Department of Parks and Wildlife

BIODIVERSITY AUDIT II METHODOLOGY

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1. WHAT IS IT?

A Biodiversity Audit of Western Australia's 53 Bioegeographical Subregions in 2002 and the *Bioregional Summary of the 2002 Biodiversity Audit for Western Australia* (together comprising Audit I) were released by the former Department of Conservation and Land Management in 2003 and represented the first comprehensive list of biodiversity assets for the State, plus their condition, threats and some information on existing recovery actions, data gaps and priorities for management.

Biodiversity Audit II (Audit II) was commenced in 2012 by the former Department of Environment and Conservation to follows a similar form as Audit I. Biodiversity Audit II is an evidence-based and expert opinion assessment of components of WA's terrestrial and aquatic[1] biodiversity. It presents a 'snap shot' in time of our knowledge of the condition of the State's biodiversity (trends between 2002 and 2013), the pressures that the State's biodiversity has endured since 2002 and forecast future threats over the next 20 years. It also provides the management requirements to address those threats. Although begun in 2012, the main data collection for Audit II was conducted in 2013, with some follow up and collation occurring in 2014.

Audit II has been designed to provide a collated synopsis of biodiversity knowledge and biodiversity conservation priorities in a single location. It provides added value to existing corporate data, especially through the inclusion of relevant trend and management information, which are currently only recorded in *ad hoc* and disparate sources (eg. recovery plans, threatened species nomination forms, scientific publications) or as sources where this information is not currently articulated. Audit II has a similar structure to Audit I, focused on IBRA subregions and whole of State scale. Audit II contains two main sections - subregional profiles and biodiversity assets. Audit II also represents an improvement in access to information, and ability to search and analyse by trends at whole of State or subregional scale.

2. WHY IS IT NEEDED?

Audit II will be available as a resource for all staff within the Department of Parks and Wildlife (Parks and Wildlife), and it will be a first point of reference for staff seeking biodiversity information (as Audit I has been used). Audit II will be used to inform regional and strategic planning which drives the direction of on-ground actions; be an important source of subregional context information during environmental impact assessments and planning; and allow important analysis of longer term trends in condition and management requirements. Audit II methodology has incorporated some aspects of state of the

[1] Includes coastal, inland waters and estuarine environments but not marine

environment reporting, which allows analysis of change over time by a range of different measures. It will therefore help to address a long-standing issue of poor understanding of why investment in biodiversity conservation is important.

An important function of Biodiversity Audit II is that the methodology allows quantification of the "known unknowns", such as species and ecological communities which are under threat, but for which important metrics are not known. This analysis of gaps provides substantiation for biological survey and research priorities. The approach of Audit II allows reporting according to international frameworks (eg. International Union for Conservation of Nature - IUCN) to improve consistency of threatened species and ecological community listing. It also forms a basis for future comparisons to demonstrate trends over time.

3. AUDIT II PROCESS

Audit II was commenced in late 2012 with the support of the (then) Directors of Nature Conservation, Regional Services and Science divisions. The project was endorsed by Parks and Wildlife's Corporate Executive in September 2013.

The Audit II process was developed to include input from a range of sources:

- GIS section & corporate data;
- Species and Communities Branch staff and corporate data;
- Regional & Science Division staff, and data not available in corporate databases;
- Published sources;
- Environmental Management Branch staff; and
- Threatened species/communities nomination forms, impact assessment documentation and other relevant information.

Audit II methodology closely follows internationally defined metrics (such as used by the IUCN) and also maintains consistency with Audit I, however it was also designed for additional functionality to allow collation, analysis and prioritisation and co-ordination of management actions. The data collection phase of Audit II ran between December 2012 and April 2014 (16 months) and included 121 people (across Regional and Fire Management Services and Science and Conservation divisions) who participated in 96 workshop days. Approximately 1,000 biodiversity assets were examined across nine Parks and Wildlife regions and 55 IBRA subregions, representing the biggest project to date undertaken within Parks and Wildlife. Collation and gap-filling occurred for the remainder of 2014, and development of an online accessible database occurred in 2015.

IBRA subregion boundaries were chosen as the basis of Audit II because they are nationally accepted boundary systems, independent of organisational boundaries (such as local government areas (LGAs) or Parks and Wildlife regions) and they allow comparison between Audit I and Audit II. Audit I was done using IBRA v. 6.1 while Audit II was done using IBRA v. 7, and there were small changes to IBRA subregions between the two audits (change to naming convention, change in the Geraldton Sandplans/Yalgoo area which are small on a State scale). Biodiversity Audit II comprises two parts – subregional profiles and biodiversity assets.

- Subregional profiles - Includes remnant vegetation, tenure, dominant land uses, linear infrastructure, and climate and climate change statistics. The GIS section has prepared statistics for

each of these sections and each subregion has a separate report. Snapshot comparison time periods were 2002 and 2012 with the analysis completed in the first half of 2013.

- Biodiversity assets – includes information on threatened flora and fauna, threatened and priority ecological communities and some wetlands; trends, threats and required management actions for each biodiversity asset in each such subregion where it occurs, collated into a series of spreadsheets.

The detailed methodology for subregional profiles is [INSERT CROSS REF TO METHODOLOGY BY JANINE KINLOCH]

4. BIODIVERSITY ASSESTS

Western Australia is internationally recognised for its biodiversity values. Subregional profiles provide the "flavour" of each area, whereas the biodiversity assets section is focussed on species and ecological communities under threat and wetlands. Audit II represents a summary of known information about terrestrial biodiversity assets in 2013, and change over time in condition of these assets between 2002 and 2013. The biodiversity assets section provides a summary of names, current condition, trends since 2002, pressures that have operated since 2002, predicted future threats (20 year time horizon) and required management actions for threatened flora and fauna, threatened and priority ecological communities, and internationally and nationally recognised wetlands for each of the subregions and also at State level. The information collected to quantify current condition aligns with internationally accepted frameworks (IUCN Red List Criteria for taxa and ecosystems) which can be used for assessment of threat category. Assets addressed by the Biodiversity Audit II (as at July 2014) include:

- 413 taxa of threatened flora (critically endangered, endangered and vulnerable);
- 215 taxa of threatened fauna (critically endangered, endangered and vulnerable);
- 360 ecological communities (critically endangered, endangered, vulnerable, priorities 1 to 4);
- **Pending:** 102 internationally and nationally significant wetlands (Ramsar and DIWA listed; known and potential);
- **Pending:** approx. 1000 subregionally known and potentially significant wetlands.

4.1 Biodiversity assets included

Table 1: Biodiversity assets included in Biodiversity Audit II.

Audit II terminology	Source	Caveats
threatened flora or declared rare flora	*Wildlife Conservation Act 1950* Wildlife Conservation (Rare Flora) Notice 2013 Schedule 1 Extant taxa	all threatened flora are considered terrestrial
threatened fauna	*Wildlife Conservation Act 1950* Wildlife Conservation (Specially Protected Fauna) Notice 2013 Schedule 1 Fauna that is rare or is likely to become extinct	terrestrial only, see definition below; thought to be extant in WA or have management actions relevant for WA
threatened ecological communities	List of Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment (May 2013)	threat categories Critically Endangered, Endangered or Vulnerable only

Audit II terminology	Source	Caveats
priority ecological communities	Priority Ecological Communities for Western Australia Version 21 (4 May 2014)	all priority categories included
potentially threatened taxa; candidate priority ecological communities	Potential priority/threatened ecological communities	minor part of Audit II, not comprehensive, current condition, threats and management actions not included; passed directly to Species and Communities Branch to progress.
Pending: internationally significant wetlands	Listed on The Ramsar Convention on Wetlands as at 31 January 2013	Found in WA or within State waters
Pending: nationally significant wetlands	Listed on The Directory of Important Wetlands in Australia as at 31 January 2013; Wild Rivers (?)	Found in WA or within State waters
Pending: subregionally significant wetlands	Any other wetland in WA nominated by staff for inclusion – a wide range of authorities such as reports, HEVAE process or staff knowledge	Found in WA or within State waters

In the case of overlaps, the Biodiversity Audit II reflects the highest level of recognition (for example, all Ramsar listed wetlands are also DIWA listed but Ramsar listed ones appear as internationally significant wetlands).

Biodiversity Audit II has been confined to terrestrial taxa and ecosystems, defined as having at least part of the lifecycle or occurrence on land or in an aquatic environment, including:

- Vertebrate and (listed) invertebrate fauna confined to terrestrial habitats;
- Birds which nest or roost on mainland WA or islands within WA State waters;
- Marine turtles which nest in WA (not completed);
- Aquatic fish or crustaceans that occur in wetland habitats (may be fresh, brackish, saline or estuarine but not marine); and
- Ecological communities and wetlands may be fresh, brackish, saline or estuarine but not marine and occur within WA State boundaries.

Part of the role of the Biodiversity Audit II was to identify taxa and ecological communities which may be threatened and need further investigation. This was completed for potential/candidate priority ecological communities and commenced for priority flora and fauna (see section 4.5 below).

4.2 Biodiversity Audit II methodology

4.2.1 Work undertaken prior to workshops

Species and Communities staff interrogated corporate databases and pre-populated Excel spreadsheets with:

- Scientific names & common names (flora and fauna); community name and database identifier (ecological communities);
- Number of populations (flora) or occurrences (ecological communities);
- Known population size (flora only);
- Extent of occurrence area calculated from the population/record/occurrence locations (flora, fauna and ecological communities); and
- Most recent date (year only) for record by subregion.

Comment [FS1]: And fauna? JM – nope, corporate databases don't record the number of populations for fauna

Corporate data sources used for biodiversity assets:

- Threatened and Priority Flora (TPFL) database – records from 1 January 1992 to 31 January 2013 using 2012 threatened flora list, with taxa newly listed in 2013 added and 2013 name changes implemented;
- Threatened Fauna database - records from 1 January 1992 to 31 January 2013 using 2012 threatened fauna list, with taxa newly listed in 2013 added and 2013 name changes implemented;
- TEC database – all spatially defined threatened or priority ecological community records (including polygons and points) interrogated progressively by subregion between January 2013 and July 2013 for all available dates using 2012 threatened ecological community and priority ecological community lists, incorporating 2014 additions, deletions and name changes;
- Priority ecological communities not spatially defined as per 2014 PEC list; and
- Wetlands – all listed Ramsar and DIWA recognised sites at January 2013, with additional processes to identify wetlands of subregional significance.
- Priority flora and fauna by Parks and Wildlife region

The range of record dates from 1992 to 2013 was designed to select current known distribution. Although data interrogation was from 1992, this was done to address absence of recent records, especially for remote areas. Therefore the distribution information was calculated using a start date of 1992 to determine which subregions should be included in the distribution of a particular taxon, but from 2002 for all metrics (ie. population counts and trends only included records from 2002 to 2013). Information for some biodiversity assets was completed in early 2014, but trends relate only to the period 2002 to 2013.

4.2.2 Workshops

After initial design, scoping, testing and development were completed in late 2012 and early 2013, round-table and informal workshops were held in Perth between February and August 2013, and involved Regional and Fire Management Services and Science and Conservation staff (5 to 10 people per session, one biodiversity asset each day for a week for each Parks and Wildlife region). Remaining biodiversity assets were addressed in follow-up sessions with staff in Species and Communities branch and regional offices between September 2013 and April 2014. Although the logistics of workshops organisation required collation information by Parks and Wildlife region the focus of data collection occurred according to IBRA subregions. As such, Species and Communities staff prepared spreadsheets of relevant biodiversity assets by subregion (including records from subregions wholly within the region boundaries plus the whole of boundary subregions; done to ensure that no asset was overlooked. The workshop focus of the Biodiversity Audit II was designed to promote communication between District, Region, Species and Communities and Science staff, improve the understanding of junior staff regarding biodiversity assets and encourage discussion of important biodiversity conservation issues.

Spreadsheets were developed with a series of drop-down menus for consistency and pre-populated with information from corporate databases. These were used at workshops or at one-on-one sessions with individuals to facilitate information collection. These spreadsheets as well as spatial data and other available data sources were used a starting point for discussion, with Biodiversity Audit II utilising staff knowledge, interpretation and correction of corporate data. This approach was necessary as either much of the information collected by Audit II was not currently held in corporate databases, databases were not consistent with staff knowledge (for a wide range of reasons discussed further below), or the timescale of Audit II was not reflected in available information. In general, only Parks and Wildlife staff[2], corporate data and within-agency information was used to provide input to the Biodiversity Audit II (in addition to publicly available publications).

There has been international development of an accepted threat taxonomy for direct threats to biodiversity assets, by Salafsky et al. (2008). The WA Biodiversity Audit II adapted the threat taxonomy from Salafsky et al. (2008) for relevance to WA, and consistent terminology was used regardless of asset type, accompanied by a "specify" field which allowed more explanation for the threat mechanism. Past pressures, future threats and required management actions were collated from staff discussions, often with reference to recovery plans. Staff were requested to only include the top 80% of past pressures, future threats and required management actions. This approach was taken to expedite discussion, provide a filter for long lists of actions included in recovery plans and capture the most important threats and management actions appropriate at both subregional and State scale.

Workshops were included as the "value-adding" part of Audit II as they encouraged discussion, collaboration and information sharing between staff in different divisions, often with different perspectives. Consequently, the information gathered using the Biodiversity Audit II process is not available elsewhere – it has consolidated information from different sources to discern trends and reasons for trends which allows comparison across different types of biodiversity assets, or between subregions to determine patterns, identify recovery action and research priorities and provide summary data for staff and stakeholders.

4.2.3 Collation stage

Information from workshops required collation and gaps were addressed by addition of information from published sources and grey literature. The primary Audit II methodology was the use of workshops to discuss current condition, trend and management actions, however some information from the range of sources (discussed above) was added at the collation stage. Information source is included for each biodiversity asset. More information about each of these is included in the appendices.

4.3 Biodiversity assets excluded

Biodiversity assets not included in Audit II:

- Exclusively marine fauna – cetaceans, sharks;
- Fauna found outside WA State waters - albatrosses, sea snakes;

[2] Exceptions were: Andrew Burbidge, Mark Harvey (WAM), and Bill Humphreys (WAM).

- WC Act[3] Wildlife Conservation (Rare Flora) Notice 2013 Schedule 2 – Taxa presumed to be extinct;
- WC Act Wildlife Conservation (Specially Protected Fauna) Notice 2013 Schedule 2 – fauna presumed to be extinct;
- WC Act Wildlife Conservation (Specially Protected Fauna) Notice 2013 Schedule 3 – Migratory birds protected under an international agreement, although those also listed under Schedule 1 are included;
- WC Act Wildlife Conservation (Specially Protected Fauna) Notice 2013 Schedule 4 – other specially protected fauna;
- Listed on List of Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment (May 2013) as Presumed Destroyed; and
- Any threatened taxa found in WA but only listed under EPBC Act or IUCN Red List but not on WA State lists.

The former distribution of extinct taxa and presumed destroyed ecological communities are noted in subregion summaries but are not covered in detail and do not have management requirements. There are a small number of taxa which are thought by staff to be extinct in WA, however these are included in the Biodiversity Audit II as they still appear on notices of extant taxa and may have relevant threats and research or management actions. There are a small number of mammals which historically occurred in WA and are listed under WC Act Wildlife Conservation (Specially Protected Fauna) Notice 2013 Schedule 1 to conform to national listing processes but are not thought to be extant. A flexible approach was taken to these species because sometimes management actions (such as translocations) are relevant, and thus these species may be included in Audit II. Where taxa are listed as threatened or presumed destroyed ecological communities have been excluded from Biodiversity Audit II, the name appears in spreadsheets but notes reasons for exclusion. This was done to avoid uncertainty about whether or not a taxon or community was considered in Audit II.

4.4 Decision-making – which information to include?

When collating information on the current condition, trends, past pressures, future threats and required management actions, a number of sources are usually available which address some or all aspects, but usually restricted in some way (eg. population counts in TPFL included populations which were known not to be extant; published survey information may only cover part of the range; recovery plans are not available for all species and communities, or where available may be out of date; a scientific paper describes taxonomic changes, etc). Therefore, Audit II methodology uses input from a wide range of available sources (different for each asset) plus interpretation of what this means. Consequently, it became necessary to develop a hierarchy of information sources for what appears in Audit II as current known information. This hierarchy is as follows (highest to lowest):

1. Unpublished recent information and/or expert opinion from scientist, regional, Species and Communities or EMB staff (workshops and one-on-one);
2. Published information such as recovery plan, action plan, SPRAT or scientific paper (if current);
3. Unpublished current information from DPaW databases or nomination for listing; and
4. Other unpublished information or grey literature (if current), older published information and Audit I.

[3] *Wildlife Conservation Act 1950*

Where there is a difference in information from different sources, eg. TPFL different to regional officer, the officer's advice was recorded and the Species and Communities information put into the notes section and the information source recorded. Trends were included, along with the dominant/main reason for the trend. If two or more trends are evident, these are noted but only the dominant reason is recorded. In this way, the best available information could be used for each metric, and sources were noted for each.

4.5 Current condition

The term "IUCN metrics" (or sometimes "metric") is collectively used to describe:

- Known number of populations[4] (flora and fauna);
- Known number of occurrences[5] (ecological communities);
- Known number of mature individuals (flora and fauna only);
- Extent of occurrence (flora, fauna, ecological communities);
- Area of occupancy (flora, fauna, ecological communities);
- Extent and severity of abiotic degradation (ecological communities); and
- Extent and severity of biotic degradation (ecological communities).

More information is included in Appendix B.

All IUCN metrics should be tracked accurately over time, but this depends on accurate, up-to-date, curated and accessible corporate data, together with the additional interpretation required to discern the underlying meaning or trends that became evident with tracking over time. At present, this type of information management is not available within Parks and Wildlife, so Audit II represents partial achievement of this ideal state as it won't be updated over time.

In Audit I regional staff scored the "condition" of a threatened species or ecological community according to one of four condition categories: degraded; fair; good; or near pristine. Change in the condition (ie. trend) of a species or community using five categories: extinction (no observations in 20 years); rapidly declining; static; improving; or unknown. These single word condition and trend scores are now manifestly inadequate for recovery planning and management as they mask assessment against a number of criteria for species decline and recovery.

The information contained in Audit II represents a large improvement on Audit I. Whereas the information contained in subregional chapters in Audit I came solely from regional staff (with some external review), Audit II relies on a wide variety of sources, and each IUCN metric is attributed with a trend. Throughout Audit II, the term "current condition" or "condition" is collectively used for flora, fauna and ecological communities to describe:

- Known number of evolutionary significant units (ESUs) and trends (flora and fauna only);
- Known number of populations or occurrences and trend (ecological communities);
- Known number of mature individuals and trend (flora and fauna only);
- Extent of occurrence and trend (flora, fauna ecological communities);
- Area of occupancy and trend (flora, fauna ecological communities);
- Extent and severity of abiotic degradation and trend for each (ecological communities); and

[4] Discussion of sub/populations and locations is included in Appendix B
[5] Discussion of occurrences and locations is included in Appendix B

- Extent and severity of biotic degradation and trend for each (ecological communities).

More information is included in Appendix B.

4.6 Not complete at this stage (June 2015)

4.6.1 Wetlands

As at June 2015, the wetlands section of the Audit II has not been completed. However, it is intended that information on wetlands will be added to the portal.

4.6.2 Expedited assessment of priority taxa

The detailed process for biodiversity assets described above describes the Biodiversity Audit II approach to threatened flora and fauna, threatened and priority ecological communities and wetlands. However, there are approximately 3000 priority flora and fauna which have undergone an expedited process to identify those taxa for which the current (2013) priority category is inadequate. Appendix E contains more details on this methodology. This analysis is not complete as at June 2015, and requires additional staff time for completion.

4.6.3 Management effectiveness

It was originally intended that Audit II would include an analysis of a subset of approximately 10 reserves randomly selected as a representative sample from each subregion to determine reserve management effectiveness. The methodology for this part of Audit II included staff filling in a survey for each reserve, and a small number (approx. 20) of Parks and Wildlife managed reserves were completed. Information collected to date includes tenure, biodiversity values, threats, management goals, management actions and an assessment of the effectiveness of those management actions for the reserves. It was anticipated that the reserve section of Audit II would analyse, at subregional and State scale, the effectiveness of management across geographic areas, reserve attributes (eg. size), landscape level threats, current resourcing and inform reprioritisation of management actions, if necessary. Significant work is required to finalise survey questions and develop an online reporting tool for data collection (with links to allow automatic entry from corporate databases and pre-population fields) for roll out to regional staff. Regional staff would then be responsible for completing the data entry for reserves in their Parks and Wildlife region. In some cases this is not likely to be too time-consuming as there are few reserves; however some regions have a very large number of reserves to complete.

More information on the methodology for reserve selection and development of the reserve management effectiveness assessment are included in Appendix E.

4.6.4 Turtles and migratory birds

Turtles (Schedule 1) and migratory birds (listed in only in Schedule 3; those in Schedule 1 are completed) are not completed as of June 2015.

4.6.5 Classification of ecological communities for further analysis

The biotic, abiotic and wetland characteristics are all important for the further analysis of ecological communities. There is considerable overlap between categories, for example a wetland includes vascular plants, vertebrate animals and aquatic invertebrates. This analysis has not been completed and requires further work in order to finesse.

4.7 Guide to appendices

Guide to more detailed methodology (Appendices)

Biodiversity asset type	**Nomenclature & Reliability/ data sources**	**IUCN metrics/ condition**	**Surveys & conservation status**	**Past pressures & future threats**	**Management actions**
Flora	Appendix A	Appendix B Part 1	Appendix C	Appendix D	Appendix E
Fauna	Appendix A	Appendix B Part 1	Appendix C	Appendix D	Appendix E
Ecological communities	Appendix A	Appendix B Part 2	Appendix C	Appendix D	Appendix E
Wetlands	Appendix A	Appendix B Part 3	Appendix C	Appendix D	Appendix E
Identification of potential/candidate ecological communities	Appendix F				
Priority taxa	Appendix G				
Management effectiveness	Appendix H				

This methodology provides cross references to Audit II spreadsheets (column headings THIS_FORMAT) and to Biodiversity Audit II: Spreadsheet Codes which contains a list of all codes used in spreadsheets and their meanings (cross reference to Tables).

4.8 References

JM to add

APPENDIX A: NOMENCLATURE & RELIABILITY/DATA SOURCES - NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEETS

This methodology should be read in conjunction with Biodiversity Audit II: Spreadsheet Codes ("Spreadsheet Codes").

Sorting columns on far left hand side of spreadsheet:

- Scale (SCALE) – Western Australia for whole of State assessment or relevant subregion. Multiple rows are listed here to account for the number of threats and management.
- Region (DPAWREGION) – Parks and Wildlife region that the biodiversity asset is present in, can include one region name or a list of regions where the asset is present in more than one.

Cross ref Table 1 & 2 Spreadsheet Codes.

Flora and fauna:

- Listing schedule (SCHEDULE) – gives the appropriate schedule of the WC Act, can be used to sort for taxonomic group.
- Taxon name (NAMESCIEN & NAMECOMMON) – scientific name & common name as per Government Gazette Schedules (2013) and corporate databases.
- Distribution (DIST) – For flora, this includes a list of subregions where the taxa occurs and for fauna it is the name of populations in the subregion (eg. one subregion contains island populations so these are listed, while another population might occur over several subregions on the mainland).

Cross ref Table 3 Spreadsheet Codes.

Ecological communities:

- Community name (COMMUNITYNAME) – name as per published TEC list (May 2013) and PEC list (26 March 2013, updated to 4 May 2014 during Audit II process to incorporate changes to names and new listings in 2013).
- Community identifier (COMMUNITYID) - community identifier as per TEC database (from Species and Communities).
- Description (COMMUNITYDESC) – Description as per TEC database (from Species and Communities).

Cross ref Table 4 Spreadsheet Codes.

Wetlands

JM to add - Wetland title as per Ramsar and DIWA listing

Trends

Audit II brings a consistent approach to trend direction and then adds the reason for trends. Each IUCN metric is attributed with the direction of the trend between 2002 and 2013 – decreased, static, increased and unknown. Then the reason for the trend is included to allow further analysis - pressures > recovery actions, new knowledge - biological survey, new knowledge – taxonomy, increases = losses, no change, recovery actions > pressures. Trend columns are: KNOWNESU_TREND, KNOWNPOPS_TREND, KNOWNOCC_TREND, MATIND_TREND, EOOAREA_TREND, AOOAREA_TREND, DEGABIOTIC_EXTENTTREND, DEGABIOTIC_SEVERITYTREND, DEGBIOTIC_EXTENTTREND, DEGBIOTIC_SEVERITYTREND.

Reliability/Data sources
Cross ref Table RL1 Spreadsheet Codes.

The term "reliability" was used during the design of Biodiversity Audit II as an indicator of rigour and to provide some measure of degree of confidence in the reported information. However, throughout the Audit II process, the decision-making process was refined in relation to data sources (see section 4.4 Decision-making above), and the label "reliability" was no longer accurate. However, the term was not changed as it was used so extensively throughout (all condition metrics have associated reliability columns) and so it should be read as a type of data source. This structure allows analysis of Audit II results according to type of data source (but not actual data source). Reliability fields are associated with number and trend columns, ie. for evolutionary significant units (KNOWNESU_RELIAB & KNOWNESU_TRENDRELIAB), known number of populations (KNOWNPOPS_RELIAB & KNOWNPOPS_TRENDRELIAB) and known number of mature individuals (MATIND_RELIAB & MATIND_TRENDRELIAB).

The 5 types or categories of data source and examples are:

- Expert opinion – expert opinion based on knowledge and experience, either in a workshop situation or individually;
- Quantitative unpublished data and expert opinion - expert opinion informed by some quantitative data (eg. limited monitoring)
- Quantitative analysis of data not publicly available – information from corporate databases or other sources that are not publicly available in that form (eg. population counts; applications to take; results of within-department monitoring, survey or research projects; spatial and other data kept by the Region or District).
- Quantitative analysis of data published or publicly available but not peer reviewed - information from corporate databases that is publicly available (eg. locations); information provided as part of impact assessment or planning process; publicly available reports which have not clearly been peer reviewed;
- Quantitative analysis of data published or publicly available following peer review – includes scientific papers, recovery plans, information from SPRAT, regional surveys and any other peer reviewed information; and
- Not applicable when the metric or trend is unknown.

The last column for each IUCN metric was used for notes on the authority, and any other relevant notes for that metric. The need for this notation arose because it became too hard to follow when there was only one notes column in a spreadsheet as each metric and/or trend may have a different data source or authority.

APPENDIX B: CURRENT CONDITION - NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEET

Part 1: Flora and fauna

Known number of evolutionary significant units (ESUs)

Cross ref Table 5 Spreadsheet Codes.

The number of ESUs captures diversity below the level of the currently recognised taxon, which may be genetic, morphological or reflect outlier/disjunct populations. The approach largely follows Mortiz (1994); however it may also include management units where appropriate. Usually the number of ESUs is only relevant at State level and subregional listing is "refer to State level" (with some exceptions where ESUs occur in different subregions, so each relevant subregion records 1 ESU and State level is a sum of subregions).

Where there has been a split of the taxon (eg. 'Genus species' has become 'Genus species subsp. A' and 'Genus species subsp. B', then 'Genus species subsp. A' records a decrease in number of ESUs (ie. 2 ESUs to 1) and 'Genus species subsp. B' records an increase (0 ESUs to 1).

Known number of populations

Cross ref Table 6 Spreadsheet Codes.

This section reports the number of all known extant biological populations in 2013 (KNOWNPOPS_NUM & KNOWNPOPS_TRANS). There is considerable international debate about what constitutes a population, however Biodiversity Audit II methodology uses this term as it is used by staff in formal and informal ways. This definition incorporates the IUCN terms subpopulation (ie. geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange, typically one successful migrant individual or gamete per year or less; IUCN 2011 p. 19) and/or location (ie. geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present; IUCN 2011 p. 41). IUCN criteria only consider biological subpopulations (i.e. not defined by political or national boundaries; IUCN 2011 p.5) so the Audit II has maintained consistency with this approach.

For flora, an extant flora population is one which has living plants or has the potential to have living plants and is managed as such, ie. a population which has been cleared for roads or housing is not counted, but a population with no living plants but intact soils and vegetation is counted. For flora, this column included data from TPFL, which wasupdated if necessary by staff. Audit II reports biological populations where possible, defined as genetically connected (or likely to be so), to overcome the issues of population numbering according to administrative boundaries, such as different tenure or arbitrary distance but not reflective of ecology, and an example is illustrated in Diagrams 1 and 2 (counted as 2 populations and 6 populations, respectively).

Diagram 1 – counted as 2 biological populations

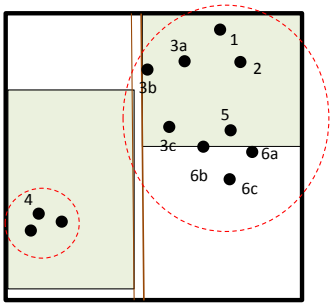
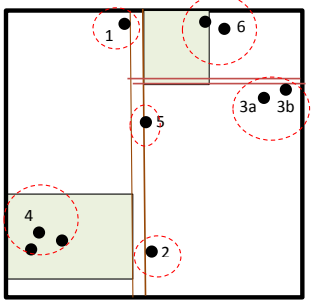
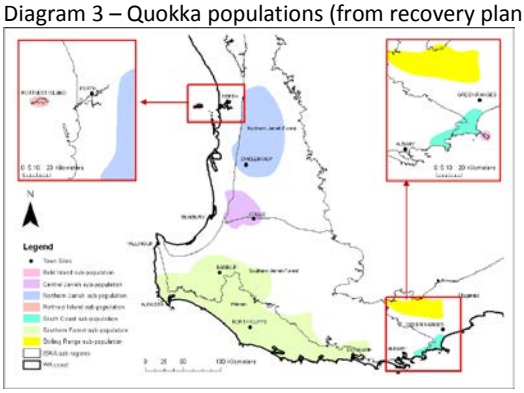


Diagram 2 – counted as 6 populations



For fauna, known populations are counted together with any credible potential or anecdotal reports which need further investigation (eg. survey) or management. Fauna populations are not recorded in the WA Threatened Fauna database; rather this data comes from available published information and/or expert opinion. There are significant issuew with defining populations for mobile and translocated taxa, and in most cases, genetic substantiation is not available so Audit II uses geographic locations as descriptors (DIST). Fauna populations may be larger than one subregion and/or shared across subregional boundaries and are counted in all relevant subregions (with two notable exceptions). Diagram 3 demonstrates an example of a complex count of populations by subregion.

Diagram 3 – Quokka populations (from recovery plan 2013)



SWA02 – Rottnest (1 pop considered extant, other Swan Coastal Plain populations thought to be locally extinct in subregion)
JAF01 - Central Jarrah Forest, Northern Jarrah Forest (pop count = 2)
JAF02 - Central Jarrah Forest , Southern Jarrah Forest, South Coast (pop count = 3)
WAR01 - Southern Jarrah Forest (pop count = 1)
ESP01 - South Coast, Stirling Range, Bald Island (pop count = 3)
Western Australia – Rottnest, Northern Jarrah Forest, Central Jarrah Forest, Southern Jarrah Forest, South Coast, Stirling Range, Bald Island (pop count = 7)

Where fauna has a distribution wider than one subregion, such as the South West or Pilbara, then each component subregion is listed with the same population name (and count of 1 population). Importantly, the number of populations at State level does not always represent the sum of the individual subregions. In the Shark Bay area, Heirrisson Prong, Dirk Hartog Island, Dorre Island and Bernier Island are in YAL01 and Francois Peron and Faure Island are in CAR02, so discussion of Shark Bay needs to include both subregions. Two areas important for fauna conservation are split over subregional boundaries but for ease of accounting, are counted as if their entire area occurs in one subregion: Dryandra is counted in JAF01 only and Lorna Glen is counted in GAS02 only.

The number of populations includes the total number of natural and translocated populations, but the number of translocations is noted separately to allow this comparison to be made. Only WA populations are counted, although those outside WA are noted in text cells for context. Populations included in number of populations are consistent for all other measures (number of mature individuals, extent of occurrence, area of occupancy), ie. included or excluded from all. Number of populations can be assessed against IUCN criteria B or C (for subpopulations or locations; IUCN 2011).

Translocations (including reintroductions and introductions for flora and fauna; KNOWNPOPS_TRANS) are counted where they are reproductive, producing second or subsequent generations, in accordance with IUCN 2011 (assessment against conservation status criteria includes self-sustaining translocated or re-introduced subpopulations within the taxon's natural range). Translocated populations which have not reproduced or it is too early to determine are not included in the overall population count. Translocated populations which have management intervention such as watering or predator exclosure fencing are included where they are successfully reproducing (although "self-sustaining" is arguable in

such circumstances, difficulties arise in excluding populations which are successfully reproducing with management intervention). Translocations which augment an existing population are NOT counted as a translocated population but changes in number as a result are included in number of mature individuals (next section). Captive populations (eg. zoo, breeding centre), seed orchards, cultivated and unauthorised revegetation/translocations are not included in the IUCN metrics (but may be notes in the explanatory text).

The trend in number of known populations (KNOWNPOPS_TREND) provides a direct comparison from number known in 2002 to number known in 2013, and the reasons for this trend. The trend in number of populations can be used in assessment against IUCN criteria B or C (IUCN 2011) and allows analysis by reason for trend. This column does not require quantification (ie. Audit II did not ask Species and Communities staff for number of populations in 2002 due to complexities of biological populations (see above), those which were known but not recorded on TPFL and those taxa added to threatened lists during the period). Where a taxon was not listed as threatened in 2002, but the population was known to local staff or via another source, the trend is static. However if the taxon was not listed as threatened in 2002, or the listing came about due to taxonomic changes, and new populations were found during this time, then this was recorded as an increase due to biological survey. Populations which were lost are recorded where this was known (ie. cleared or became locally extinct), but a "decreased" trend was only used where staff were relatively certain and it was relevant to the population as a whole.

Known number of mature individuals

Cross ref Table 7 Spreadsheet Codes.

The known number of mature individuals (MATIND_RAW & MATIND_CAT) represents current knowledge of number of mature individuals (ie. juveniles excluded). For flora, this column included data from TPFL, which wasupdated if necessary by staff. However, where this figure was inaccurate (eg. not all populations have recent population counts, different recording/estimation methods over time, backlog in data entry) updates were made according to staff records. For fauna, Species and Communities database does not record number of known mature individuals, so this information is sourced from published sources and/or expert opinion. There may be some sensitivity about publication of exact numbers, particularly for threatened species with only one population or location, but this information is useful for within-agency use, hence the categorised value (to order of magnitude) is also provided. Population reduction (measured as percentage decline) can be assessed against IUCN criterion A or number of mature individuals (raw number) can be assessed against IUCN criterion C (IUCN 2011). This approach is taken at subregional and State level.

There are issues of consistency as relatively few threatened fauna and flora have been regularly monitored over the period 2002 to 2012 and this column contains data that originates from a number of sources. Examples:

- Taxon A - Population 3 was last counted in 2005 (info in TPFL), Population 2 was last counted in 2012 (info not in TPFL, collected from District officer), Population 1 was counted as part of a clearing permit application in 2010 (pre-impact information in TPFL but not post-impact) and a new population was found in 2012 (info not in TPFL). The number of mature individuals for Taxon A comprises: Population 3 TPFL count + Population 2 District officer's count + Population 1 count – loss due to clearing (District officer's count/estimation or application to take) + number in new population (most recent year of survey for this taxon would be 2012).

- Taxon B - staff advise to use the published (2012) recovery plan estimate for number of mature individuals.
- Taxon C – Population 2 was last counted in 2003 (info in TPFL) but all other populations have not been visited since 2001 and staff are not sure these populations are extant, so number of mature individuals is unknown.

The trend in number of known mature individuals (KNOWNPOPS_TREND) provides direct comparison from number known in 2002 to number known 2013, and the reasons for the trend. As for other recorded trends, this column does not require quantification, but reports published information where available and/or expert opinion. Trends are recorded by subregion and at State level (these may be different according to scale). Population trends can be used in assessment against IUCN criteria A and/or C (IUCN 2011) and all for analysis of recent trends.

Known extent of occurrence

Cross ref Table 8 Spreadsheet Codes.

Known extent of occurrence (EOOAREA_RAW & EOOAREA_CAT) is the area (in hectares) of extent of occurrence for confirmed populations, roughly translated as “area of total range”. By necessity, Audit II has used a number of different methods to calculate EOO, in order of priority as follows:

1. Published areas from recovery plan, action plan or other published information or unpublished nomination to the Threatened Species Scientific Committee (if this figure includes only WA extent and is relatively recent); or
2. Species and Communities calculation of extent of occurrence using post-1992 data points (corporate databases) alpha hulls (default alpha value is 5 unless otherwise stated) (if the polygon is consistent with understanding of current known populations); or
3. If no published information available and the calculated alpha hull is inaccurate, use of minimum convex polygon around known populations/points, whether they are currently in corporate databases or not.

The alpha hull methodology was chosen for the Biodiversity Audit II as simulation studies show that it is more readily able to detect changes in extent of occurrence through time as it is less susceptible to sampling biases, for more detail see Burgman & Fox (2003) and IUCN (2011, p. 33). However, it is acknowledged that any methodology requires accurate data, so the calculated alpha hull extent of occurrence may be inaccurate when:

- corporate records are inaccurate (notably incorrect identification and/or location);
- despite being selected for post-1992, records are not reflective of current distribution (eg. where there have been contractions in range over time so that the historical records no longer reflect current distribution or lack of recent records although the population remains extant); or
- data points are omitted from the corporate data (ie. no records in corporate database for locations known to staff); or
- data points have not been included or excluded according to the same rule set for counting as for population (such as translocations, extinctions, etc).

Collectively, these sources of error, non-currency and omission have resulted in criticism of use of alpha hull methodology in some cases, which is why the figure used in published documents or in advice to the Threatened Species Scientific Committee may be more appropriate for some taxa, however it is acknowledged that this may impact the future repeatability of the Biodiversity Audit II.

The calculation method for each extent of occurrence is recorded in EOOAREA_METHOD. Where the taxon is only known from one or two populations with point locations only, the extent of occurrence cannot be calculated and area of occupancy is used (N/A appears in EOOAREA_RAW). Extent of occurrence is calculated at State level only and is not appropriate at subregional scale because where the populations occur over multiple subregions, the extent area clipped to subregion boundaries is not meaningful. Ideally, the percentage of distribution made up by each subregion is desirable, however the differences in calculation methods mean this was not possible for Biodiversity Audit II. The known populations counted in Column KNOWNPOPS_NUM are the same as those used for calculation of EOO area. All extents of occurrence have been calculated for WA only and do not include distribution in other jurisdictions. Extent of occurrence areas can be assessed against IUCN criterion B (IUCN 2011).

The trend in known EOO (EOOAREA_TREND) provides a direct comparison from known EOO area in 2002 compared to 2013, and the reasons for this trend. This column allows analysis by reason for trend and assessment against IUCN criteria A or B (IUCN 2011). While the EOO area is only presented at State level, it is often possible to include the trend by subregion, eg. reflecting survey or management actions in one area but not over the rest of the range.

Known area of occupancy

Cross ref Table 9 Spreadsheet Codes.

Known area of occupancy (AOOAREA_RAW) is area (in hectares) of habitat occupied by the taxon. Area of occupancy is always equal to or less than extent of occurrence. As for extent of occurrence, source hierarchy is:

1. mapped boundaries provided by staff (not available on corporate databases);
2. published area of occupancy (eg. in a recovery plan or scientific paper), where available and recent;
3. where staff are confident to estimate based on the area of a geographic feature (eg. wetland, mesa), size of plants (plants 1m x 1m multiplied by the number of plants), area of habitat (eg. type of vegetation) or area areas on report forms; or
4. less confident order of magnitude estimate (without providing a more exact estimate of area).

The categorised value (to order of magnitude) is included (AOOAREA_CAT) to allow assessment against IUCN criteria B and D (IUCN 2011). Biodiversity Audit II originally tried to include an estimation technique for area of occupancy using the number of records in corporate database and grids ($1km^2$ up to $10km^2$), however feedback from staff indicated these estimates were an inappropriate over-estimate of the area of occupancy, and could be an order of magnitude out. Trend in known area of occupancy (AOOAREA_TREND) provides a direct comparison from area occupied in 2002 to area in 2013, and the reasons for this trend. This column allows analysis by reason for trend and assessment against IUCN criteria A, B and D (IUCN 2011).

Habitat specificity

Cross ref Table 10 Spreadsheet Codes.

Habitat specificity (HABITATSPEC_SPATIAL) is recorded for taxa using descriptions highly restricted, restricted, moderate, broad, widespread and unknown. While these terms are not defined as part of Audit II, they were explained to workshop participants as indicative of how strictly the taxon was linked to habitat, such that if the taxon is only found on banksia sand plain or banded ironstone formation then it is "highly restricted" even though the habitat type has quite a large area. Alternatively, if a taxon is known from more than one habitat type then it is not restricted. The trend for habitat specificity (HABITATSPEC_TREND) provides a direct comparison from known habitat types in 2002 to known habitat types in 2013, and the reasons for the trend.

Part 2: Ecological communities

Number of known occurrences

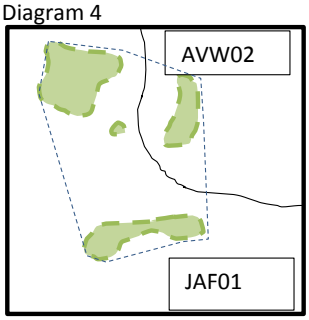
Cross ref Table 11 Spreadsheet Codes.

This section includes the number of known occurrences (KNOWNOCC_NUM & KNOWNOCC_CAT) by subregion. The column was pre-populated from the TEC database and updated if necessary by staff. Boundaries and points were used as some communities were included in one dataset or the other or had both types of data, and double counting was avoided. Where the database figures were incorrect or disputed on the ground, these were adjusted using additional data or best judgement by Parks and Wildlife staff (eg. new occurrence recognised but not yet on the database, interpretation of boundaries/points.

Where an ecological community occurrence crosses subregional boundaries, the number of occurrences by subregion is usually counted according to the subregion of majority occurrence. However, in some cases, a very large occurrence that crossed a subregional boundary was included in both subregions but counted once in the overall number of occurrences, at the discretion of staff. This approach was taken for pragmatic reasons, to reduce the complexity of counts (eg. there was no point in replicating current condition, threats and management for a small area in the minority occurrence subregion), to address the inaccuracy of IBRA boundary mapping on the ground, and to address inaccuracies in occurrence boundaries or points. Some occurrences of ecological communities characteristic of the Swan Coastal Plain are currently mapped as being in JAF01, and the Biodiversity Audit II took the advice of staff who advised subregional boundary did not accurately reflect biogeography in that area, so these occurrences appear as if in SWA02 and not JAF01. The Whicher Scarp area (boundary between southern SWA02 and JAF02) is similarly problematic. While it is acknowledged that this approach may affect the repeatability of Audit II methods, allowing discretion for counts of number of occurrences and areas of occupancy provides meaningful interpretation of corporate data, and better caters for management requirements than if a pure "data only" approach had been taken.

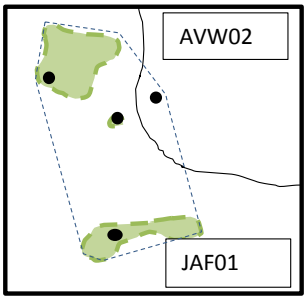
Refer to Diagrams 4 to 9 for demonstration on occurrence counts and use of boundaries for calculating extent of occurrence and area of occupancy

Diagram 4



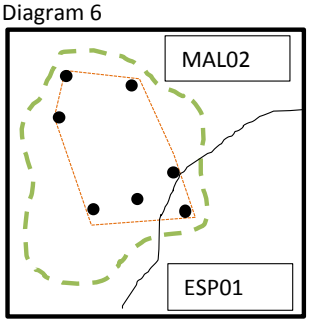
Whole of State: 4 occurrences, 1 in AVW02 and 3 in JAF01
Extent of occurrence is area bounded by blue dotted line (State)
Area of occupancy (State/each subregion) = sum of polygons (green)

Diagram 5



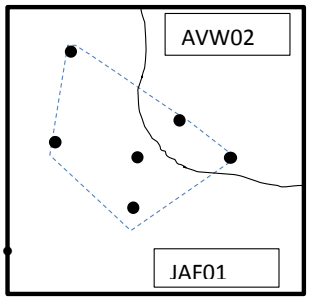
Whole of State: 4 occurrences, 1 in AVW02 and 3 in JAF01
Extent of occurrence is area bounded by blue dotted line (State)
Area of occupancy is sum of polygons, JAF01 only
Area of occupancy for AVW02 is estimate/unknown
Area of occupancy for State is area of polygons + estimate

Diagram 6



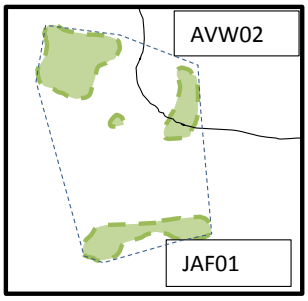
Occurrences: All considered 1 as dots represent sampling points
Extent of occurrence – N/A (cannot be calculated for 1 occ)
Area of occupancy is area bounded by green dotted line and is estimated if possible, otherwise it is the area within points (orange).
Usually listed in subregion of majority occurrence (MAL02)
If past pressures, future threats or management actions differ, can area can be listed in each subregion separately

Diagram 7



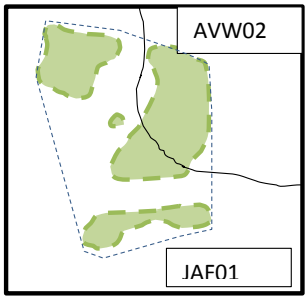
Occurrences: considered to be separate
Whole of State: 6 occurrences, 2 in AVW02 and 4 in JAF01
Extent of occurrence is area bounded by blue line (State)
Area of occupancy is estimate/unknown

Diagram 8



Whole of State: 4 occurrences, 1 in AVW02 and 3 in JAF01
Area of occupancy recorded as if all of boundary occurrence is in AVW02

Diagram 9



Whole of State: 4 occurrences, 1 in AVW02 and 4 in JAF01
Area of occupancy recorded according to subregional boundaries (ie. sum of area in AVW02 and sum of area in JAF01).

The trend in number of known occurrences (KNOWNOCC_TREND) provides a direct comparison from number known in 2002 to number known in 2013, and the reasons for this trend. This column does not require quantification (ie. did not ask Species and Communities staff for number of occurrences in 2002 as the community may have been known and/or listed without spatial boundaries). However increases which are genuine recognition of the biodiversity values of communities since 2002 are recorded as an increase (eg. banded ironstone formations, calcretes). As for populations, decrease in trend indicates the loss of one or more whole occurrences - otherwise it is recorded in area of occupancy (ie. decrease in area). There is significant debate in literature and within Parks and Wildlife about what constitutes loss of an ecological community, such as where there have been multiple pressures over time, changes in species composition and lack of ecological function. Biodiversity Audit II recorded advice of staff on examples but did not develop a rule-set to define thresholds of species change within a community. Significant further work is required in this area.

Extent of occurrence

Cross ref Table 12 Spreadsheet Codes.

The extent of occurrence area (EOOAREA_RAW) is calculated by drawing a boundary (minimum convex polygon) around the known occurrences (outer boundary and/or points). EOO is calculated at State level only and Diagrams 4 to 9 show examples of how this calculation is done (unless otherwise noted). Extent of occurrence area categorised value (EOOAREA_CAT) includes the area to order of magnitude (and allocated to IUCN category thresholds). Differences between data types (points and polygons) means it is not possible to calculate alpha hulls for occurrences of ecological communities, hence the use of

minimum convex polygon. The extent of occurrence trend (EOOAREA_TREND) provides a direct comparison from number known in 2002 to number known in 2013, and the reasons for the trend.

Area of occupancy

Cross ref Table 13 Spreadsheet Codes.

The area of occupancy (AOOAREA_RAW) is the area of known occurrences (boundaries, with estimates or unknown for points), calculated by subregion. Diagrams 4 to 9 show examples of how this calculation is done. The area of occupancy trend (AOOAREA_TREND) provides a direct comparison from number known in 2002 to number known in 2013, and the reasons for the trend.

Degree of Degradation of the Abiotic and Biotic Components

Cross ref Table 14 Spreadsheet Codes.

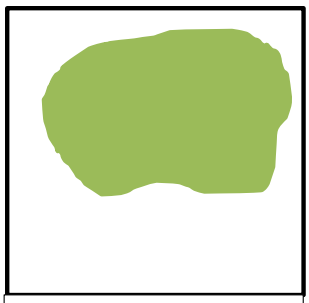
The extent of degradation (abiotic component DEGABIOTIC_EXTENTCAT; biotic interactions and assemblages DEGBIOTIC_EXTENTCAT) is the percentage area of occupancy and/or volume of the abiotic and biotic environment which is considered to be degraded in condition (in 2013 or most recent prior), as measured or estimated by staff (averaged for all occurrences in the subregion) and allocated to categorised value. The IUCN uses the total extent of the ecological community in 1750 as baseline and then compares a 50 year period in the past, present or future to determine remaining extent and obtain percentage decline. However, in WA the total extent of the ecological community in 1750 is often unknown, so “extent” is interpreted as being mapped area or estimate (if mapped boundaries are not available) as baseline and is usually the same as area of occupancy. However, the exceptions to this approach are: where there has been recent change to area of occupancy such that mapped boundaries are not reflective of former extent and Montane Thicket of the eastern Stirling Range, for which there is a recent publication (Barrett and Yates 2014) which applies the IUCN criteria. The term degraded/degradation has been defined flexibly in Audit II as:

a. as synonym for ecosystem collapse defined by Keith et al. (2013), ie. transformation or loss of identity or defining features through loss of characteristic species and/or ecosystem function (outside the bounds of natural variation), examples include clearing, removal of substrate, hydrological changes, climate change; or
b. as “significant impact” in the case of landscape level processes such as weed invasion, changed fire regimes and grazing, this may not be ecosystem collapse, and from which recovery is possible.

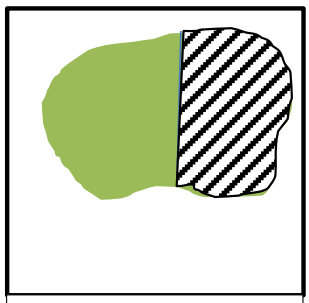
Audit II approach adapts the approach that is recommended by Keith et al. (2013) (IUCN Red List criteria for ecosystems, version 2.0) and recently adopted by the IUCN. IUCN status thresholds are set at percentile increments (ie. degradation of abiotic and biotic component is ≥90%, ≥80%, ≥70%, ≥50% or ≥30% depending on criteria used). Audit II initially attempted to use IUCN 10 percentile bands, however, when used in the first few workshops, it became evident that staff had significant difficulty in allocating the extent of degradation into such small increments, and they expressed concern about the arbitrary nature of guessing. Therefore, Audit II determined a more workable approach, which included “up to” categories, was easier for staff to understand and left less room for guess work. Table 14 in Spreadsheet Codes describes how the Audit II categories are used. In future, the Biodiversity Audit II categories can be then equated these to nearest IUCN threshold for further analysis of conservation status.

Complexity with regard to boundary changes over time was encountered, and judgement was required to allocate correct categories. For example, Diagram 10 below shows an example of an ecological community occurrence which was mined. In this case the pre-mining area was known, so extent of degradation is 25 to 50% degraded (biotic & abiotic), > 95% severity.

Diagram 10



Occurrence boundary in 2002 area = 250ha

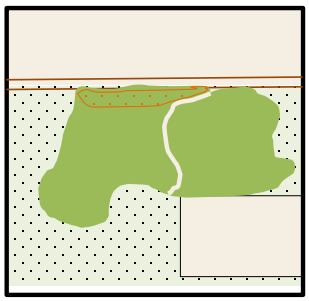


Mining in 2007 clears vegetation and removes substrate, reduces occurrence boundaries to 140ha. No additional impacts to remaining area.

2013 area of occupancy = 140ha; trend 2002-2013 = contracting. Reduction of 110ha (44%) of known extent = 25 to 50% degraded (biotic & abiotic), > 95% severity.

However, if the current mapping represents a cleared or fragmented community (ie. the original extent is unknown) and area of occupancy is used as the baseline then degree of degradation is estimated. For example, Diagram 11 shows a vegetation ecological community occurrence current area of occupancy, with the pre-clearing area unknown. The green area shows the area mapped as the ecological community while the orange shaded area represents a degraded area (weed invaded and sparsely vegetated) and there is a track through the bushland (cleared). In this case the extent of degradation for the biotic component is 5 to 25%, but <5% for the abiotic, with mapped boundary area used to obtain the percentage.

Diagram 11



In many cases, the degraded areas have been left out of mapped boundaries, so this can make quantification or estimation difficult through uncertainty about the baseline. For example, in Diagram 11, the light green area represents an area of degraded vegetation surrounding the mapped ecological community boundary, and may have previously been considered part of the same mapped ecological community but is now so changed that the baseline area cannot be reliably estimated. Therefore, the extent of degradation is likely to be much higher than 5 to 25% and <5% for biotic and abiotic components respectively, but it is not possible to quantify due to lack of understanding of the 1750 extent of the ecological community. In general, wetland and subterranean ecological communities were harder to quantify (particularly when attempting to determine dewatering as a percentage degradation), than for vegetation assemblages, resulting in many unknowns for current condition.

The severity of degradation (abiotic component DEGABIOTIC_SEVERITYCAT; biotic interactions and assemblages DEGBIOTIC_SEVERITYCAT) is the relative severity of impact as estimated by staff (averaged for all occurrences in the subregion) and allocated to categorised value. Keith et al (2013) defines relative severity of degradation as representing the ratio of observed change in environmental suitability (for ecosystem biota) over a given time to the amount of change that would cause an ecosystem to collapse, and the IUCN status thresholds are similarly set at percentile increments (as for extent of degradation; ≥30%, ≥50%, ≥70%, ≥80% ≥90% or depending on criteria used). In practice however, the research to fully define assemblages (unimpacted communities) plus the ongoing monitoring required to determine change over time has rarely been done, so this measure of condition is based on staff opinion, and published work where available.

Common patterns observed in Audit II included:

- Ecological communities in good or better condition with no obvious impacts were rated as extent of degradation < 5% (abiotic and biotic) with < 5% severity.
- Ecological communities subject to point impacts such mining, exploration, infrastructure development, road construction, etc which resulted in removal of vegetation and/or substrate were rated as generally relatively small extent of degradation (< 5% or 5 to 25% categories for abiotic and biotic components) but very severe impacts (> 95% severity for abiotic and/or biotic components).
- Ecological communities subject to landscape-level threats have larger extents of degradation but usually less severity (although if these cause ecosystem collapse then they may be in higher categories).
- The lack of monitoring data means that severity is generally less well understood than extent, although staff are confident in advising severity at either end of the range (no/small impacts or severe impacts) but far less confident about distinguishing middle of the range.
- Separation of abiotic and biotic impacts is very useful for wetlands in particular.
- The Audit II classification system performed well when addressing either point impacts or landscape-scale impacts; however it performed poorly (ie. categories were less meaningful) when both impact types were relevant.
- The Audit II method requires “average” extent and severity of degradation across occurrences in a subregion, however this difficult and is of less value when there are larger numbers of occurrences (such as for the SWA02) or across large geographic areas.

The extent and severity of degradation of abiotic and biotic components collectively indicate average condition of ecological communities across the subregion and across their range (State). Trends in extent of degradation (abiotic DEGABIOTIC_EXTENTTREND & biotic DEGBIOTIC_EXTENTTREND) and trends in severity of degradation (abiotic DEGABIOTIC_SEVERITYTREND & biotic

DEGBIOTIC_SEVERITYTREND) represent the direction and magnitude of change since 2002, using spatial data if available, published information or expert opinion.

Part 3: Wetlands

JM to add

APPENDIX C: MOST RECENT SURVEY AND CONSERVATION STATUS.

Most recent survey (flora and fauna)

Cross ref Table 15 Spreadsheet Codes.

For flora and fauna, the year of most recent targeted survey records the most recent survey for the taxon and whether it was detected (MOSTRECENTSURVEY_DETECT), not detected (MOSTRECENTSURVEY_NODETECT) or anecdotal (MOSTRECENTSURVEY_ANECDOTAL). Targeted survey could be any survey (such as a monitoring program, reserve survey or area survey) done by any person where the taxon was recorded with reasonable certainty the identification was correct. This section also captures survey effort for cryptic or elusive species by recording where there has been survey effort but no detections. An anecdotal report was where the staff had access to records or information to indicate presence of the taxon but not a formal survey or the record was potentially inaccurate due to misidentification. Anecdotal reports were only included in Audit II if they were later than targeted survey and indicated ongoing interest in the taxon. The section captures the "currency" of knowledge about the taxon and whether or not survey and/or monitoring effort has been dedicated to it between 2002 and 2013.

Most recent condition assessment/survey (ecological community)

Cross ref Table 15 Spreadsheet Codes.

The year of most recent condition assessment (MOSTRECENTSURVEY_COND) or anecdotal observation (MOSTRECENTSURVEY_ANECDOTAL) records the most recent and type of survey and/or condition assessment. Although ecological communities may be visited by staff, they are infrequently assessed for condition and monitoring is often not reported to Species and Communities Branch. Therefore, staff were asked to provide the year of the most recent visit (or other data source such as EIA report or scientific publication), on which the reports of condition such as extent and severity of degradation were based. Anecdotal observation was recorded where staff were not confident in reporting condition but the ecological community was still present.

Conservation status

Cross ref Table 16 Spreadsheet Codes.

The EPBC Act status (STATUSEPBC) was populated by Species and Communities Branch, however some taxa were missed and others were added as status from SPRAT during data cleaning (July to December 2014). JM - needs checked for completeness before entry to database.

WA Status (STATUSWA) according to DPaW corporate databases in 2013, was usually input to spreadsheet at the same time as database extractions, but checked during data clean up. The year that the status was set was placed in the current threat category (YEARCURRENTTHREAT) JM - needs checked for completeness before entry to database, some entries are currently blank but all should have dates.

Reason for WA listing (LISTING REASON) contains the IUCN criteria under which the taxon was listed, from corporate databases, some entries are currently blank but all should have codes. Please note these are the IUCN criteria used at the time of listing, and do not necessarily correspond to more recent

categories. Problems arose in the spreadsheet because drop down lists use current wording, this column needs revision. JM - needs checked for completeness before entry to database.

Recovery planning

Cross ref Table 16 Spreadsheet Codes.

The commencement year of the most recent published recovery plan (RECOVERYPLANCOMMENCE), is usually the State recovery plan unless noted otherwise. This section includes:

- individual taxa and multi-species recovery plans and interim recovery plans;
- recovery plans which are written for ecological communities of which the threatened taxon is a component;
- interim and full recovery plans for ecological communities; and
- recovery plans in preparation.

This section provides a measure of the currency and coverage of recovery plans. Populations and occurrences found after publication of a recovery plan are presumed to be covered by the recovery plan (recovery actions), however some of the metrics contained in them may be out of date.

Tenure (ecological communities)

Cross ref Table 17 Spreadsheet Codes.

Tenure (TENURE) provides a list of all tenure types in which the ecological community occurs.

APPENDIX D: PAST PRESSURES AND FUTURE THREATS - NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEET

Cross ref Table 18 Spreadsheet Codes.

- Follows international threat taxonomy, adapted for WA, from Salafsky et al. (2008).
- Consistent approach for all biodiversity assets – provides a category and a specify in each case so analysis can be conducted by threat type.
- Attempts to report the driver as well as the mechanism.
- Past pressures are those which have been realised within the last 10 years.
- Future threats are those which are likely or possible and include continuation of past pressures and any new or additional threats.
- Top 80% of past pressures and future threats only.

APPENDIX E: MANAGEMENT ACTIONS – NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEET

Cross ref Table 19 Spreadsheet Codes.

- Builds on management actions from Audit I.
- Consistent approach for all biodiversity assets – provides a category and a specify in each case so analysis can be conducted by management action.
- Not restricted to Parks and Wildlife management, other organisations and roles are also identified.
- Categories of management actions are research, evaluation, conservation planning, direct management & indirect management.

APPENDIX F: IDENTIFICATION OF POTENTIALLY THREATENED TAXA AND ECOLOGICAL COMMUNTIIES - NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEET

Potential/candidate PECs were identified through selection of small land systems and small Beard vegetation associations (ie. less than 50,000 ha) in the extensive land use zone as a first pass. This short list was then manually sorted via a workshop attended by senior Science and Species and Communities staff, and approx. 150 (CHECK) vegetation-based potentially threatened ecological communities have been identified and information passed on the Species and Communities Branch for further action. The process has not been undertaken for the intensive land use zone (ie. Beard mapping but no land system mapping). Further input from staff would be required to complete this task for the intensive land use zone.

Potential issues for intensive land use zone:

- Scale and comparability of mapping (eg. Beard, Gibson, Keighery, Mattiske, consultants who do their own definitions); and

- Definition of ecosystem collapse may be required – chronic and long term threats – fire in/frequency, pc dieback, lowered water table, climate change driving changes to temperature and rainfall.

KB TO ADD
SREs - WAM

APPENDIX G: PRIORITY TAXA - NOTES ON INTERPRETATION, CAVEATS AND LINKS TO SPREADSHEET

ANALYSIS FOR THIS PART OF AUDIT II HAS NOT BEEN FINALISED.

There is less information available for priority species than for threatened species, so often IUCN metrics, past pressures, future threats and management requirements are not known. Priority taxa nominations are done within the Department at the discretion of Species and Communities staff, ie. not the Threatened Species Scientific Committee. Categories are allocated (1 to 4 for flora and 1 to 5 for fauna) based on the level of perceived risk, with most concern for the conservation of Priority 1 taxa.

A large number of priority taxa (2939 taxa in December 2012) are largely data deficient (in IUCN terms), however Audit II attempted to present the number of priority species (in each priority category) per subregion. As part of discussions about the priority taxa process, it became apparent that there was no regular review process, resulting in some taxa retained on these lists but with enough information known such that they no longer met the definition for the priority category. In addition, an important outcome of the Biodiversity Audit II is to determine which taxa are the highest priority for reassessment of conservation status. Reassessment of conservation status may be to move higher (ie. more threatened) or lower (ie. less threatened) categories to reflect the real level of threat. Therefore, in consultation with Regional, Science and Species and Communities staff, a process was developed to determine the following:

- Taxa in need of reassessment (higher, lower or unknown); and
- Impediments to reassessment of the taxon (taxonomic issues, inadequate biological survey or consolidation of existing knowledge).

Staff in Audit II workshops were asked to perform a very quick check of priority taxa in their Parks and Wildlife Region and pick out those taxa which are in need of reassessment of conservation status, with relevant notes made on why each taxon was selected, the direction of the likely change and any impediments. Staff often had a “watch list” for species of concern and were able to very quickly identify those taxa which are now known to be more widespread than previously thought. WA Herbarium staff and Andrew Brown (Species and Communities Branch) also contributed info for those taxa in their area of specialty. The Biodiversity Audit II methodology effectively acted as a review process for Priority listed taxa, and allowed compilation of a series of short lists for further action:

- taxa likely have a higher conservation status (ie. more threatened);
- taxa likely to move lower in conservation status or off the Priority list entirely (ie. less threatened); and
- taxa in need of reassessment but for which the direction of change is unknown.

It is acknowledged that this process addressed some "known unknowns" but failed to address the "unknown unknowns" which were skipped by staff. Nonetheless, this represents the most comprehensive review of Priority lists to date.

APPENDIX H: RESERVE MANAGEMENT EFFECTIVENESS

ANALYSIS FOR THIS PART OF AUDIT II HAS NOT BEEN FINALISED.

One of the aims of Audit II was the assessment of effectiveness of management across Parks and Wildlife managed lands. Audit II also attempted to capture where management isn't occurring or is constrained. Audit II developed a survey for completion by regional staff for a selection of reserves in each subregion (10 reserves or as many as occur in the subregion if less than 10). A reserve selection methodology was refined by GIS Branch to select a short list of 20 reserves per subregion on the basis of:

- Range of areas (representatives of small and large reserves);
- Geographic spread within the subregions (north/south, east/west); and
- Coastal/island and inland.

Regional staff were asked to fill in a large number of questions about the tenure, biodiversity values, threats, management goals and management actions for the reserves. All Parks and Wildlife regions have had exposure to the reserve management effectiveness survey and have completed some example reserves from their region. However the survey requires some further work to finalise, and then development of an online reporting tool for data collection for roll out to regional staff. Although reserves are selected according to IBRA subregion, they are then allocated by Parks and Wildlife region for staff involvement. Regional staff are then responsible for completing the rest of the selected reserves in their Parks and Wildlife region (eg. 10 reserves selected for JAF02 are allocated to South West, Warren and South Coast regions according to regional boundaries). In some cases this is not likely to be too time-consuming as there are few reserves; however some regions have a very large number of reserves to complete. As a general guide, a very small reserve with no active management for biodiversity values has taken 3-4 hours to complete, while a large reserve encompassing many management issues may take a full day of staff time to complete. Development of a an online reporting tool and staff familiarity with the process would increase the speed for completion, and allowing automatic entry from corporate databases (TENIS, spatial data) and pre-populating fields with relevant information would improve efficiency.

Potential issues:

- management effectiveness at whole of subregion scale - aims to evaluate broader scale issues that influence the effectiveness of management; but how many reserves are enough to make comment about reserve management effectiveness at subregional scale?
- definition of goals for management - in many cases hasn't been done;
- landscape level threats – very hard to demonstrate effectiveness unless there is intensive management and monitoring .

APPENDIX I: ISSUES IDENTIFIED IN AUDIT II PROCESS & SUGGESTED CHANGES FOR AUDIT III

- Requires re-design of data management systems, tracking of biodiversity assets and trends over time.
- Too much weighting of edges of range for threats and management actions compared to main area of range caused by subregional reporting (ie. Taxon A has 10 pops in SWA02 and 1 in JAF02; both subregions assessed the top 80% of threats and management actions relevant to populations but those in SWA02 are diluted and those in JAF02 are inflated).
- Reluctance of people to report loss of populations where habitat remains but the taxon hasn't been observed for many years (can't be certain it's really NOT there); results in counts biased towards increases due counting of new populations (ie. increase due to survey effort; certainty that the new population really IS there).
- Doesn't allow weighting of importance of populations… population counting method is the same for 1 plant or 1000 plants. This skews the number of populations so it looks like less risk (ie. 2 populations instead of 1).
- Extent and severity of degradation are averaged across entire subregion – too coarse to be useful if there's more than a couple of occurrences or if there is a large geographic range.
- Counting mature individuals is very hard for some groups of taxa and maybe less important than managing habitat.

APPENDIX J: GLOSSARY

EPBC Act

PEC

TEC

SPRAT