Australian Government

Department of Climate Change, Energy, the Environment and Water

EŎologiŎal a oyitoNiyg SèsteY AustNalia óE a SAú deŎisioY suppoNt guidayŎe YateNial

a oyitoNiyg, EØaluatioY, wepoNtiyg ayd IYpNoØeYeyt SeŎtioY

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Cataloguing data

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Acknowledgements

The authors thank EMSA Protocol Advisory Group members for their input.

Acknowledgement of Country

Our department recognises the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge Aboriginal and Torres Strait Islander Peoples as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, and present.

Cover

Clockwise from top left:
Narrow-leaved Mallee revegetation Kangaroo Island SA, Kangaroo Island Landscape Board
Eucalyptus oleosa woodland monitoring WA, Helen Langley
Creamy candles Mt Taylor Nature Reserve ACT, Sandra Walpole
Tiverton Springs monitoring Queensland, Sam Nicol
South East Forest National Park monitoring NSW, TERN
Plant collecting Steve Irwin Wildlife Reserve Cape York Queensland, TERN
Ecological field monitoring data entry using an app, TERN
Scientist using data collection app for monitoring, TERN

Contents

Figures

Summary

This document includes descriptions of a range of Ecological Monitoring System Australia (EMSA) guidance material, which has been prepared to assist with selection of EMSA modules in future Natural Heritage Trust projects. Please contact the MERI team (LTMP@dcceew.gov.au) if you require any further information.

See the module documents on the TERN website for more in-depth information on each module.

The recommended minimum paper size for printing the infographics is A3.

EMSA module groups and descriptions

- The EMSA module groups and descriptions infographic provides a high-level summary of all EMSA modules.
- This page categorises the 24 EMSA modules into 7 groups and provides a short description for each module. It also identifies which modules have standard and enhanced protocol options. The modules are listed in alphabetical order within each group.

EMSA modules linked to plot

- The EMSA modules linked to plot infographic shows which modules require prior completion of the Plot selection and layout module and which do not.
- This page categorises the 24 EMSA modules into 3 groups. The orange tiles are modules that are linked to a plot, i.e., the Plot selection and layout module. The green tiles are modules with one or more protocols that rely on completion of the Plot selection and layout module (other protocols in these modules can be completed without a linked plot). The blue tiles are modules which can be completed without a linked plot.

EMSA module links and dependencies

- Refer to the EMSA module links and dependencies infographics for mind-maps showing links between EMSA modules.
- These pages contain mind-maps of each module in alphabetical order, showing links between modules. Refer to the key included on each page for descriptions of the tile and arrow types.

MERIT project service type and associated EMSA modules

- See the MERIT Project service type and associated EMSA modules infographic to see the suggested EMSA modules for each MERIT project service.
- This page includes each of the 32 project services in MERIT with a list of associated EMSA modules under each project service. Refer to the key for a description of the tile types used.

Orange-footed bandicoot case study: MERIT project services and EMSA module selection

- See the Orange-footed bandicoot case study: MERIT project service and EMSA module selection guide for an example of how a (fictitious) MERI plan can inform MERIT project service and EMSA module selection. The project has Environment Outcome Logic 1: Species and Landscapes (Threatened Species).
- This infographic is based on a MERI plan for improving the population trajectory of the fictitious orange-footed bandicoot (from the MERI training course in Learnhub). The first page identifies the relevant MERIT project services and lists the EMSA modules associated with each project service. Refer to the key for a description of the tile types used. The second page includes the MERI plan summary and summarises the total number of MERIT project services and minimum number of recommended EMSA modules.

Purple-eared rock-wallaby case study: MERIT project services and EMSA module selection

- See the Purple-eared rock-wallaby case study: MERIT project services and EMSA module selection for an example of how a (fictitious) MERI plan can inform MERIT project service and EMSA module selection. The project has Environment Outcome Logic 1: Species and Landscapes (Threatened Species).
- This infographic is based on a MERI plan for re-introducing the fictitious Purple-eared rock-wallaby to its former range. It includes the MERI plan summary, identifies the relevant MERIT project services, lists EMSA modules associated with the project services, and summarises the total number of MERIT project services and minimum number of recommended EMSA modules. Refer to the key for a description of the tile types used.

Great Southern Australian Ramsar site case study: MERIT project services and EMSA module selection

- See the Great Southern Australian Ramsar site case study: MERIT project services and EMSA module selection for an example of how a (fictitious) MERI plan can inform MERIT project service and EMSA module selection. The project has Environment Outcome Logic 3: Ramsar Wetlands Protection.
- This infographic is based on a MERI plan for protecting and remediating the fictitious Great Southern Australian Ramsar site. The first page identifies the relevant MERIT project services and lists the EMSA modules associated with each project service. Refer to the key for a description of the tile types used. The second page includes the MERI plan summary and summarises the total number of MERIT project services and minimum number of recommended EMSA modules.

EMSA module description table

- Refer to this table (attached separately) for a detailed overview of all EMSA modules.
- This Excel spreadsheet includes the module name, a paragraph description of the module and data captured, presence of protocol levels (standard or enhanced), if the module is linked to the Plot selection and layout module, links to other EMSA modules, recommended number of personnel per protocol, and estimated time requirements for each protocol.

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EMSA module groups and descriptions

Group	Module name	Module description
Plot	Condition	Record biodiversity condition of the plot using a combination of point and plot-based methods.
	Photopoints	Use one of three protocols to create 360-degree panoramas from three points in the plot.
	Plot description	Record physical information about the plot such as landform, slope, aspect and disturbance (standard or enhanced protocol).
	Plot selection and layout	Complete a desktop assessment of the project area, then select plot locations and layout core monitoring plot (and optional fauna plot).
	Soils	Describe and characterise soils in the plot using up to 4 protocols (standard or enhanced protocol option for soil sub-pit and metagenomics protocol).
Vegetation	Basal area	Record basal area in plots where there is a dominant growth form of trees, shrubs and/or mallee greater than 2 m in height (standard or enhanced protocol option for diameter at breast height measure).
	Coarse woody debris	Record coarse woody debris length, diameter and decay class in the plot (standard or enhanced protocol).
	Cover	Record vegetation and substrate cover within the plot using the point-intercept method (standard or enhanced protocol).
	Floristics	Create a species list and collect vouchers of flora in the plot (standard or enhanced protocol).
	Plant tissue vouchering	Collection, drying and appropriate storage of representative plant tissue samples (standard or enhanced protocol).
	Recruitment	Record age class structure and survivorship of vegetation within the plot.
	Vegetation mapping	Classify vegetation across the project area using structural and floristic data at mapping points.
Post-fire monitoring	Fire severity	Record fire severity within the plot using the point-intercept method and by measuring maximum trunk char height.
Fauna surveys	Camera trapping	Deployment, re-equipping and retrieval of camera traps to monitor vertebrate fauna.
	Fauna aerial surveys	Count vertebrate fauna in a transect using manned aircraft.
	Fauna ground counts	Direct counts of fauna using transects or vantage point protocols.
	Herbivory and physical damage	Record herbivory and physical damage from vertebrate fauna using belt transect or active plot search protocols.
	Invertebrate fauna	Collect and identify terrestrial invertebrate fauna using 5 field sampling protocols and a post-field sample curation protocol.
	Sign-based fauna surveys	Record vertebrate fauna signs (e.g., tracks) using up to 5 protocols.
	Vertebrate fauna	Incorporates a range of survey techniques (trapping and non-trapping) to identify the diversity of the vertebrate fauna community (standard or enhanced protocol option for trapping survey set-up and closure protocol).
Opportunistic observations of flora or fauna	Opportune	Record opportune observations (e.g., sightings, calls, signs) of flora and fauna. Observations can be recorded at any location or stage of the project.
Targeted survey of species or ecological communities	Targeted surveys	Surveys of species or ecological communities that do not align with the standard requirements of other modules. Should be used in addition to other plot-based surveys.
Interventions	Interventions	Records intervention area, type and activities. Use in combination with other modules to assess ecological changes over time.
	Pest fauna control activities	Record vertebrate pest fauna removal activities such as shooting, baiting, trapping and mustering. Use in conjunction with *Interventions*.

Note: Patterned tiles indicate that standard or enhanced protocol levels are available in the module.

Modules with all protocols linked to a plot

- Plot selection and layout
- Basal area
- Coarse woody debris
- Condition
- Cover
- Fire severity
- Floristics
- Invertebrate fauna
- Photopoints
- Plant tissue vouchering
- Plot description
- Recruitment
- Soils
- Vertebrate fauna

Modules with at least one protocol linked to a plot*

- Camera trapping
- Herbivory and physical damage
- Sign-based fauna surveys

*Other protocols in these modules can be completed without a linked plot

Modules with protocols that do not require a linked plot

- Fauna aerial surveys
- Fauna ground counts
- Interventions
- Opportune
- Pest fauna control activities
- Targeted surveys
- Vegetation mapping

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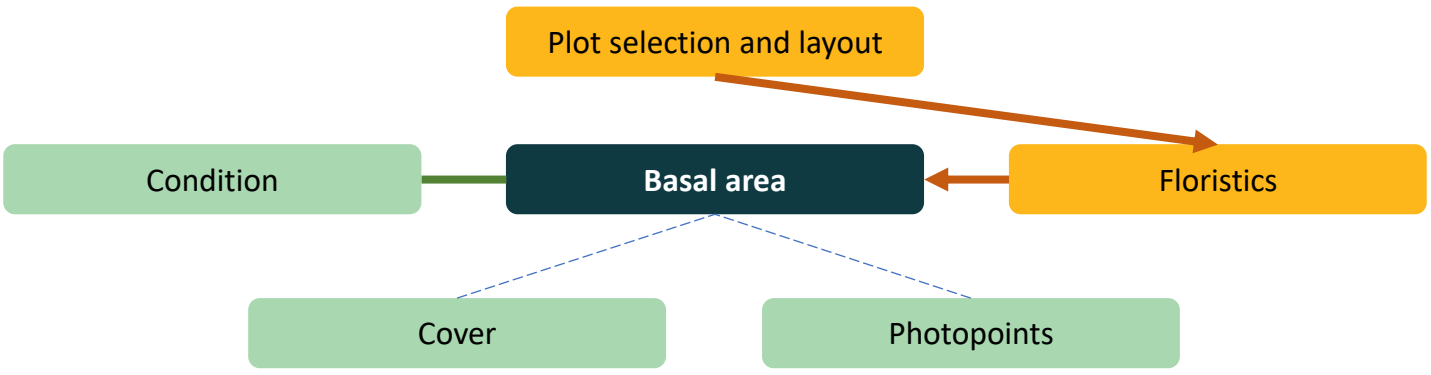
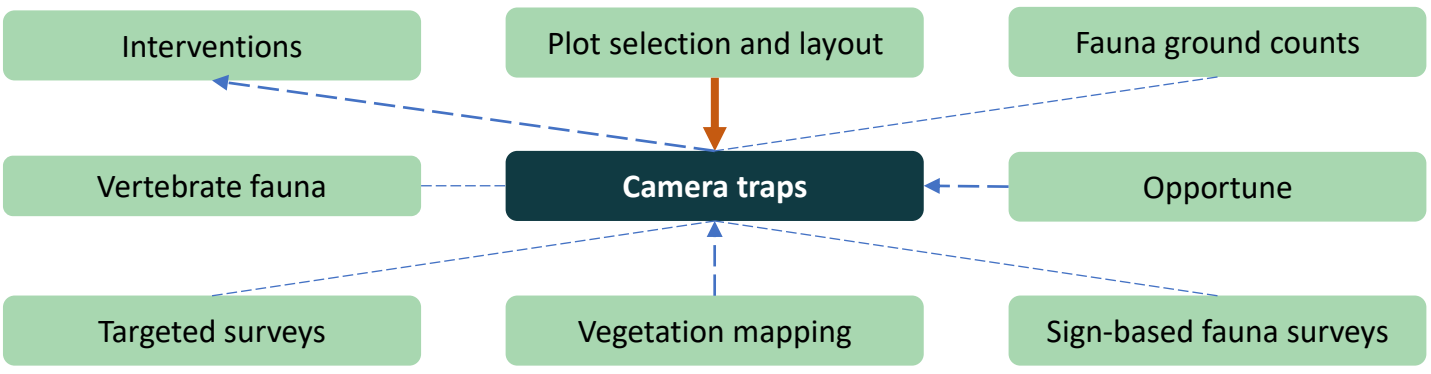
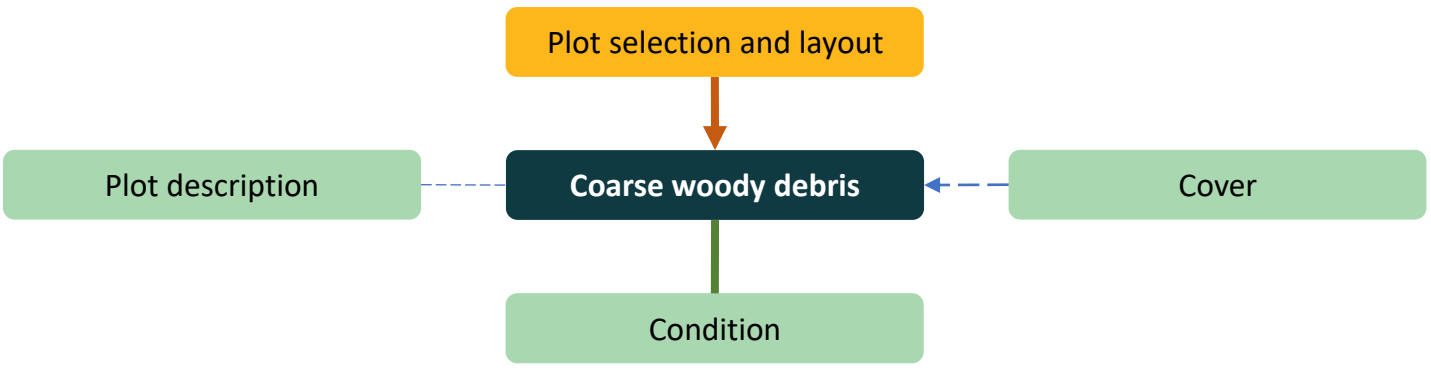
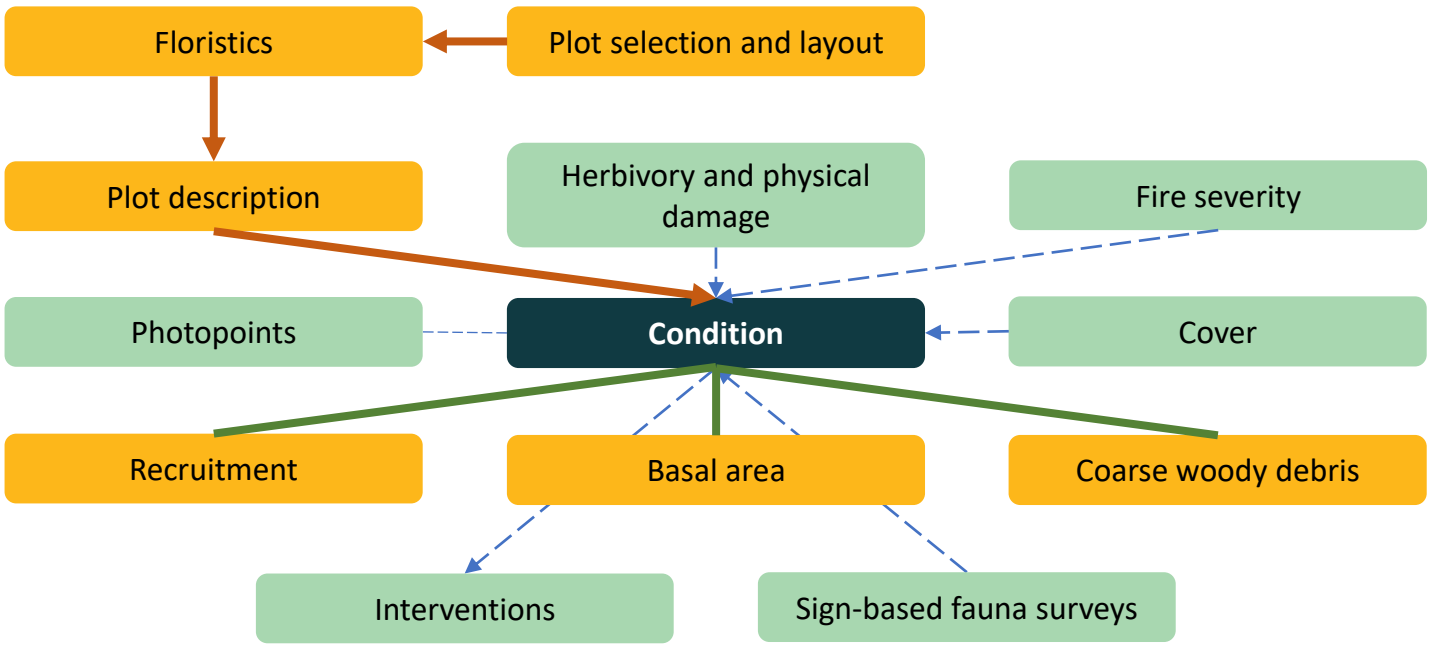
Module links and dependencies









Key:

- Yellow tiles: mandatory modules
- Light green tiles: optional modules
- Orange solid line with arrow: One module must be completed before the other
- Green solid line: Complete modules concurrently
- Blue dashed line: Modules are complementary, may be completed concurrently
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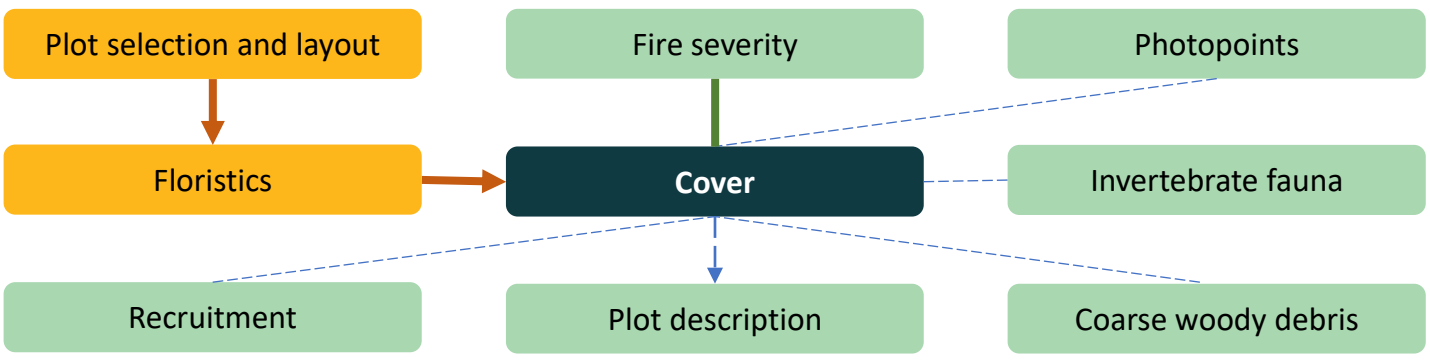

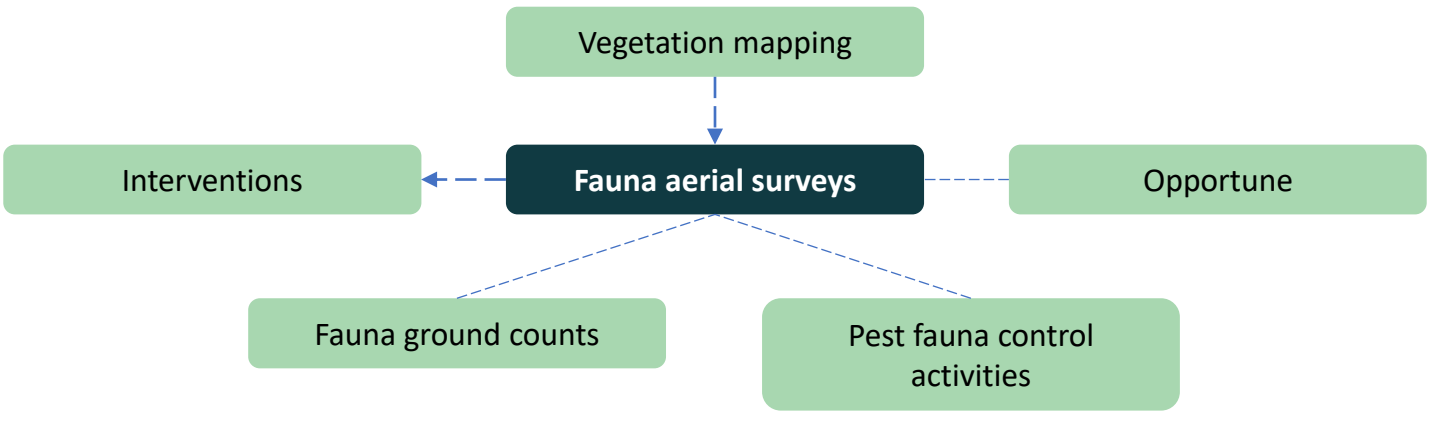

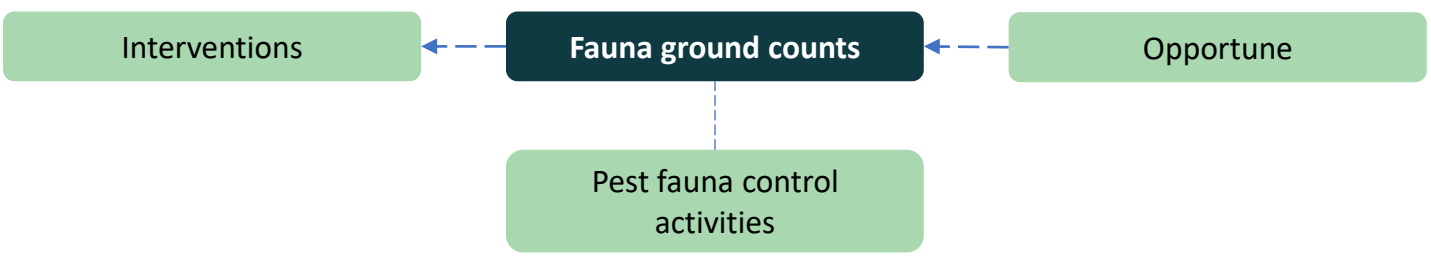

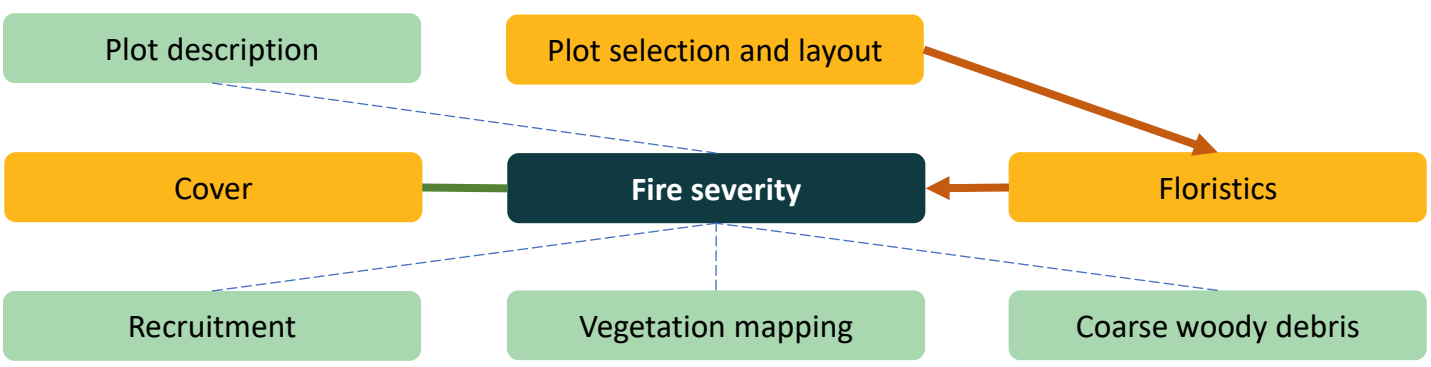

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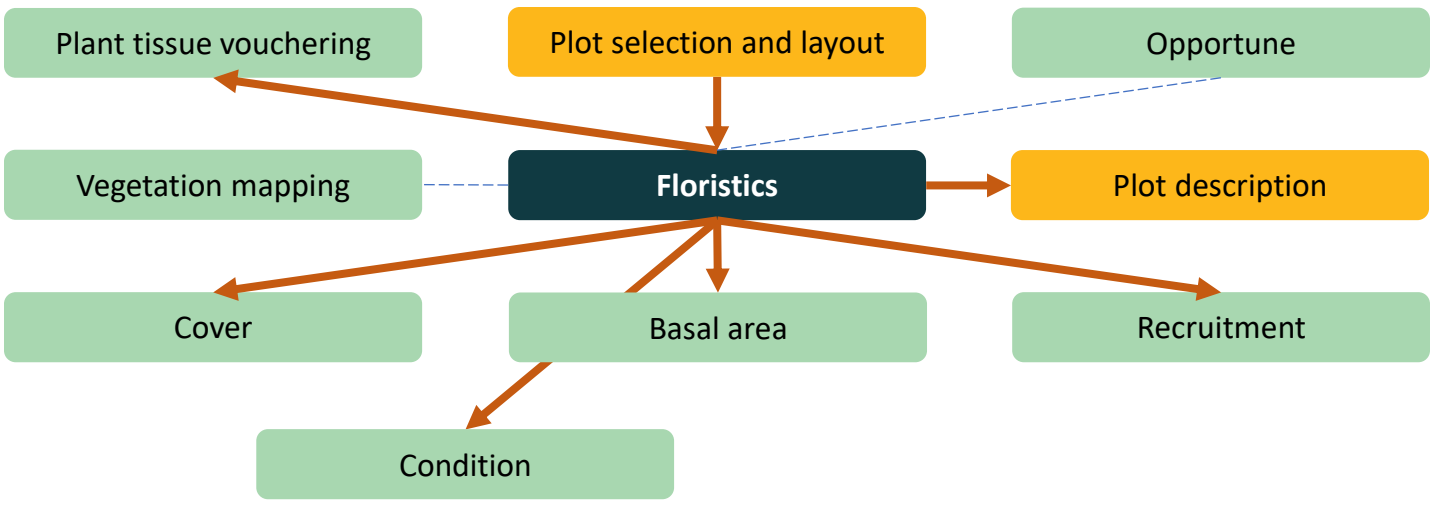

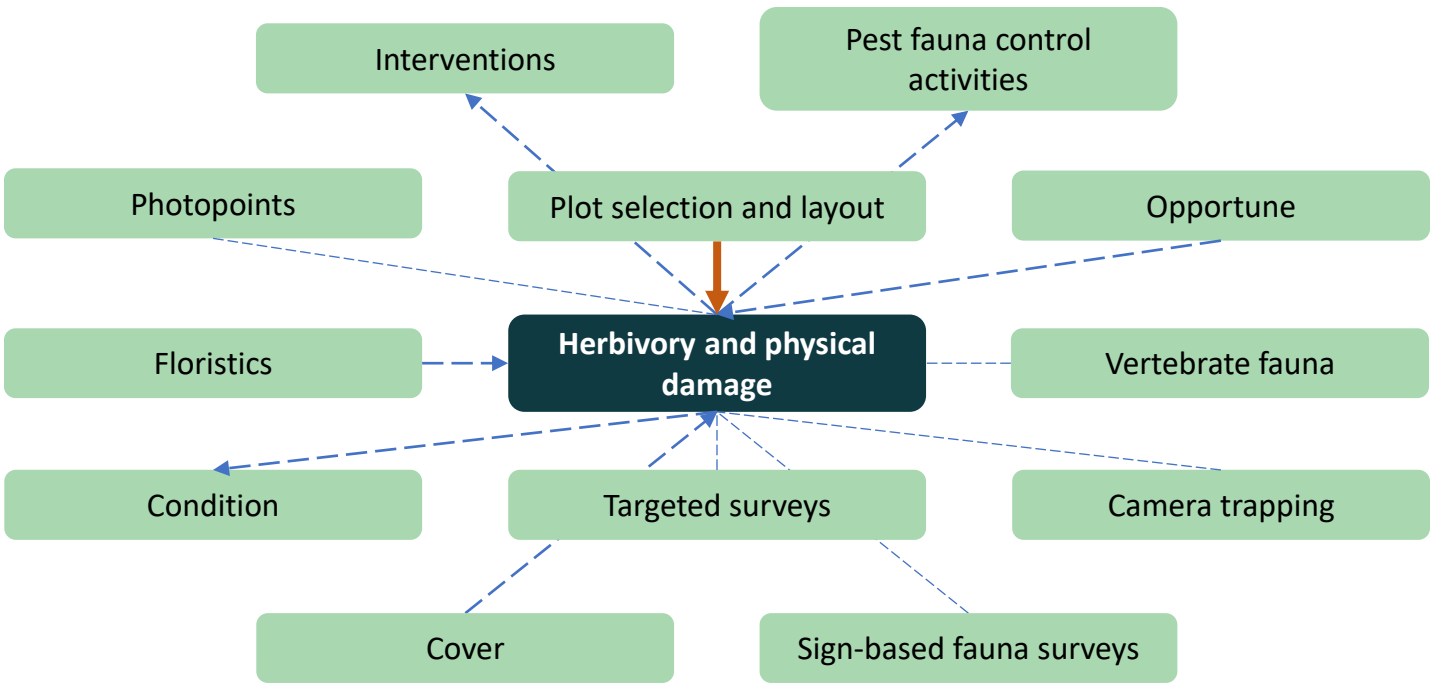

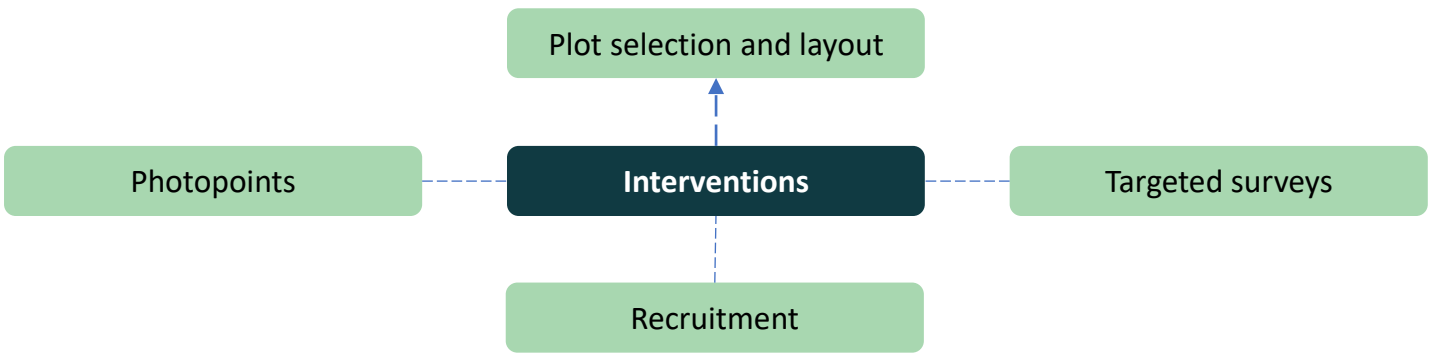

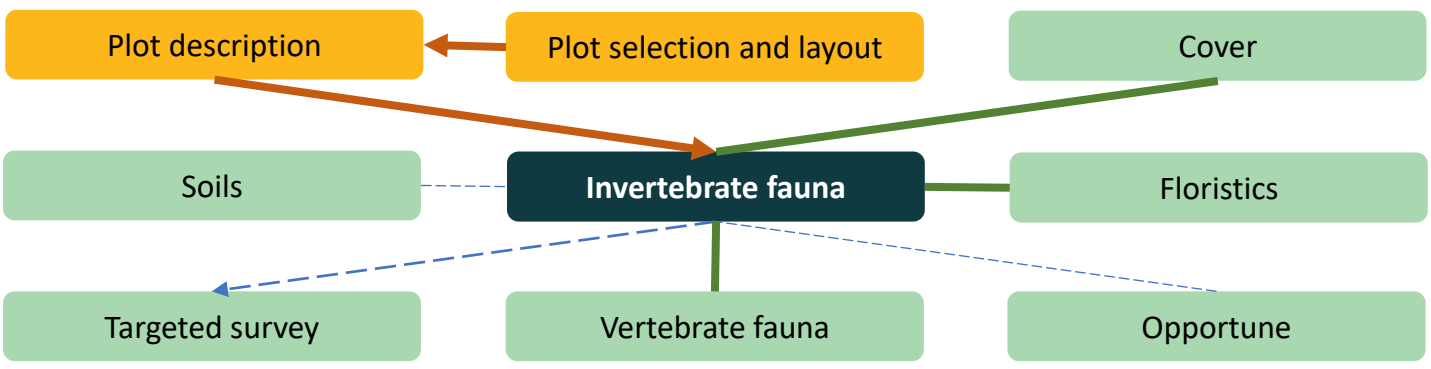

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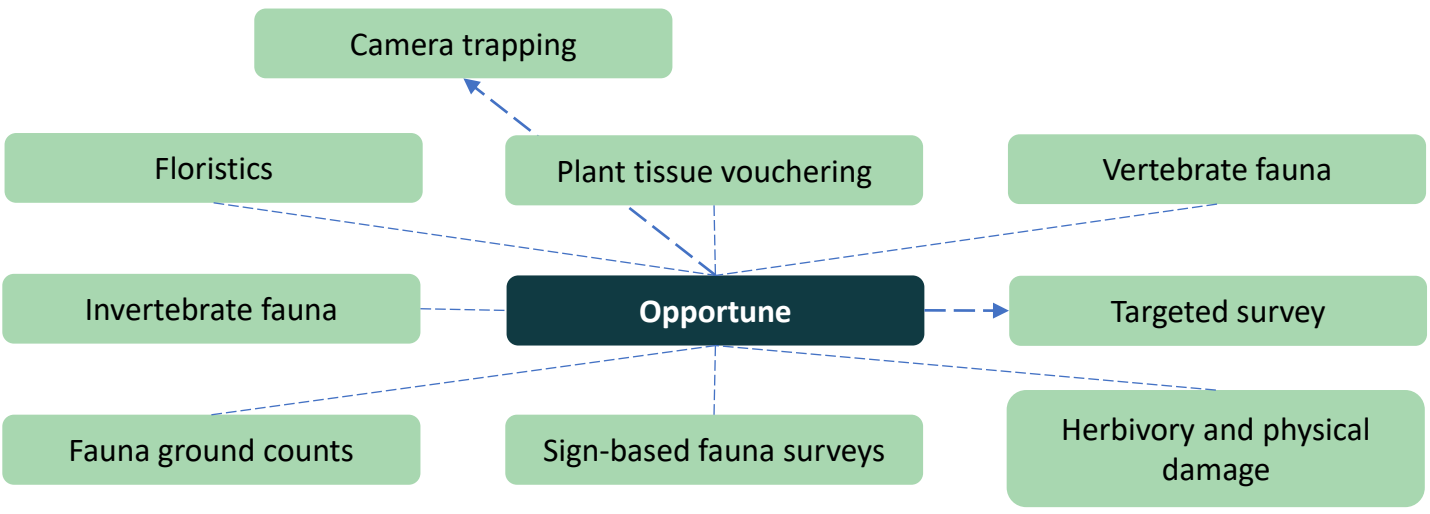

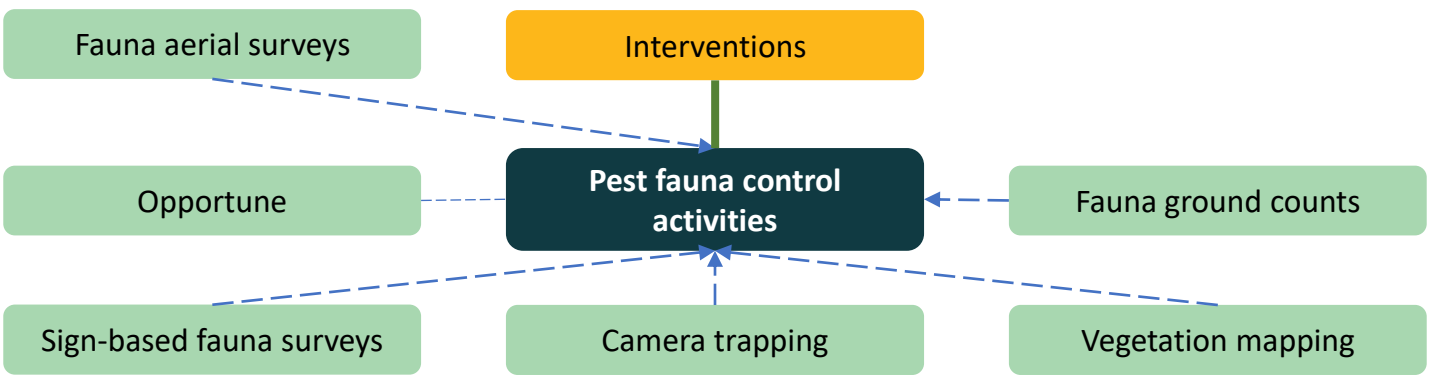

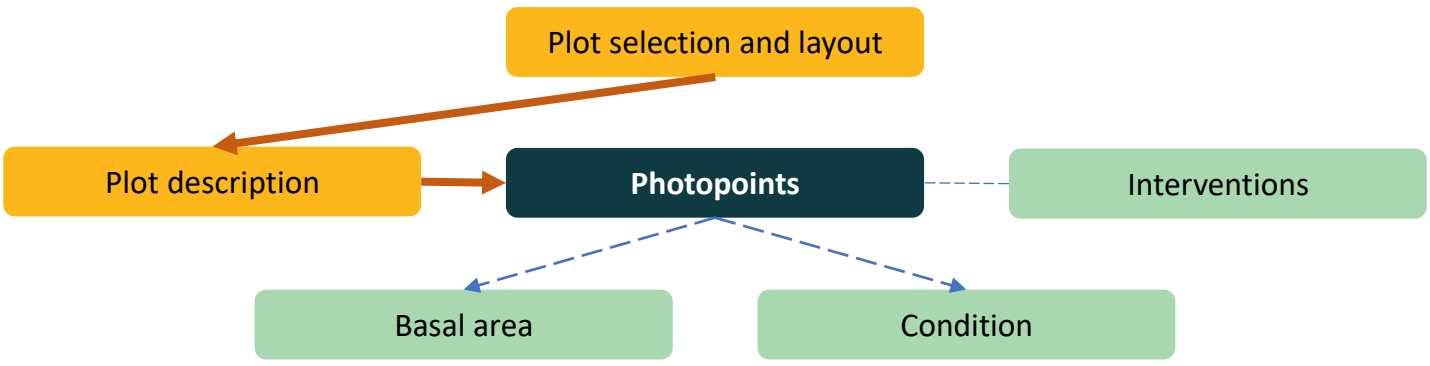

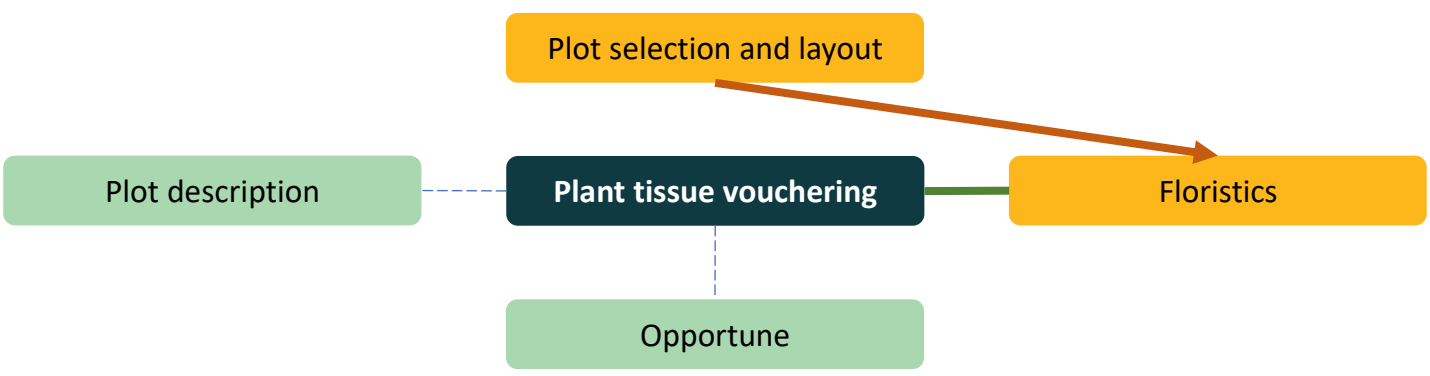

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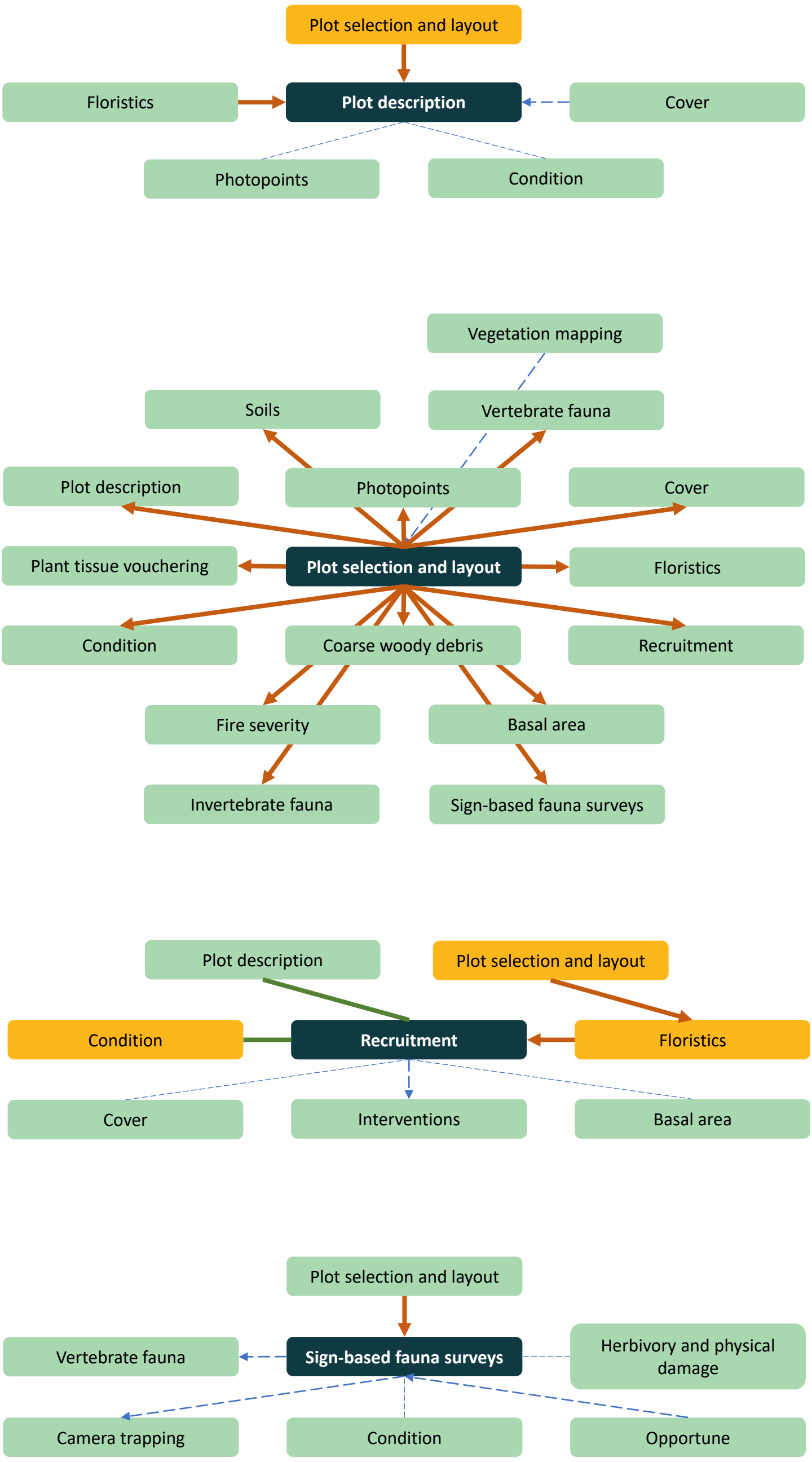

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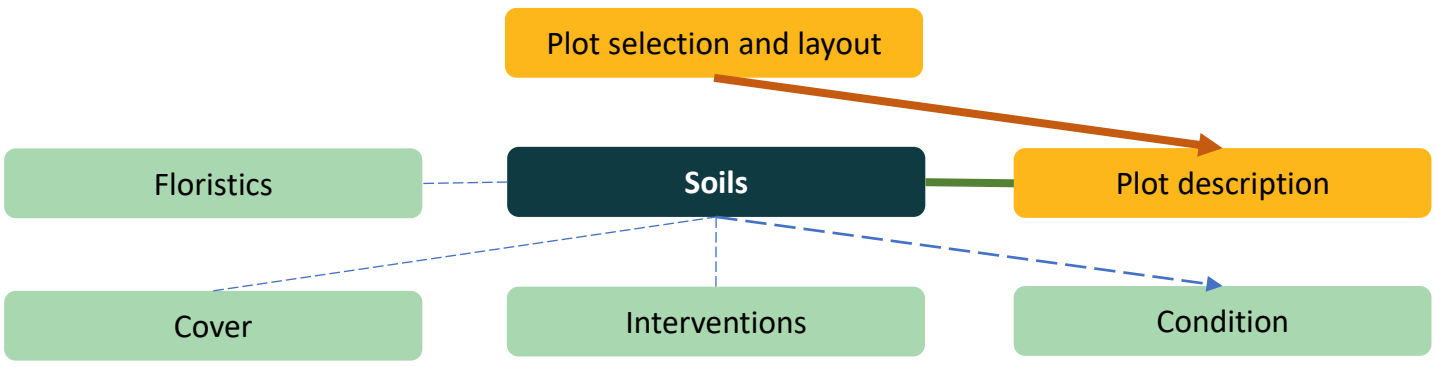
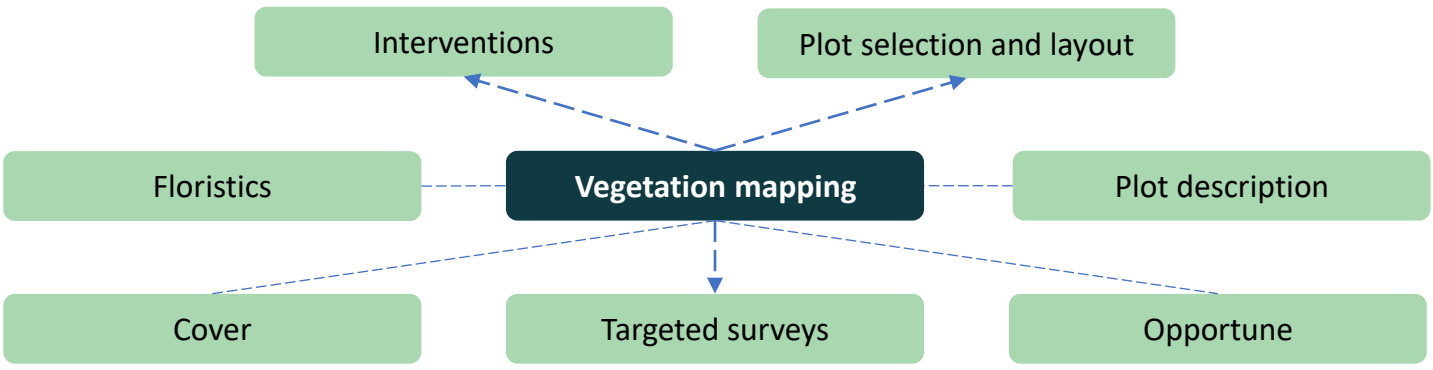
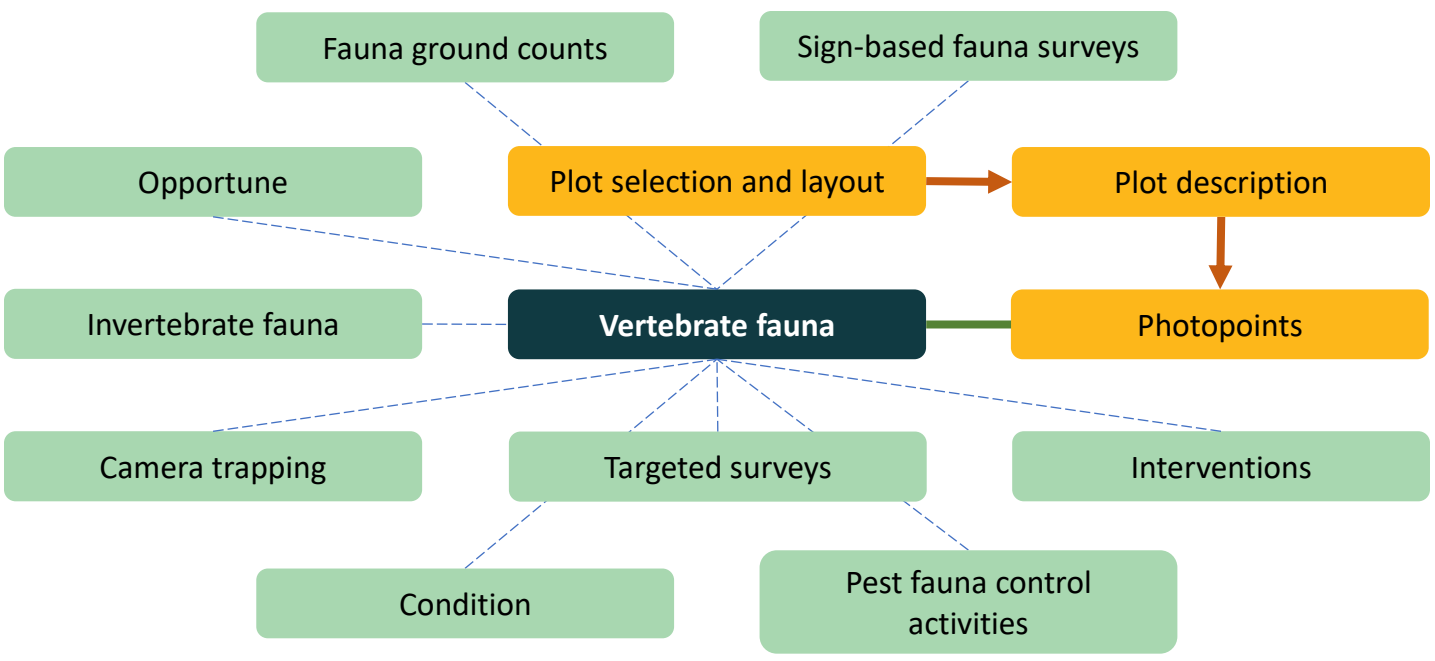


Targeted surveys (module coming soon)





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MERIT project services and associated EMSA modules

Service type: Planning

- Community/stakeholder engagement
  - Report directly into MERIT
- Identifying and prioritising the location of potential sites
  - Report directly into MERIT

Service type: Initiation

- Fauna survey
  - Camera trapping
  - Fauna aerial surveys
  - Fauna ground counts
  - Herbivory and physical damage
  - Invertebrate fauna
  - Plot selection and layout
  - Sign-based fauna surveys
  - Targeted surveys
  - Vertebrate fauna
- Flora survey
  - Plot selection and layout
  - Floristics
  - Basal area
  - Cover
  - Plant tissue vouchering
  - Plot description
  - Photopoints
  - Targeted surveys
  - Vegetation mapping
- Farm management survey
  - Report directly into MERIT
- Habitat condition assessment survey
  - Plot selection and layout
  - Floristics
  - Plot description
  - Condition
  - Basal area
  - Coarse woody debris
  - Recruitment
  - Photopoints
  - Cover
  - Fire severity
  - Herbivory and physical damage
  - Plant tissue vouchering
  - Soils
  - Vegetation mapping
- Pest animal survey
  - Camera trapping
  - Fauna aerial surveys
  - Fauna ground counts
  - Herbivory and physical damage
  - Plot selection and layout
  - Sign-based fauna surveys
  - Targeted surveys
- Seed germination/plant survival survey
  - Interventions
  - Cover
  - Floristics
  - Photopoints
  - Plot description
  - Plot selection and layout
  - Recruitment
  - Vegetation mapping
- Skills and knowledge survey
  - Report directly into MERIT
- Soil testing
  - Interventions
  - Plot selection and layout
  - Soils
- Synthesising and finalising baseline data
  - Report directly into MERIT
- Water quality survey
  - Interventions
- Weed distribution survey
  - Interventions
  - Cover
  - Floristics
  - Plot selection and layout
  - Targeted surveys
  - Vegetation mapping

Supplementary module

- Opportune

Key:
- Dark purple, dark green or red tile with white text: MERIT project service
- Green or pink tile with white text: recommended module
- Light green tiles with black text: select at least one module, depending on monitoring requirements and anticipated project outcomes
- Dotted tile: no EMSA module, report directly into MERIT
- White tile: optional module

Service type: Implementation

Project services that report directly into MERIT

- Communication materials
- Establishing and implementing conservation agreements

Project services with recommended Interventions module

- Remediating riparian and aquatic areas
- Improving hydrological regimes for site eco-hydrology
- Controlling access
- Captive breeding, translocation or re-introduction programs
- Debris removal
- Establishing and maintaining pest animal-free enclosures
- Erosion management
- Habitat augmentation
- Implementing Fire severity management actions
- Improving land management practices
- Managing disease
- Removing weeds
- Revegetating habitat
- Seed collection and propagation
- Site preparation
- Undertaking emergency interventions to prevent extinctions

Project service with 2 recommended modules

- Controlling pest animals
- Interventions
- Pest fauna control activities

Orange-footed bandicoot case study: MERIT project services and EMSA module selection

Outcome 1: Species and Landscapes. To mitigate new and established threats (such as feral pests and weeds) and restore habitat to support our domestic and international priorities

Long term outcomes
Threatened Species: The trajectory of species targeted under the Threatened Species Action Plan 2022-2032 and other EPBC Act listed species is improved

MERIT project services and associated EMSA modules

Service type: Planning

- Community/stakeholder engagement
- Identifying and prioritising the location of potential sites
- Report directly into MERIT
- Report directly into MERIT

Service type: Initiation

- Fauna survey
- Camera trapping
- Fauna aerial surveys
- Fauna ground counts
- Herbivory and physical damage
- Invertebrate fauna
- Plot selection and layout
- Sign-based fauna surveys
- Targeted surveys
- Vertebrate fauna
- Flora survey
- Plot selection and layout
- Floristics
- Basal area
- Cover
- Plant tissue vouchering
- Plot description
- Photopoints
- Targeted surveys
- Vegetation mapping
- Habitat condition assessment survey
- Plot selection and layout
- Floristics
- Plot description
- Condition
- Basal area
- Coarse woody debris
- Recruitment
- Photopoints
- Cover
- Fire severity
- Herbivory and physical damage
- Plant tissue vouchering
- Soils
- Vegetation mapping
- Seed germination/plant survival survey
- Interventions
- Cover
- Floristics
- Photopoints
- Plot description
- Plot selection and layout
- Recruitment
- Vegetation mapping
- Skills and knowledge survey
- Report directly into MERIT
- Synthesising and finalising baseline data
- Report directly into MERIT

Service type: Implementation

- Communication materials
- Report directly into MERIT
- Controlling access
- Interventions
- Habitat augmentation
- Interventions
- Improving land management practices
- Interventions
- Revegetating habitat
- Interventions

Supplementary module

- Opportune

Key:
- Dark purple, dark green or red tile with white text: MERIT project service
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- White tile: optional module

Orange-footed bandicoot case study: MERIT project services and EMSA module selection

MERI plan summary

Title: Better protection for the Orange-footed bandicoot (the complete MERI plan is available in the MERI training course in Learnhub).

Project background: The fictitious Orange-footed Bandicoot (*Perameles auranipes*; OFB) is a small nocturnal mammal which was once found across 70 percent of Australia. However, post-European settlement, the OFB has undergone significant decline due to threats such as predation by cats and foxes, and loss of habitat due to agricultural clearing. The now vulnerable OFB is presumed extinct in all states and territories, with the exception of South Australia and Queensland where the last remaining populations in the wild are known to exist at five locations.

The Better protection of the OFB project (the project) is focused on improving the trajectory of the bandicoot population at Newark Range, South Australia. The project will implement activities delivering social and physical change to benefit the bandicoots. Its activities will be aimed at directly enhancing the remaining habitat for OFB, including running a behaviour change campaign to influence local communities to reduce activities known to negatively impact bandicoots. It is anticipated that habitat enhancement through the project will also benefit other native fauna in the same locations. The project has secured funding under the Australian Government's Caring for Nature program and will run for five years from 2023 to 2028.

Monitoring and interventions:
- Identify key sites for revegetation
- Vegetation surveys and habitat assessments.
- Camera traps to detect presence and estimate abundance of both the OFB and predators such as domestic and feral cats.
- Targeted surveys and opportunistic sightings of the OFB.
- Surveys of social perceptions and reported behaviours.
- Direct inquiries with project partners and participants (for example, via workshops and consultations).
- A synthesis of data derived from measurement activities and internal reporting.
- Install 'Bandicoot bunkers' and plant native species known to support foraging and/or nesting habitat.
- Control domestic stock access to OFB habitat.

Total number of MERIT project services: 13

See the MERI plan summary for more detail

Communication materials	Fauna survey	Habitat condition assessment survey	Revegetating habitat	Synthesising and finalising baseline data
Community/stakeholder engagement	Flora survey	Identifying and prioritising the location of potential sites	Seed germination/plant survival survey	
Controlling access	Habitat augmentation	Improving land management practices	Skills and knowledge survey	

Minimum number of recommended EMSA modules: 12

See the MERI plan summary for more detail

Basal area	Condition	Photopoints	Recruitment
Camera trapping	Floristics	Plot description	Targeted surveys
Coarse woody debris	Interventions	Plot selection and layout	Vertebrate fauna

All other EMSA modules are optional for this project.
Note that there is no requirement to select the Opportune module in project MERI plans.

Purple-eared rock-wallaby case study: MERIT project services and EMSA module selection

Outcome 1: Species and Landscapes. To mitigate new and established threats (such as feral pests and weeds) and restore habitat to support our domestic and international priorities

Long term outcomes
Threatened Species: The trajectory of species targeted under the Threatened Species Action Plan 2022-2032 and other EPBC Act listed species is improved

MERI plan summary

Title: Re-introducing the Purple-eared rock-wallaby to its former range

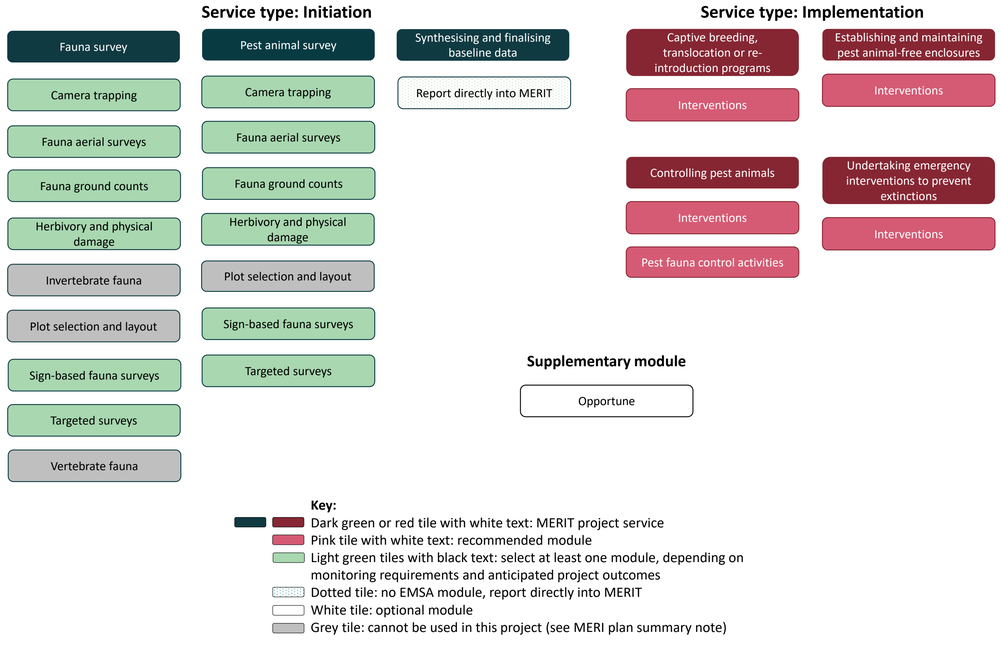
Project background: The fictitious Purple-eared rock-wallaby (*Petrogale purpurei*; PERW) was once found on rocky outcrops and cliffs across South Australia, the Northern Territory and Western Australia. The species has undergone significant decline due to predation by cats and foxes and is now listed as critically endangered. The PERW is now only found in Western Australia in three locations.

This project is focused on maintaining the healthy breeding population at Sandstone Cliffs, WA, and establishing three new pest animal-free enclosures for re-introduction (suitable locations have already been identified). The project will also mitigate the threat of feral predators by removing cats and foxes from the new enclosures. The project will run for five years from 2023-2028.

Monitoring and interventions:
- Maintain the PERW breeding population in the established pest animal-free enclosure.
- Establish and maintain three new pest animal-free enclosures for re-introduction.
- Use fauna surveys and camera traps to detect presence and estimate abundance of both the PERW and pest species in the re-introduction sites, before and after re-introduction.
- Removal of pest fauna from the re-introduction areas.

Note:
- Due to the specific habitat requirements the PERW (inaccessible cliffs and rocky outcrops), the Plot selection and layout EMSA module is not suitable for this project. EMSA modules that require prior completion of the Plot selection and layout module cannot be used on the site. The delivery partner may choose to apply for an exemption through the EMSA Protocol Advisory Group to use alternative monitoring protocols for the project.

MERIT project services and associated EMSA modules



Total number of MERIT project services: 7

See the MERI plan summary for more detail

- Captive breeding, translocation or re-introduction program
- Controlling pest animals
- Establishing and maintaining pest animal-free enclosures
- Fauna survey
- Pest animal survey
- Synthesising and finalising baseline data
- Undertaking emergency interventions to prevent extinctions

Minimum number of recommended EMSA modules: 6

See the MERI plan summary for more detail

- Camera trapping
- Fauna ground counts
- Sign-based fauna surveys
- Interventions
- Pest fauna control activities
- Targeted surveys

All other EMSA modules are optional for this project.
Note that there is no requirement to select the Opportune module in project MERI plans.

Great Southern Australian Ramsar site case study: MERIT project services and EMSA module selection

Outcome 3: Ramsar Wetlands Protection.

- To support conservation activities in wetlands recognised under the Ramsar Convention such as eradicating and managing invasive species.
- Priority actions at targeted Ramsar sites will reduce threats, restore or maintain ecological character and increase climate change resilience.

Long term outcomes

The ecological character of targeted Ramsar sites is maintained and/or improved, building resilience to climate change

MERIT project services and associated EMSA modules

Service type: Planning

- Identifying and prioritising the location of potential sites
- Report directly into MERIT

Service type: Initiation

- Fauna survey
  - Camera trapping
  - Fauna aerial surveys
  - Fauna ground counts
  - Herbivory and physical damage
  - Invertebrate fauna
  - Plot selection and layout
  - Sign-based fauna surveys
  - Targeted surveys
  - Vertebrate fauna
- Pest animal survey
  - Camera trapping
  - Fauna aerial surveys
  - Fauna ground counts
  - Herbivory and physical damage
  - Plot selection and layout
  - Sign-based fauna surveys
  - Targeted surveys
- Synthesising and finalising baseline data
  - Report directly into MERIT
- Water quality survey
  - Interventions
- Weed distribution survey
  - Interventions
  - Cover
  - Floristics
  - Plot selection and layout
  - Targeted surveys
  - Vegetation mapping

Service type: Implementation

- Controlling pest animals
  - Interventions
  - Pest fauna control activities
- Improving hydrological regimes for site eco-hydrology
  - Interventions
- Remediating riparian and aquatic areas
  - Interventions

Supplementary module

- Opportune

Key:

- Dark purple, dark green or red tile with white text: MERIT project service
- Green or pink tile with white text: recommended module
- Light green tiles with black text: select at least one module, depending on monitoring requirements and anticipated project outcomes
- Dotted tile: no EMSA module, report directly into MERIT
- White tile: optional module
- Grey tile: cannot be used in this project (see MERI plan summary notes)

Great Southern Australian Ramsar site case study: MERIT project services and EMSA module selection

MERI plan summary

Title: Protecting and remediating the Great Southern Australian Ramsar site

Project background: The Great Southern Australian Ramsar site provides habitat to a wide range of key wetland and terrestrial species within the region. The site supports a wide range of native flora and fauna including eight threatened species of fish, amphibians, plants, birds and invertebrates. It is also habitat for ten migratory birds listed under international agreements.

This project directly addresses the key threats of invasive pest animal and weed species, which impact on native plants and animals. The Ramsar site is a key breeding site for the Swamp Frog and, following site remediation, may provide suitable habitat for critically endangered Freshwater Mussels. This project will improve our understanding of species population dynamics and enhance wetland habitats for the Swamp Frog and Freshwater Mussel.

Monitoring and interventions:
- Vegetation surveys to determine areas of invasive weed species infestation.
- Water quality surveys.
- Camera traps to detect presence and estimated abundance of pest animals (such as feral pigs, goats and deer) at key locations during target species breeding periods.
- Targeted surveys and opportunistic sightings of Swamp Frogs in known habitats.
- Presence and estimated abundance of Freshwater Mussels.
- Implement a pest animal control program to reduce instream and bank habitat degradation due to grazing and trampling to improve the ecological character of the site.
- Identify key areas for remediation.
- Work with relevant water management agencies to influence improved environmental watering regime to increase the area of Swamp Frog and Freshwater Mussel breeding habitat and refuge wetland locations.
- Implement targeted weed control programs contributing to the reduction in key threats to the ecological character of the site.

Notes:
- As the site is regularly inundated, the Plot selection and layout EMSA module is not suitable for this project. EMSA modules that require prior completion of the Plot selection and layout module cannot be used on the site. The delivery partner may choose to apply for an exemption through the EMSA Protocol Advisory Group to use alternative monitoring protocols for the project.
- Vertebrate fauna and Invertebrate fauna survey EMSA modules cannot be used on aquatic fauna such as the Freshwater Mussel. Survey effort can be recorded under the Targeted surveys EMSA module.

Total number of MERIT project services: 9

See the MERI plan summary for more detail

- Controlling pest animals
- Remediating riparian and aquatic areas
- Fauna survey
- Synthesising and finalising baseline data
- Identifying and prioritising the location of potential sites
- Water quality survey
- Improving hydrological regimes for site eco-hydrology
- Weed distribution survey
- Pest animal survey

Minimum number of recommended EMSA modules: 6

See the MERI plan summary for more detail

- Camera trapping
- Pest fauna control activities
- Herbivory and physical damage
- Targeted surveys
- Interventions
- Vegetation mapping

All other EMSA modules are optional for this project.
Note that there is no requirement to select the Opportune module in project MERI plans.