

FOREST PROTECTED AREA CLASSIFICATION: PROGRESS REPORT

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Aim of this report

This progress report aims to provide the core group with project development feed back. This including the following:

- A recap on projects objectives and outputs.
- Integration of the proceedings of the stakeholder conservation target setting workshop (held on the 15 & 16 of May 2003) into a revised conservation targets table. (This has been presented in annex 1&2 of this report)
- Progresses regarding data capture.
- A discussion on approaches to be used for the next stages of the project (threat analysis, prioritization, and socio-economic trade off analysis.)

Recap of project objectives

Refer to figure 1 for a schematic representation of project mission, purpose and objectives.

Workshop outputs (conservation targets table)

The identification of biodiversity elements and the setting of corresponding conservation targets are critical to the success of systematic conservation planning. As a result, substantial effort has been put into obtaining input from a wide range of experts and stakeholders. This involved three review steps, the first with the project core group, and the second involving an expert focus group. The third and final review step took the form of a workshop during which the proposed elements and methods of determining targets were presented and reviewed. The inputs from the workshop, as well as the project teams response to these have been summarized in Annex 1. Taking cognizance of the workshop inputs, a final set of biodiversity elements (pattern and process) and corresponding methods for deriving targets have been developed (Annex 2). Once the process of gathering and cleaning the data sets required to describe the biodiversity elements has been completed (see following section) the actual target values for each element will be determined using the outlined methods. It is suggested that once this has been completed, the target values be reviewed by members of the core and focus groups.

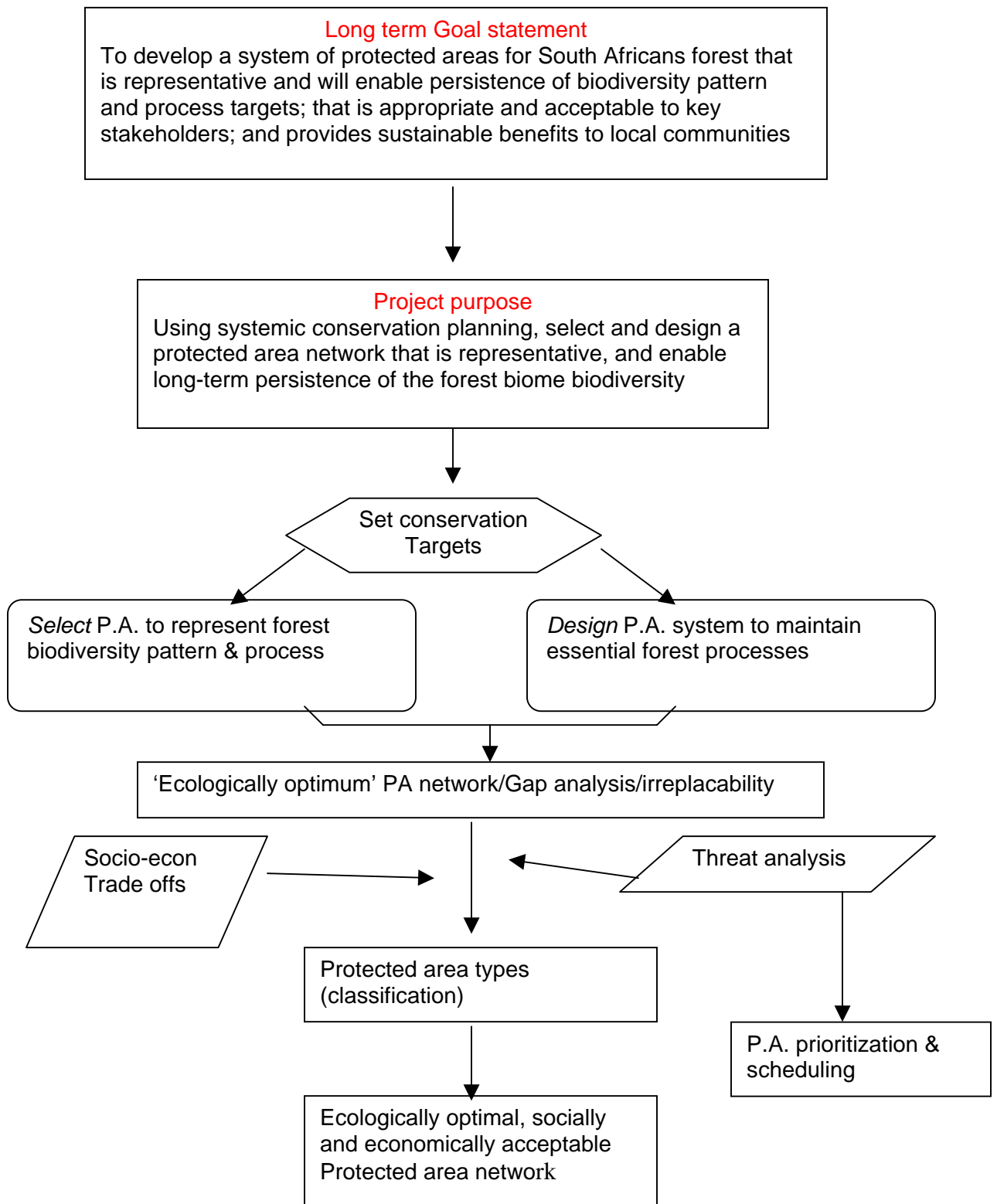


Figure 1: Flow chart of major project objectives and outputs

Progressing on developing irreplaceability values: data gathering, cleaning and analysis

The primary data sets required to assign irreplaceability values to forests (based on the targets) can be grouped into the following categories:

- Protected areas
- Forest patch distribution
- Floral species distributions
- Faunal species distributions.
- Other

Protected areas

Currently there is no single comprehensive layer describing the distribution (and boundaries) of protected areas in South Africa. However, there are a number of sources that are able to provide specific sets of data (either for certain categories of protected area or for specific regions). We have attempted to gather data from as many sources as possible (Table 1), where possible focussing on provincial conservation agencies, which often have the best protected area data (especially KwaZulu-Natal Wildlife, Mpumalanga Parks Board and the Western Cape Nature Conservation Board). These datasets are being combined on a provincial basis to produce a final GIS database, which will be as comprehensive as possible.

Table 1. Progress made on gathering of protected area spatial data

| Province | Data received from | Still awaiting data from | Action/Status |
|------------------|---|---------------------------------------|--|
| 1. Limpopo | 1. DWAF 2. DEAT | 1. Environmental Affairs, Pietersburg | Awaiting return of GIS technician from leave |
| 2. Mpumalanga | 1. DWAF 2. DEAT 3. Mpumalanga Parks Board | None | None |
| 3. KwaZulu-Natal | 1. DWAF 2. DEAT 3. KwaZulu-Natal Wildlife | None | None |
| 4. Eastern Cape | 1. DWAF 2. DEAT | None | None |
| 5. Western Cape | 1. DWAF 2. DEAT 3. Western Cape Nature Conservation Board | None | None |

Forest patch distribution

The forest patch layer used by the CSIR for the forest classification study is incomplete in many areas. DWAF has been busy with mapping forest patches at a scale of 1:10,000, and this data are now available. Also, staff of some provincial conservation agencies have been busy updating their forest coverage's. We have gathered data from the CSIR, DWAF and relevant conservation agencies (Table 2). These datasets are being combined on a provincial basis to produce a final GIS database, which will provide A more complete picture of the distribution of forest patches in South Africa.

Table 2. Progress made on gathering of forest patch data

| Province | Data received from | Still awaiting data from | Action/Status |
|------------------|---|---------------------------------|----------------------|
| 1. Limpopo | 1. DWAF 2. CSIR | None | None |
| 2. Mpumalanga | 1. DWAF 2. CSIR 3. Mpumalanga Parks Board | None | None |
| 3. KwaZulu-Natal | 1. DWAF 2. CSIR 3. KwaZulu-Natal Wildlife | None | None |
| 4. Eastern Cape | 1. DWAF 2. CSIR | None | None |
| 5. Western Cape | 1. DWAF 2. CSIR | None | None |

Floral species distributions

The primary source of floral species distributions is the database developed by Professor L. Mucina. This database was used extensively in the forest classification project, and provides the most comprehensive database of primarily forest tree species. This data has already been obtained. In addition, some additional data has been obtained from Mervyn Lotter of the Mpumalanga Parks Board.

Faunal species distributions

During the execution of the forest classification project, Dr Hylton Adie gathered faunal distributional data from a range of sources. This database represents the most comprehensive database available describing the distribution of forest fauna. Dr Adie has agreed to provide this database, as long as we obtain permission from the original providers. Substantial progress has been made on this, with the majority of sources having already given permission (Table 3).

Table 3. Progress made on gathering faunal data. This table indicates which identified sources have/haven't already given permission to Dr Adie for us to use the data.

| Data source | Groups covered | Permission given | Action/Status |
|---|------------------------------------|-------------------------|---|
| Mpumalanga Parks Board | Mammals Frogs Reptiles | Yes | None |
| Transvaal Museum | Mammals Reptiles | Yes | Transvaal Museum to be paid amount required for access. |
| Western Cape DWAF Scientific Services | Unknown | Yes | None |
| Western Cape Nature Conservation Board | Mammals Frogs Reptiles | No | Dr Helen de Klerk to be contacted. |
| University of Stellenbosch | Butterflies Mammals Reptiles | Yes | None |
| Forest Biodiversity Programme (University of Natal) | Birds Mammals Reptiles | No | Dr Harriet Eeley contacted, awaiting permission. |
| Bird Atlas Data | Birds | No | Avian Demography Unit to be contacted. |
| KwaZulu-Natal Wildlife | Birds Mammals Reptiles | No | Contacted Mr Neil Langley, awaiting permission. |

Other

At this stage the only critical database falling into this category in the National Land-Cover database. Tom Vorster and Sam Mabena (DWAF) are currently determining whether DWAF has a copy of this dataset. If not, we will approach the CSIR.

Update: Data received from Izak van der Merwe and Tom Vorster (4 July 2003).

Determining priority areas for conservation action

Threat and conservation value (irreplacability) are essential components of systemic conservation area categorization and scheduling for conservation action. Areas with high threat and high conservation value should receive priority attention (refer to figure 2) below

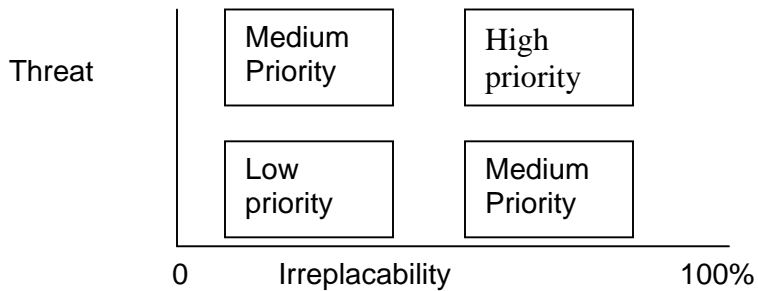


Figure 2. Conservation action scheduling

A modeling approach has been adopted to assess threat. This will entail the following steps.

- Analysis of the kinds of threats impacting on indigenous forest.
- Assessment of cause and effect dynamics of these threats.
- Assess the availability of spatially referenced data, and where necessary evaluate surrogate data for threats.
- Development of (GIS linked- expert system type) rule based model to predict the occurrence, nature and extent of threats to forest.

Identifying threat factors

This section provides an overview of the methodology. Further details will be provided in an in-depth threat analysis report (work in progress). Available literature has been summarized and presented in Table 4 considers key threat issues and data sources.

Table 4. Threat issues considered, explanation and potential data sources

| Threat issues | Explanation | Data source |
|-----------------------------|---|---|
| Regional population density | Important driving factor to most threats | Population census data, in regions of FMU |
| Poverty level of population | High poverty levels imply increase dependence on forest products for subsistence | Poverty index maps (CSIR) |
| Accessibility | Inaccessible forest will be protected from many human impacts; low flat areas will be more attractive to clearing and agriculture | Proximity to roads, towns and villages Topographical position of forest patch (Digital terrain maps) |

| Threat issues | Explanation | Data source |
|---|--|--|
| Land claims | Important consideration that needs to be managed | Department of land affairs data sources |
| Land tenure | Management implications | DWAF data |
| Suitability to alternative land use | Important in certain areas such as urban development | Possible agricultural potential and risk of urban development |
| Subsistence use (Medicinal plants, fuel wood, building materials, clearing for agriculture and grazing) | High demand and non sustainable harvesting of forest products | Inferred from poverty level index and population density and proximity. Also from FMU questionnaire data |
| Commercial timber extraction | High value forest will have increase demands legal or illegal timber harvesting | DWAF data sources |
| Inappropriate tourism, resort development and urban expansion | Could become a major threat if unplanned or not regulated (Biodiversity not mainstreamed into regional planning) | DWAF data sources Or inferred from proximity to tourism destinations and routes |

Understanding forest threat dynamics

To enable us to predict the nature and extent of biodiversity threats (operating both now and in the future) we intend to adopt a rule based modeling approach. Before modeling threats, we need to understand cause and affect dynamics. Each threat activity, (such as over harvesting, for example) is caused by an underlying driving factor such as poverty or overpopulation, these variables we call *threat drivers*. These drivers give rise to a set of *potential threats* that become *predicted threats* provided certain *trigger factors* are present. The degree to which these predicted threats are likely to impact on biodiversity (*threat impacts*) is a determined by a set of factors called *threat modifiers*. This is diagrammatically represented in figure 3.

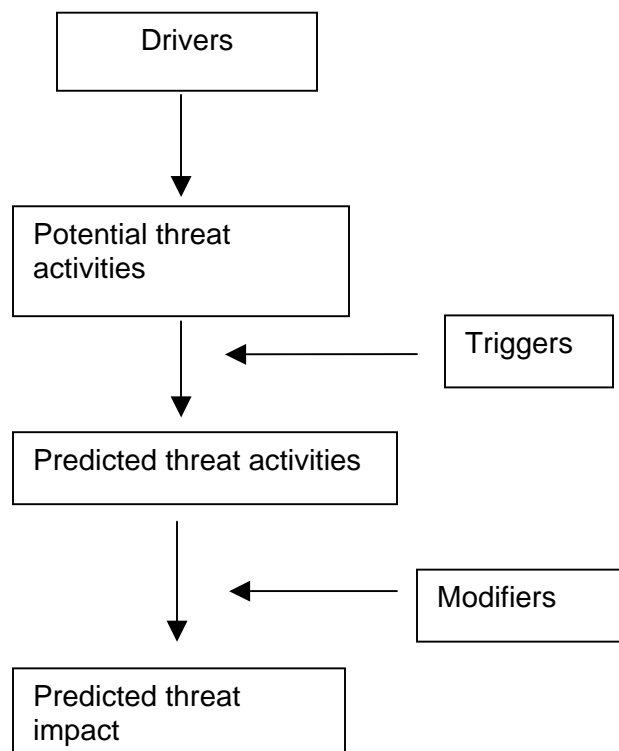


Figure 3. Conceptual outline of proposed rule based model predicting the nature and extent of biodiversity threats to natural forest.

Examples of *Drivers* include population density, poverty level of surrounding populations, tourism demand for an area and urban development pressure (coastal areas). Examples of *threat triggers* include accessibility (topography and roads), land tenure change (land claims), high presence of medicinal plants, and level of disturbance. Examples of *threat modifiers* include management and law enforcement capacity, land tenure, fire hazard and electrification (demand for fuel wood).

Developing a threat index for forest patch clusters

Each forest will need to be assigned a threat index (smaller forest patches will need to be grouped into relatively homogenous forest patch clusters and will be dealt with as a single unit).

Because threat values are relative, a semi –qualitative approach will be adopted. Two approaches are being considered, a rule based approach and a weighted scoring system.

Weighted scoring system

Each threat factor can be analyzed according to four dimensions: its relative importance weighting, the magnitude of the threat, its probability of increasing in the future, its relative degree of irreversibility and the degree to which it is synergistic and cumulative with other threats.

Threat score = sum of (importance rating) X (magnitude of threat) X (probability of occurrence) X (irreversibility + cumulative index)

It is important to realize that there is a difference between forest currently facing threat to forest that are likely to face threat in the future. The index combines this into one overall threat score by incorporating a probability correction factor (for example threats that are currently operating get a probability of 1 or 100 %, while those that have a good chance of occurring may get a probability rating of 0.7 or 70 %)

The major problem with this approach is the subjectivity involved with determining weightings.

Rule based threat assessment

Rules will be used to represent relationships between the various threat factors. They will use logical associations of factors to predict the future threat scenario.

Rule based modeling (as used expert systems¹) makes use of heuristic ('rules of thumb') type information, typically used by experts to reach decisions. Rules based models may be deep or shallow. A shallow model structure requires a set of conditions to reach a conclusion, and is achieved with a minimal set of rules. Deep knowledge structure uses a series of layers with rule sets deriving each successive layer. In threat modeling the layers would be first determine potential threats, second layer uses trigger factors to determine predicted threats, and third layer uses modifiers to determine predicted degree of impact.

An example of shallow rule structure would be:

IF [regional population densities] are HIGH
And [poverty levels are] HIGH
And [accessibility to forest] is HIGH

¹ See for example Berliner D.D. An expert system approach to decision making for savanna management. Msc thesis. University of Witwatersrand

And [subsistence value of forest] is HIGH or MEDIUM
THEN [threat index] is HIGH

Example of deep rule structure

IF [regional population densities] = HIGH
And [poverty levels are]= HIGH
THEN [Drivers]= HIGH

AND

IF [Drivers] = HIGH
And [Triggers] = yes
And [Modifiers]= LOW
THEN [Threats] = HIGH

The advantages of using deep over shallow knowledge structures are is that the model includes underlying causes, which can improve understanding and can be used in 'what-if' sensitivity analysis.

Discussion on approach to determining socio economic trade-off costs

Trade off analysis requires an assessment of what is being lost or gained. Using a resource economics approach, costs can be split into a number of values that forest provides. A distinction is made between biodiversity/ landscape/ ecosystem functional values and socio-economic values (the former are included as part of the assessment of conservation value using the concept of irreplaceability), while socio-economic values will be the subject of this analysis.

Table 5. Forest in South Africa can be considered to have the following socio-economic values. Each forest type has intrinsic socio-economic values, which are modified by specify issues for each forest patch.

| Socio-economic values | Explanation | Intrinsic value for each forest type | Value Modifiers |
|---------------------------------------|-------------|--------------------------------------|------------------|
| Cultural value –non consumptive | | | |
| Cultural value- consumptive | | | Medicinal plants |
| Subsistence/livelihoods value | | | Forest products |
| Commercial timber value | | | |
| Commercial non timber forest products | | | |
| Tourism value | | | Scenic |

A similar modeling approach to the threats analysis will be explored. As outlined in table each forest type will be assigned an intrinsic value that will be modified by location specific (spatial) data.

Annex 1: Straw dog conservation targets table, showing input received during workshop and, project team response.

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|------------------------------|--|--|--|---|
| Pattern | | | | |
| 1. Forest types ¹ | 15% of current extent ² , adjusted upwards for each type on basis of species-area curve analysis ³ | <ol style="list-style-type: none"> 1. Relative rarity (% area covered) Group 1 Rank = 2 2. Forest patch fragmentation Group 1 Rank = 3 3. Reduction of historic extent Group 1 Rank = 4 4. Degree of endemism of forest type (assigned at group level, as either endemic or non-endemic to South Africa) Group 1 Rank = 5 5. Use primary geographic spread across latitudinal or longitudinal gradients to identify three ecotype zones (two extremes and central) within the distributional range of each type. Final target values will be distributed proportionally on the basis of forest area within each zone. Group 1 Rank = 1 | <ol style="list-style-type: none"> 1. Good 2. Good 3. Low (estimation required) 4. Good 5. Good | <p>Both groups ranked forest type as the most important pattern element for inclusion.</p> <p>Base target determination:</p> <ol style="list-style-type: none"> a. There was some discussion by both groups concerning the use of 15% as a base target value. b. Group 1 suggested that a sensitivity analysis be undertaken with a range of base values to assess the impact of starting figures on the final target values. c. Group 2 suggested that the target should be 30%, or at least double that used for other biomes. <p><i>Response:</i> At this stage it is felt that the suggestion of undertaking a sensitivity analysis is sound, and will incorporate aspects of the comments by members of Group 2. It is also suggested that an expert review on the final target figures be conducted.</p> <p>Potential means of adjusting:</p> <ol style="list-style-type: none"> a. Group 1 ranked the adjustments (see relevant column for rankings), while Group 2 unfortunately didn't have sufficient time to do so. However, Group 2 felt that the adjustments were fine as they stood. b. Group 1 indicated that fragmentation should be broken up into size, number and inter-patch distance. The critical issue is that more fragmented forest types are assigned higher targets. c. Group 1 suggested that 1890 be used as the starting point for the reduction in historic extent. This is due to data availability for the intervening period. d. Group 1 added that the location of forests representative of a type within a region or centre of endemism could also be used to adjust target values. e. It was correctly pointed out that the use of primary geographic gradients is not strictly an adjustment factor and should be removed. However, the distribution of target values using this approach was considered valuable and should still be used in the analysis. <p><i>Response:</i></p> <ol style="list-style-type: none"> a. No response required. b. All three issues (size, number and inter-patch distance) will be considered during the process of assigning a relative fragmentation score to each forest type. c. The starting data of 1890 will be used, and the relevant data will be obtained with the assistance of Izak van der Merwe (DWAF). If information is unavailable, a process of assigning forest types to relative categories of historic loss will be used. d. The location of forests in regions and centres of endemism will replace the degree of endemism of forest types, which was given a low ranking by participants. e. The team agrees with this point, and will remove this from the adjustment list but still make use of this technique to distribute the target values across the geographic range over which each type occurs. |

¹ Using the objective, national type classification completed by the CSIR Environmentek for DWAF. This classification identifies 12 major and 24 minor types. Study proposes using the more detailed 24 minor types.

² A base target value of 15% has been used to identify a representative forest reserve network for Australia (Pressey *et al.* 1996. Forest Ecology and Management 85: 311-333) and could be considered as a minimum for international best practice.

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|-----------------------------------|--|---|---|---|
| 2. Old-growth forest ⁴ | For each forest type, at least three forests with presence of old-growth | None | Unknown (may require estimation, e.g., period since last logging) | <p>Group 1 ranked this pattern element lowest of the four, while Group 2 suggested removing it completely.</p> <p><i>Response:</i> Subsequent discussions suggested that the problem might lie with the terminology used, with old-growth forest being a northern hemisphere (temperate forest) concept that possibly is not relevant to South African forests. A degree of consensus was reached that "Old-growth forest" should be replaced with either "Low disturbance forest" or "Late successional forest". The original reason for including this element was to capture older areas of forest, which it was felt supply a unique set of habitats and services. For this reason, the term "Late successional forest" will be adopted.</p> |

³ This method of determining base target values has been used in both the CAPE and SKEP projects, and involves analyzing species-area curves to compare species turnover and relative species numbers for areas of similar size among ecoregional classification units.

⁴ It is assumed that later successional stages provide unique habitats.

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|---|--------------------------------|--|-------------------|--|
| 3. Forest-dependent species (those requiring forest for reproduction) | 4 known locations ⁵ | <ol style="list-style-type: none"> 1. Species rarity (as indicated by the number of known locations) Group Rank = 3 2. Red List/Red Data Book status (differential adjustment dependent on actual red list category) Group Rank = 1 3. South African endemics Group Rank = 2 | Moderate-Good | <p>Group 1 rated this pattern element second to forest type, but suggested that it be lumped with forest-associated species. Group 2 on the other hand felt that it was adequately covered by other pattern elements and could be removed.</p> <p><i>Response:</i> The species elements will be used in a secondary step after forest types, which will involve checking whether the attainment of forest type targets adequately attains species-specific targets. This use of species at a later stage in the analysis is thus sensitive to the possible association of species with forest type (in fact tests that assumption), and considers the weaknesses inherent in species distributional data. For this reason this element will not be removed from the analysis.</p> <p>The separation of species into forest-dependent and forest-associated was primarily done to clarify the selection of species. The two elements could be combined into one; especially as the base targets and adjustment factors are similar. However, for simplicity of communication forest-dependent and forest associated species will still be separated.</p> <p>Base target determination:</p> <ol style="list-style-type: none"> a. Group 1 suggested that rather than 4 known locations, the base target should be 10 known locations. b. Group 2 suggested that all populations of highly threatened species should be conserved. <p><i>Response:</i></p> <ol style="list-style-type: none"> a. Ten known locations will be adopted as the base target. This also complies with guidelines from the IUCN regarding the classification of Red Data plant species. b. It is suggested that the actual species target values be subjected to expert review. This will allow experts to assess whether the determined targets are adequate for conservation of the species and adjust as required. So rather than set 100% of known locations as a target for certain species <i>a priori</i>, it is suggested that this should be informed by the process of target determination and subsequent expert review. In addition, by using 10 known locations as the base target, species with 10 or less known locations will automatically be assigned target values of 100%. <p>Potential means of adjusting:</p> <ol style="list-style-type: none"> a. Both groups assigned similar rankings to the 3 adjustment factors (see relevant column for rankings). However, Group 2 suggested that species rarity could be removed as an adjustment factor. <p><i>Response:</i></p> <ol style="list-style-type: none"> a. The species rarity adjustment factor has substantial overlap with the Red List/Red Data Book adjustment, so we agree with both groups ranking it lowest. As a result, the species rarity adjustment will be removed. |

⁵ The available species data only indicates known locations of species (i.e., presence-only).

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|--|---|---|-------------------|--|
| 4. Forest-associated Red list/Red Data Book or South African endemic species | 4 known locations ⁵ | <ol style="list-style-type: none"> Species rarity (as indicated by the number of known locations) Group Rank = 3 Red List/Red Data Book status (differential adjustment dependent on actual Red list category) Group Rank = 1 South African endemics Group Rank = 2 | Moderate-Good | <p>Group 1 rated this pattern element third to forest type and forest-dependent species, but suggested that it be lumped with forest-dependent species. Group 2 on the other hand ranked it second to forest type.</p> <p><i>Response:</i> The separation of species into forest-dependent and forest-associated was primarily done to clarify the selection of species. The two elements could be combined into one; especially as the base targets and adjustment factors are similar. However, for simplicity of communication forest-dependent and forest associated species will still be separated.</p> <p>Base target determination:</p> <ol style="list-style-type: none"> Group 1 suggested that rather than 4 known locations, the base target should be 10 known locations. Group 2 suggested that all populations of highly threatened species should be conserved. <p><i>Response:</i></p> <ol style="list-style-type: none"> Ten known locations will be adopted as the base target. This also complies with guidelines from the IUCN regarding the classification of Red Data plant species. It is suggested that the actual species target values be subjected to expert review. This will allow experts to assess whether the determined targets are adequate for conservation of the species and adjust as required. So rather than set 100% of known locations as a target for certain species <i>a priori</i>, it is suggested that this should be informed by the process of target determination and subsequent expert review. In addition, by using 10 known locations as the base target, species with 10 or less known locations will automatically be assigned target values of 100%. <p>Potential means of adjusting:</p> <ol style="list-style-type: none"> Both groups assigned similar rankings to the 3 adjustment factors (see relevant column for rankings). However, Group 2 suggested that species rarity could be removed as an adjustment factor. <p><i>Response:</i></p> <ol style="list-style-type: none"> The species rarity adjustment factor has substantial overlap with the Red List/Red Data Book adjustment, so we agree with both groups ranking it lowest. As a result, the species rarity adjustment will be removed. |
| Process⁶ | | | | |
| 1. Natural ecotonal/edge processes ⁷ | No specific target, but will aim to maximise number of selected forests with natural edge effects (Proportion of untransformed to transformed areas immediately surrounding patches). | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element second to connectivity.</p> |

⁶ The assumption is made that smaller scale process (e.g., pollination, provision of roosting and foraging habitats) will be accounted for by attaining pattern targets or the larger-scale processes listed. For this reason, they have not been specifically mentioned.

⁷ Forests occur in a matrix of surrounding habitats. It is assumed here that patches surrounded by transformed habitats (e.g., agriculture, urbanization) will be affected by unnatural (negative) edge processes (e.g., alien species invasion).

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|--|--|---|-------------------|---|
| 2. Connectivity (surrogate for linkage related processes, e.g., macro-scale dispersal, migration and gene flow) ⁸ | No specific target, but will aim to maximise number of linkages among forests (both between patches of the same and different forest types) during the design phase aimed at identifying linkages using friction analysis; attention will also be given to trans-boundary forests. | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element as the most important.</p> <p>a. Group 1 suggested that faunal migration (altitudinal) gradients (e.g. starred robins) be included as a process element.</p> <p><i>Response:</i></p> <p>a. Linkages identified to ensure connectivity among forest patches (both among patches of the same type and patches of different types) would also account for faunal migration gradients. So it is felt that faunal migration gradients should not be described as a separate process element, but rather used to assist in identifying linkages.</p> |
| 3. Natural disturbance regime | For each forest type, minimum of three areas large enough (minimum size to be defined) to allow and provide resilience against natural processes (fire, windthrow, gap formation etc). | | | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements and Group 1 supplied no ranking for this element.</p> <p>a. Concern was raised about why three was set as a minimum – is there a more justifiable way of deciding on the number of patches required.</p> <p>b. Also how do we decide on what patch sizes are suitable for the maintenance of this process.</p> <p><i>Response:</i></p> <p>a. It is suggested that the degree of fragmentation of forest type (as calculated for the forest type pattern element) will be used to decide on the minimum number of patches required as a target. Forest types showing higher degrees of fragmentation will require larger numbers of patches. Forest types will be assigned to three fragmentation classes, low, moderate and high. Types with fragmentation scores falling within the low category will require a minimum of three patches of a minimum size, types in the moderate category will require 5 patches and types in the high category will require 10 patches.</p> <p>b. The decision as to what patch sizes are required will be informed by the size distribution of patches for each forest type. The target will focus on selecting the largest extant patches of each type. By way of example, the target for a forest type falling in the low fragmentation class will be at least three of the largest extant patches.</p> |
| 4. Resilience against climate change | Minimum of one altitudinal gradient for each forest group (broad forest types) where possible | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements and Group 1 supplied no ranking for this element.</p> |

⁸ Connectivity will be considered using a spatial modeling technique aimed at identifying linkages acting as biodiversity corridors among patches.

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|---|---|---|-------------------|---|
| 5. Intra-forest seed and propagule dispersal | For each forest type, minimum of three areas large enough (10's to 10,000's ha) to sustain viable populations of important dispersal vectors (e.g., birds, bats, primates and bushpigs <i>Potamochoerus porcus</i>). | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element as third most important (equal importance to pollination; foraging, roosting and breeding habitat; and herbivory).</p> <p>a. Concern was raised about why three was set as a minimum – is there a more justifiable way of deciding on the number of patches required.</p> <p>b. Also how do we decide on what patch sizes are suitable for the maintenance of this process.</p> <p><i>Response:</i></p> <p>a. It is suggested that the degree of fragmentation of forest type (as calculated for the forest type pattern element) will be used to decide on the minimum number of patches required as a target. Forest types showing higher degrees of fragmentation will require larger numbers of patches. Forest types will be assigned to three fragmentation classes; low, moderate and high. Types with fragmentation scores falling within the low category will require a minimum of three patches of a minimum size, types in the moderate category will require 5 patches and types in the high category will require 10 patches.</p> <p>b. The decision as to what patch sizes are required will be informed by the size distribution of patches for each forest type. The target will focus on selecting the largest extant patches of each type. By way of example, the target for a forest type falling in the low fragmentation class will be at least three of the largest extant patches.</p> |
| 6. Pollination in forest types | For each forest type, minimum of three areas large enough (10's to 1,000's ha) to support viable populations of important pollinators | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element as third most important (equal importance to seed and propagule dispersal; foraging, roosting and breeding habitats; and herbivory).</p> <p>a. Concern was raised about why three was set as a minimum – is there a more justifiable way of deciding on the number of patches required.</p> <p>b. Also how do we decide on what patch sizes are suitable for the maintenance of this process.</p> <p><i>Response:</i></p> <p>a. It is suggested that the degree of fragmentation of forest type (as calculated for the forest type pattern element) will be used to decide on the minimum number of patches required as a target. Forest types showing higher degrees of fragmentation will require larger numbers of patches. Forest types will be assigned to three fragmentation classes; low, moderate and high. Types with fragmentation scores falling within the low category will require a minimum of three patches of a minimum size, types in the moderate category will require 5 patches and types in the high category will require 10 patches.</p> <p>b. The decision as to what patch sizes are required will be informed by the size distribution of patches for each forest type. The target will focus on selecting the largest extant patches of each type. By way of example, the target for a forest type falling in the low fragmentation class will be at least three of the largest extant patches.</p> |
| 7. Foraging, roosting and breeding habitat area for forest dependant fauna. | Entire forest patches across the natural range of patch sizes occurring in the study area. No specific targets required - attainment of pattern targets for forest types and species would account for this process. | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element as third most important (equal importance to seed and propagule dispersal; pollination; and herbivory).</p> |

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability | Workshop input and responses |
|-----------------------------------|---|---|-------------------|---|
| 8. Herbivory by large herbivores. | For each forest type, minimum of three areas large enough (10's to 10,000's ha) to maintain the associated herbivory processes. | None | Good | <p>Unfortunately, Group 2 could not reach consensus on ranking the process elements. Group 1 ranked this process element as third most important (equal importance to seed and propagule dispersal; pollination; and foraging, roosting and breeding habitats).</p> <p>a. Concern was raised about why three was set as a minimum – is there a more justifiable way of deciding on the number of patches required.</p> <p>b. Also how do we decide on what patch sizes are suitable for the maintenance of this process.</p> <p><i>Response:</i></p> <p>a. It is suggested that the degree of fragmentation of forest type (as calculated for the forest type pattern element) will be used to decide on the minimum number of patches required as a target. Forest types showing higher degrees of fragmentation will require larger numbers of patches. Forest types will be assigned to three fragmentation classes; low, moderate and high. Types with fragmentation scores falling within the low category will require a minimum of three patches of a minimum size, types in the moderate category will require 5 patches and types in the high category will require 10 patches.</p> <p>b. The decision as to what patch sizes are required will be informed by the size distribution of patches for each forest type. The target will focus on selecting the largest extant patches of each type. By way of example, the target for a forest type falling in the low fragmentation class will be at least three of the largest extant patches.</p> |

Annex 2: Final conservation targets table (biodiversity pattern and process elements, and corresponding methods for adjusting conservation targets.

| Biodiversity element | Base target determination | Potential means of adjusting/distributing base target | Data availability |
|--|--|---|--|
| 1. Forest types ¹ | 15% of current extent ² , adjusted upwards for each type on basis of species-area curve analysis ³ | <ol style="list-style-type: none"> 1. Relative rarity (% area covered) 2. Forest patch fragmentation (by combining measures of patch size, number and inter-patch distance) 3. Reduction of historic extent (since 1890) 4. Location of forests within regions and centres of endemism. | <ol style="list-style-type: none"> 1. Good 2. Good 3. Low (estimation required) 4. Good 5. Good |
| 2. Late successional forest ⁴ | For each forest type, at least three forests with presence of late successional stages | None | Unknown (may require estimation, e.g., period since last logging) |

¹ Using the objective, national type classification completed by the CSIR Environmentek for DWAF. This classification identifies 12 major and 24 minor types. Study proposes using the more detailed 24 minor types.

² A base target value of 15% has been used to identify a representative forest reserve network for Australia (Pressey *et al.* 1996. *Forest Ecology and Management* 85: 311-333) and could be considered as a minimum for international best practice. However, a sensitivity analysis aimed at assessing the impact of different base targets will be undertaken. Then a process of expert review of the actual target values will be undertaken, before the target values are finalized.

³ This method of determining base target values has been used in both the CAPE and SKEP projects, and involves analyzing species-area curves to compare species turnover and relative species numbers for areas of similar size among ecoregional classification units.

⁴ It is assumed that later successional stages provide unique habitats.

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| 3. Forest-dependent species (those requiring forest for reproduction) | 10 known locations ⁵ | 1. Red List/Red Data Book status (differential adjustment dependent on actual red list category) 2. South African endemics | Moderate-Good |
| 4. Forest-associated Red list/Red Data Book or South African endemic species | 10 known locations ⁵ | 1. Species rarity (as indicated by the number of known locations) Group Rank = 3 2. Red List/Red Data Book status (differential adjustment dependent on actual Red list category) Group Rank = 1 3. South African endemics Group Rank = 2 | Moderate-Good |
| Process⁶ | | | |
| 1. Natural ecotonal/edge processes ⁷ | No specific target, but will aim to maximise number of selected forests with natural edge effects (Proportion of untransformed to transformed areas immediately surrounding patches). | None | Good |

⁵ The available species data only indicates known locations of species (i.e., presence-only). The determined target values will be subject to expert review before target values are finalised.

⁶ The assumption is made that smaller scale process (e.g., pollination, provision of roosting and foraging habitats) will be accounted for by attaining pattern targets or the larger-scale processes listed. For this reason, they have not been specifically mentioned.

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| 2. Connectivity (surrogate for linkage related processes, e.g., macro-scale dispersal, migration and gene flow) ⁸ | No specific target, but will aim to maximise number of linkages among forests (both between patches of the same and different forest types) during the design phase aimed at identifying linkages using friction analysis; attention will also be given to trans-boundary forests. | None | Good |
| 3. Natural disturbance regime. | For each forest type, minimum of three of the largest extant patches (assumes that larger areas will allow for and provide resilience against natural processes, e.g. windthrow, gap formation, fire etc) | Forest patch fragmentation (by combining measures of patch size, number and inter-patch distance) | |
| 4. Resilience against climate change | Minimum of one altitudinal gradient for each forest group (broad forest types) where possible | None | Good |

⁷ Forests occur in a matrix of surrounding habitats. It is assumed here that patches surrounded by transformed habitats (e.g., agriculture, urbanization) will be affected by unnatural (negative) edge processes (e.g., alien species invasion).

⁸ Connectivity will be considered using a spatial modeling technique aimed at identifying linkages acting as biodiversity corridors among patches.

| | | | |
|---|---|---|------|
| 5. Intra-forest seed and propagule dispersal | For each forest type, minimum of three of the largest extant patches (assumes that larger patches will sustain viable populations of important dispersal vectors, e.g., birds, bats, primates and bushpigs <i>Potamochoerus porcus</i>). | Forest patch fragmentation (by combining measures of patch size, number and inter-patch distance) | Good |
| 6. Pollination in forest types | For each forest type, minimum of three of the largest extant patches (assumes that larger patches will support viable populations of important pollinators). | Forest patch fragmentation (by combining measures of patch size, number and inter-patch distance) | Good |
| 7. Foraging, roosting and breeding habitat area for forest dependant fauna. | Entire forest patches across the natural range of patch sizes occurring in the study area. No specific targets required - attainment of pattern targets for forest types and species would account for this process. | None | Good |

| | | | |
|-----------------------------------|--|---|------|
| 8. Herbivory by large herbivores. | For each forest type, minimum of three of the largest extant patches (assumes that larger patches will maintain the associated herbivory processes). | Forest patch fragmentation (by combining measures of patch size, number and inter-patch distance) | Good |
|-----------------------------------|--|---|------|