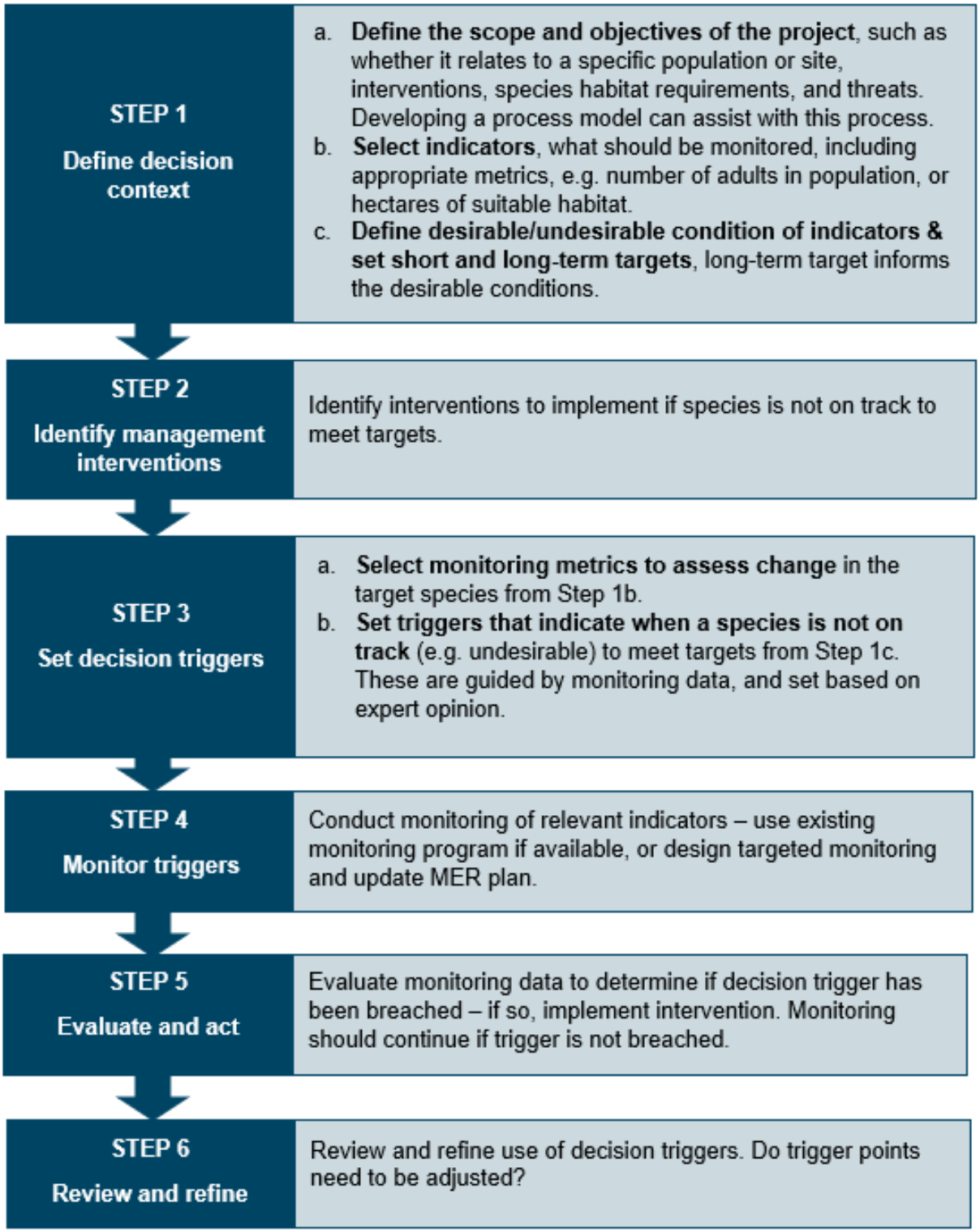

Figure 2 Steps for setting trigger points, and how they fit into the existing SoS MER framework and guidelines

Adapted from de Bie et al. (2018) and DPIE (2020). Trigger points inform when interventions are required, to ensure species stay on track for achieving their targets.

Step 1: Define the ‘decision context’

The first step involved with setting trigger points is to define the scope, indicators and target condition (or ‘decision context’) within which trigger points will be set.

This is the foundation for the rest of the process, so it is important to spend some time getting it right. The process for defining the decision context involves the following:

1a. Define the scope of management

Trigger points are set for each species separately, so in all instances this will include identifying the target species. For site-managed species, triggers should be set for each site separately. This reflects the fact that the condition of the species may vary substantially between sites, and so a trigger point that is appropriate at one site may not be appropriate at another.

The tables in Appendix A will help you to define the scope. First, in Table 7 (Appendix A), provide background information on the species – the name, population trend, management site and long-term target. Next, note down what you know about the species’ habitat requirements, threats and interventions that are currently taken to manage the species. This helps identify which parts of the system you can influence, to inform the interventions taken if a trigger point is crossed (Step 2). Conceptual models, such as influence diagrams (DPIE 2020) can be used to assist with defining the scope.

Next, in Table 8 (Appendix A), note down all of the data available from the monitoring program. Start with the metrics used to monitor the target species (e.g. abundance, occupancy, number of breeding pairs), then move on to any additional indicators (e.g. threats, habitat condition). Include details for all elements monitored. This information will be used to select which metrics and indicators you will set trigger points for.

1b. Select one or more indicators

Monitoring changes in the condition of indicators provides information as to whether a species is approaching or has crossed a trigger point. If a trigger point is crossed and an intervention triggered, indicators then demonstrate whether the species is responding as expected to that intervention (Mayfield et al. 2020). Selecting appropriate indicators is therefore one of the most critical parts of setting trigger points.

When setting triggers for threatened species management, the primary indicator should, wherever possible, be the condition of the target species.

You can also set trigger points for additional indicators, such as environmental conditions or threats (Step 3a). These should, however, ideally be in addition to setting triggers for the target species. Most species are subject to multiple stressors, so may suffer undocumented declines if attention is focused solely on other indicators. If triggers are set for other indicators, the same steps should be followed as for setting triggers for the target species.

Setting trigger points for additional indicators can have the benefit of providing information at different temporal or spatial scales. For example, changes in the condition of threatening processes (e.g. invasive species outbreaks) often precede the observed decline in the condition of the target species. Having a trigger based on the threat may therefore highlight the problem earlier than the trigger for the condition of the target species, enabling intervention before the target species suffers extensive decline. Linking trigger points to

threatening processes can also help to identify the appropriate intervention. For all indicators, there should be a measurable cause–effect relationship with the desired condition of the target species.

The feasibility and cost-effectiveness of the indicator should be considered. Some indicators require more resources than others, for example if monitoring must be conducted frequently, is in a remote location, or requires expensive technology. Consider the ability to detect change in the condition of the indicator with the available resources. If resource constraints limit the ability to detect change in the indicator, then another less resource-intensive indicator should be chosen.

1c. Define the desirable and undesirable condition of the target species

This helps inform where trigger points should be set, as the objective is to ultimately prevent the condition of the species from deteriorating.

The desirable condition should reflect what the organisation wishes to achieve for the species over time. For site-managed species within the SoS program, the desirable condition should therefore be the long-term target at that site, as defined in the species database.

The undesirable condition indicates the population is impaired and is functioning at a level that jeopardises its long-term survival.

Natural systems are often more nuanced than just a desirable and undesirable condition. To reflect this, you may also want to define the acceptable and the unacceptable condition (Figure 3), as summarised in Table 1.

Table 1 How to define the condition of target species

Condition state	Examples of how to define
Desirable condition – the long-term target for the site, or defined using another approach as described opposite	• Population size that indicates that the population is at or near the carrying capacity for that site • Past data from when the population was in good condition (i.e. a reference point or reference condition) • Condition of another population of the same species that is known to be in good condition • Expert opinion, then refined through additional monitoring or research (de Bie et al. 2018)
Acceptable condition – represents a decline from the desirable condition, but not into a condition that means the species is immediately threatened.	Consider that monitoring was conducted – what result would make you watch the species a bit more closely, but not necessarily concern you? For example, if the desirable condition is when the population is at or near carrying capacity, the acceptable condition may be the minimum viable population size for the site.
Undesirable condition – indicates the population is impaired and is functioning at a level that jeopardises its long-term survival.	The IUCN Red List of Threatened Species listing criteria (IUCN 2012) is a useful resource to help you to consider what this may entail.
Unacceptable condition – indicates the population is at high risk of local extinction in the short-term.	Considering the IUCN listing criteria (IUCN 2012) may help you define this.

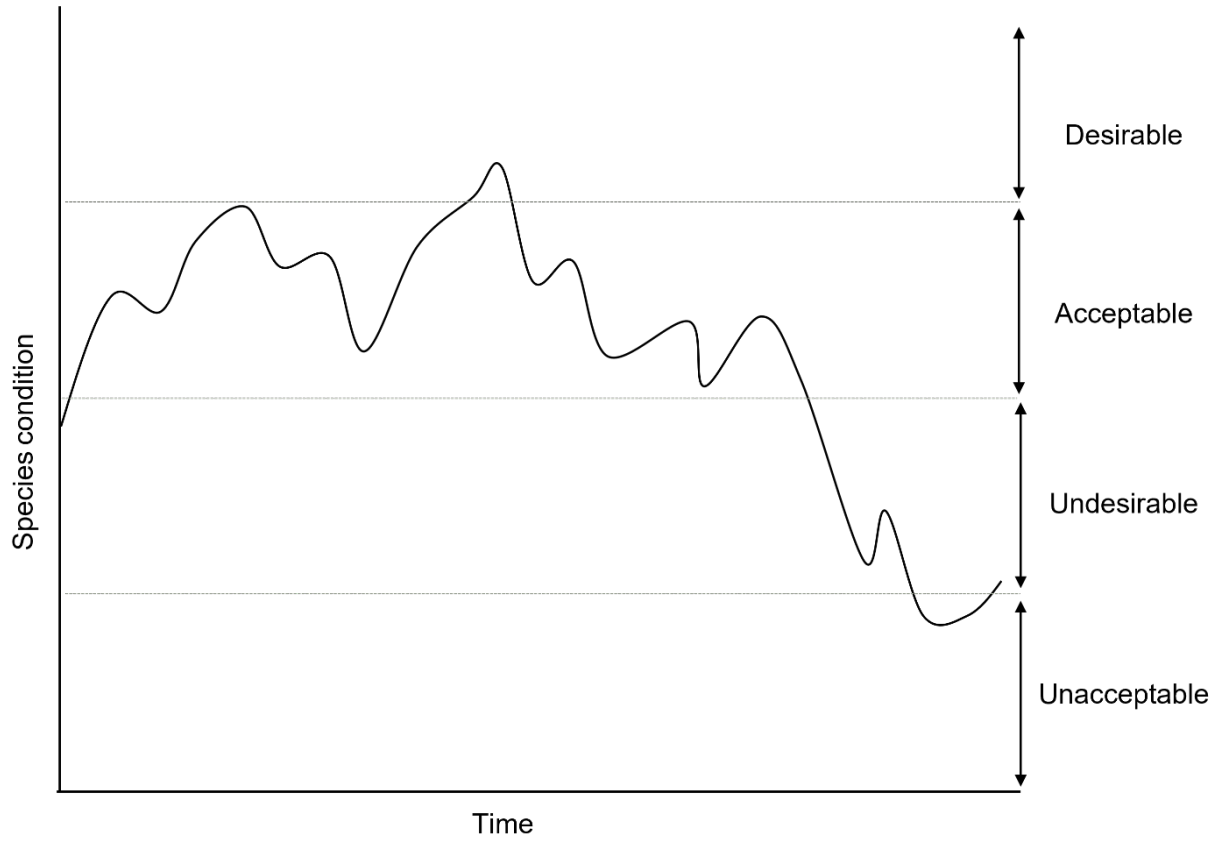

Figure 3 Defining the condition of the target species

Defining the desirable and undesirable condition of the target species helps to inform where trigger points should be set. The acceptable and unacceptable condition can also be defined.

Step 2: Identify interventions

Make a list of all the interventions that could be implemented to affect change in the condition of the target species.

Considering the range of available interventions at the planning stage, before they are required, is part of what makes trigger points proactive. Therefore, an essential element of setting trigger points is to have management interventions available that can affect change in the system and prevent further decline (Table 2).

Table 2 Possible intervention types that could be implemented, and examples

Intervention type	Example/approach
Escalation of interventions (outlined in the scope in Step 1)	If you are already undertaking pest control as an intervention, this intervention may become more frequent or be applied across a broader spatial scale if a trigger point is breached.
Investigative actions	You could increase monitoring to reduce uncertainty around the extent of decline, or conduct assessments to determine the cause of decline.
New interventions that are not currently implemented	If a conceptual model has been developed for your species, looking at the threats and drivers outlined in the model can help you to identify where new interventions could be implemented. This may also highlight where factors are outside the reach of management (e.g. drought), but where recovery effort could be directed after the threat passes. To identify new interventions, it can be helpful to consider 'pie in the sky' options. If resources were not a limiting factor, what could be done to protect the target species? Even if these interventions are unlikely to be feasible in practice, thinking outside the box can be a good way to generate discussion and brainstorm new ideas that may be more practical.

Identify appropriate interventions for all decline scenarios

Successive trigger points usually represent a continued decline in the condition of the target species. Identify interventions that would be appropriate to take across the full spectrum of decline, from the desirable condition and the current condition, right through to the worst-case scenario. Explicit consideration of what to do in the worst-case scenario means there is a plan in place if it eventually happens.

The intensity of the intervention should reflect the severity of the decline. Investigative interventions should be limited to when the species is in relatively good condition, and should have a level of caution built in. For example, you could include a trigger point for increased monitoring before there is an urgent need for intervention, followed by a trigger point to implement the outcome of the monitoring.

Consider interventions that require substantial preparation

Factor in preparation time for all interventions that will require substantial lead time to implement, such as population supplementation, translocation, or captive breeding. This may also include factoring in time to conduct small-scale trials to verify the efficacy of actions, before rolling them out across a broader scale. Including a trigger point to initiate preparations for large-scale, resource-intensive interventions so they are ready when required, rather than waiting until they are required to start working on them, means they will be available if the relevant trigger point is breached.

Step 3: Set the trigger points

In Step 2 you identified what interventions you could take to affect change in the condition of the target species. In Step 3 you will identify at what level of change those interventions would be implemented.

When setting trigger points for a decline in the condition of the target species, each trigger point must be assigned at least one intervention. The number of triggers that can be set is therefore restricted by the number of interventions identified in Step 2. Multiple interventions can be assigned to one trigger point. Interventions can also be assigned to multiple trigger points, escalating to become more frequent or across a broader spatial scale over successive triggers.

Trigger points work best when several successive triggers are set, representing a worsening in the condition of the target species. Always set a minimum of 2, but preferably more trigger points, thinking through the trajectory of decline from desirable to undesirable. Each trigger point represents an opportunity to implement additional interventions to prevent further decline, so more trigger points mean more opportunities to act.

Trigger points should always be expressed quantitatively. Qualitative triggers that contain subjective terms, such as ‘substantial’ or ‘maintain’, are open to interpretation and are not measurable. As such, qualitative descriptive terms should be avoided, and all measurable elements of the trigger point should be expressed numerically.

The process for setting trigger points involves the following steps, described in detail below.

3a. Select monitoring metrics for assessing change in the target species

Select one or more monitoring metrics from those outlined in Step 1 and repeat the process for each metric separately.

We recommend you set triggers for at least 2 metrics that measure change in the condition of the target species, alongside any triggers set for other indicators like threats, except when triggers are set for surrogate indicators only (see below).

Different metrics often provide information at different temporal or spatial scales, or may indicate different underlying causes of decline. Setting triggers for multiple metrics can therefore provide a more comprehensive indication of the condition of the target species.

Key considerations that influence the choice of metric are described in Table 3.

Table 4 provides examples of different metrics that can be used to set triggers, depending on the monitoring data collected for the species (see Table 3). An example is given for how the trigger point would be expressed using each metric, and illustrated in Figure 4.

Table 3 Key considerations, questions and recommended actions for selecting a monitoring metric

Consideration	Questions	Recommended actions
Species current condition	Do you know the most recent result of monitoring for that metric?	If you don't know the most recent result of monitoring, select another metric.
Data availability	How much data is available for the metric?	If you monitor multiple metrics, select the metrics that have the most data available – this helps inform the expected extent of natural fluctuation in condition.
Accuracy	What are the confidence intervals around the monitoring data? What degree of accuracy do you require in the results of monitoring?	Select metrics that can detect a decline more quickly and accurately, to enable a timely response. Set triggers for more than one metric to increase the opportunity to detect a decline.
Variability	Does the metric fluctuate a lot? Do you have an idea of the expected level of fluctuation from the available data? What causes the fluctuation?	Set triggers for the metrics you have the greatest understanding of. For metrics that fluctuate substantially, consider whether using rolling averages or ranges will be useful (see FAQs).
Relation of metric to species condition	Do you know the relationship between changes in the metric, and the condition of the species?	If selecting metrics that provide an indirect measure of condition (e.g. occupancy), ensure there is an established relationship with species condition. Set triggers for metrics that assess different aspects of species condition (e.g. abundance and occupancy).

Table 4 Examples of metrics that can be used to set triggers

Metric	Trigger-setting approach
Count data – represents the true number of individuals within a population	If count data is available, it provides the most direct way to measure change in the population and should be used for setting trigger points. Trigger points set using this metric would be expressed as a decrease or increase in the number of individuals observed (Figure 4 A).
Abundance – usually measured as the number of individuals within a spatial unit such as a hectare or kilometre	Trigger points set using this metric would be expressed as a decrease or increase in the abundance per spatial unit (Figure 4 B).
Occupancy – used to measure presence across specified grid cells (or spatial units) within a larger site	Triggers would be expressed as either an increase or decrease in the number of cells occupied within the site (Figure 4 C). The ability to interpret changes in population trends based on changes in occupancy can be limited. The accuracy increases as the number of grid cells monitored increases (Ellis et al. 2014), so in small sites with fewer grid cells this metric may not be sensitive enough to be used as a trigger. Also, the relationship between occupancy and abundance is not always linear (Ellis et al. 2014), and so it is possible species abundance may decline while occupancy remains relatively consistent, or declines at a slower rate. If monitoring resources allow, we recommend that you set triggers for count or abundance data as well as occupancy to ensure the condition of the population is accurately monitored (see FAQs for advice on setting trigger points for multiple metrics). Alongside changes in the number of sites occupied, consider whether different patterns of change in the cells occupied provides useful information. For example, if all cells within a concentrated area of the site become unoccupied, would this trigger a different response than if there was a random decline in the cells occupied across the site?
Total cover – used to measure the area covered by plant species	Triggers set using this metric would be expressed as a decrease or increase in the total area covered (Figure 4 D). This metric is comparatively easy and quick to measure, often using quadrats and measured within a defined spatial unit. As such, it can provide a good indication of changes to the distribution of plant species. It is a relatively coarse metric, and so for some species, changes to the total cover might not reflect changes to the total number of individuals. It can also be sensitive to the time of year that sampling is conducted, so may not be appropriate to use all year round. You may therefore want to use this in conjunction with another more precise metric, such as count data, when changes to the number of individuals is of concern. This metric is useful for measuring changes in the condition of species, such as some plants and fungi, where it is difficult, or not relevant to management, to identify individuals. As with occupancy, it might also help to consider whether different patterns in decline of the areas covered provides any useful information as to the likely cause of decline. If cover reduces in a specific area, would this warrant a different response than if cover was reduced uniformly across a site?

Consider other metrics relating to the target species

Any of the other metrics collected across the SoS program can be used for setting trigger points if the following requirements are met. A metric must:

- be defined quantitatively
- have a meaningful link to the condition of the species
- be capable of defining the desirable and undesirable condition of the species
- be measurable with the required level of accuracy and frequency (i.e. within the resource constraints of the monitoring program)
- be linked to a management response (i.e. you know what interventions are likely to improve the condition of the metric based on experience or published research).

If the above requirements are met, then the available metrics may include:

- activity index
- biodiversity response proxy
- density or abundance of key habitat feature
- extent of occurrence
- growth rate
- infection rate
- mortality
- per cent ground cover
- ramet/genet count
- reproductive success/recruitment
- various genetic metrics.

Using metrics for additional indicators

Alongside metrics for measuring change in the target species, you can set trigger points for metrics that measure change in the condition of other indicators (e.g. threats). These trigger points can be set entirely independently of the trigger points set for the target species to provide additional information on the condition of the system.

They can also be incorporated as condition dependencies in the trigger points set for the target species. This relates the condition of the target species to other indicators, helping to interpret changes in the condition of the species. See Appendix C for details on incorporating condition dependencies into trigger points.

Triggers for additional indicators can also be used in place of triggers set for the target species (i.e. as a surrogate indicator). Trigger points should be set for the target species whenever possible. However, there are instances where the target species is difficult to detect, making it challenging or not cost-effective to measure change in the target species. In this situation, trigger points can be set for surrogate indicators. To do so, there should be a validated relationship with the target species, and a justification provided for why the surrogate is appropriate (OEH 2018).

Additional indicators should be selected from the list of indicators you identified in Step 1, and may include:

- habitat condition, extent (area of occupancy or extent of occurrence)
- vegetation or habitat structure or composition
- abiotic factors e.g. soil nutrients, rainfall, temperature
- co-occurring or ‘representative’ (surrogate) species
- threat response.

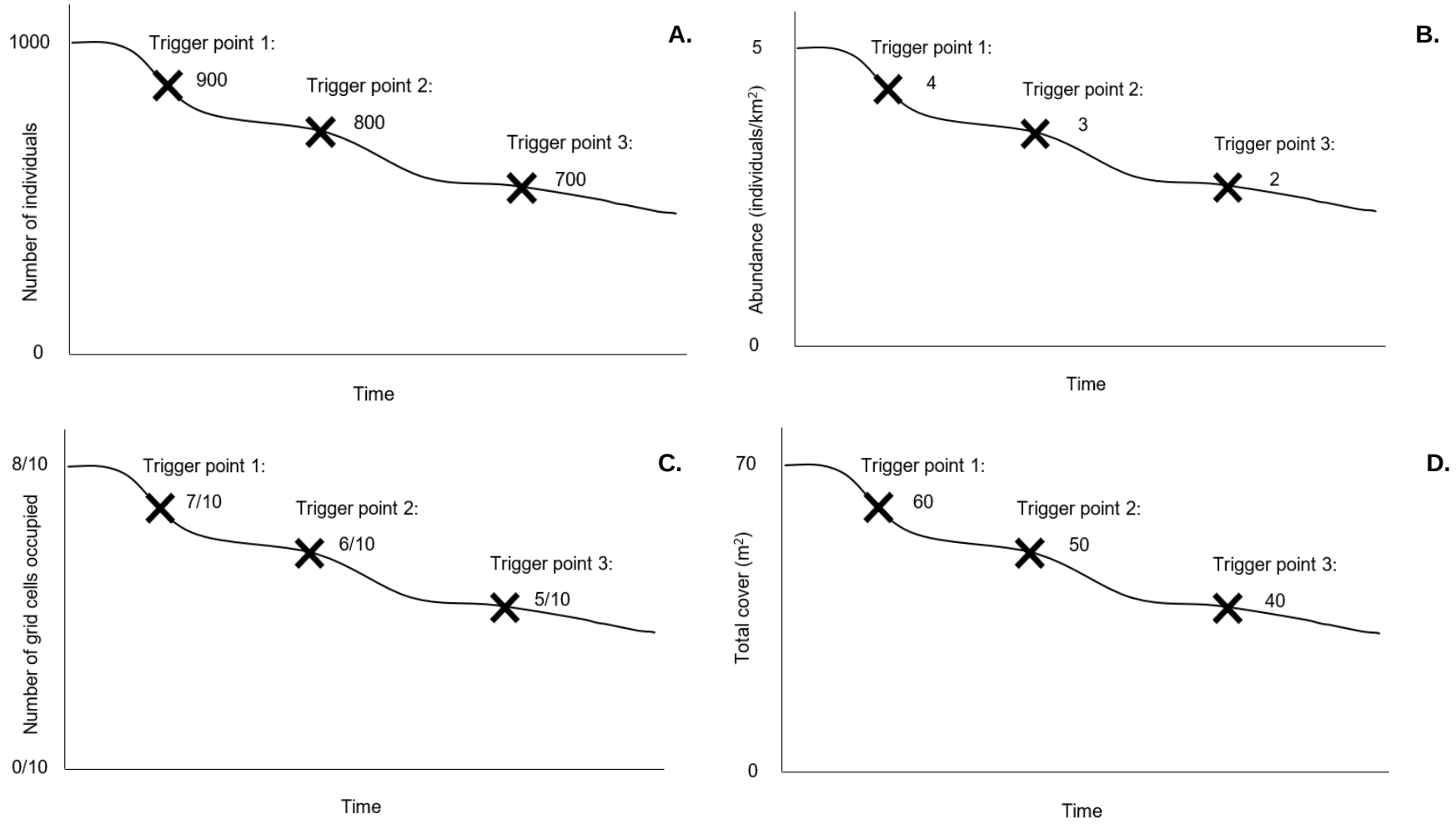

Figure 4 Examples of setting trigger points for the metrics: A) count data, B) abundance, C) occupancy, D) total cover

Clockwise, beginning from the top figure: A) An example of count data (starting from a current population size of 1,000 individuals), B) abundance (starting from a current population abundance of 5 individuals/km^2), C) occupancy (starting from a current occupancy of 8/10 grid cells occupied) and D) total cover data (starting from a current total cover of 70m^2). The trigger points used in all examples are hypothetical and used for illustrative purposes and should not be taken as indications of appropriate trigger points.

3b. Set the desired level of change for each trigger point

For each intervention identified in Step 2, decide the level of change at which the intervention would be implemented to reverse a decline. Provide a justification for why the trigger points are appropriate.

This is one of the most challenging, yet most important, parts of setting trigger points. Remember, setting triggers is intended to be an iterative process. Triggers need not be permanently fixed once they are set – they should be reviewed and updated as new evidence becomes available. There is therefore no 'wrong' trigger point.

Include key considerations

Make a note of how the considerations outlined in Table 5 are likely to influence trigger points for your species. Once triggers have been set, revisit these notes and make sure they are properly reflected in the triggers. This may require several iterations and consultation with colleagues and experts to reach an agreed level.

Table 5 Key considerations, questions and recommended actions when deciding the level of change for each trigger points

Consideration	Questions	Recommended actions
Population variability	How much does the condition of the species fluctuate from year to year? What fluctuations are natural, and what fluctuations warrant intervention?	Identify the limit of natural variation from monitoring data outlined in Step 1 – variation outside the expected limit is likely to warrant a trigger point. For metrics that fluctuate substantially, consider whether using rolling averages or ranges will be useful (see FAQs).
Detectability	How frequently is monitoring conducted? Is monitoring sensitive enough (temporally/spatially) to identify the level of change you want to use as a trigger point?	If monitoring is not sensitive enough, set trigger points that are less cautious (i.e. at a greater level of decline) to ensure they can realistically be detected.
Species condition	Is the species already in poor condition? Has the species already crossed one or more trigger points?	Set trigger points that are more cautious (i.e. in closer succession) to enable more opportunity to respond. Be more accommodating of the possibility of falsely identifying that a trigger point has been breached. Assign more intensive interventions to latter trigger points.
Time to implement intervention	How long will it take to implement the intervention?	Account for preparation time. If necessary, include a separate preparatory trigger (see Step 2).
Time for species to respond to intervention	Is the species likely to continue to decline for a period after the intervention is implemented? How long will it take for you to detect that an intervention has been successful in reversing the decline?	Set the trigger point at an appropriately proactive level of decline.

Select an approach to setting triggers for a decline in species condition

There are different approaches you can use to set trigger points for decline in species condition. Select from the following options, depending on the current condition of your species.

If the species is currently in good condition (desirable or acceptable), then:

The condition estimates (e.g. desirable, undesirable) outlined in Step 1 inform where trigger points are set (Figure 5), following the steps below:

1. Set trigger points near the boundaries between conditions, to prevent the species from deteriorating into a worse condition – this ensures the species remains on track to meet the long-term target for the site.
2. If there are enough interventions, set one or more triggers in all condition bands (i.e. desirable – unacceptable), considering which interventions are appropriate for each condition band (see Step 2).

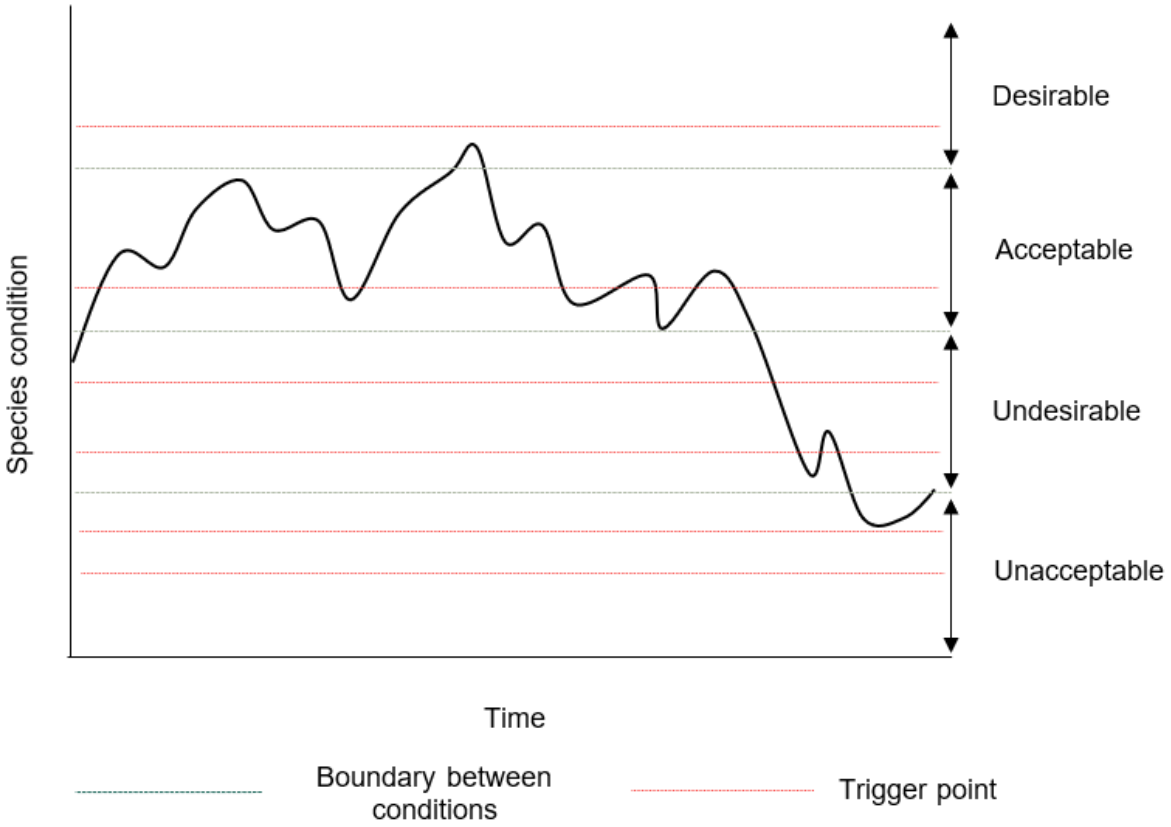

Figure 5 For species currently in good condition, the boundaries between conditions can inform where trigger points are set

If the species is currently in poorer condition (undesirable or acceptable), then:

It is important to set trigger points that are relevant to the current, concerning condition of the species. Triggers may be within only the unacceptable condition, and so there are no further bounds between conditions to inform where triggers should go. Trigger points therefore represent the tolerance for further decline, and the capacity to undertake additional actions.

To set triggers for these species, it can help to consider a hypothetical decline scenario (Figure 6), by following the steps below:

1. Start with the current, actual condition of the target species, as outlined in Step 1 (i.e. the most recent result of monitoring data).
2. Consider a level of decline that you think would indicate that the current management interventions are no longer working, and additional interventions would be required to prevent further decline – this is the first trigger point.
3. Then consider that, despite the additional interventions implemented at the first trigger point, the condition of the species continues to worsen.
4. What level of decline indicates that the additional interventions implemented at the first trigger point have not been successful, and that further intervention is required? This is the second trigger point.
5. Repeat this process, until all available interventions have been assigned to a trigger point.

In this scenario, the condition estimates should still be defined. You can also still set trigger points in the desirable and acceptable condition bands, which would be implemented in the event of an improvement then subsequent decline in condition.

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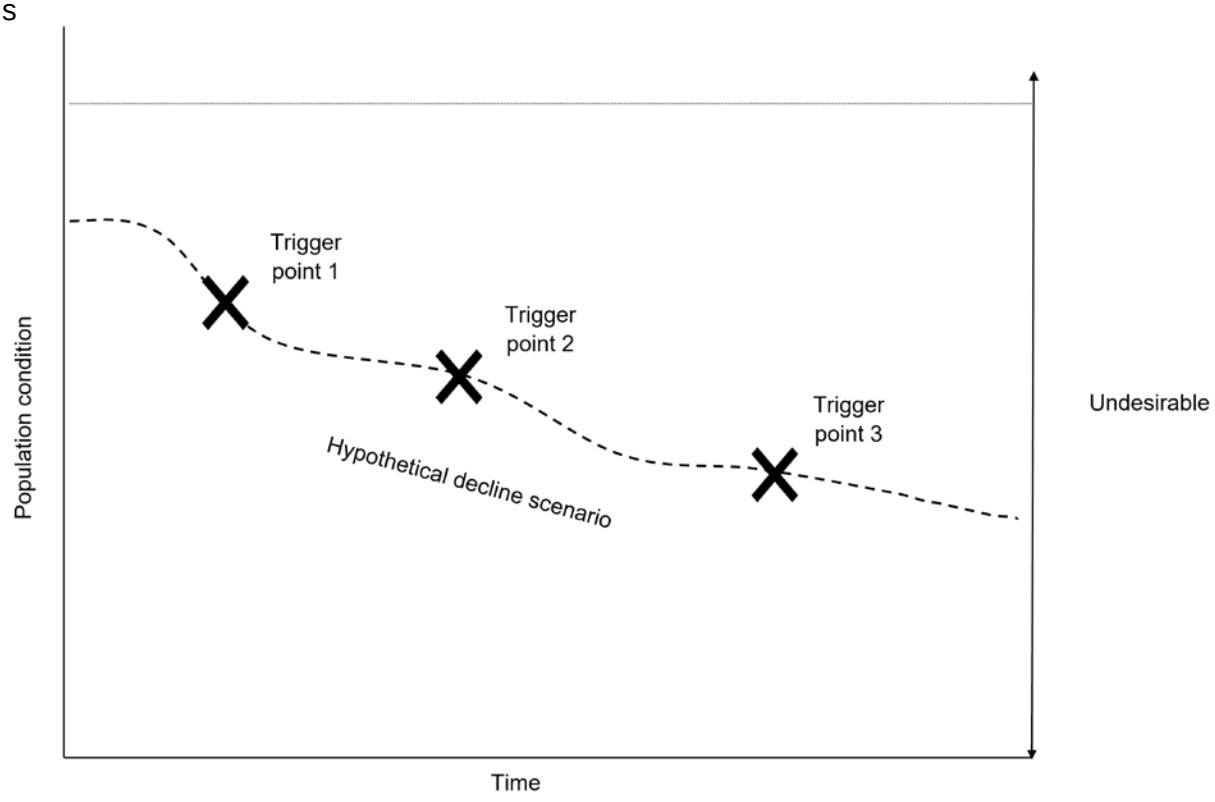

Figure 6 For species already in poorer condition, considering a hypothetical decline scenario can assist with setting trigger points

Include justification for the selection of the trigger

For every trigger point set, provide a justification for why that specific level of change is appropriate to use as a trigger point.

Relate the justification to any of the main influential factors that you outlined in Table 5. Be as specific as possible. Justifications should be based on data where supporting monitoring data is available. However, if supporting data is not available, e.g. if monitoring has only recently begun, justifications can be defined based on expert opinion, and can be defined simply.

Providing a justification encourages you to consider why you have chosen that level of change as an appropriate trigger point. It also provides transparency in the decision-making process. This can serve as a reminder for when you review trigger points (Step 6) and can be beneficial if new staff members take over the role of managing the species.

Table 6 Key questions to consider and justify when selecting a trigger point

Key questions	Examples of how a trigger may be justified
Why is the trigger point ecologically suitable for the species?	• Is it outside the expected extent of natural fluctuation? • Species-specific traits that may influence management (e.g. very long- or short-lived) • The trigger represents the numbers required for high probability of breeding • Whether the species has previously been in this condition, and how that transpired (e.g. were there negative consequences?) • Probability of success or extinction at this level • How this condition relates to other indicators (e.g. habitat, environment, threat) • Minimum viable population
How does the trigger point relate to the management intervention?	• It provides enough time to investigate the decline • It is the minimum change in the condition of the species that could be detected by monitoring • It provides enough time to implement the management intervention, and for the species to respond • The decline in the condition of the species warrants intensive intervention
Are there any other factors influencing the decision?	• Public expectation/pressure to intervene at a given level of decline • Economic/resource considerations • IUCN Red List Criteria (IUCN 2012) - trigger points can be set to warn that the species is approaching an uplisting, and intervention is required to prevent that from happening

Consider setting triggers for recovery

Alongside knowing when more interventions are required to prevent a species' condition from declining further, it can be useful to know when some interventions are no longer required. Triggers for recovery can be used for this purpose. Rather than setting trigger points to initiate additional interventions, triggers for recovery are points at which actions are turned off.

The process for setting triggers for recovery largely follows the same steps as setting triggers for declining condition – with the omission of Step 2, as it doesn't require the identification of additional interventions.

The process of outlining the scope of management outlined in Step 1 remains the same. When selecting monitoring metrics (Step 3a), we recommend you use the same metrics for triggers for recovery that you would use for triggers for declining condition. Therefore, all the key considerations for selecting monitoring metrics outlined in Step 3a still apply. Generally, triggers for recovery should be cautious, and set when the species is in a better condition than would warrant additional intervention being taken. They should reflect that the species has an improved condition band (e.g. has improved from undesirable to acceptable condition), and there is some certainty that it will not decline again imminently.

For example, if your metric is count data, and there are currently 1,000 individuals within the population:

- If the species declines below 800 individuals, this may trigger additional interventions.
- These interventions may be successful, causing the population to start to recover.
- You may want to set a trigger to turn off the interventions that were initiated when the population declined below 800 individuals.
- This trigger for recovery should be set higher than 800 individuals.
- Alternatively, the trigger for recovery could be if the population remains above 800 for several successive monitoring intervals, e.g. if the rolling average is above 800, rather than a one-off observation.
- This reduces the chance that the population will again decline below 800 individuals, and the intervention will have to be reinstated.

Many of the key considerations for setting trigger points (Step 3b) are also applicable. For example, the expected range of natural variation in the condition of the species is still likely to inform triggers for recovery. If a trigger for decline is based on a species declining below the lower bound of natural variation, then a trigger for recovery might be once the species condition returns within the expected range of natural variation. Again, an appropriate level of caution should be applied. While interventions might be triggered as soon as a species is observed to decline below the natural bound of variation, triggers for recovery may only be triggered once the species has been within the expected range of variation for several years (or several monitoring intervals, at a time frame relevant to your species).

Step 4: Monitor your species

A vital aspect of applying a trigger-point approach to management is a commitment to targeted monitoring to detect whether triggers have been breached.

If there is already a monitoring program designed for the species, then this can be used to assess whether the trigger points have been breached. To assess whether the monitoring program is suitable for this purpose, consider:

- Monitoring frequency – is monitoring conducted frequently enough to detect whether trigger points have been crossed within a suitable time frame? This depends on the length of time it will take to implement interventions if a trigger point is breached, as well as the estimated time it will take for the target species to respond to the intervention.
- Monitoring sensitivity – can the monitoring program detect change in the condition of the monitoring metric with an appropriate level of sensitivity? That is, can it accurately detect when a trigger point has, and has not, been crossed?

If there is not yet a monitoring program, then follow the SoS MER guidelines (OEH 2018) and develop an SoS MER plan, ensuring the above points are considered.

Step 5: Evaluate the monitoring data

Monitoring data should be evaluated soon after it is collected to ascertain whether a trigger point has been breached.

Once you have finished collecting data for a monitoring period (e.g. annual, six monthly – whatever period is relevant to your species), evaluate the data to see if a trigger has been breached. If a trigger has been breached, then the designated intervention should be implemented (or turned off, if it is a trigger for recovery). If a trigger point hasn't been breached, is it close to being breached? If so, consider the length of time until the population will next be monitored, and the trajectory of decline. If there is a long interval until the next scheduled monitoring event, and you suspect the population is likely to cross the trigger point before then, you may wish to schedule additional monitoring (resources permitting) to keep a closer eye on the population. Alternatively, you may wish to implement the planned interventions early to prevent the trigger point from being crossed between scheduled monitoring events.

Step 6: Review and refine trigger points

Triggers should be reviewed in line with reporting on outcomes, e.g. annually or more or less frequently as appropriate.

Trigger points are intended to be implemented as part of an adaptive approach to management, and may be updated as more information becomes available (de Bie et al. 2018). For example, collecting new monitoring data may indicate the population is bigger than you thought, and so the trigger points are no longer suitable.

If trigger points have been crossed, the review should determine whether the assigned interventions have been implemented. If so, have they been successful in restoring the condition of the target species? If not, a hypothesis should be documented, and you should consider revisiting your estimated species responses, such as those defined in your response to management curves (DPIE 2020). If no trigger points have been crossed, consider whether this is appropriate and the trigger point remains the same, or whether triggers should become more precautionary. Justification for the appropriateness of trigger points helps ensure they are a transparent approach to managing threatened species.

Frequently asked questions

How can I express triggers in original units or as a percentage change?

Translating a percentage of change to raw numbers can help you to consider the ecological consequences of the change in condition and may often be a more suitable means of expressing trigger points to ensure they are ecologically meaningful.

However, for some monitoring metrics (e.g. count data), the trigger point may be expressed as a percentage of change (e.g. a 10% reduction or increase in population size). To set triggers as a percentage change, it is important to have an accurate baseline for the population condition, defined using the same monitoring metric used to set the trigger. Assessment of whether the trigger has been crossed should always refer to this baseline condition, and not the condition of the population the previous year. This helps to prevent 'shifting baseline syndrome'. With shifting baseline syndrome, annual declines of less than the percentage used as the trigger point may occur, gradually reducing the population without triggering any response. If uncertainties exist around the baseline population condition, consider whether the same percentage of decline would be an appropriate trigger point if the baseline was smaller or larger, and incorporate this caution into the trigger point.

Can I use a range to set triggers instead of specific numbers?

In some scenarios, it can be difficult to set trigger points as a specific number. For example, species with fluctuating populations, cryptic species, or when monitoring is less sensitive to changes in the condition of the metric. In these scenarios, trigger points can be expressed as a range (Figure 7). The approach to setting triggers is the same, but if monitoring detects a change to the condition of the metric to any level within the range, then the trigger point is breached.

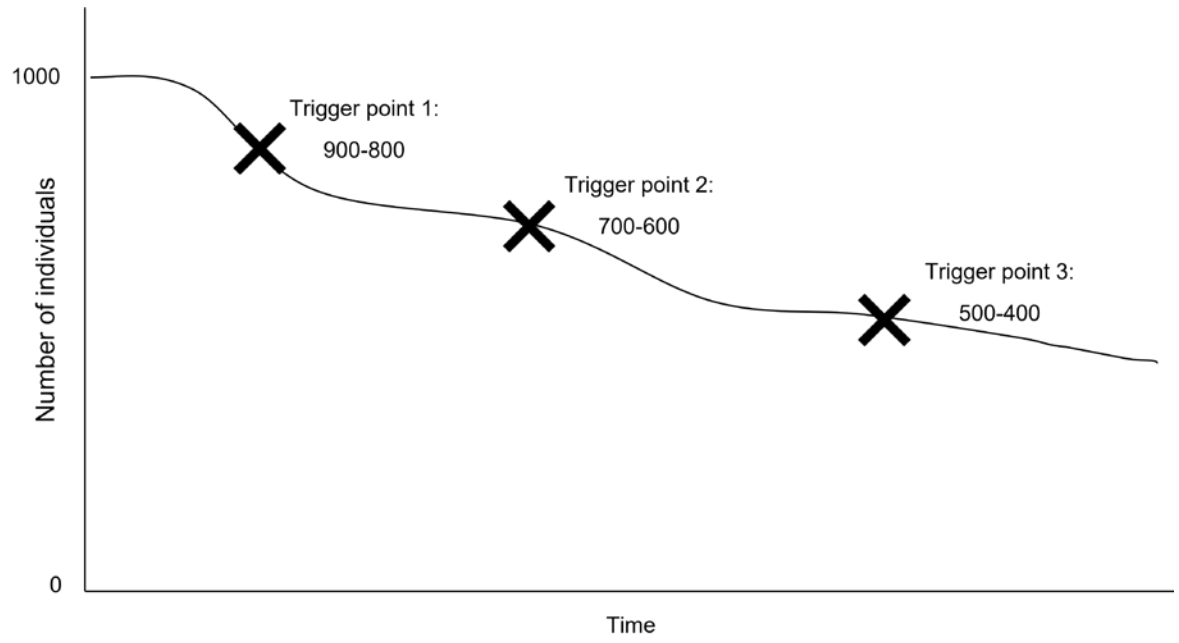

Figure 7 An example of how trigger points are expressed as a range, starting from a current population size of 1,000 individuals

My species' population fluctuates between years, how can I set meaningful triggers?

For some species, a one-off decline in monitoring data will not be a serious cause for concern. Population sizes can fluctuate from year to year, depending on a range of factors, and often recover quickly. However, if declines are observed several years in a row, or if a substantial decline occurs as a one-off, that may indicate there is an underlying problem.

For such species, it is possible to set triggers based on rolling averages of monitoring data, such as a 3-year average (Figure 8). Apply the following rules:

- The trigger point remains the same.
  - In the example, 800 individuals.
- The trigger is not breached as long as the rolling average remains above the trigger point.
  - For example, the annual monitoring data crosses the trigger point, but then recovers in the following years (Year 6 in Figure 8).
- Any decline in condition below the trigger point initiates a management response.
  - This may include a sustained decline across several years (Year 11 in Figure 8).
  - It may also include a one-off substantial decline in condition (Year 16 in Figure 8).

To use this approach to setting trigger points, consider a time frame that is biologically meaningful for your species. For some species a 3-year average may be suitable but for others a longer time frame may be more appropriate. For example, if the population fluctuates significantly every year, using an average across a longer time frame can more accurately indicate that a decline is of concern.

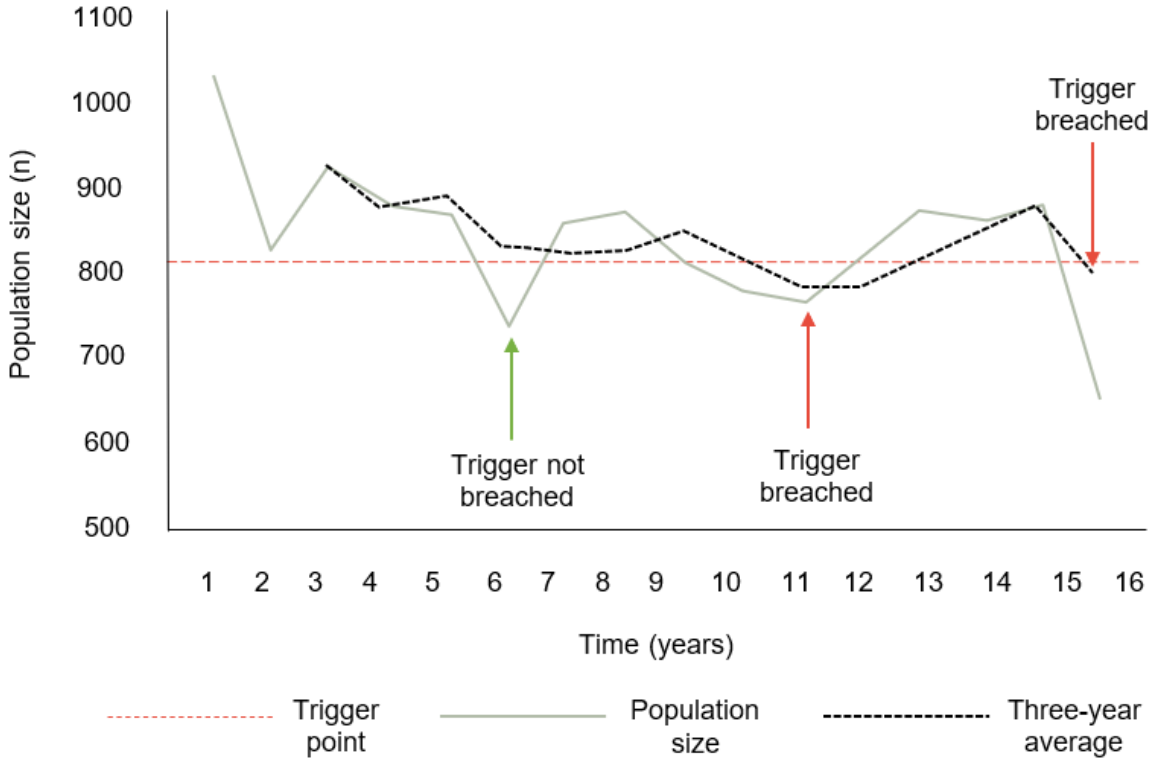

Figure 8 **An example of how trigger points are expressed using rolling averages**

How do I set trigger points for more than 2 metrics for the target species?

There are different approaches to setting triggers using multiple metrics. The most suitable approach depends on whether changes in the condition of different metrics trigger the same response, and the level of certainty required that a decline is occurring.

If changes to the condition of different metrics trigger different interventions, then trigger points should be set entirely separately. For example:

- Metric 1: ‘a decline from 900 to 800 individuals’
- Metric 2: ‘a decline from 7/10 to 6/10 grid cells occupied’.

If changes in the condition of different metrics trigger the same interventions, then an ‘and/or’ approach can be used, depending on the relative tolerance towards Type I and Type II errors. Type I errors, also known as false positives, falsely indicate a trigger point has been breached when it has not. Type II errors, also known as false negatives, falsely indicate a trigger has not been breached when it has.

- If tolerance towards Type I errors is lower than the tolerance towards Type II errors, the trigger can be expressed as a decline in Metric 1 **and** a decline in Metric 2:
    - For example, ‘a decline from 900 to 800 individuals **and** a decline from 7/10 to 6/10 grid cells occupied’.
    - This is suitable when the target species is in relatively good condition, as the risk of falsely identifying that a trigger has not been breached is higher, because confirmation is required from both metrics.
- If tolerance towards Type II errors is lower than the tolerance towards Type I errors, the trigger can be expressed as a decline in Metric 1 **or** a decline in Metric 2:
    - For example, ‘a decline from 900 to 800 individuals **or** a decline from 7/10 to 6/10 grid cells occupied’.
    - This presents a higher risk of falsely identifying that a concerning decline is occurring, potentially resulting in intervention when it is not required.
    - It is therefore suitable for species that are more threatened, because the tolerance for not detecting a true decline is low.

It is also suitable when one of the metrics is less sensitive to decline, as it makes it easier to identify that intervention is required.

When setting trigger points for changes in occupancy, should I use observed or estimated occupancy?

Occupancy can be expressed as ‘observed occupancy’, whereby the number of cells where individuals have been observed are recorded. Alternatively, occupancy models can be used to estimate occupancy, accounting for the imperfect probability of detection between grid cells within a site. Observed occupancy provides evidence of the number of cells occupied, so is more accurate, but may be more time-consuming to monitor than estimated occupancy. Determining which approach is more suitable for setting triggers is likely to depend on the number of cells, the resources available for monitoring, the confidence intervals around estimated occupancy, and other contextual factors that make accurate detection of species challenging. If confidence intervals are wide, and the estimated range includes very low occupancy, then observed occupancy may be more appropriate.

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Case studies

1. Tranquillity mintbush (*Prostanthera askania*)

The tranquillity mintbush has a restricted distribution, being found only in the Central Coast local government area (LGA). It is listed as endangered in New South Wales and is managed by a group as part of the site-managed stream of SoS.

Scope

Background: Due to being a site-managed species, trigger points were set for a population at a single site. The population at the site is declining overall, however, the decline is not uniform across the site. The species is subject to a range of threats including trampling, habitat degradation, and being shaded out due to altered fire regimes.

Interventions: Current interventions include weed control and management trials to introduce disturbance.

Monitoring: 20 m x 20 m plots across 6 subpopulations, some of which undergo management and some of which are controls. All subpopulations are monitored, and a range of data is collected, including total cover, condition and population demographics. Monitoring has occurred since 2017.

Long-term target: Not yet determined.

Annual target: Not yet determined.

Population outcome: On track (inferred).

Monitoring metrics

Metric 1: Total foliage cover (in m^2) for the subpopulation

Metric 2: Total foliage cover (in m^2) for the entire site

Specific considerations

A primary consideration for this population is the relative lack of monitoring data. Only 3 years of monitoring data is available, with the survey at the beginning of this time representing the baseline condition for the population, resulting in several uncertainties associated with this species. The lack of long-term monitoring data creates uncertainty about whether this small population has always been small, or whether it is a remnant of a once larger population. Genetic work has not been conducted for the population, so there is uncertainty around the genetic diversity. The species has a patchy distribution, and it is difficult to count the number of individuals in each patch, as it grows in dense thickets and can propagate vegetatively when branches take root and they remain in contact with the soil. There is also a lack of data on seedbank longevity, as well as lack of knowledge on critical processes such as the reliance on disturbance. Further, decline is not uniform across the site, with decline in some plots being offset by increases in other plots, giving a false representation that the condition of the site is largely stable, or only slightly decreasing.

The uncertainty around the prior size of the population and genetic diversity, coupled with the non-uniform decline and difficulties counting individuals, meant that the management group were concerned that setting triggers solely for the entire site could mask local loss of genetic diversity.

The group incorporated these considerations into the trigger points in the following ways:

1. The difficulty counting individuals was incorporated by setting trigger points for total foliage cover.
   a. This enables changes in the condition of the population to be measured, without requiring precise estimates of the number of individuals.
2. The concern for the non-uniform decline was incorporated through the addition of the subpopulation metric.
   a. The group worked through setting triggers and interventions for one subpopulation, but in practice this would require triggers for each of the 6 subpopulations.
   b. The relevant information is already collected at each subpopulation, so once triggers were set, this did not require additional resources, only a commitment to checking whether the triggers have been breached.
   c. Setting triggers for each subpopulation, as well as the entire site, helps the group to closely monitor the condition of each population, ensuring local diversity won't be lost.
   d. It also provides information at 2 spatial scales. If a decline is observed in only one subpopulation, this suggests a localised habitat issue. However, if the decline is observed across the entire site, this suggests a larger scale issue, such as poor environmental conditions.
3. Because of the uncertainty around the historic size of the population and the genetic diversity, the group used a precautionary approach to setting triggers and interventions.
   a. Trigger points were set when there was still a relatively high proportion of the baseline population remaining.
   b. The initial trigger points included investigative interventions to determine the cause of the decline.
   c. Establishing what's causing the decline while there is still a high proportion of the population remaining provides time to prepare and implement interventions to prevent further decline.

Example trigger points

Metric 1

Figure 9 provides an example of how triggers were set for Metric 1 – total foliage cover (in m^2) for the subpopulation.

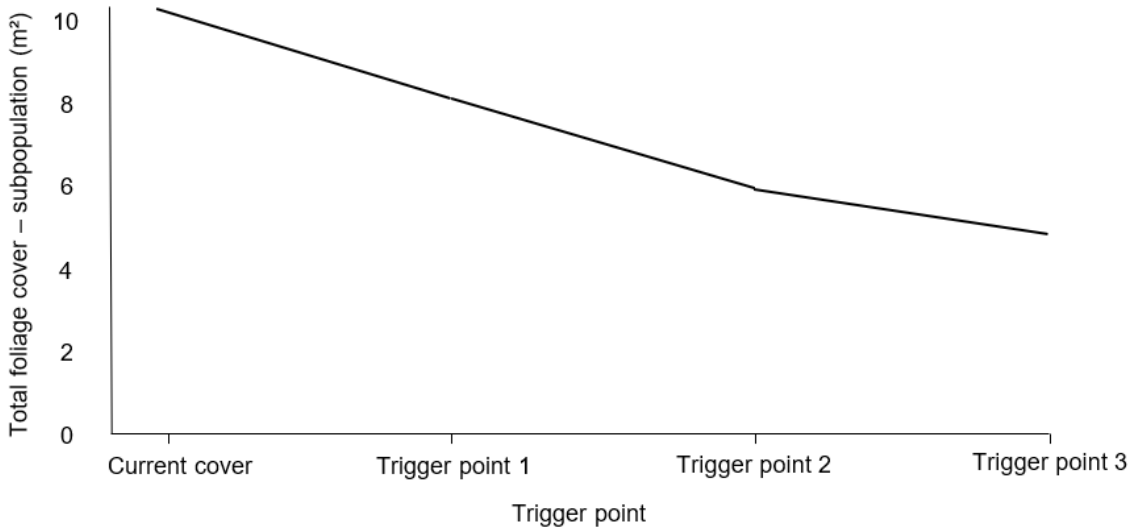

Figure 9 An example of how triggers were set for Metric 1 for the tranquillity mintbush

Metric 2

Figure 10 provides an example of how triggers were set for Metric 2 – total foliage cover (in m^2) for the entire site. Triggers set for this metric are more precautionary than that for Metric 1.

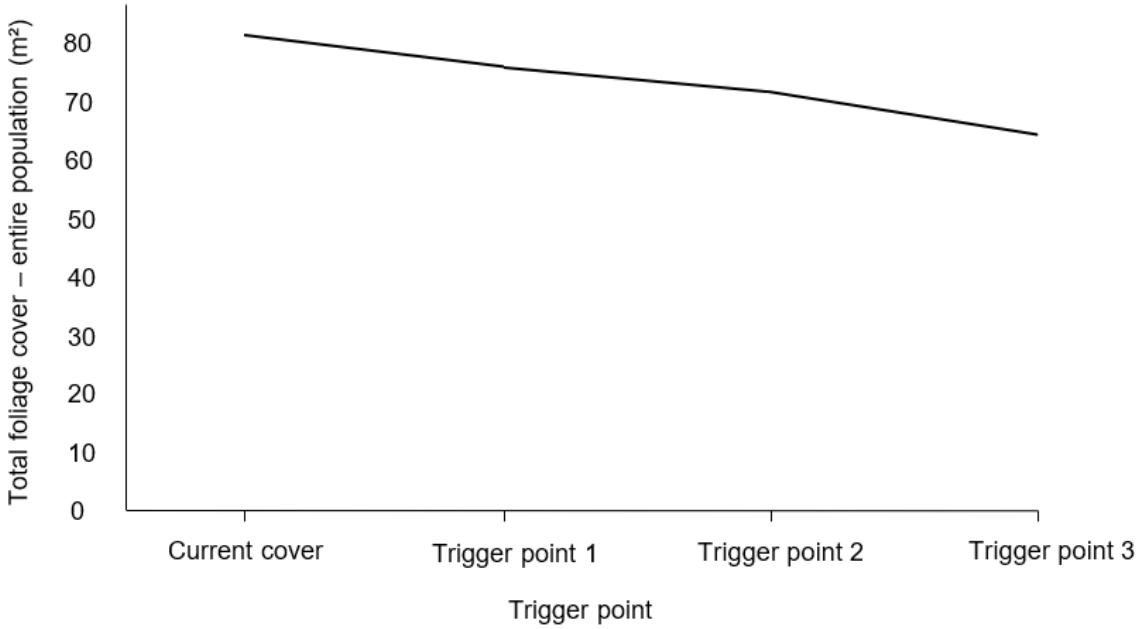

Figure 10 An example of how triggers were set for Metric 2 for the tranquillity mintbush

Further information

After initial trigger points had been set, the group decided the total cover metric wouldn't work in isolation, and that there would also have to be a metric such as number of individuals or density, or demographics such as number of seedlings compared with number of plants senescing. Further work for the species would include setting triggers for an additional metric at site and subpopulation level.

The group also wanted to set triggers for vegetation cover, such as canopy or mid-story cover. This would provide an indication of the impending threat of plants being shaded out before there is any substantial impact to the plants. However, there is no established relationship between the level of shading and the impact to the plants because there can be sufficient light available for *P. askania* despite having a dense tree canopy layer. It is a nuanced relationship that is affected by factors such as the aspect of the slope the population is on, rainfall, soil seedbank and degree of light penetrating the ground. Further research would therefore be required to establish this before triggers can be set.

2. Mainland ground parrot (*Pezoporus wallicus wallicus*)

The eastern subspecies of the mainland ground parrot is found across the south-east coast of Australia from Western Victoria up to Southern Queensland. It is listed as vulnerable in New South Wales and is managed by a group as part of the site-managed stream of the SoS project.

Scope

Background: Due to being a site-managed species, trigger points were set for a population at a single site. The population at the site was healthy and listed as 'on track' before the bushfires of summer 2019–20. This is supported by a relatively lengthy dataset that has been collected annually for 15 years. The group therefore had some idea of what the expected abundance and occupancy would be when the site is in good condition. However, the population was severely impacted by the fires, dropping to below 10% of the pre-fire abundance, and 25% of pre-fire occupancy. Additionally, the monitoring data does not include any previous recovery from large fires at the site, which was unburnt for almost 40 years, and so the anticipated recovery time frame was uncertain.

Interventions: Due to being in a wilderness area, no direct management interventions currently occur for the population.

Monitoring: Conducted once a year for 15 years, and involves dusk call listening surveys at standard points.

Long-term target: The population continues to increase to carrying capacity (to be determined).

Annual target: The abundance of eastern ground parrots at all 4 monitoring sites is the same or higher than the average density recorded at each site since 2004.

Population outcome: On track (pre-bush fire).

Monitoring metrics

Because of the severity of the impact of the fires, triggers were set for anticipated recovery, rather than for decline. This required predicting what the recovery time frame would look like. For example, by Year 5 post-fire, what % of abundance and occupancy do you expect to have returned to the site? Trigger points represent when the actual recovery deviates significantly from the predicted recovery. Trigger points for both metrics therefore also required a time frame.

Metric 1: Population abundance (individuals / 10 ha as a % of baseline data). This metric was measured against the average value of baseline data spanning 15 years. Because the metric is for post-fire recovery, 100% of the baseline value indicates a return to the pre-fire condition.

Metric 2: Occupancy (number of units occupied out of a total number that were occupied pre-fire). Again, 100% of the baseline value indicates a return to the pre-fire condition.

Specific considerations

The species is relatively mobile, and the numbers fluctuate annually. There may therefore be uncertainty about the expected size of the population in any given year, even before the fire. This variation in turn makes it difficult to define the condition to return the population to – should the group aim for the lower or upper limit of variation? Monitoring is also infrequent, occurring only once a year for 1 or 2 nights, and so only a snapshot of the condition of the

population is provided. Finally, because there has not previously been any monitoring of a post-fire recovery for this population, the expected rate of recovery was unclear. Uncertainty is therefore high for this species.

The group incorporated these considerations into trigger points using several approaches:

1. To deal with the issue of the fluctuating population, the group used an average of the available dataset to define the condition they aimed to return the species to.
    a. They decided to use an average of the entire dataset, rather than the most recent snapshot (e.g. the most recent 3 to 5 years).
    b. This is because the environmental conditions have varied substantially during that time, and as a result so has the population size.
    c. They therefore felt that using a longer term average would account for this climate-driven variability.
2. To account for the infrequent monitoring, the group decided to include the occupancy metric alongside abundance.
    a. Abundance is likely to fluctuate more, and will be influenced by the conditions on the night of monitoring, as well as variations between observers.
    b. Including the occupancy metric provides a more coarse, easy-to-measure reflection of the population condition.
    c. This complements the more nuanced abundance metric, as each provides information about a different component of recovery.
    d. Although ideally monitoring would be more frequent or more robust, this isn't feasible due to resource constraints, and so using 2 metrics helps to more accurately track the condition of the population.
3. To deal with uncertainty around the expected rate of recovery, the group used 2 approaches. The first was to set triggers that increased incrementally each year.
    a. Having incremental triggers helps them to closely monitor the population as it recovers.
    b. They will be prepared to implement lower cost interventions, such as habitat management, if the population doesn't show initial signs of recovery in the first couple of years.
    c. Incremental triggers then provide time to prepare for more intensive interventions, such as population supplementation, if the habitat management is unsuccessful.
    d. This creates the opportunity to save resources as well as protecting the population, as lower cost interventions are implemented first.
    e. If the population is naturally recovering, even at a relatively slow pace, none of the triggers will be breached.
4. The second approach to deal with uncertainty around the expected rate of post-fire recovery was incorporated into the interventions.
    a. The interventions included reviewing monitoring data for post-fire recovery at other SoS sites with comparable habitat and fire history.
    b. If the rate of recovery is slower than that of other sites, this provides an indication that further intervention is required.
    c. If the population surpasses the trigger by the specified year, then there is no requirement to compare recovery with other sites.

Example trigger points

Metric 1

Figure 11 provides an example of how trigger points were set for Metric 1 – population abundance. Incremental triggers (trigger points 1a–d) ensure recovery continues towards pre-fire abundance at the anticipated rate. If recovery stagnates (trigger points 2 and 3), increasingly intensive interventions are implemented to attempt to return abundance to the pre-fire level.

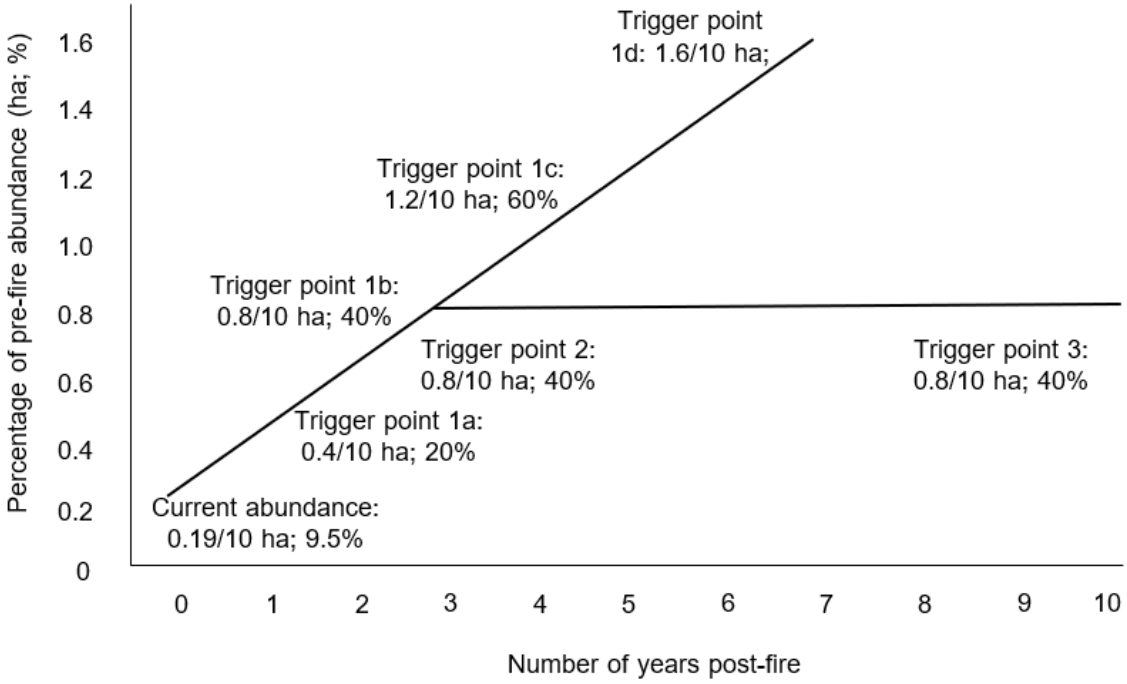

Figure 11 An example of how trigger points were set for Metric 1 for the ground parrot

Metric 2

Figure 12 provides an example of how trigger points were set for Metric 2 – occupancy. Again, incremental triggers (trigger points 1a+b) ensure progress at the anticipated rate, and additional triggers (trigger points 2 and 3) initiate increasingly intensive interventions. Note the estimated timescale for recovery is faster for this metric.

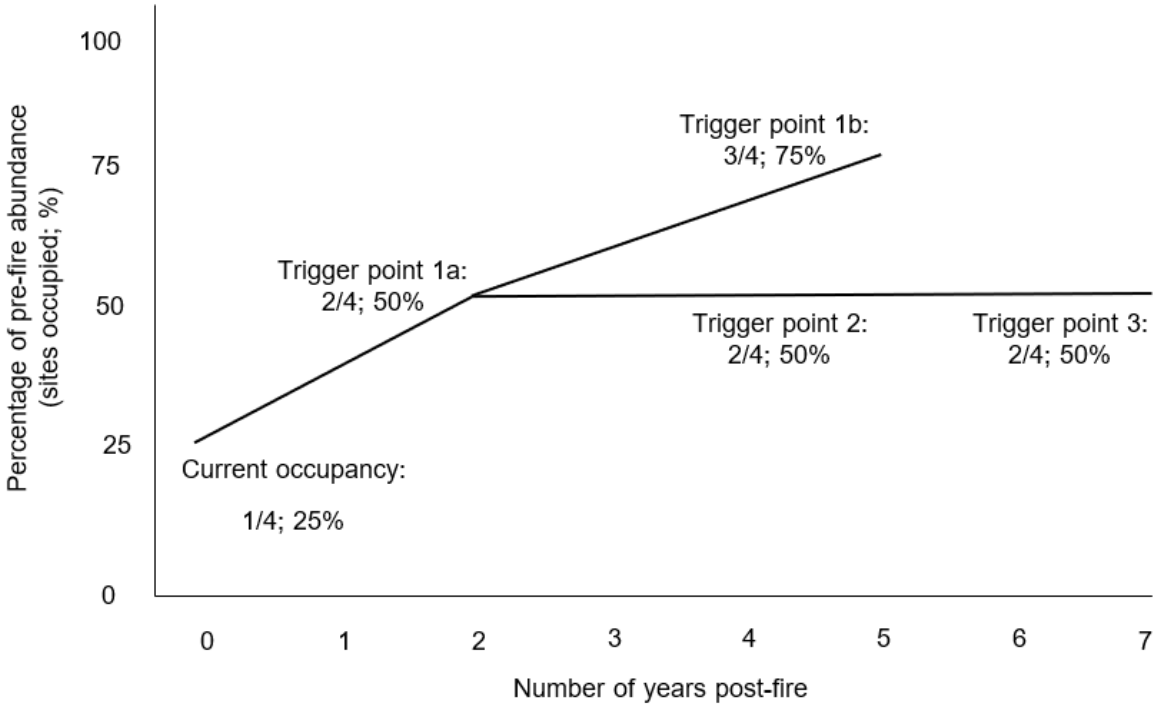

Figure 12 An example of how trigger points were set for Metric 2 for the ground parrot

Further information

Subsequent monitoring revealed that the ground parrot population has since rebounded to pre-fire numbers very quickly. However, the year since the fire has been characterised by significant rainfall due to being a La Niña year. The group agreed that the precautionary approach to setting incremental trigger points remains relevant, as there is no guarantee that future fires will be followed up with such favourable environmental conditions. The trigger points for post-fire recovery at the site would therefore not be changed.

Appendix A: Tables for defining the scope of management

First, provide background information on the species – the name, trajectory and management site (Table 7). Next, note down what you know about the species habitat requirements, threats and interventions. This helps identify which parts of the system you can influence, to inform the interventions taken if a trigger point is crossed. Conceptual models, such as influence diagrams (DPIE 2020) can be used to help define the scope.

Table 7 Define the scope of management: background information

Define the scope			
Target species			
Scientific name			
Target species trajectory	Increasing	Decreasing	Stable
Management site			
Long-term target			
Habitat requirements			
Threats			
Interventions			

Next, use Table 8 to note down all of the data available from the monitoring program. Start with the metrics used to monitor the target species (e.g. abundance, occupancy), then move on to any additional indicators (e.g. threats, habitat condition). Include details for all elements monitored. You can use this information to select which metrics and indicators you will set trigger points for.

Table 8 Identifying the monitoring metrics and indicators

Monitoring program	
Metric 1	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:
Metric 2	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:
Metric 3	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:
Additional indicator 1	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:
Additional indicator 2	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:
Additional indicator 3	
Metric name:	Number of years of data:
Frequency of data collection:	Most recent result of monitoring:

Appendix B: Approach to developing these guidelines

These guidelines were developed over a series of workshops with SoS project coordinators, site managers and external species experts.

This guidance is based on the output of several workshops run with SoS project coordinators from 2020–21. Before the workshops, a structured elicitation approach (McBride et al. 2012) was developed to set triggers for threatened species management (Table 9).

Table 9 Elicitation approach to set triggers for threatened species management

Step	Description
1	**First group workshop** • Explain process – e.g. background and purpose of decision triggers • Select monitoring metrics • Select management sites
2	**Round 1 independent questionnaire** • Define desirable and undesirable condition of monitoring metric • Set trigger points and interventions using chosen monitoring metric – provide rationale
3	**Second group workshop** • Discuss the monitoring metric – was it appropriate? Why, or why not? • Discuss trigger points and interventions set in questionnaires – e.g. major discrepancies, rationales
4	**Round 2 independent questionnaire** Opportunity to update desirable and undesirable condition of metric, trigger points and interventions – provide a rationale as to why the values were updated

We worked through the process shown above with small groups of SoS project coordinators and external experts, documenting their insights and concerns at each step throughout the process. In doing so, we drew on their practical insights to develop guidance for setting trigger points as part of a threatened species MER framework.

Appendix C: Including condition dependencies in trigger points

Sometimes it can be useful to include condition dependencies in the trigger points set for a target species. This relates the condition of the target species to other covariates, helping to interpret changes in the condition of the species. The inclusion of condition dependencies makes trigger points more accommodating of variation that cannot necessarily be mitigated by management, and can provide an indication of the likely cause of decline. Condition dependencies may therefore influence whether or not a trigger point is breached, and which (if any) interventions are implemented. It is important to have an established, quantifiable relationship between the target species and the covariate to include it as a condition dependency in the trigger or response. Wherever possible, the condition dependency should be quantitatively defined. Condition dependencies may relate to:

- environmental variables
- target species' life cycle
- populations of the same species at nearby sites
- populations of similar species at the same site.

Environmental variables

If the species condition is closely related to environmental conditions, such as rainfall, then the trigger or response may include a condition dependency that relates to those conditions. For example:

- If the target species is sensitive to drought, and the population has declined during a dry period, this likely indicates that lack of rainfall is driving the decline.
- In this case, the response may simply be to wait and check that the species recovers after a period of rainfall, accounting for any lag periods between favourable climatic conditions and a detectable response in the species condition.
    - The trigger point is not breached, no intervention is implemented.
- Alternatively, if the species is particularly threatened, mitigation measures may be implemented (if they are available).
    - For example, providing supplementary watering to a threatened plant during periods of drought.

Species lifecycle

For some species that go through boom–bust life cycles, fluctuations down to low numbers may be a natural part of the life cycle that is not concerning, so the trigger or response may include a condition dependency that accommodates this. For example:

- The population of the target species declines to below the trigger point after a 'boom' event, and this is a normal part of the life cycle.
    - The trigger point is not breached, no intervention is implemented.
- The population does not recover above the trigger point after a recruitment event, or after the usual temporal interval.
    - This indicates there is an issue with the species or habitat condition.
    - The trigger point is breached, and intervention is implemented.

Other metrics could also be monitored to support confidence in the condition of boom–bust species. For example:

- Trigger points are set for metrics relating to reproductive output during ‘boom’ events.
  - This provides an indication of the ability of the population to replenish again in the future.
  - If reproductive output is below the trigger point during a ‘boom’ event, additional action may be required, even if the population size has rebounded as expected.

Populations of the same species at nearby sites or populations of other species at the same site

Changes in populations of the same species at nearby sites, or populations of other species at the same site, may also influence decisions about if and how to act.

If populations of the same species at nearby sites are also declining, **or** if populations of other species are declining at the same site:

- This may indicate that larger scale issues, such as poor environmental conditions, are driving decline.
  - The trigger point may not be breached.
  - More wide-ranging actions may be implemented.

If the decline is restricted to the target species at one localised site:

- This may indicate a site-specific issue is driving the decline.
  - Targeted interventions should be implemented.

This is different to setting separate trigger points for other indicators, and can be implemented in the following ways:

- Changes in the condition of the covariate can be built into the trigger point for the target species.
  - The trigger point remains the same, but the response may differ.
- Assessing the condition of the covariate may be included as part of the intervention.

Table 10 demonstrates how condition dependencies can be built into trigger points. This builds a degree of flexibility into the trigger, as it acknowledges that the population is likely to fluctuate/decline when environmental conditions are poor, but this is not necessarily of concern. Note, however, that the condition dependency is only built into the first 2 trigger points, so if the third trigger point is breached, a management response is initiated regardless of the rainfall.

Table 10 An example of how to incorporate condition dependencies into trigger points

Trigger point number	Value used as trigger point	Intervention assigned to trigger point
1	800 individuals AND > 50 mm rain in previous 3 months	Habitat management
2	700 individuals AND > 50 mm rain in previous 3 months	Invasive species control
3	500 individuals	Population supplementation

Table 11 demonstrates how condition dependencies can be reflected in the intervention initiated if a trigger point is breached.

Table 11 An example of how condition dependencies can be built into interventions

Starting from a current population size of 1,000 individuals:

Trigger point number	Value used as trigger point	Intervention assigned to trigger point
1	800 individuals	Check rainfall for previous 3 months. If < 50 mm, no action is taken. If > 50 mm, implement habitat management
2	700 individuals	Check rainfall for previous 3 months. If < 50 mm, no action is taken. If > 50 mm, implement invasive species control
3	500 individuals	Population supplementation

In these examples, rainfall can be swapped for other covariates as appropriate. Note, however, that the rainfall is defined quantitatively, and other covariates should also be defined quantitatively wherever possible.